EA02-025

FORD

10/27/03

BOOK 27 OF 61

PART 1 OF 5

BOX 23 OF 28

Molecular Characterization
(FTIR, Qualitative, Conventional and Microscopic)

Hexport Deposit

Spectra as received are characteristic of a glycol based material [probably brake fluid] and a metal salt [probably an oxalate].

Spectra of the methanol solubles are characteristic of a glycol based material [probably brake fluid] and ester.

Spectra of the insolubles are characteristic of essentially a metal salt [possibly an oxalate].

Converter Deposit

Spectra as received are characteristic of a glycol based material [probably brake fluid] and a metal salt [probably an oxalate].

Spectra of the methanol solubles are characteristic of a glycol based material [probably brake fluid, ester, and other material.

Spectra of the insolubles are characteristic of essentially a metal salt [probably an oxalate].

Spacer Deposit

Spectra of the deposit [as received] are characteristic of a metal salt [probably an oxalate] and a glycol based material [probably brake fluid].

Washer Deposit

Spectra of the deposit [as received] are characteristic of a glycol based material [probably brake fluid] and a metal salt [possibly an oxalate].

Diaphragm #2 Internal Fluid/Deposit

Spectra as removed are characteristic of a glycol based material [probably brake fluid] and a metal salt [possibly an oxalate].

Water Content, % by weight[1] ~10
(ASTM D 1744)

[1] Accuracy of this result is unknown based on the small sample size and possible interferences caused between compounds present in the deposit and the titrant.

INFORMATION[2]

Chemical Resistance	Polytetrafluoroethylene [Teflon ®][3]	Polyimide [Ultem ®]	Polyester [Valox ®]
Brake Fluid [100%conc./73°F/ 180 days]	no information listed	no information listed	no observed changes no tensile strength change
Sulfuric Acid	no observed changes -2% tensile change [30%conc/212°F/8hr]	no observed changes -3% tensile change [20% conc/73°F/100 days]	no observed changes -4% tensile change [36%conc/73°F/180 days]
Water Absorption, % [1/8 in thick sample, 24hr]	<0.01	0.24-0.34	0.06-0.08 [30% glass filled]
Environmental Stress Cracking			
Brake Fluid [100% conc/2500 psi stress/72°F]	no information listed	>336 hours - no failure	no information listed

[2] Information obtained from *Modern Plastics Encyclopedia*, October 1994, November 1996: Teflon ® manufactured by DuPont, Ultem ® and Valox ® are manufactured by General Electric. Ultem ® is a polyetherimide material similar to Kapton ® polyimide which is manufactured by DuPont. Ultem ® was substituted for informational purposes only since Kapton ® information was not readily available [water absorption information is for Kapton ®, Ultem ® value is 0.25.]

[3] "Not known to dissolve in any known solvent and not attacked by highly corrosive acids and caustic materials". *Today's Chemist At Work*, January 1998

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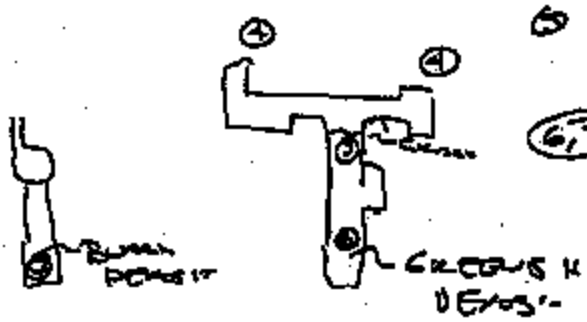
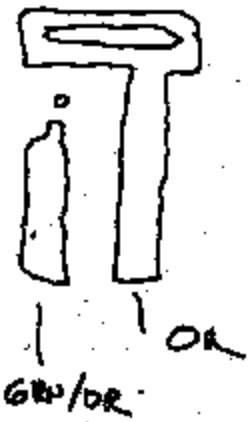
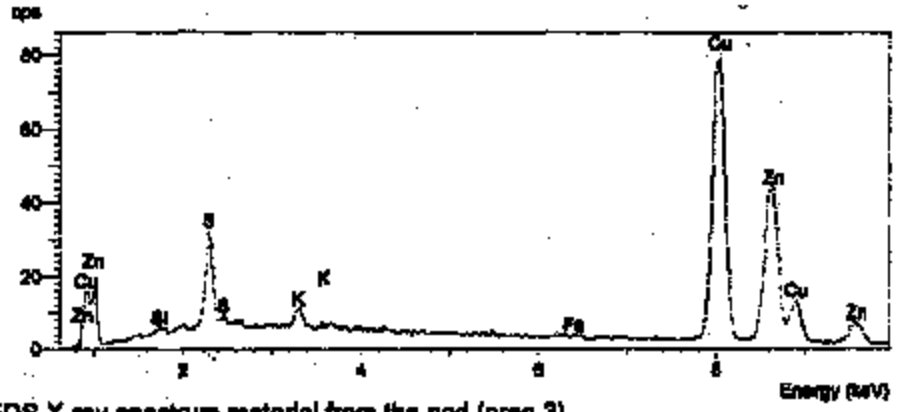
Concur: _____
Mary Haga
Organic Section

By: Gayle D. Gullen
Gayle D. Gullen (GGULLEN)
Product Materials Engineer



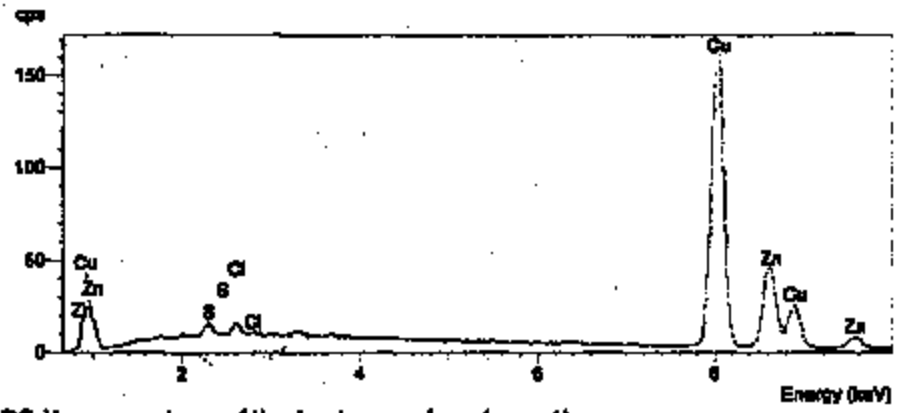


1. DOCUMENT ARC DAMAGE CORROSION OF STATIONARY COATING
2. EXAMINE PITTING IS IT ARC DAMAGE OR CORROSION
3. EXAMINE PAD FOR ARC DAMAGE AS-IS. EDS OF COATING
4. DETERMINE FRACTURE MODE. CLEAN IF NECESSARY (REV. TAPE)
5. MODE OF CRACK IF POSSIBLE.
6,7. EDS OF DEPOSITS (SCRAPE IF NECESSARY TO AVOID PEELS FROM BASE METAL.



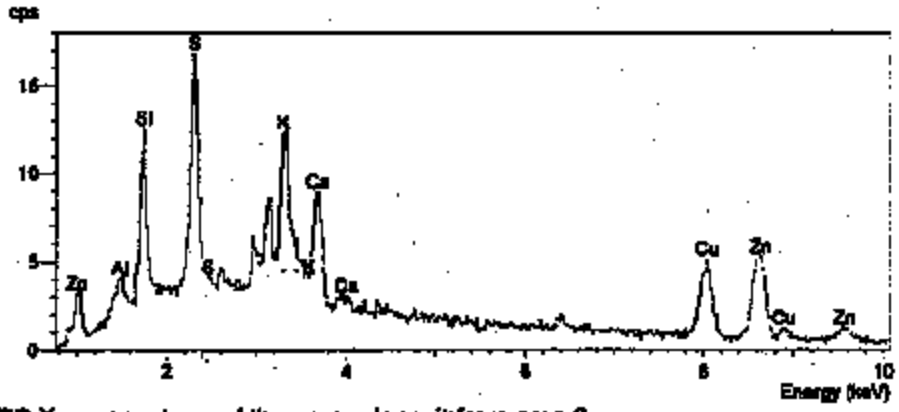
EDS X-ray spectrum material from the pad (area 3).

Note: Nominal magnifications given for photomicrographs.



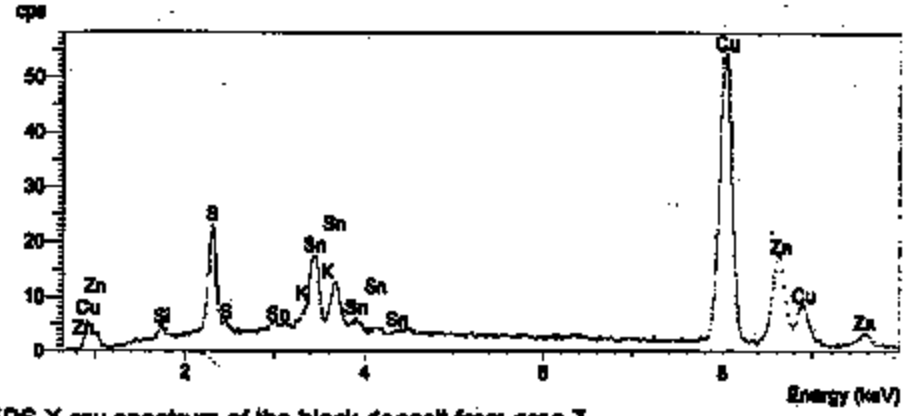
EDS X-ray spectrum of the fracture surface (area 4).

Note: Nominal magnifications given for photomicrographs.



EDS X-ray spectrum of the green deposit from area 6.

Note: Nominal magnifications given for photomicrographs.



EDS X-ray spectrum of the black deposit from area 7.

Note: Nominal magnifications given for photomicrographs.

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS (continued)

LIST OF ABBREVIATIONS

Ac	acetyl	gl	glass, glassy	dbom	rhombohedral
ace	acetone	gas	gases	s	soluble in
acid	acid solutions	hc	hydrocarbon solvents	slv	silvery
alk	alkaline solutions	hex	hexagonal	sl	slightly soluble in
amorp	amorphous	hp	heptane	soln	solution
anh	anhydrous	hx	hexane	sp	sublimation point
aq	aqueous	hyd	hydrate	stab	stable
blk	black	hyg	hygroscopic	stabl	stabilizer
brn	brown	I	insoluble in	temp	temperature
bz	benzene	liq	liquid	tetr	tetragonal
chl	chloroform	MeOH	methanol	thf	tetrahydrofuran
col	colorless	mono	monoclinic	tol	toluene
conc	concentrated	octahed	octahedral	tp	triple point
cry	crystals, crystalline	orne	orange	trans	transition, transformation
cub	cubic	orth	orthorhombic	tricl	triclinic
cyhex	cyclohexane	os	organic solvents	trig	trigonal
dec	decomposes	peth	petroleum ether	unstab	unstable
dil	dilute	pow	powder	viol	violet
dioxe	dioxane	prec	precipitate	visc	viscous
eth	ethyl ether	pur	purple	vs	very soluble in
EtOH	ethanol	py	pyridine	wh	white
exp	explosive, explosive	reac	reacts with	xyl	xylene
flam	flammable	refrac	refractory	yel	yellow

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PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS (continued)

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PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS (continued)

No.	Name Formula	CAS No.	Physical state	mp/°C density/g cm⁻³	bp/°C Other data	Solubility
699	Caesium(I) iodide CsI	7789-17-5 [illegible]	wh cub cry	621 4.51	>1280 [illegible]	H_2O, alk solv
700	Caesium(I) iodate(V) iodide $CsIO_3$	[illegible]	wh cry powder	[illegible]		H_2O, EtOH
701	Caesium(I) iodate $CsIO_3$	[illegible]	rhombohedral cry	[illegible]	dec [illegible]	H_2O
702	Caesium(I) iodate(V) $CsIO_3$	[illegible]	monoclinic cry	[illegible]	[illegible]	H_2O; s acid
703	Caesium(I) iodate(VII) $CsIO_4$	[illegible]	tetragonal cry	[illegible]		H_2O; sl solv
704	Caesium(I) iodate(V) hydrate $CsIO_3 \cdot H_2O$	[illegible]	wh pyroelec cry			sl H_2O; s acid, alk; i EtOH, eth
705	Caesium(I) iodide CsI_3	[illegible]	black hex cry	[illegible]		
706	Caesium(I) triiodide CsI_3	[illegible]	wh yel orthorh powder	[illegible]		H_2O, sl acid; EtOH, dmf; [illegible]
707	Caesium(I) tetraiodide CsI_4	[illegible]	red prisms or needles	[illegible]		H_2O; EtOH; s HI
708	Caesium(I) iodide dihydrate $CsI \cdot 2H_2O$	[illegible]	blue-gray fibr powder			
709	Caesium(I) iodate $CsIO_3$	[illegible]	gray cry powder			H_2O; weak acid
710	Caesium(I) iodate(V) iodate $CsIO_3 \cdot HIO_3$	[illegible]	gray tetrahedral cry	[illegible]	dec [illegible]	H_2O; EtOH; s HI
711	Caesium(I) iodate(V) hydrate $CsIO_3 \cdot H_2O$	[illegible]	tab bl, wetd, hex	[illegible]		
712	Caesium(I) iodate $CsIO_4$	[illegible]	blue-gray cry			H_2O; EtOH; s alk acid
713	Caesium(I) iodate(V) periodate $CsIO_3 \cdot HIO_4$	[illegible]	gray powder			
714	Caesium(I) iodate(V) periodate hydrate $CsIO_3 \cdot HIO_4 \cdot H_2O$	[illegible]	blue-gray hygr cry	[illegible]		H_2O; EtOH
715	Caesium(I) iodate $CsIO_4$	[illegible]	yel-brn monocl cry hygr	[illegible]		H_2O; EtOH, acid
716	Caesium(I) iodate dihydrate $CsIO_4 \cdot 2H_2O$	[illegible]	gel-like orth dipyr hygr	[illegible]		H_2O; EtOH; EtOH; s [illegible]
717	Caesium(I) iodate $CsIO_4$	[illegible]	colless cry	[illegible]		H_2O; s EtOH
718	Caesium(I) iodate $CsIO_4$	[illegible]	gray-wht hex cry	[illegible]		H_2O; sl acid
719	Caesium(I) iodate monohydrate $CsIO_4 \cdot H_2O$	[illegible]	blue-gray cry	[illegible]		sl H_2O; s acid
720	Caesium(I) iodate $CsIO_4$	[illegible]	gray powder			H_2O; s acid, alk
721	Caesium(I) iodate(V) dihydrate $CsIO_4 \cdot 2H_2O$	[illegible]	red-brn hygr cry	[illegible]		vs H_2O
722	Caesium(I) iodate $CsIO_4$	[illegible]	wetd, bluish cry or powder			H_2O; wetd; sol
723	Caesium(I) iodate(VII) $CsIO_4$	[illegible]	yel hex cry	[illegible]		H_2O; HNO; s HNO₃
724	Caesium(I) iodate $CsIO_4$	[illegible]	bl tetrahed cry	[illegible]	[illegible]	sl H_2O
725	Caesium(I) iodate dihydrate $CsIO_4 \cdot 2H_2O$	[illegible]	blue monocl cry	[illegible]	[illegible]	sl H_2O
726	Caesium(I) iodate $CsIO_4$	[illegible]	blue cry	[illegible]		s H_2O; i ov
727	Caesium(I) iodate(VII) hydrate $CsIO_4 \cdot H_2O$	[illegible]	glass monocl cry			s H_2O; sl EtOH; i ov
728	Caesium(I) iodate(VII) tetrahydrate $CsIO_4 \cdot 4H_2O$	[illegible]	blue tetrahed cry	[illegible]		vs H_2O; sl EtOH
729	Caesium(I) iodate $CsIO_4$	[illegible]	blue-gray powder	[illegible]		H_2O; s acid, alk; sol
730	Caesium(I) iodate $CsIO_4$	[illegible]	gray cry	[illegible]	[illegible]	H_2O
731	Caesium(I) iodate $CsIO_4$	[illegible]	wetd, bluish cry	[illegible]	[illegible]	s H_2O; sol alk
732	Caesium(I) iodate $CsIO_4$	[illegible]	wetd, bluish cry or powder			
733	Caesium(I) iodate $CsIO_4$	[illegible]	yel hex cry	[illegible]		
734	Caesium(I) iodate $CsIO_4$	[illegible]	bl tetrahed cry	[illegible]	[illegible]	
735	Caesium(I) iodate dihydrate $CsIO_4 \cdot 2H_2O$	[illegible]	blue monocl cry	[illegible]		
736	Caesium(I) iodate $CsIO_4$	[illegible]	blue cry			
737	Caesium(I) iodate(VII) hydrate $CsIO_4 \cdot H_2O$	[illegible]	glass monocl cry			
738	Caesium(I) iodate(VII) tetrahydrate $CsIO_4 \cdot 4H_2O$	[illegible]	blue tetrahed cry	[illegible]		
739	Caesium(I) iodate $CsIO_4$	[illegible]	blue-gray powder	[illegible]		H_2O; s acid, alk; sol
740	Caesium(I) iodate $CsIO_4$	[illegible]	gel cry	[illegible]		H_2O
741	Caesium(I) iodate $CsIO_4$	[illegible]	wetd, bluish cry or powder	[illegible]	[illegible]	s H_2O; sol alk
742	Caesium(I) iodate $CsIO_4$	[illegible]	wetd, bluish cry	[illegible]		

PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS (continued)

No.	Name Formula	CAS RN Mol. Wt.	Physical State	mp/°C density/g cm^{-3}	bp/°C Other Data	Solubility
730	Copper(II) nitrate trihydrate $Cu(NO_3)_2 \cdot 3H_2O$	10031-43-3 241.602	blue crystals; very hygr.	2.07		vs H_2O; s EtOH
731	Copper(II) nitrate trihydrate $Cu(NO_3)_2 \cdot 3H_2O$	10031-43-3 241.602	blue crystals; hygr.	1.14 2.32	170 dec	vs H_2O; EtOH
732	Copper(I) oxide Cu_2O	1317-39-1 143.091	red-orange solid			H_2O; d NH$_4$OH; s alk
733	Copper(II) oxide CuO	1317-38-0 79.545	black powder	dec 1100		H_2O; EtOH; sol in d NH$_4$OH
734	Copper(II) oxide CuO	1317-38-0 79.545	blk powder or pressed cry	6.40 6.31	0.2	H_2O; EtOH; d NH$_4$OH
735	Copper(II) perchlorate $Cu(ClO_4)_2$	13770-18-8 206.446	grn hygr cry	dec 130		s H_2O, alc, dioxane; insol. alc
736	Copper(II) perchlorate hexahydrate $Cu(ClO_4)_2 \cdot 6H_2O$	13770-18-8 314.539	blue crystal; cry; hygr	2.12	dec 100	vs H_2O; EtOH; MeOH; Me$_2$CO; sol. alc
737	Copper(II) perchlorate tetrahydrate $Cu(ClO_4)_2 \cdot 4H_2O$	13770-18-8 324.537	blue-grn crystals; cry			H_2O; s sol. MeOH
738	Copper(II) selenate pentahydrate $CuSeO_4 \cdot 5H_2O$	15168-20-8 304.65	blue-blk cry	dec 100 2.56		s H_2O; sol. MeOH; d NH$_4$OH; sol. EtOH
739	Copper(II) silicate $CuSiO_3$	1317-31-6 123.61	blue-blk modifiers or powder	3.65 dec		none sol.
740	Copper(II) sulfate dihydrate $CuSO_4 \cdot 2H_2O$	10257-54-2 187.61	blue crystals; cry	2.31	1	H_2O; s sol. MeOH
741	Copper(II) sulfate $CuSO_4$	7758-98-7 159.61	blue-grn hygr powder	3.603		H_2O; MeOH; sol. in gly
742	Copper(II) sulfide CuS	1317-40-4 95.61	grn-gray hygr powder or dense cry	4.60 dec		s H_2O; EtOH
743	Copper(II) sulfate pentahydrate $CuSO_4 \cdot 5H_2O$	7758-99-8 249.685	blue cryst cry	2.286	1	vs H_2O; s EtOH; sol. MeOH
744	Copper(II) sulfide, basic $CuSO_4 \cdot 3CuO$	1333-11-6 386.270	grn flakes; cry	3.88		H_2O
745	Copper(II) sulfide CuS	1317-40-4 95.611	blk hex cry	dec 220 4.76	0.1	H_2O; MeOH; dil acid; alc
746	Copper(II) tartrate trihydrate $CuC_4H_4O_6 \cdot 3H_2O$	815-82-7 308.684	blue-grn powder			d H_2O; s acid; alc
747	Copper(II) telluride CuTe	12018-03-7 191.15	yel-blk cry	dec 400 7.00		
748	Copper(II) tungstate $CuWO_4$	13587-35-4 311.39	yellow powder	7.5	0	
749	Copper(II) tungstate dihydrate $CuWO_4 \cdot 2H_2O$	13587-35-4 347.41	grn powder			H_2O; d HCl/HNO$_3$; dilute mineral acids
750	Curium Cm	7440-51-9 247	silv metal; hex cr sub	13.51	3110	
751	Cyanogen C_2N_2	460-19-5 52.036	clr metal; hex	1.012 0.95	3987 0.4	s alk sol
752	Cyanogen bromide CNBr	506-68-3 105.914	wh cry	2.015 0.95		
753	Cyanogen iodide CNI	506-78-5 153.91	wh cry	2.35		
754	Dysprosium chloride $DyCl_3$	10025-74-8 162.47	wh cry	4.4		
755	Dysprosium(III) chloride $DyCl_3$	10025-74-8 162.51	wh cry	721 dec		sol. H_2O
756	Dysprosium(III) fluoride DyF_3	13837-86-3 168.501	pale cry	5.6		sol. H_2O
757	Dysprosium(III) iodide DyI_3	13813-45-9 418.21	wh red cry	5.9		s H_2O
758	Dysprosium(III) nitrate $Dy(NO_3)_3$	10143-38-8 339.49	yel cry	2.67	0	s H_2O
759	Dysprosium(III) oxide Dy_2O_3	1308-87-8 373.00	gray cry	7.81		
760	Dysprosium(III) sulfate $Dy_2(SO_4)_3$	13847-35-2 563.70	lum cryst	3.0		
761	Dysprosium(III) sulfide Dy_2S_3	12070-27-7 293.00	gray cry	4.3		
762	Dysprosium(III) sulfide DyS	12070-28-8 194.57	lum cry	7.1		
763	Dysprosium(III) telluride Dy_2Te_3	12067-28-3 848.91	gray cry	6.9		
764	Dysprosium(III) oxide Dy_2O_3	1308-87-8 373.00	wh sub cry	3.60 7.81	0	s acid
765	Dysprosium(III) sulfide Dy_2S_3	12070-28-7 421.24	red-brn diatomic cry	5.09		
766	Einsteinium Es	7429-92-7 252	metal; sol	8.84	0	
767	Erbium Er	7440-52-0 167.26	silv metal; hex	9.05 9.07	2900 0.4	H_2O; s acid
768	Erbium bromide $ErBr_3$	13536-79-3 326.96	lilac cry	5.85 7.0		
769	Erbium bromide $ErBr_3$	13536-79-3 403.07	vlet hygr cry	5.6		s H_2O
770	Erbium chloride $ErCl_3$	10025-75-7 323.60	vlet crystal; cry; hygr	3.9 4.1	0	s H_2O

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ONLINE SEARCH RESULTS

MD 1153 SRL

Searcher: Tracy Primich, x43625
PROFS: tprimich

Requester: Norm Lapointe
Phone: x42666
Dept. No.: T540/AVT

February 9, 1999

Time Spent: 4 hours

TOPIC: rxn of brake fluid and brass

SEARCH STRATEGY: Searched chemical, materials, automotive, patent literature.

Searched for brake fluid, hydraulic fluid, components of brake fluid (e.g. glycol ethers, polyethylene glycols), types of brake fluid (e.g. DOT 3, DOT 4). Searched for copper, Cu, cuprates, brass, copper alloys, precipitates...anything to do with copper or brass.

RESULTS:

Struck out! What follows is a list of *any* article or patent vaguely connecting brake fluid and copper.

L18 ANSWER 2 OF 3 CAPLUS COPYRIGHT 1999 ACS
AN 1991:586613 CAPLUS
DN 115:186613
TI Hydraulic fluids for automobile brakes with precipitation resistance
IN Arakawa, Yoshe; Suzuki, Naomi; Yamada, Tsunayoshi; Nakahayashi, Osamu; Endo, Hiroshi; Seki, Hisao
PA Nissan Motor Co., Ltd., Japan; Ethylene Chemical K. K.
SO Jpn. Kokai Tokkyo Koho, 4 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 03122193	A2	19910524	JP 89-258904	19891005

OS MARPAT 115:186613
AB The fluids are mixts. of nonmineral hydraulic fluid for automobile brakes and 0.005-0.5% pptn. preventives of R1NR2C(:S)SnC(:S)NR1R2 (R1-2 = C1-5 alkyl; n = 1, 2, 4) and/or [R1NR2C(:S)S]nM (M = Na, K, Zn, Cu, Pb, Sb, and Te). Thus, tetramethylthiuram disulfide was added to a hydraulic fluid for brakes, contg. polyoxyalkylene monoalkyl ether boric acid ester, and heated with a Cu plate. Pptn. of Cu, which clogs the fluid path, was prevented.

L18 ANSWER 1 OF 3 CAPLUS COPYRIGHT 1999 ACS
AN 1992:430295 CAPLUS
DN 117:30295

TI Hydraulic fluids for brakes in automobiles
IN Arakawa, Yoshie; Iida, Norio; Yamada, Tsuneyoshi; Seki, Hisao; Matsuzaki, Koso
PA Nissan Jidosha K. K., Japan; Ethylene Chemical K. K.
SO Jpn. Kokai Tokkyo Koho, 4 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 04055499	A2	19920224	JP 90-165684	19900626

OS MARPAT 117:30295
AB The fluids contain 0.005-0.05 wt.% of N-contg. compds. (as pptn. inhibitors) having the general formula R1C(O)NHCnH2nNHC(O)R2 or HOPhCH:NCmH2mN:HCPhOH (R1, R2 = H or PhOH group; n = 0-3; and m = 0-4).

L3 ANSWER 3 OF 5 CAPLUS COPYRIGHT 1999 ACS
AN 1987:19207 CAPLUS
DN 106:19207
TI Boric esters for brake fluids
IN Minagawa, Kamichiro; Takano, Yoshinori
PA Nippon Oils and Fats Co., Ltd., Japan
SO Jpn. Kokai Tokkyo Koho, 7 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 61103885	A2	19860522	JP 84-225541	19841026
	JP 02046038	B4	19901012		

AB Anticorrosive title compds. are prepd. by adding 1-10 mol (vs. active H) C2-4 alkylene oxides to active H-contg. compds. in the presence of alkali catalysts, neutralizing the resulting polyethers by 0.5-1.5 equiv. (vs. alkali catalysts) hydroxy acids, and adding boron compds. Thus, 7.4 kg BuOH was added to 17.6 kg ethylene oxide in the presence of 56 g KOH to obtain 24.9 kg polyether, which was neutralized with 90% aq. lactic acid (I), and then 1.24 kg boric acid was added at 100-120.degree. and 30-70 mm Hg to obtain 25.5 kg boric ester which showed viscosity 2510 cSt (at -40.degree.), and JIS K2233 corrosion behavior against tinplate, steel plate, Al, cast iron, brass, and Cu 0, -0.02, 0, 0.03, 0.02, and -0.03 mg/cm2, resp., vs. 2534, -0.17, -0.31, -0.16, -0.56, -0.29, and -0.35, resp., using 104 g 35% HCl instead of I.

L3 ANSWER 4 OF 5 CAPLUS COPYRIGHT 1999 ACS
AN 1984:36904 CAPLUS
DN 100:36904
TI Corrosion inhibitors for boron-containing lubricants
IN Holstedt, Richard A.; Jessup, Peter
PA Union Oil Co. of California , USA
SO U.S., 10 pp. Cont.-in-part of U.S. Ser. No. 319,073.
CODEN: USXXAM
DT Patent
LA English
FAN.CNT 8

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	US 4412928	A	19831101	US 81-333998	19811223
	US 4410436	A	19831018	US 81-319073	19811109
	US 4623474	A	19861118	US 81-329385	19811210

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	US 4629579	A	19861216	US 84-679286	19841207
	US 4557843	A	19851210	US 85-696024	19850129
	US 4627930	A	19861209	US 85-695959	19850129
	US 4629580	A	19861216	US 85-696006	19850129
	US 4657686	A	19870414	US 85-696025	19850129
	CA 1257606	A1	19890718	CA 85-480025	19850425
	US 4756842	A	19880712	US 86-878203	19860625
	US 4801729	A	19890131	US 87-140153	19871230
PRAI	US 81-319073	19811109			
	US 81-329385	19811210			
	US 80-158828	19800612			
	US 80-158981	19800612			
	US 81-329384	19811210			
	US 81-333998	19811223			
	US 82-418196	19820915			
	US 82-434602	19821015			
	US 83-478513	19830301			
	US 83-476513	19830318			
	US 83-482941	19830407			
	US 83-525691	19830823			
	US 83-525718	19830823			
	US 83-525719	19830823			
	US 83-525720	19830823			
	US 84-679286	19841207			
	US 85-695959	19850129			
	US 85-696006	19850129			
	US 85-696025	19850129			
	US 86-884980	19860711			

AB Dodecyliminobis(phenylethylene) borate (I) [88433-74-3] and similar reaction products of H3BO3 and N-alkyl(or phenyl)diethanolamines are load-carrying agents in lubricating oils contg. 2,5-bis(octyldithio)-1,3,4-thiadiazole (II) [13539-13-4] and terephthalic acid [100-21-0] as corrosion inhibitors for Cu and Pb, resp. I is manufd. by treatment with H3BO3 of the reaction product of dodecylamine [124-22-1] and styrene oxide [96-09-3]. II is manufd. from octyl mercaptan [111-88-6], CI, and 2,5-dimercapto-1,3,4-thiadiazole [1072-71-5]. Similarly manufd. is 2,5-bis(decyldithio)-1,3,4-thiadiazole [88433-75-4].

L3 ANSWER 5 OF 5 CAPLUS COPYRIGHT 1999 ACS
AN 1984:36900 CAPLUS
DN 100:36900
TI Lubricating oil containing a boron compound and corrosion inhibitors
IN Holstedt, Richard A.; Jessup, Peter
PA Union Oil Co. of California , USA
SO U.S., 10 pp.
CODEN: USXXAM
DT Patent
LA English
FAN.CNT 8

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	US 4410436	A	19831018	US 81-319073	19811109
	US 4412928	A	19831101	US 81-333998	19811223
	US 4629579	A	19861216	US 84-679286	19841207
	US 4557843	A	19851210	US 85-696024	19850129
	US 4627930	A	19861209	US 85-695959	19850129
	US 4629580	A	19861216	US 85-696006	19850129
	US 4657686	A	19870414	US 85-696025	19850129
	CA 1257606	A1	19890718	CA 85-480025	19850425
	US 4756842	A	19880712	US 86-878203	19860625
	US 4724099	A	19880209	US 86-884980	19860711
	US 4801729	A	19890131	US 87-140153	19871230
PRAI	US 80-158828	19800612			
	US 80-158981	19800612			

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	US 81-319073	19811109
	US 81-329384	19811210
	US 81-329385	19811210
	US 81-333398	19811223
	US 81-333998	19811223
	US 82-418196	19820915
	US 82-434602	19821015
	US 83-478513	19830301
	US 83-476513	19830318
	US 83-482941	19830407
	US 83-525691	19830823
	US 83-525718	19830823
	US 83-525719	19830823
	US 83-525720	19830823
	US 84-679286	19841207
	US 85-695959	19850129
	US 85-696006	19850129
	US 85-696025	19850129
	US 86-884980	19860711

AB Dodecyliminobis(phenylethylene) H borate (I) [88375-27-3] and similar reaction products of H3BO3 and N-alkyl(or phenyl)diethanolamines are load-carrying agents in lubricating oils contg. 2,5-bis(octyldithio)-1,3,4-thiadiazole (II) [13539-13-4] and terephthalic acid [100-21-0] as corrosion inhibition for Cu and Pb, resp. I is manufd. by treatment with H3BO3 of the reaction product of dodecylamine [124-22-1] and styrene oxide [96-09-3]. II is manufd. from octyl mercaptan [111-88-6], Cl, and 2,5-dimercapto-1,3,4-thiadiazole [1072-71-5]. Similarly manufd. is 2,5-bis(dodecyldithio)-1,3,4-thiadiazole [13539-12-3].

L5 ANSWER 1 OF 4 CAPLUS COPYRIGHT 1999 ACS
AN 1976:76709 CAPLUS
DN 84:76709
TI Functional fluids containing epoxide stabilizers
IN Herber, John F.; Street, Robert W.; Richard, William R., Jr.
PA Monsanto Co., USA
SO Ger. Offen., 25 pp.
CODEN: GWXXBX
DT Patent
LA German
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	DE 2512891	A1	19751009	DE 75-2512891	19750324
	DE 2512891	B2	19810507		
	DE 2512891	C3	19820318		
	US 3941709	A	19760302	US 74-454650	19740325
	NL 7503404	A	19750929	NL 75-3404	19750321
	NL 180020	B	19860716		
	NL 180020	C	19861216		
	ES 435861	A1	19761216	ES 75-435861	19750321
	BE 827081	A1	19750924	BE 75-154669	19750324
	FR 2265850	A1	19751024	FR 75-9143	19750324
	FR 2265850	B1	19820507		
	JP 50134990	A2	19751025	JP 75-35265	19750324
	JP 57056959	B4	19821202		
	AU 7579415	A1	19760930	AU 75-79415	19750324
	GB 1479410	A	19770713	GB 75-12250	19750324
	CA 1045624	A1	19790102	CA 75-222895	19750324
	CH 615945	A	19800229	CH 75-3709	19750324
PRAI	US 74-454650		19740325		

AB Acid formation is retarded in hydraulic fluid compns. comprising .gtoreq.50 wt.% of phosphorus acid esters, and/or carboxylic acid esters, and/or esters of polyhydroxy compds. by

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addn. of 1-10 wt.% of an epoxy compd., such as dibutyl 5,6-epoxynorbornane-2,3-dicarboxylate (I) [58130-55-5]. Thus, to a base fluid contg. dibutyl phenyl phosphate [2528-36-1] 94.2, poly(alkylmethacrylate) 5.1 and H2O 0.2% was added 4.7% I. Upon testing at 135.degree. for 150 hr, the acid no. was 0.5, and the corrosion of metal blanks in mg/cm2 was Mg 1.33, Al -0.01, Cd -0.18, Cu -0.43, and Ag -0.06.

L5 ANSWER 2 OF 4 CAPLUS COPYRIGHT 1999 ACS
AN 1975:173425 CAPLUS
DN 82:173425
TI Ester base fluid compositions
IN Thompson, Quentin Elwyn; Reid, Stanley Lyle; Weiss, Richard Wolf
PA Monsanto Co., USA
SO Brit., 10 pp.
CODEN: BRXXAA
DT Patent
LA English
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	GB 1365592	A	19740904	GB 72-34640	19720725

AB High temp. oxidn. stable fluids, useful as hydraulic fluids, heat transfer fluids, and lubricants, comprised synthetic ester bases contg. a K organophosphorus compd. prepd. by esterification of a .beta.-H-free polyol with a P compd. Thus, dipentaerythritol was esterified with phosphorus acid and octanoic acid and the complex ester acid product treated with K2CO3. The high temp. oxidn. and Pb, Mg, and Cu corrosion stability of a synthetic ester base comprising a mixt. of pentaerythritol and dipentaerythritol esters of C5-9 aliph. acids contg. the inhibitor product were superior to those of ester base contg. no inhibitor or K octanoate and K neodecanoate inhibitors.

L5 ANSWER 3 OF 4 CAPLUS COPYRIGHT 1999 ACS
AN 1973:516852 CAPLUS
DN 79:116852
TI Additives for hydraulic fluids and metal cleaning and pickling fluids
IN Elliott, John Scotchford; Crail, Ian R. H.; Davis, Bryan Terence
PA Castrol Ltd.
SO Brit., 10 pp.
CODEN: BRXXAA
DT Patent
LA English
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	GB 1323061	A	19730711	GB 69-30336	19690616

GI For diagram(s), see printed CA Issue.
AB I[e.g. R = (CH2)2CO2H, Bu, (CH2)3O(CH2)2O(CH2)2OH, CHMeCO2H, o-C6H4OH, m- and p-C6H4CO2H], useful as hydraulic fluid and mineral acid cleaning soln. additives, were prepd. by heating the appropriate amine with itaconic acid either in H2O or as solids. E.g., p-H2NC6H4CO2H with itaconic acid were refluxed together for 2 hr at 190.degree. to yield 84% I (R = p-C6H4CO2H). Addn. of 0.2% I (R = Bu) to 37.5% propylene carbonate, 10.0% butyl triglycol, 48.3% of adipic acid esterified with 90:10(%) methyl triglycol-diethylene glycol mixt., 3.0% of 5.5:1.0 (molar) propylene oxide NH3 condensate, 1.0% di-Bu phthalate, 0.1% Bu2NH, and 0.1% benzotriazole reduced the wt. change Cu in SAE70R3 from -0.113 to -0.042 g/cm2 and stopped Al pitting.

L5 ANSWER 4 OF 4 CAPLUS COPYRIGHT 1999 ACS
AN 1972:542128 CAPLUS

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DN 77:142128
TI Antioxidants for ester-base functional fluids
IN Thompson, Quentin E.; Reid, Stanley L.; Weiss, Richard W.
PA Monsanto Co.
SO U.S., 6 pp.
CODEN: USXXAM
DT Patent
LA English
PAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	US 3584711	A	19720815	US 70-28139	19700413

AB Oxidn. resistance of ester lubricants prepd. from neopentyl glycol, MeC(CH2OH)3, EtC(CH2OH)3, or mono-, di- or tripentaerythritol and C4-22 carboxylic acids, is ensured by the addn. of alkali metal organophosphorus salts. They are prepd. by esterification of a polyhydric alc. with a slight excess of mixt. of carboxylic- and a P-acid or deriv., then reacting with an alkali metal base. Thus, dipentaerythritol 3, H3PO3 3 and octanoic acid 15.3 moles and 200 ml PhMe were refluxed for 2 hr at 160.degree., then for 30 min at 170.degree., and the pressure lowered to 10 mm to remove volatiles. The decanted light yellow complex organophosphorus acid ester was reacted with 1.9 moles of anhyd. K2CO3 giving a filtrate inhibitor with K-P ratio 113. A mixt. of mono- and dipentaerythritol esters of C5-9 aliphatic acids contg. 2% aryl amine, 0.1% corrosion inhibitor and 15 ppm silicone defoamer, had the test results: Pb corrosion nil, appearance clear, % viscosity increase-too viscous to measure, Mg loss mg/in.2 -7.8, Cu loss -0.5, Ryder test 100. After addn. of 0.02 inhibitor meq. alkali metal/20 g base, tests were -3.2, clear, 54%, -0.08, -0.21 and 104 resp.

L8 ANSWER 2 OF 3 CAPLUS COPYRIGHT 1999 ACS
AN 1986:612847 CAPLUS
DN 105:212847
TI Research on zinc for cast alloys
AU Johnen, H.
CS Duesseldorf, Fed. Rep. Ger.
SO Metall (Berlin) (1986), 40(9), 883-4
CODEN: METLAF; ISSN: [redacted]
DT Journal
LA German
AB The effects of casting parameters and Cu content on the corrosion resistance, dimensional accuracy, and mech. properties of die-cast Zn alloys were studied. The strength is increased and elongation somewhat increased by alloying to <3% Cu. The corrosion resistance is satisfactory at >0.7% Cu and the dimensional accuracy is improved at low Cu content but high shrinkage, of .ltoeq.25 .times. 10-2% is caused by increase in Cu content. The resistance to ignition sparking of die-cast Z410 [12605-45-7], Z430 [56589-14-1], ZA8 [74434-72-3], and ZA12 [74434-71-2] was satisfactory but not ZA 27 [82512-79-6]. The last one, however, is easier to cast at lower temps. than Al alloys. The friction wear of Z410 and Z430 on gray cast iron indicates a similar behavior as the expensive bronzes. No corrosion was obsd. in aq. soln. contg. an antifreeze in automotive radiators or in a brake fluid for Z410. The fatigue properties of machined gears from the die-cast Z410 were also satisfactory. The best tool performance in machining was indicated for a high-speed steel.

L8 ANSWER 3 OF 3 CAPLUS COPYRIGHT 1999 ACS
AN 1982:602051 CAPLUS
DN 97:202051

3713 7366

TI Corrosion behavior and control of metallic materials in polyethylene glycol-ethoxylated alcohol mixtures
AU Ludosan, Eugenia; Cimpoeru, Cristina
CS Cent. Chim. Fiz., Inst. Cent. Cercet. Chim., Bucharest, Rom.
SO Rev. Chim. (Bucharest) (1982), 33(1), 57-63
CODEN: RCHUAU
DT Journal
LA Romanian
AB Corrosion of steel OLC 25 [12743-56-5], Cu, cast iron FC 20 [76722-47-9], Al-Cu-Si alloy ATS15Cu5 [83383-17-9], bronze Bz6ZnT [37241-73-9], and Cu-Zr alloy Am 58 [83400-28-6] in polyethylene glycol-undefined ethoxylated alc. mixt., which is used as brake fluid, was studied in the presence of NaNO2, borax, Na benzoate, and org. amines as corrosion inhibitors. The best corrosion inhibiting properties without forming ppts. were shown by cyclohexylamine [108-91-8].

L11 ANSWER 2 OF 3 CAPLUS COPYRIGHT 1999 ACS
AN 1981:194804 CAPLUS
DN 94:194804
TI Removal of copper ions from brake fluids
PA Toyota Motor Co., Ltd., Japan
SO Jpn. Kokai Tokkyo Koho, 4 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 56016598	A2	19810217	JP 79-92875	19790721

AB Cu2+ is removed from brake fluids to prevent galvanic corrosion. The brake fluid is contacted with Zn or Mg t o ppt. Cu in the fluid recirculation system at a location ahead of the master cylinder so that vital parts are protected.

L11 ANSWER 3 OF 3 CAPLUS COPYRIGHT 1999 ACS
AN 1968:51836 CAPLUS
DN 68:51836
TI Anticorrosive brake fluid
IN Doelling, George L.; Siefker, Joseph A.; Schwoegler, Edward J.; Putscher, Richard E.
PA Tung-Sol Electric Inc.
SO U.S., 4 pp.
CODEN: USXXAM
DT Patent
LA English
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	US 3367796		19671017	US	19620911

AB Nonpetroleum-base brake fluids can be improved to pass the Federal Specification VV-B-910 for corrosion and discoloration of Cu or brass in a vented jar by the addn. of a combination of 0.4-2% of K ricinoleate and 0.05-2% of bis(p-dimethylaminophenyl)methane, p,p'-benzylidinebis (N,N - dimethylaniline), or 4-HOC6H4CH(C6H4NMe2-4)2.

L13 ANSWER 1 OF 1 CAPLUS COPYRIGHT 1999 ACS
AN 1976:547922 CAPLUS
DN 85:147922
TI Metal corrosion inhibitor
IN Suzuki, Hiroshi
PA Agency of Industrial Sciences and Technology, Japan

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SO Japan. Kokai, 7 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
FAN.CNT 1

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 51075641	A2	19760630	JP 75-1760	19741226

AB A metal soap is dissolved in a hydroxy-substituted fatty acid amide poly(oxyalkylene) ether, and then ethanolamine, NaNO2, and/or benzotriazole is added to obtain a water- and oil-sol. corrosion inhibitor. Optionally, HOAc is also added to the soln. The corrosion inhibitor can be used in brake fluid and antifreeze compns. Thus, metal specimens such as Fe, steel, Al, brass, phosphor bronze, galvanized iron, Pb and Sn were dipped in 0.1-2.0% aq. soln. of a corrosion inhibitor contg. Mg soap 1.7, ethanolamine [141-43-5] 2, castor oil fatty acid amide poly(oxyethylene) ether [25322-68-3] 8.3, NaNO2 2, benzotriazole [27556-51-0] 1, and water 85 parts at 90.degree.. No corrosion was obsd. even after a 24 hr dipping.

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Ford Central Lab
1-[illegible]-94

- Hexpost
  + Sample black sludge id:
    water – doubtful to detect by IR or KFR
    brake fluid
    unknown

- Kapton (3-diaphram squares)
  + Sample fluids –
    - water –
    - brake fluid –
    - unknown
  + Assess Kapton's sensitivity to water/brake fluid.

- Cap
  - ~~Disc~~ – steel cover disc
    + Sample heavy black deposits

- El[illegible] Inc.
  - id black compound on one blade
  - id gray compound on 2nd blade

- Stationary Tripend
  - Remove ½ [illegible] photo SEM → clean
    & determine fx mode.

(once)

3713 7391

2/12 · Cut insulation off wires – Both copper wires were relatively clean no continuous corrosion existing. Small flakes of green residue spotty over wires.

3713 7392

CENT. LAB. TESTS

3713 7393

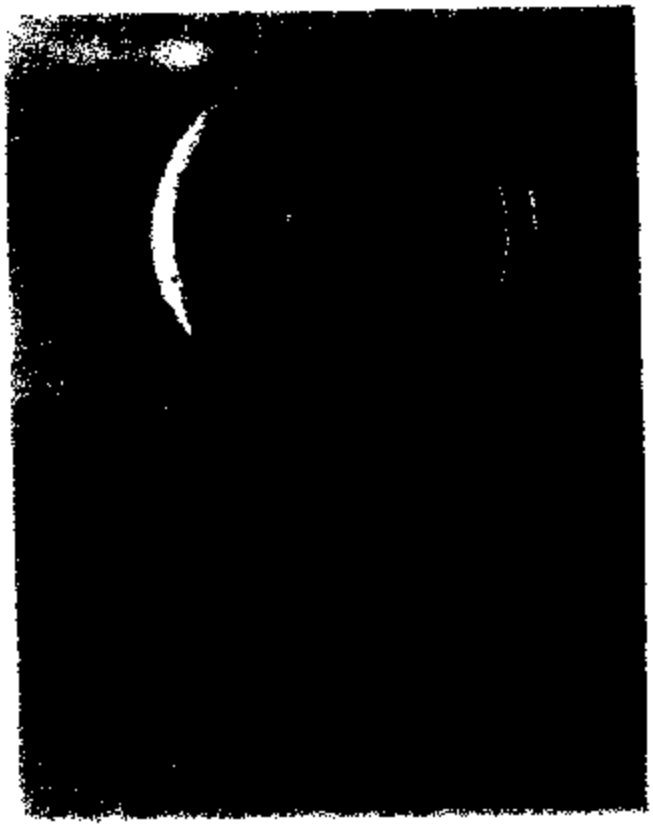


FIG. I (As Rec'd)

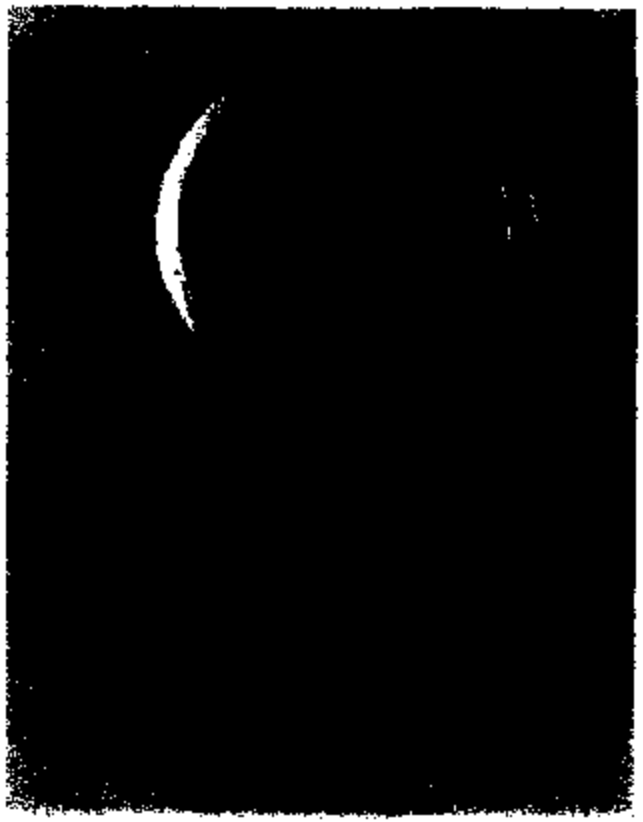


FIG. I (As Rec'd)

3713 7394

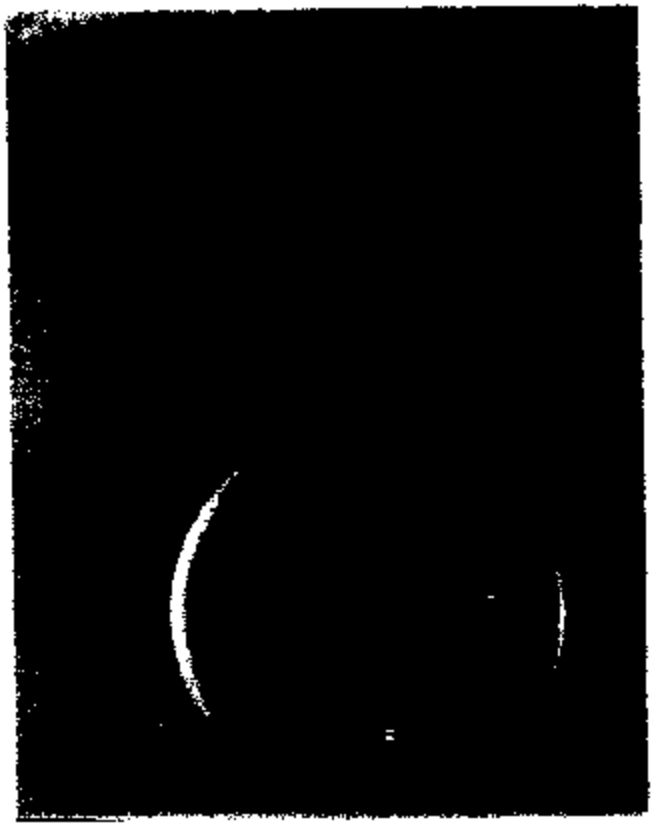


FIG 2 SAMPLE REMOVED

FIG 1 (AS REC'D)

8713 7395

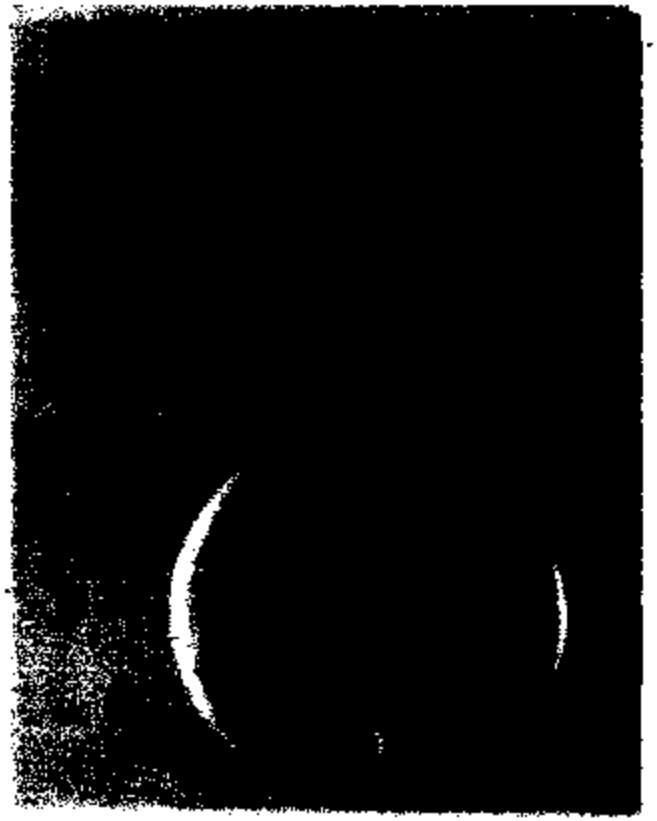


FIG 2. SAMPLE REMOVED

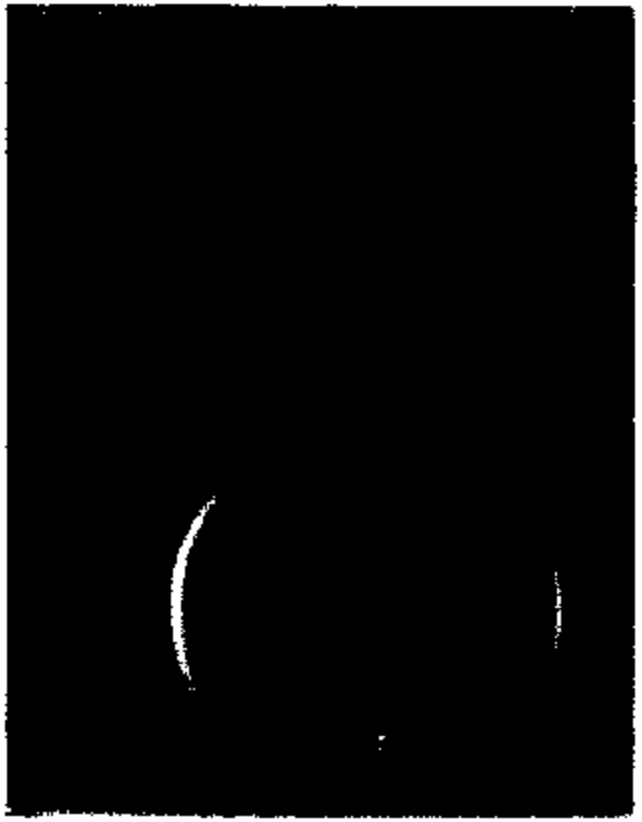


FIG 2 SAMPLE REMOVED

3713 7398

****
* Note printed by NLAPOINT on 24 Mar 1999 at 12:36:22 *
****

From: FPORTER --DRBN007 Date and time 03/18/99 17:17:39
To: SMCCART3--DRBN005
cc: SLAROUCH--FORDNA1 RCARTER --DRBN005
SREIMERS--DRBN007 NLAPOINT--DRBN005

FROM: F. J. Porter USAET(UTC -05:00)
Subject: Brake Switch Analysis - Junk Yard Part

I would like to meet with you when the "Memphis" material analysis is ready. Please keep me informed.

Thanks.

Regards,
Fred Porter OV - fporter fporter@ford.com
Chassis E/E Systems Applications (313)845-3722
Bldg 5 - Mail Drop 5030 - Cubicle 3E004 fax: 390-4165
*** Forwarding note from SMCCART3--DRBN005 03/18/99 15:46 ***
To: FPORTER --DRBN007
cc: SMCCART3--DRBN005 SLAROUCH--FORDNA1
RCARTER --DRBN005

FROM: SHAUN McCarthy USAET(UTC -05:00)
Subject: Brake Switch Analysis - Junk Yard Part
We have disassembled the switch you gave me that showed corrosion inside the switch area. Inorganic analysis of the material has been completed. The reddish material is FeO(OH) and the whitish material is 2ZnCO3-3Zn(OH)2. Extensive photos have been taken through out the disassembly. Our conclusion by examining the path or location of corrosion is that fluid entered through the connector area for this sample.
We would be glad to meet with you and show you the photos and discuss our conclusions.
Analysis is still underway regarding the material from the "Memphis" switch.

Regards,
SHAUN McCarthy SEL Room 1339 Mail Stop 1170
32-21355 FAX 32-31129

3713 7397

****
* Note printed by NLAPOINT on 24 Mar 1999 at 12:44:05 *
****

From: FPORTER --DRBN007 Date and time 03/18/99 17:17:39
To: SMCCART3--DRBN005
cc: SLAROUCH--FORDNA1 RCARTER --DRBN005
SREIMERS--DRBN007 NLAPOINT--DRBN005

FROM: F. J. Porter USART(UTC -05:00)
Subject: Brake Switch Analysis - Junk Yard Part

I would like to meet with you when the "Memphis" material analysis is ready. Please keep me informed.

Thanks.

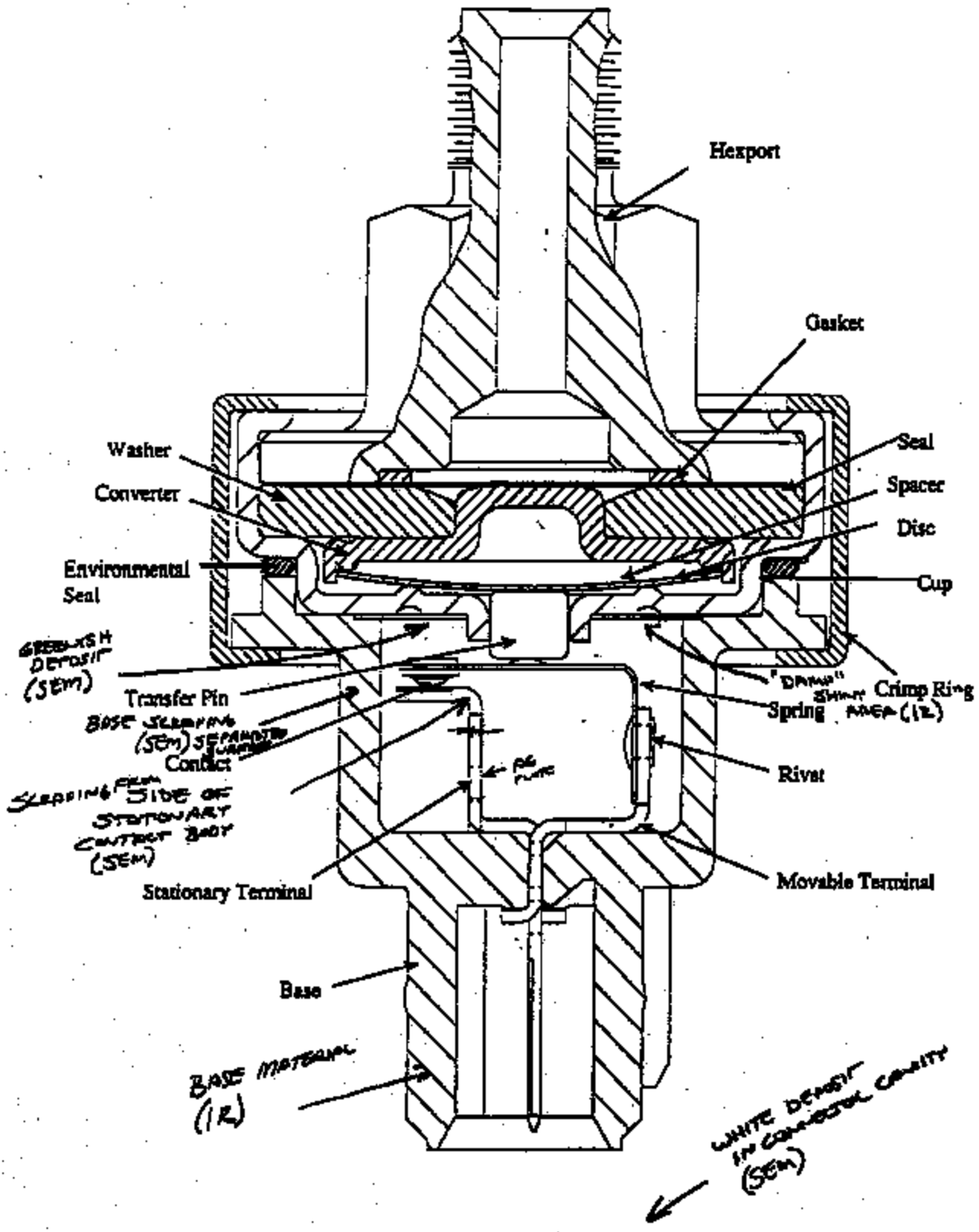
Regards,
Fred Porter OV - fporter fporter@ford.com
Chassis E/E Systems Applications (313)845-3722
Bldg 5 - Mail Drop 5030 - Cubicle 3H004 fax: 390-4145
*** Forwarding note from SMCCART3--DRBN005 03/18/99 15:46 ***
To: FPORTER --DRBN007
cc: SMCCART3--DRBN005 SLAROUCH--FORDNA1
RCARTER --DRBN005

FROM: SHAUN McCarthy USART(UTC -05:00)
Subject: Brake Switch Analysis - Junk Yard Part
We have disassembled the switch you gave me that showed corrosion inside the switch area. Inorganic analysis of the material has been completed. The reddish material is FeO(OH) and the whitish material is 2ZnCO3-3Zn(OH)2. Extensive photos have been taken through out the disassembly. Our conclusion by examining the path or location of corrosion is that fluid entered through the connector area for this sample.
We would be glad to meet with you and show you the photos and discuss our conclusions.
Analysis is still underway regarding the material from the "Memphis" switch.

Regards,
SHAUN McCarthy SRL Room 1339 Mail Stop 1170
32-21355 FAX 32-21129

3713 7398

Hydraulic Pressure Switch Cross Section



3713 7399

Central Laboratory
15000 Century Drive
Dearborn, MI 48120-1267
FAX (313) 322-1614

Report 9904108
Preliminary

January 6, 1999

To: G. Stevens/N. LaPointe/S. LaRouche (313) 32-36686 07224 FAX

From: Gayle D. Gullen (313) 32-27322

Subject: Speed Control Cut-Off Switch
Part Number: F2VY-9F924-A
Source: Customer Vehicle

Received: One opened switch which had undergone a thermal event and one unused switch base were received on January 4, 1999, from S. LaRouche.

Object: Determine if any fluid is present on the switch cup in metallic-exposed area and compare the switch base material to the unused material.

Conclusion/ Discussion: There was spectral evidence of a glycol ether [spectrally similar to Dow HD 50-4 brake fluid] and a metal soap on the metallic-exposed area of the switch cup. The customer base and unused base are spectrally similar and are composed of a polyester material. This is not the 'Noryl' material which was suspected. [Noryl is a styrenated PPO (polyphenylene oxide).]

The exact nature and source of the noted metal soap could not be conclusively determined. Metal soaps can be utilized as polymeric compounding and/or mold release agents. Metal soaps are also utilized in greases [this glycol ether material does not match known carrier grease fluids] and may also be formed in the presence of acids and metal salts [both perhaps a reaction of the polymeric base and metallic interference during the event].

Data and Analysis:

Molecular Characterization
(FTIR, Qualitative, Microscopic)

Arrow B in Figure 2 points to area where analysis was performed). Spectra of the fluid noted on the metallic surface [chloroform micro casts - several areas] are characteristic of a glycol ether [spectrally similar to Dow HD 50-4 brake fluid] with evidence of an ester and metal soap.

Spectra of the new, brown base are characteristic of a polyester on the base of terephthalic acid.

Spectra of the blackened, customer base are similar to the new base and are characteristic of a polyester on the base of terephthalic acid.

Contributor: V. Cooper

Concur: _____
Mary Hage
Organic Section

By: _____
Gayle D. Gullen (GGULLEN)
Product Materials Engineer

3713 7400

Central Laboratory
15000 Century Drive
Dearborn, MI 48120-1267
FAX (313) 322-1614

Report 9804105
Preliminary

January 6, 1999

To:	G. Stevens/N. LaPointe/S. LaRouche	(313) 32-36686	07224 FAX
From:	Gayle D. Gullen (313) 32-27322		

Subject: Speed Control Cut-Off Switch
Part Number: F2VY-9F924-A
Source: Customer Vehicle

Received: One opened switch which had undergone a thermal event and one unused switch base were received on January 4, 1999, from S. LaRouche.

Object: Determine if any fluid is present on the switch cup in metallic-exposed area and compare the switch base material to the unused material.

Conclusion/ Discussion: There was spectral evidence of a glycol ether [spectrally similar to Dow HD 50-4 brake fluid] and a metal soap on the metallic-exposed area of the switch cup. The customer base and unused base are spectrally similar and are composed of a polyester material. This is not the 'Noryl' material which was suspected. [Noryl is a styrenated PPO (polyphenylene oxide).]

The exact nature and source of the noted metal soap could not be conclusively determined. Metal soaps can be utilized as polymeric compounding and/or mold release agents. Metal soaps are also utilized in greases [this glycol ether material does not match known carrier grease fluids] and may also be formed in the presence of acids and metal salts [both perhaps a reaction of the polymeric base and metallic interference during the event].

Data and Analysis:

Molecular Characterization
(FTIR, Qualitative, Microscopic)

Arrow B in Figure 2 points to area where analysis was performed). Spectra of the fluid noted on the metallic surface [chloroform micro casts - several areas] are characteristic of a glycol ether [spectrally similar to Dow HD 50-4 brake fluid] with evidence of an ester and metal soap.

Spectra of the new, brown base are characteristic of a polyester on the base of terephthalic acid.

Spectra of the blackened, customer base are similar to the new base and are characteristic of a polyester on the base of terephthalic acid.

Contributor: V. Cooper

Concur: _____
Mary Haga
Organic Section

By: _____
Gayle D. Gullen (GGULLEN)
Product Materials Engineer

3713 7401

Central Laboratory
15000 Century Drive
Dearborn, MI 48120-1267
FAX (313) 322-1614

Report 9804105
Preliminary

January 6, 1999

To:	G. Stevens/N. LaPointe	(313) 32-36686	07224 FAX
From:	S. LaRouche (313) 84-54876		

Subject: Speed Control Cut-Off Switch
Part Number: FZVY-9F24-A
Source: Customer Vehicle

Received: One switch which had been involved in a thermal event, one unused switch, and unused switch components were received on December 17, 1998.

Object: Determine cause of thermal event.

Conclusion: Surface analysis indicates that oxide or corrosion product from the brass contacts may have transferred to the cup component of the switch. Deposits on the cup also appear to contain filler materials from the switch base.

The white deposit in the connector cavity below the wire seal appears to be from a dry chemical fire extinguisher.

Data and Analysis:

Surface Analysis
(Visual Examination, Scanning Electron Microscopy (SEM),
Energy Dispersive X-ray Spectroscopy (EDS))

The as-received condition of the switch is shown in Figure 1. The switch is shown after sampling for EDS in Figure 2 (arrow A in photograph points to area where sample was removed). Energy dispersive X-ray spectroscopy was performed on the following materials:

Oxide-like material on side surface of stationary contact body[1]

Greenish deposit visible on switch side of cup[2]

Material scraped from switch base

Material scraped from new switch base

White material in cavity of connector below wire seal

The spectra from these materials are attached.

The spectra from the material on the side of the stationary contact exhibits elements from the base metal (brass) as well as a trace amount of sulfur. This suggests that the material on the surface of the stationary contact is most likely an oxide of the base metal with possibly a sulfate.

[1] Small scraping from side of contact.

[2] Small scraping from deposit.

3713 7402

Surface Analysis - continued

The spectra from the greenish deposit on the cup exhibits mostly copper and zinc with trace amounts of sulfur, potassium, silicon, chromium, and iron. The presence of copper and zinc indicates that the deposit is primarily an oxide of the brass contact material which has transferred to the cup. The presence of sulfur suggests that some of the material may be a sulfate. The chromium and iron are most likely from the cup. The deposit also contains fibers which have spectra similar to those in the switch housing.

Spectra from the switch bases are similar. Aluminum, silicon, and calcium are most likely from the fillers (fibers, etc.) used in the housing material.

Spectra from the white deposit exhibit elements which would be found in dry chemical fire extinguishers, i.e., high phosphorus content material with plates of Si, Al, F – rich material (Muscovite).

Contributor: P. Nailos

Concur: _____
P. Klaas, Supervisor
Metallurgy Section

By: _____
Steven LaRouche (SLAROUCH)

Enclosures: Nine EDS spectra
Data sheet on muscovite

SL/sl

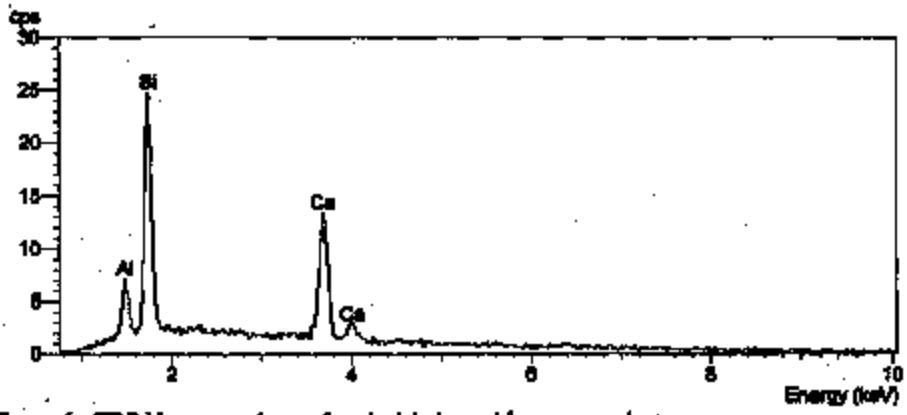


Figure 4: EDS X-ray spectrum of material shaved from a new base.

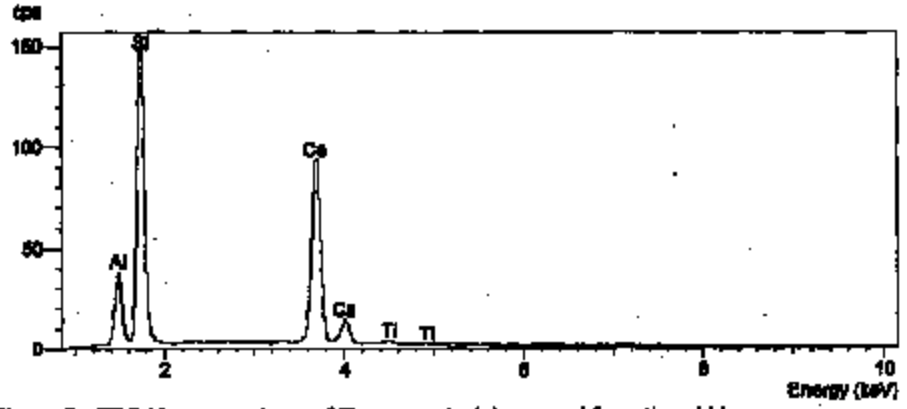


Figure 5: EDS X-ray spectrum of fibrous material scraped from the old base.

Note: Nominal magnifications given for photomicrographs.

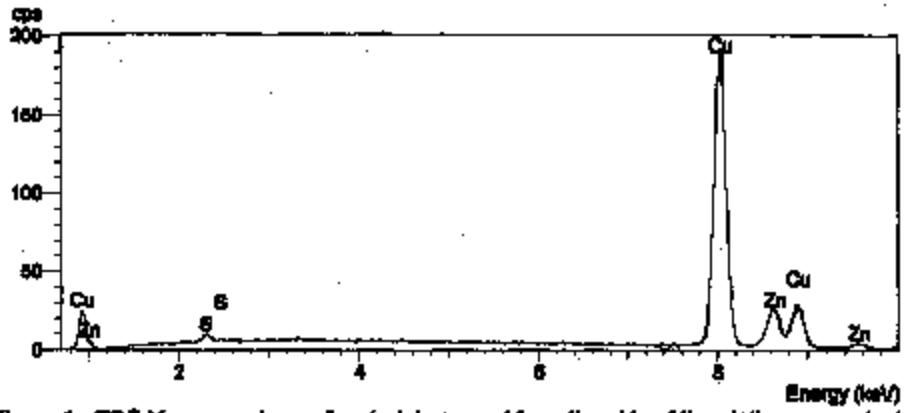


Figure 1: EDS X-ray spectrum of material scraped from the side of the stationary contact body.

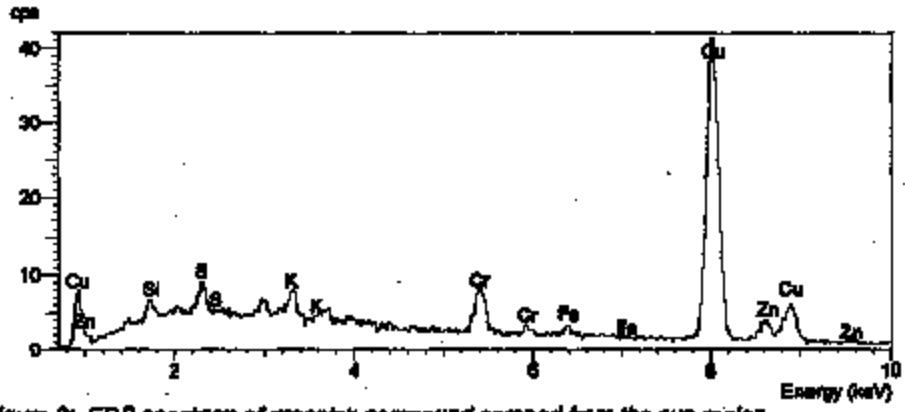


Figure 2: EDS spectrum of greenish compound scraped from the cup region.

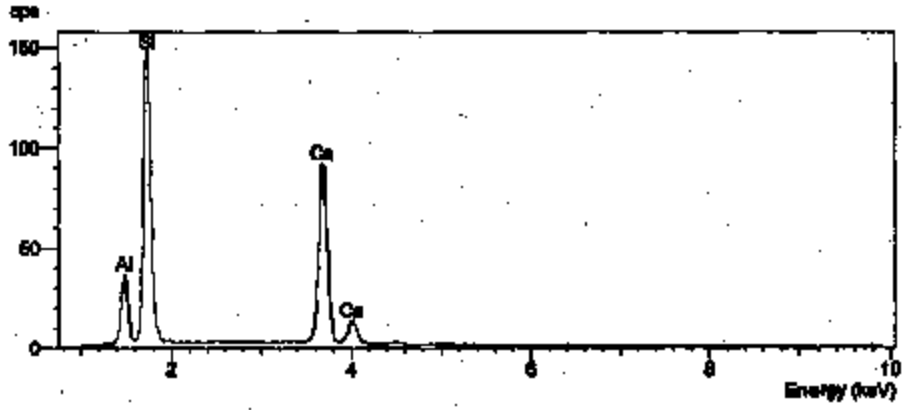


Figure 3: EDS X-ray spectrum of fibrous material scraped from the cup region.

Note: Nominal magnifications given for photomicrographs.

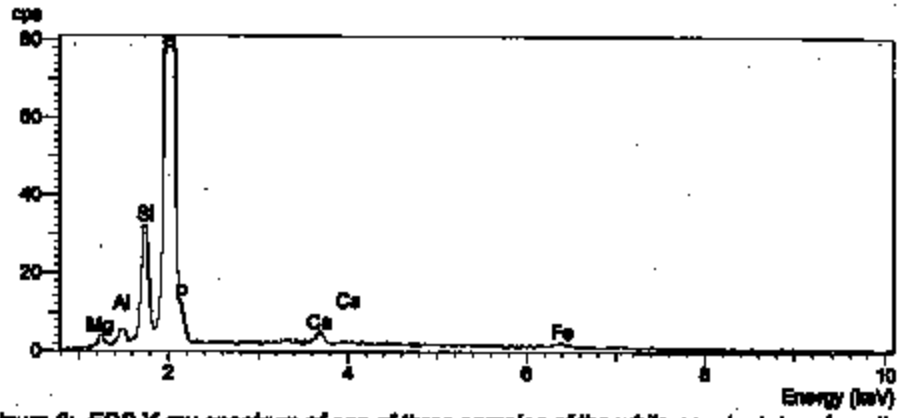


Figure 6: EDS X-ray spectrum of one of three samples of the white powder taken from the connector cavity below the wire seal.

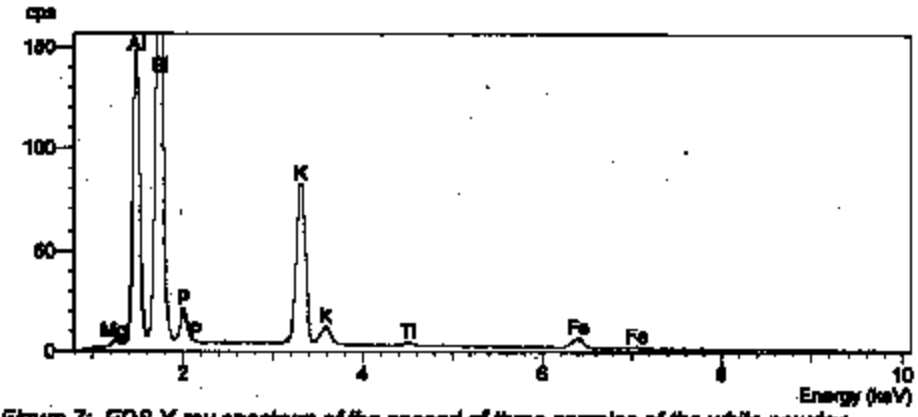


Figure 7: EDS X-ray spectrum of the second of three samples of the white powder.

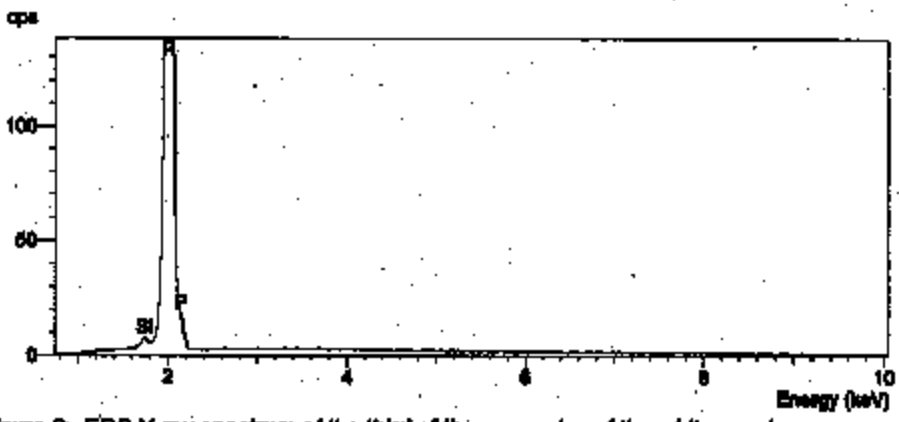
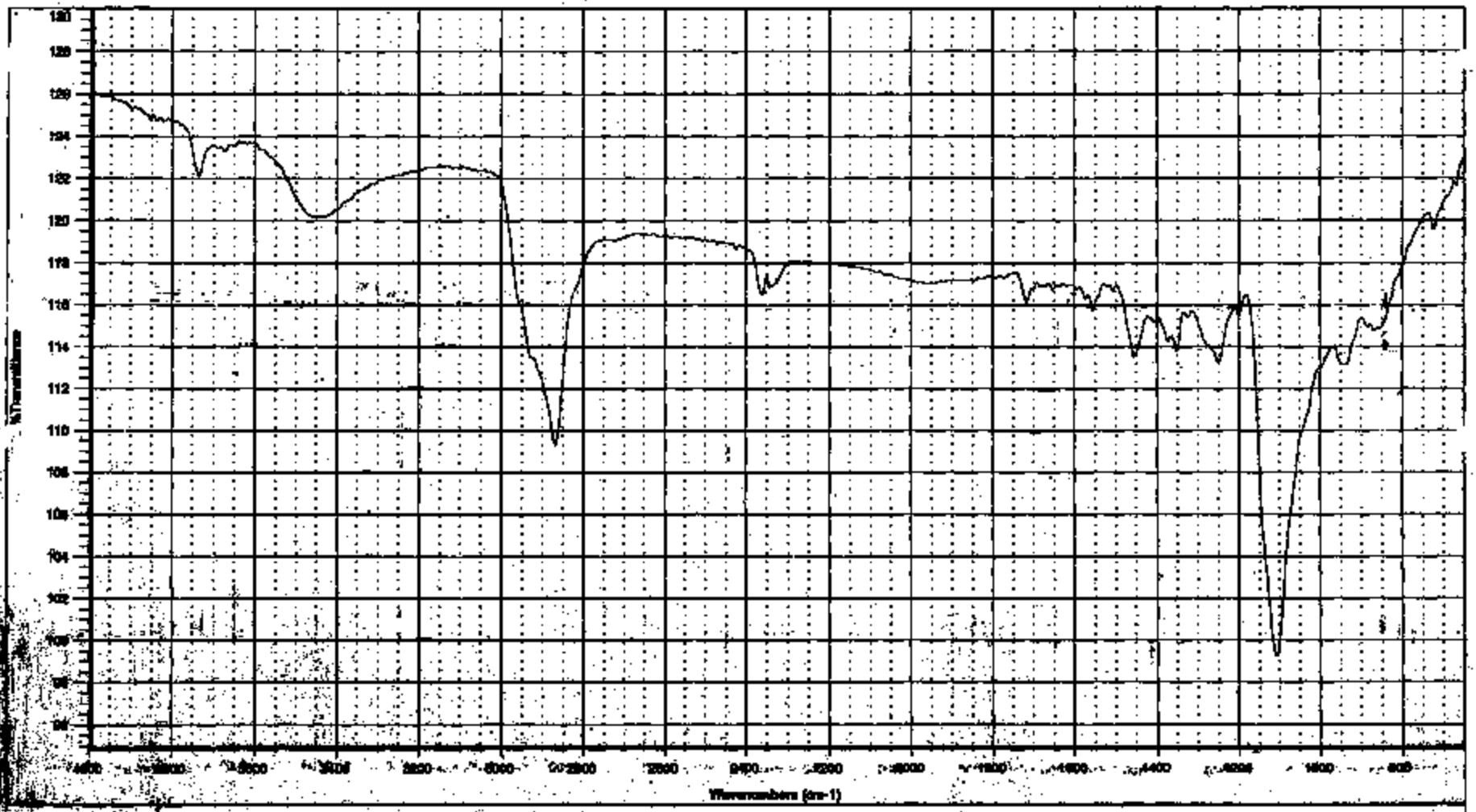


Figure 8: EDS X-ray spectrum of the third of three samples of the white powder.

Note: Nominal magnifications given for photomicrographs.



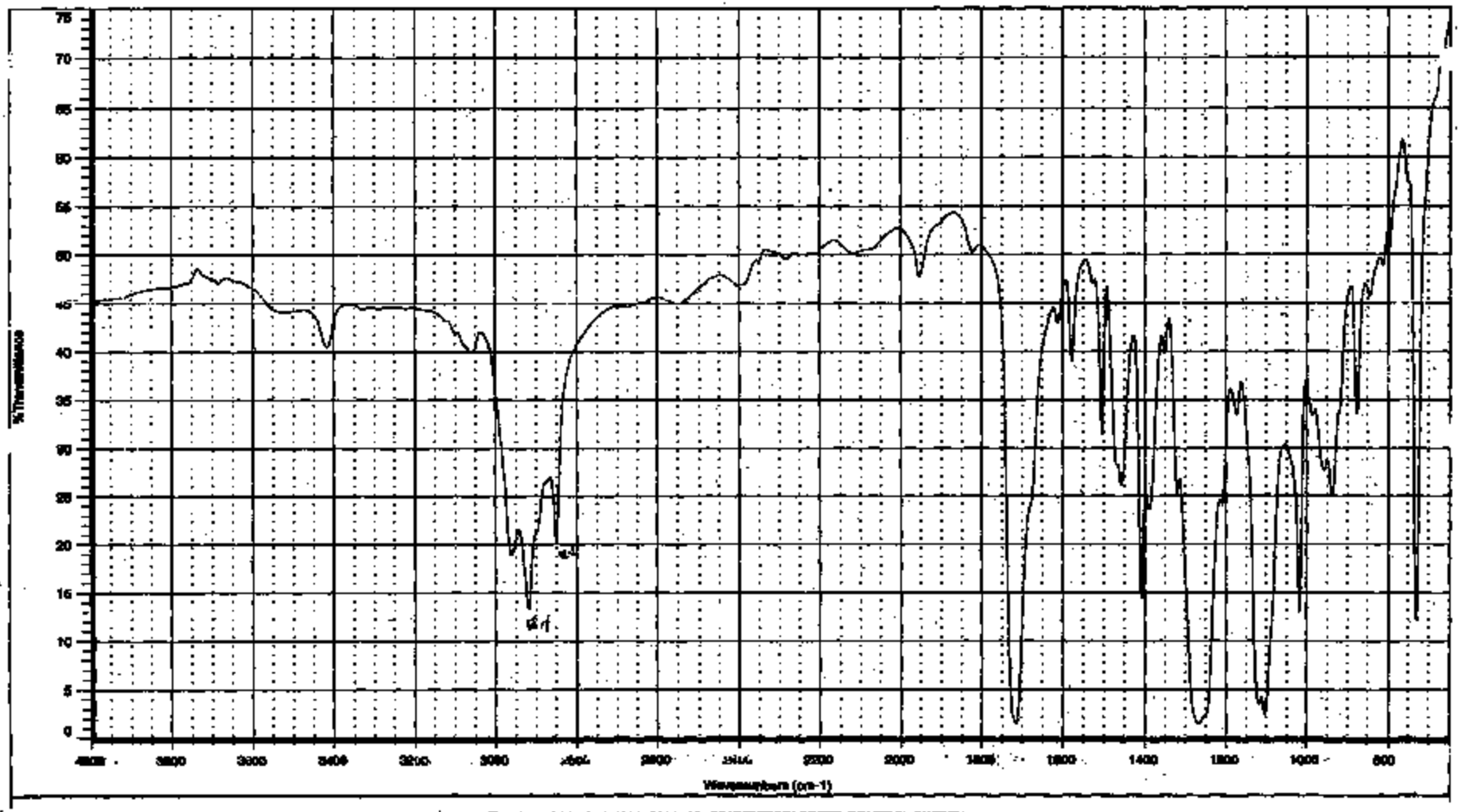
Tue Jan 05 14:15:22 1999 9604105 CONNECTOR/ SPEED CONTROL SWITCH

Chlorofluoro Micro-Coat of Metal Surface Inside Connector

VS

9713 7407

3713 7408



Date: Tue Jan 05 15:07:48 1999

Scans: 128

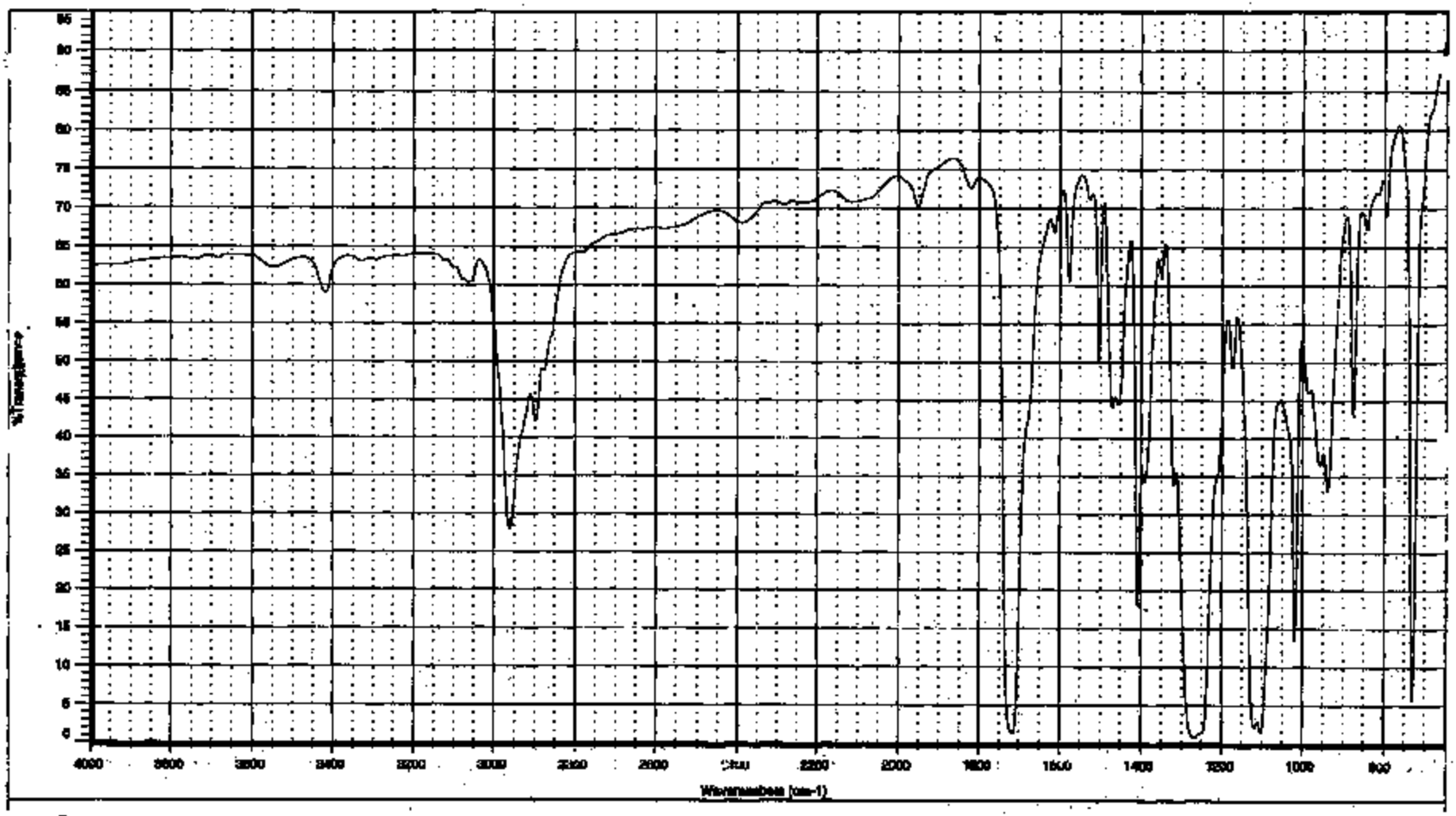
Resolution: 8.000

Tue Jan 05 16:[illegible]22 1999 5804105 CONNECTOR SPEED CONTROL SWITCH

Blackened Plastic Housing Material As Recieved Micro-FTIR

VC

3713 7409



Date: Tue Jan 05 14:32:28 1999

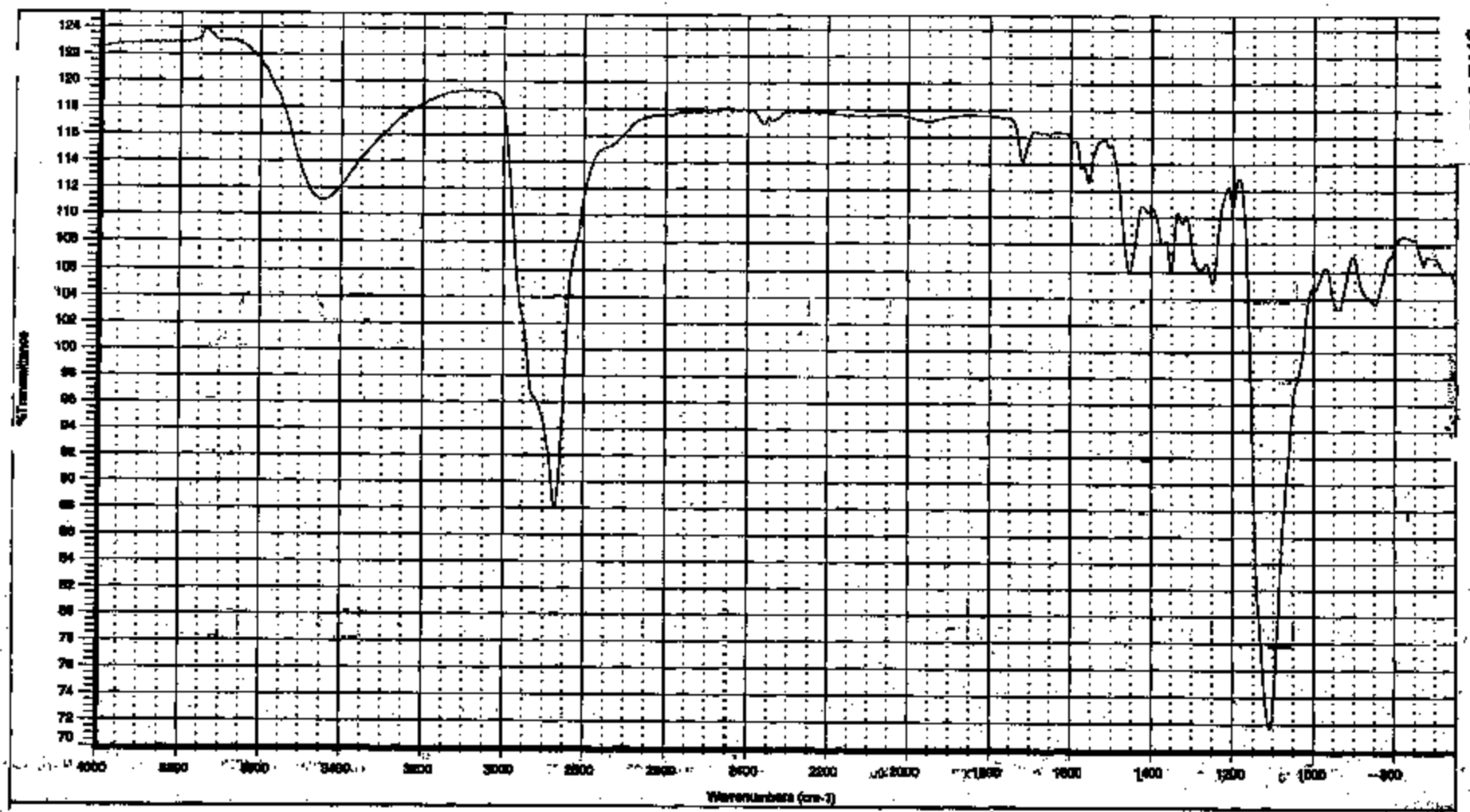
Scans: 128

Resolution: 8.000

Tue Jan 05 14:32:28 1999 98041-05 CONNECTOR/SPEED CONTROL SWITCH

Green Plastic Housing Material As Received Micro-FTIR

VC



3713 7410

Date: Tue Jan 05 13:45:55 1999

Scans: 128

Resolution: 8.000

Tue Jan 05 13:44:44 1999 6694105 CONNECTOR/ SPEED CONTROL SWITCH

Chloroform Micro-Cast of Metal Surface Inside Connector

VC

3713 7411

Date: Tue Jan 05 13:59:55 1999

Scans: 128

Resolution: 8.000

Tue Jan 05 13:59:10 1999 8904105 CONNECTOR/ SPEED CONTROL SWITCH

Chloroform Micro-Cast of Metal Surface Inside Connector

VC

T.I. Info

3713 7412

Life Testing (to Failure) of 77PS Style Device
Summary of Test Series 559-15-24

Author: Dt Ha, Design Engineering
Date: April 8, 1998
Report No.: PS/98/14

Purpose

The purpose of this test was to study the life expectancy of a 77PS style hydraulic pressure switch. The endurance test was run out to failure and a Weibull analysis performed. Failure was considered to be a leaking device.

Sample Description

The devices placed on test was a 77PS brake pressure switch with a quiet disc. The use of a quiet disc results in less energy in the system due to a smaller displacement of the disc during actuation and release. The 77PSL3-4 device was used for test. Calibration requirements for this device are as follows:

Actuation Pressure: 200-300 psig
Release Pressure: 40 psig min.

Procedure

24 switches were built on the manufacturing line. These parts were then calibrated prior to impulse testing. Results are included in this report.

Endurance testing was run to the following specification:

Temperature: 135C
Frequency: 2Hz
Total Cycles: 500,000
Electrical Load:
- 0-475,000 cycles: 13V +/- 1V, trace current
- 475,001-500,000 cycles: 13 +/- 1V, 750 +/- 50 mA

Operating Pressures:
- Pressure (Low): 0-40psig
- Pressure (High): 1400-1500 psig

After the completion of the 500,000 cycles, the switches were taken off test and calibrated to ensure they were functioning properly. They were then replaced on test and cycled to failure. The number of cycles at which each switch failed/leaked was noted. The test was stopped at 1,634,921 cycles. Six devices were on test when the test was suspended.

Results

All 24 switches passed the specification requirement of 500,000 cycles. Actuation drift after cycling was normal, averaging less than 5%. All devices were within specification after the post-500K calibrations.

Failure of the devices was first seen at 994K. Failures were seen up to 1,634,921 cycles, when the test was stopped.

Conclusion

Reliability of the switches to 500K cycles is 100 percent. However, we cannot guarantee a life cycle requirement of 1 million cycles, as there were leakage failures prior to the completion of 1 million cycles.

Raw Data

	Pre-Test Data			Post 500K					
Device	Actuation (psig)	Release (psig)	Diff (psig)	Actuation (psig)	Release (psig)	Diff (psig)	mvD (LifeTest)	Act %Drift	# Cycles to Failure
1	255.6	186.8	68.8	245.8	182.0	63.8	0.18	-3.8	**
2	253.6	184.1	69.5	243.5	178.5	65.0	0.15	-4.0	1,587,659
3	248.3	187.3	61.0	243.5	183.6	59.9	0.13	-1.9	**
4	249.5	182.0	67.5	240.2	177.6	62.6	0.16	-3.7	**
5	241.1	175.4	65.7	232.7	172.4	60.3	0.12	-3.5	1,403,522
6	248.8	183.1	65.7	244.0	186.0	58.0	0.09	-1.9	1,302,691
7	255.8	187.9	67.9	238.4	179.3	59.1	0.12	-6.8	1,344,673
8	247.5	185.9	61.6	246.5	184.9	61.6	0.13	-0.4	1,403,522
9	245.7	178.1	67.6	233.0	178.8	54.2	0.1	-5.2	1,403,522
10	249.9	184.1	65.8	240.4	179.3	61.1	0.13	-3.8	1,131,102
11	264.1	197.2	66.9	252.8	193.7	59.1	0.1	-4.3	994,232
12	255.1	187.5	67.6	247.9	183.3	64.6	0.32	-2.8	**
13	248.2	186.2	62.0	239.0	176.2	62.8	0.3	-3.7	1,438,221
14	261.4	189.6	71.8	250.3	191.5	58.8	0.07	-4.2	994,232
15	250.4	188.0	62.4	240.1	181.2	58.9	0.09	-4.1	1,131,102
16	255.1	183.4	71.7	240.7	176.7	64.0	0.31	-5.6	1,359,659
17	244.2	176.2	68.0	234.7	176.2	58.5	0.11	-3.9	1,418,250
18	251.5	187.8	63.7	240.1	183.1	57.0	2.37	-4.5	1,472,621
19	254.0	192.2	61.8	247.1	182.1	65.0	3.48	-2.7	1,511,726
20	256.8	190.7	66.1	252.2	189.6	62.6	0.3	-1.8	1,418,250
21	251.7	182.3	69.4	241.6	182.4	59.2	0.08	-4.0	1,325,190
22	250.1	183.6	66.5	239.7	182.9	56.8	0.12	-4.2	1,359,659
23	249.1	180.4	68.7	246.6	182.4	64.2	0.22	-1.0	**
24	257.4	184.1	73.3	246.6	183.4	63.2	0.24	-4.2	**
Average	251.9	185.2	66.7	242.8	182.0	60.8	0.4	-3.6	**
Sigma	5.3	4.9	3.4	5.4	4.9	3.0	0.8	1.4	

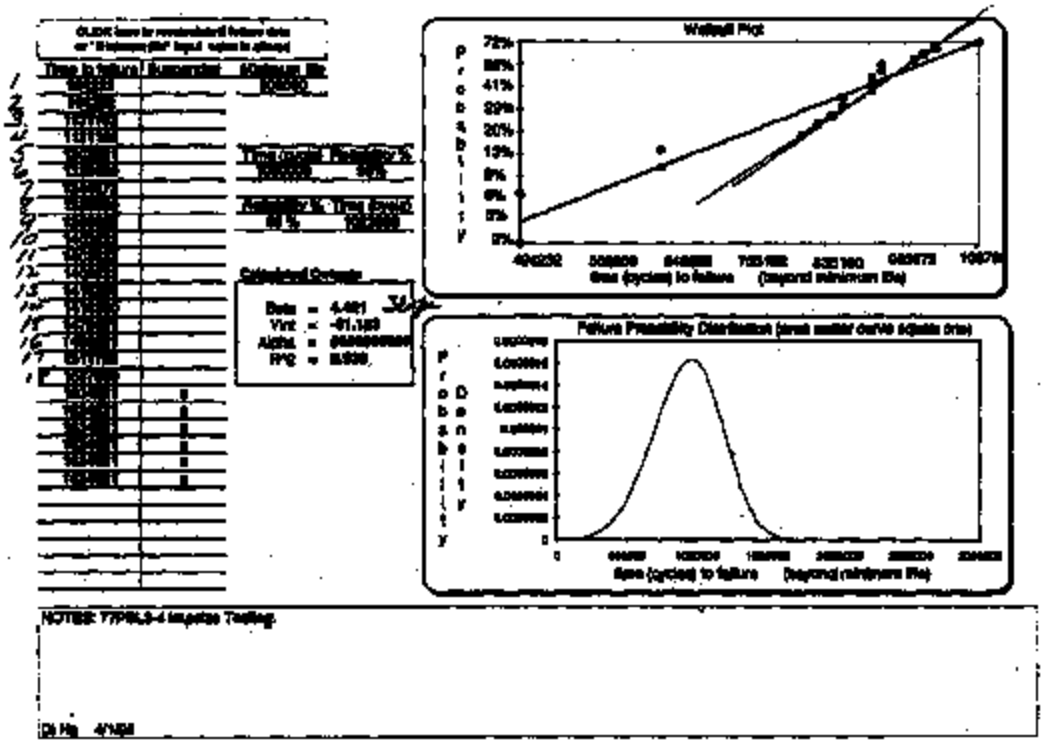
** indicates that these devices were hopulse tested to 1,634,921 cycles without failures.
The test was stopped with 1,634,921 cycles on 4/1/98.

3713 7415

Weibull Analysis

? 2 test machines or 2 failure modes

2 and 3 parameter WEIBULL ANALYSIS



3713 7416

	DATE	TIME	TO/FROM	MODE	MIN/SEC	PGS	CMD#	STATUS
04	02/18	18:48	INTUITY 821	G3-S	01'12"	003	000	OK

September 25, 1991

To: Donna Keynihan 18-27

From: Beth Kitt 10-16

Subject: Material Confirmation
TSL Request # 110022

Sample Description:

P/N 74176-1 Seal Teflon and Kapton

Results:

DSC results confirm the presence of Teflon by the characteristic melt point at 316 - 319 degrees C.

Kapton is confirmed in the seal by the IR scan. It shows the same characteristic absorbances exhibited by the sample known to be Kapton. See the enclosed scan.

Finally, the Teflon is confirmed to be on the surface of both sides of the seal by EDAX analysis.

Regards,

Beth X2069

Post-it® Fax Note 7671	Date 2-18-98 # of pages ▶ 3
To Jane Reynolds	From N.R. Lathrop
Co./Dept.	Co. Dec. Anal.
Phone # X03286	Phone # 42686
Fax # X 39-03286	Fax #

September 25, 1991

To: Donna Moynihan 12-27

From: Beth Kill 10-16

Subject: Material Confirmation
TSL Request # 110832

Sample Description:

P/N 74176-1 Seal Teflon and Kapton

Results:

DSC results confirm the presence of Teflon by the characteristic melt point at 316 - 319 degrees C.

Kapton is confirmed in the seal by the IR scan. It shows the same characteristic absorbances exhibited by the sample known to be Kapton. See the enclosed scan.

Finally, the Teflon is confirmed to be on the surface of both sides of the seal by EDAX analysis.

Regards,

Beth X3069

Post-it® Fax Note 7671	Date 2-18-99 # of pages ▶ 3
To Steve Reimers	From N.R. LaPointe
Co./Dept.	Co. Dept. Anal.
Phone # X03286	Phone # 42686
Fax # x 39-03286	Fax #

Post-it™ brand fax transmittal memo 7671 | # of pages ▸ 1

To AL Amoro	From JIM KERN
Co. PCD	Co. IMT PLASTICS
Dept. D.E.	Phone # X3777
Fax # 3586	Fax # X3141

TABLE IV
CELANEX 4000 SERIES, TYPICAL PROPERTIES
ENGLISH UNITS

Property	ASTM Test Method	Units	4300	4330
SPECIFIC GRAVITY	D792	—	1.62	1.52
WATER ABSORPTION	D570			
24 HOUR IMMERSION		%	0.08	0.10
MOLD SHRINKAGE, FLOW DIRECTION, 1/8" THICKNESS	—	in/in x 10^{-3}	3-6	2.5-4.5
MECHANICAL @ 73°F				
TENSILE STRENGTH @ BREAK	D638	psi	18,000	14,000
TENSILE MODULUS	D638	10^6 psi	1.2	1.2
ELONGATION @ BREAK	D638	%	2.7	3.1
FLEXURAL STRENGTH	D790	psi	27,000	22,000
FLEXURAL MODULUS	D790	10^6 psi	1.2	1.0
COMPRESSIVE STRENGTH	D695	psi	20,500	—
COMPRESSIVE MODULUS	D695	10^6 psi	0.9	—
SHEAR STRENGTH	D732	psi	8,100	8,400
IZOD IMPACT STRENGTH	D256			
NOTCHED		ft-lb/in	1.9	3.0
UNNOTCHED		ft-lb/in	9.3	12
TENSILE IMPACT STRENGTH	D1822	ft-lb/in²	54	68
TABER ABRASION	D1044	mg/1000 cycles	23	42
ROCKWELL HARDNESS	D785	M Scale	91	65
COEFFICIENT OF FRICTION AGAINST METALS	—			
DYNAMIC		—	0.13-0.15	0.12-0.25
STATIC		—	0.17-0.19	0.16-0.22
THERMAL				
HEAT DEFLECTION TEMPERATURE	D648			
66 psi		°F	403	424
264 psi		°F	366	378
COEFFICIENT OF LINEAR THERMAL EXPANSION	D696			
TEMPERATURE RANGE: 32°F to 284°F				
FLOW DIRECTION		in/in/°F x 10^{-5}	0.8	0.8
DEFORMATION UNDER LOAD AT 122°F, 24 HOURS	D621			
2000 psi		%	0.2	1.28
4000 psi		%	0.8	4.31
ELECTRICAL				
VOLUME RESISTIVITY	D257	ohm-cm	10^{15}	4×10^{11}
DIELECTRIC STRENGTH	D149			
SHORT TERM, 1/8" THICKNESS				
73°F, 50% RH		volt/mil	680	600
73°F, 90% RH			570	590
73°F, 6 WEEKS IN 73°F WATER			570	480
180°F, 50% RH			650	610
250°F, 50% RH			640	600
DIELECTRIC CONSTANT, 100 Hz	D150	—	3.8	4.3
DISSIPATION FACTOR, 100 Hz	D150	—	0.002	0.004

4000 SERIES UNDERWRITERS LABORATORIES RATINGS

Rating or Property*	Units	4300	4330
TEMPERATURE INDICES			
ELECTRICAL	°C	130	130
MECHANICAL w/IMPACT	°C	130	130
MECHANICAL w/o IMPACT	°C	140	140
ARC RESISTANCE	seconds	125	128
COMPARATIVE TRACKING INDEX	volts	600	550
HOT WIRE IGNITION	seconds	93	121
HIGH AMP ARC IGNITION	arcs	89	33
HIGH VOLTAGE TRACK RATE	in/min	0.5	0.5
FLAMMABILITY @1/32" UL94		HB	HB
COLOR RECOGNITION	—	AN	AN

*At 0.125" thickness except where noted.

3713 7419

August 28, 1991

To: Donna Moynihan 12-27

From: Beth Kill 10-16

Subject: GP-3 Material Confirmation
TSL Request # 110822

Sample Description:

P/N 46515-2 Thermoplastic Polyester
Celanex 4300

Results:

	P/N 46515-2	Spec.
Glass Fill	32%	30%

TGA results confirm the base contains slightly high glass fill. DSC results confirm the base material to be a thermoplastic polyester with a melting point at 223 -225 deg. C., and a glass transition at 50 - 60 deg. C., consistent with Celanex 4300.

Regards,

Beth X3069

3713 7420

AFTER CLEANING TO OBTAIN
DEBRIS ON SURFACE

1-7-99 @ T.I.

2/3

(1) Sectional Al. crimp ring.
• Inside of crimp ring — clean to O-ring
outside of O-ring slight contamination (✓)

(2) Blue O-ring (1" dia) looked in good shape.
no heat damage

nothing surprising to O-ring

(3) Base housing where O-ring seats looks good.
some dampness on one edge — But it may
wick there upon release of the crimp ring.

4. Cup O-ring surf. slightly damp. (see 3.)

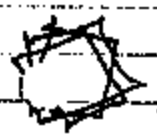
Photograph #35 of cup & apparent crack
turned out to be a hair like fibre.

(5) Cup seperated; notes;

+ Hex pot cavity: contains uniformly black coating of a
[redacted] sept, moist black sludge.

no leakage found gasket + Removed gasket & all surfaces were clean w/ acetone
+ Gasket edge showed (snipping) or deformation
wear probe suggests malt. NOT heat aged.

+ Washer & connector assy showed sufficient
fluid contamination. unused seal to chem
lab for FTIR analysis. (Taken by Al to lab)



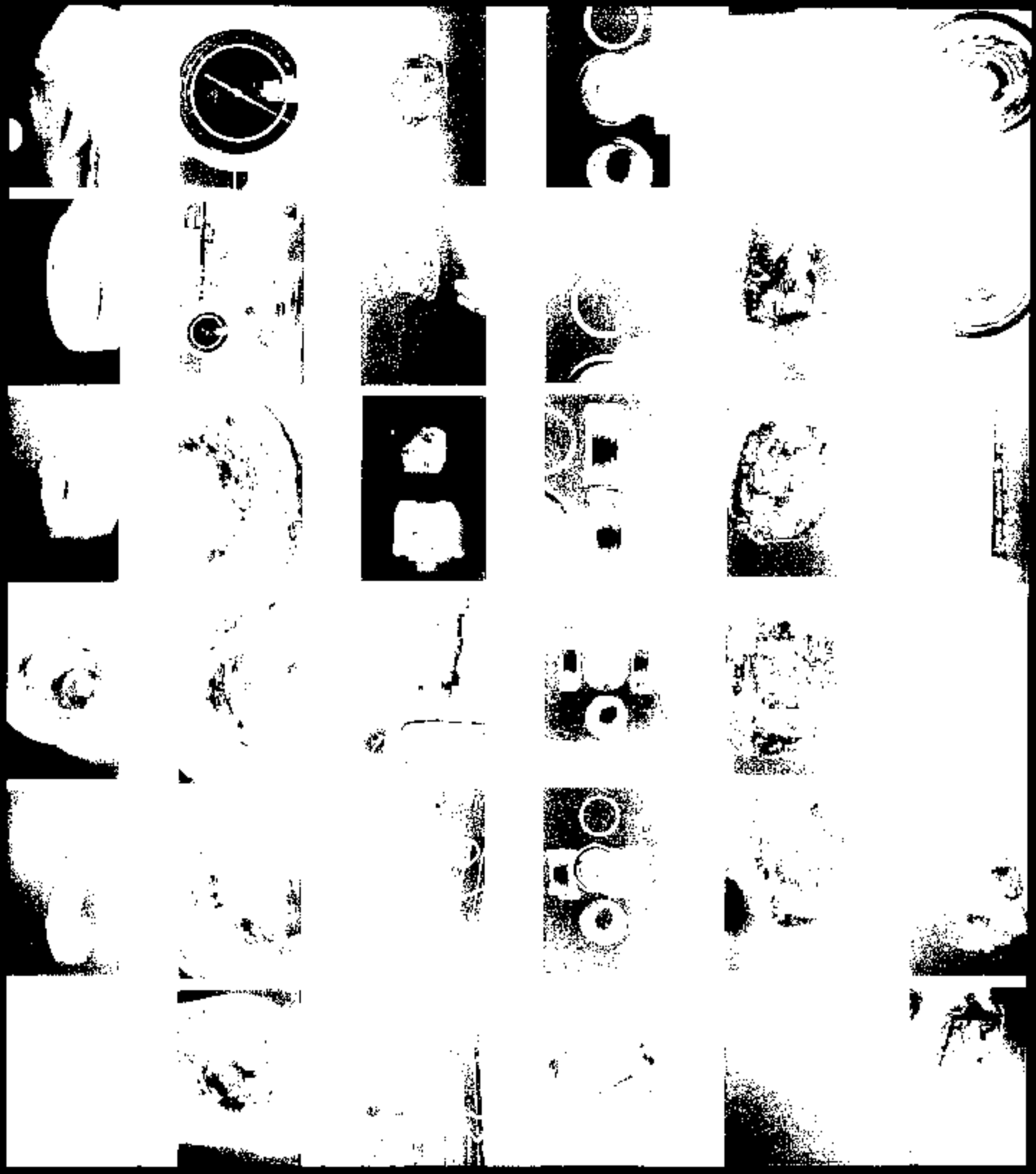
+ Kapton (Amber diaphram) 3 layers splayed

#1 brake fluid side — delamination — one surf thru cracks
all photo. #2 mid position — " & w/ crack surf.
#3 elec. side — " & w/ cracked surf.

3713 7422

TIB. LAB RESULTS

3713 7423



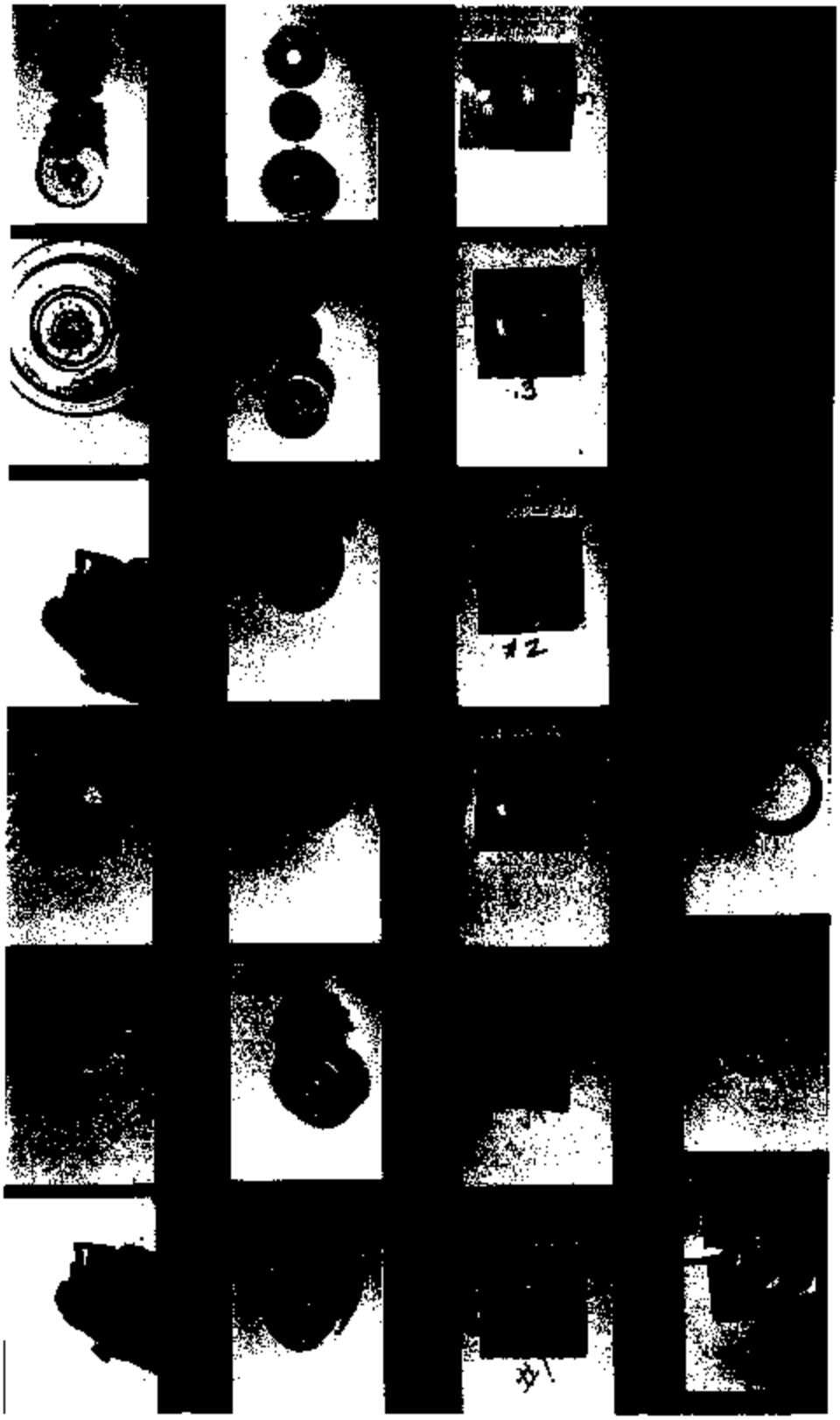
3713 7424

1-7-99

Teardown @ T.I

3713 7425

A 1



3713 7426

1-7-99
Teardown @ T.I.

2

3713 7427

B-2

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*************************************************************************
*          Note printed by NLAPOINT on 27 Jan 1999 at 12:28:13          *
*************************************************************************
```

From: FPORTER --DRBN007 Date and time 01/26/99 17:25:48
To: NLAPOINT--DRBN005 SLAROUCH--FORDNA1

FROM: F. J. Porter USART(UTC -05:00)
Subject: (U) Brake Pressure Switch Material

The following is from TI drawings

Part	Material	Comments
Modified SAE J512 Hexport	C10L10 Steel	Zinc Plating .0003 min thk w/yellow dichromate
Converter	1008 or 1010 C.R. Steel	Zinc Plating .0002-.0004 thk may have rust inhibitor
Washer	1050 CRS	Zinc Plate .0002-.0006 thk Heat treat austemper Rockwell 40-60
Cup	1010 or 1006 C.R.S.	Zinc Plating w/yellow chromate .0002-.0004 thk
Spring	Beryllium copper C17200	Mill hardened (Brush Wellman alloy 190 hm)
Kapton	Dupont 500 FN1313L	1 mil Teflon FEP 3 mil Kapton Type H 1 mil teflon FEP
Moveable Contact	Copper	Finish: DMC-133 OFHC Silver DMC-10 fine silver
Environmental Seal	Silicon JBL S7519	
Transfer Pin	L-3 Grade Steatite (DC-16E5) or L-3 Grade Steatite (DC-144E)	
Switch Rivet	CDA 260 Brass	
Gasket	Ethylene Propylene JBL Compound E-7104-70 JBL Part No. 6197E	
Spacer	Dupont Kapton 200H	.0017-.0023 thk
Crimp Ring	Aluminum 5052	
Thread Cap	LDPE	

Regards,
Fred Porter OV - fporter fporter@ford.com
Chassis E/E Systems Applications (313)845-3722
Bldg 5 - Mail Drop 5030 - Cubicle 3E004 fax: 390-4145

Dagua, Bryan

From: Hopkins, AL
Sent: Wednesday, January 20, 1999 11:21 AM
To: Dagua, Bryan; Baumann, Russell
Cc: McGuirk, Andrew; Andres, Amy
Subject: 99-033: TSL #150709: ANALYSIS OF MATERIAL REMOVED FROM 77P8 THERMAL EVENT

...ITION

OBJECTIVE:
Determine nature of deposit; in particular, determine if it is consistent with the results from Ford's analysis.

SUMMARY:
The results were very similar to those found by Ford. The main difference is that our EDX detector has a much better low energy cutoff than did the Ford detector. Their detector is unable to detect carbon and oxygen. Our analysis showed large amounts of carbon and oxygen on all three samples.

RESULTS AND DISCUSSION:
All of the samples were comprised of a mixture of different phases that had agglomerated together. A description of our findings is shown below:

BLACK FLAKE FROM TROUGH: We found the following elements which are listed in a very approximate decreasing order of preponderance: copper, oxygen, carbon, chrome, zinc, potassium, sulfur, and silver.

MATERIAL SCRAPPED FROM CUP ASSEMBLY: There were a very large number of glass fibers present which had the composition that is typically used in plastics for reinforcing purposes. In other words, this is almost certainly from thermal decomposition of the plastic base. The EDX detectable elements in these fibers are calcium, aluminum, silicon and oxygen. The rest of the material was very similar in composition to that reported for the above sample although we also detected some phosphorous in this sample.

GREEN MATERIAL ON CUP: This material was similar to that found on the first sample although the amount of chrome was much less.

The data was collected under the guidelines of TSL-S-71, Rev A which can be accessed at http://www-mcd.mc.ti.com/tsl/. SEM-EDX (Scanning Electron Microscope with Energy Dispersive Analysis of X-rays) analysis was used in the above described analysis. The data will be sent through the internal mail.

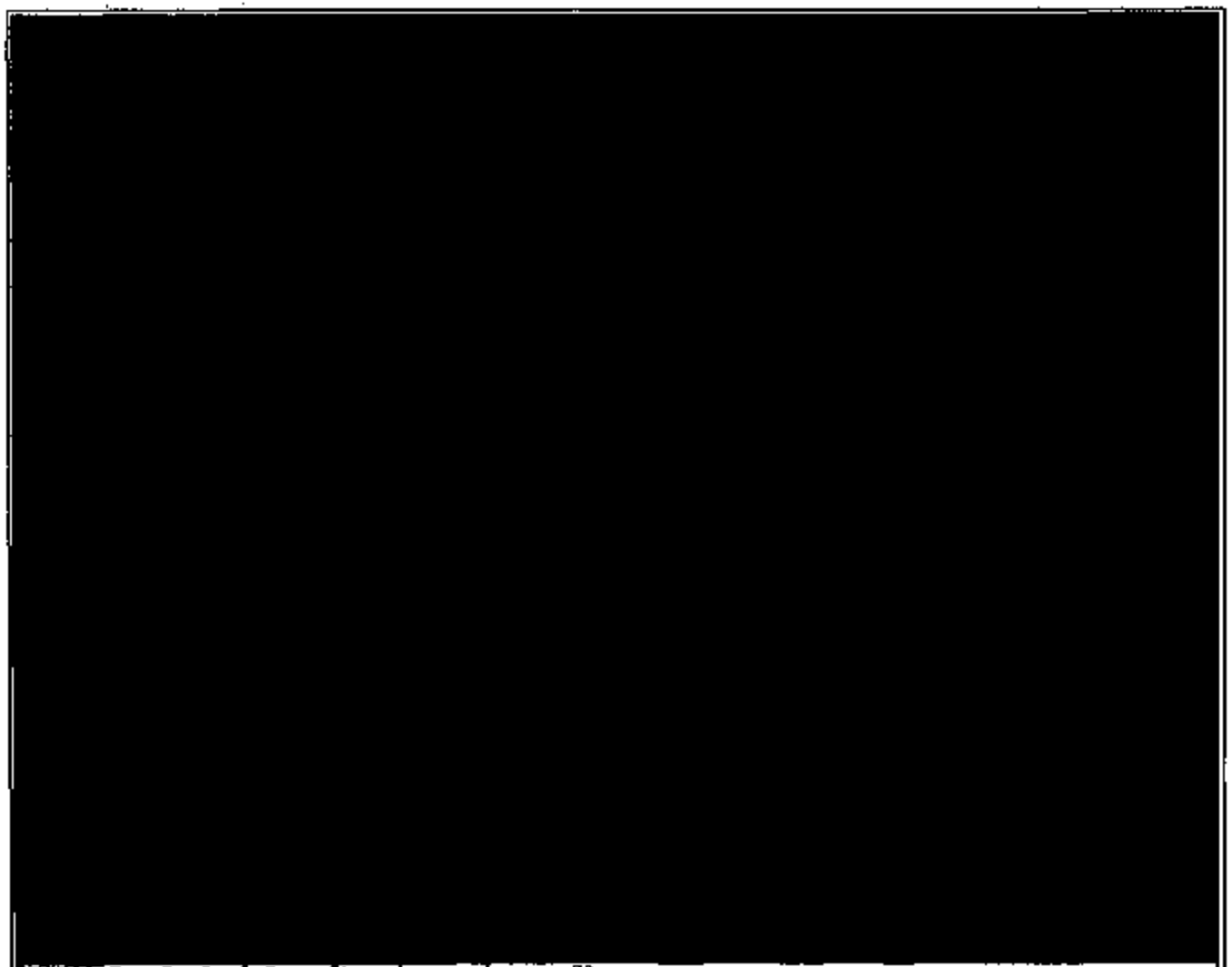
AL HOPKINS MSG ID: AHOP PHONE: 508/236-3040

3713 7429

150709 Top Surf of Cup after degreasing se 01

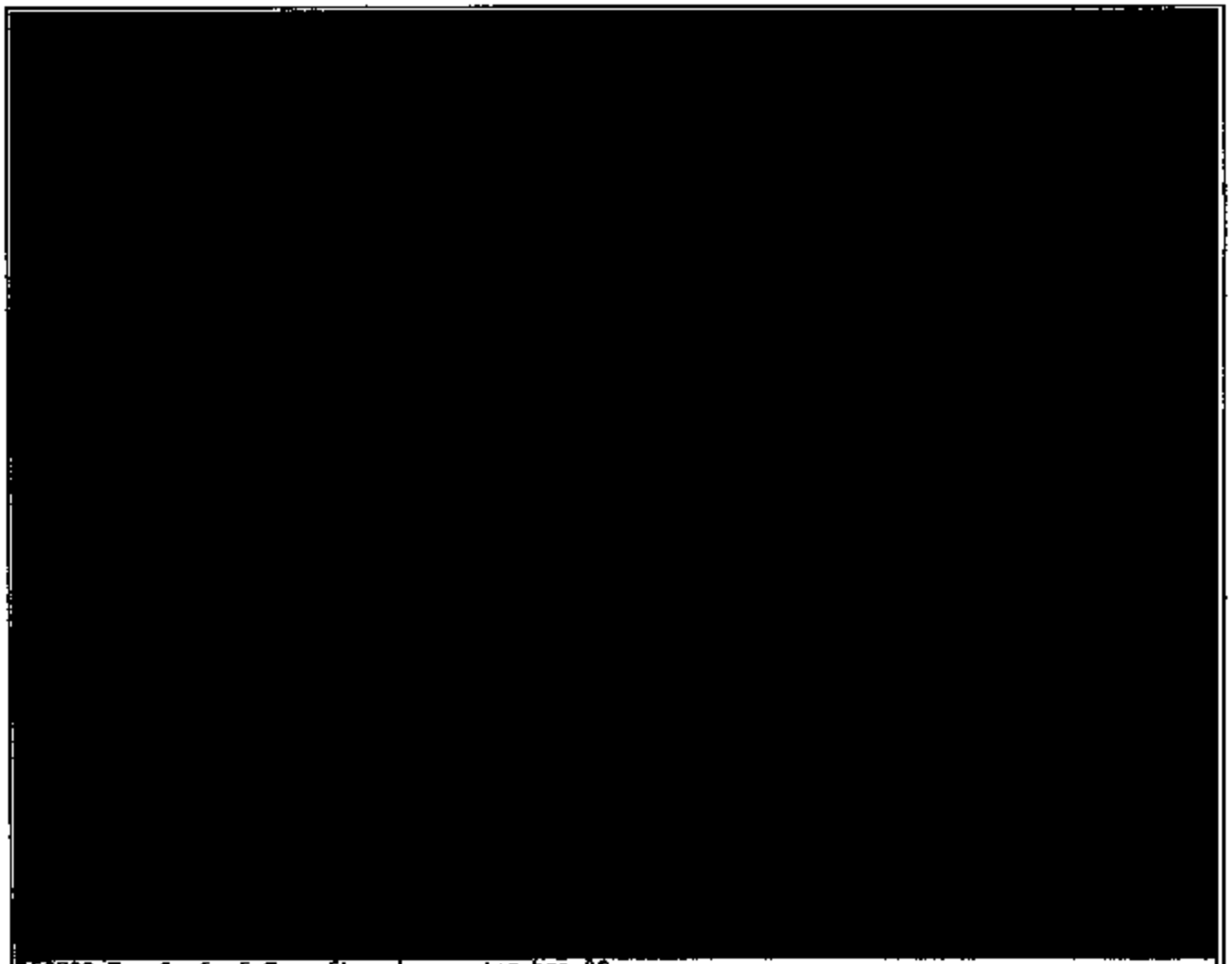
150709 Top Surf of Cup after degreasing se 01

3713 7491



150709 Top Surf of Cup after degreasing ze 01

3713 7432



150709 Top Surf of Cup after degreasing bae 02

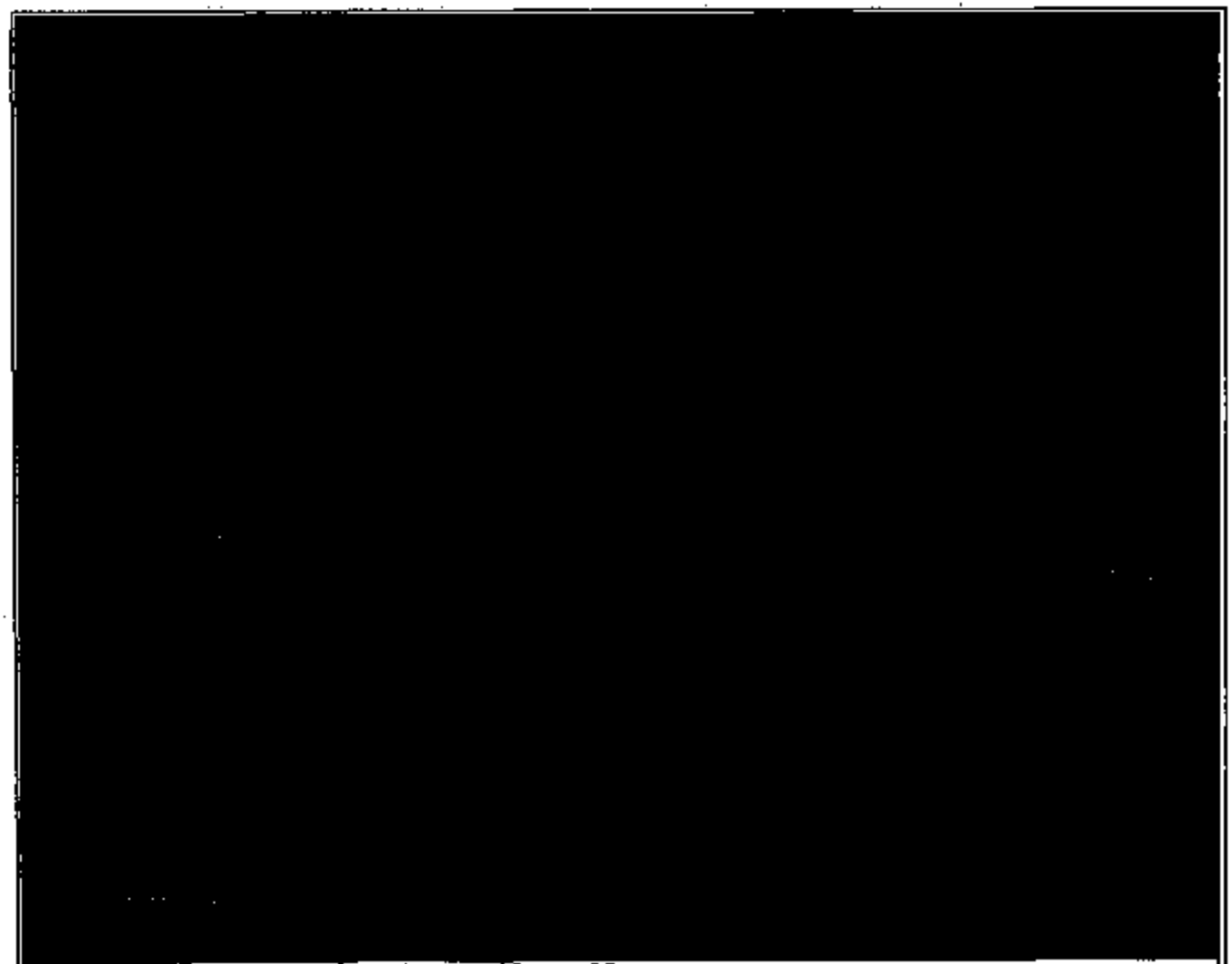
150709 Terminal Cavity after disassembly 03

3713 7494

150709 Terminal Cavity after disassembly-bse 04

150709 Terminal Cavity after disassembly sc 05

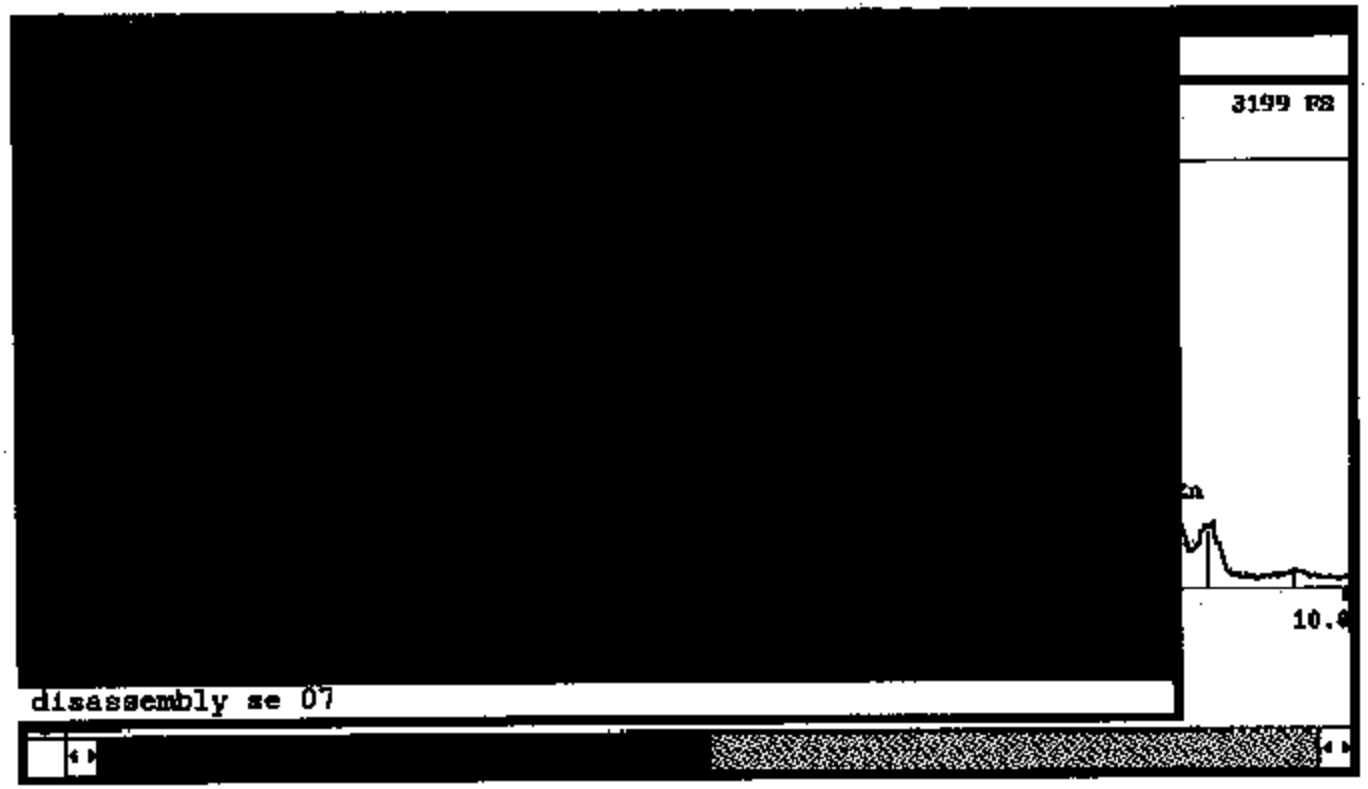
3713 7438



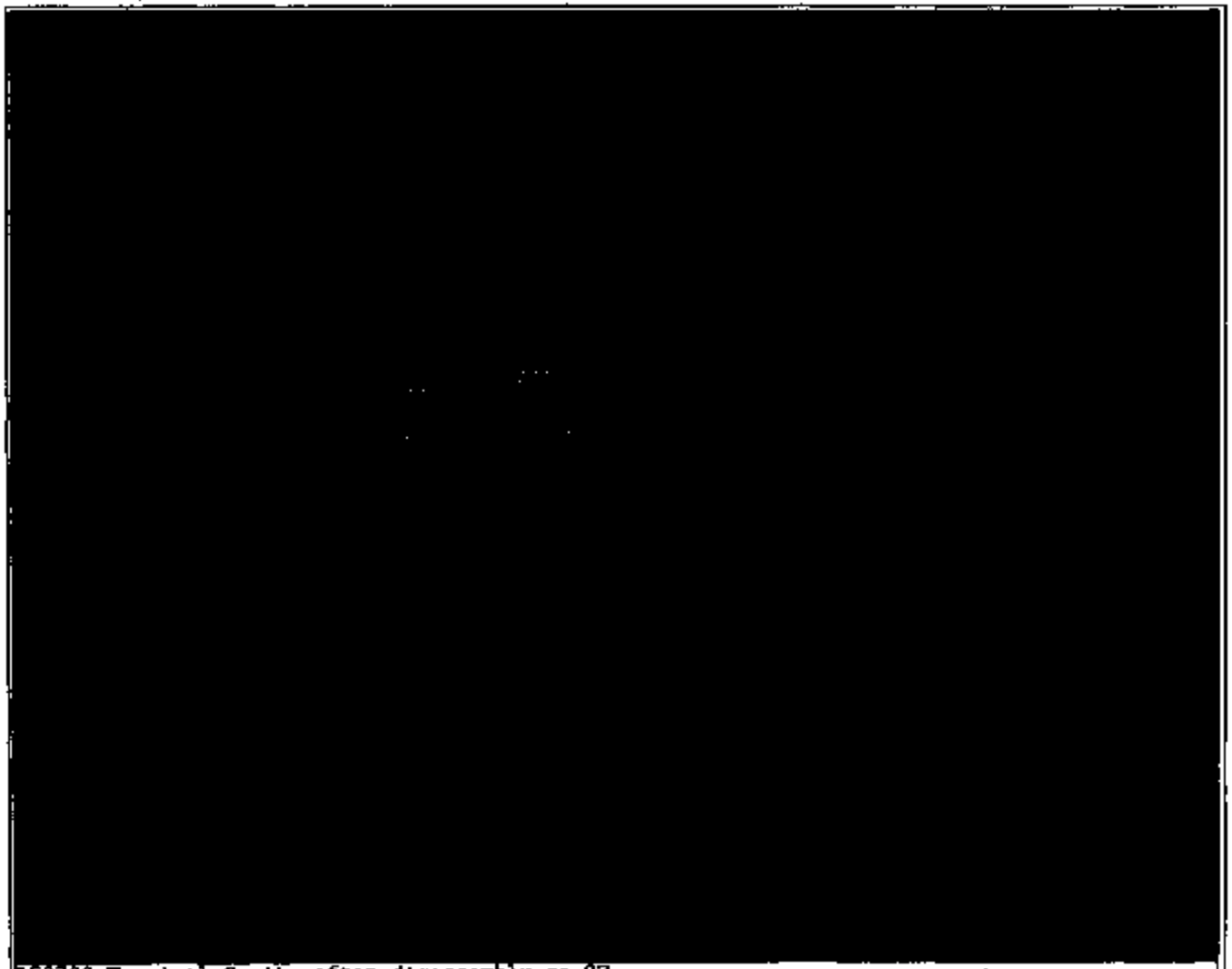
150709 Terminal Cavity after disassembly se 06

150709 Terminal Cavity after dismassembly se 07

3713 7498



3713 7439



150709 Terminal Cavity after disassembly se 07

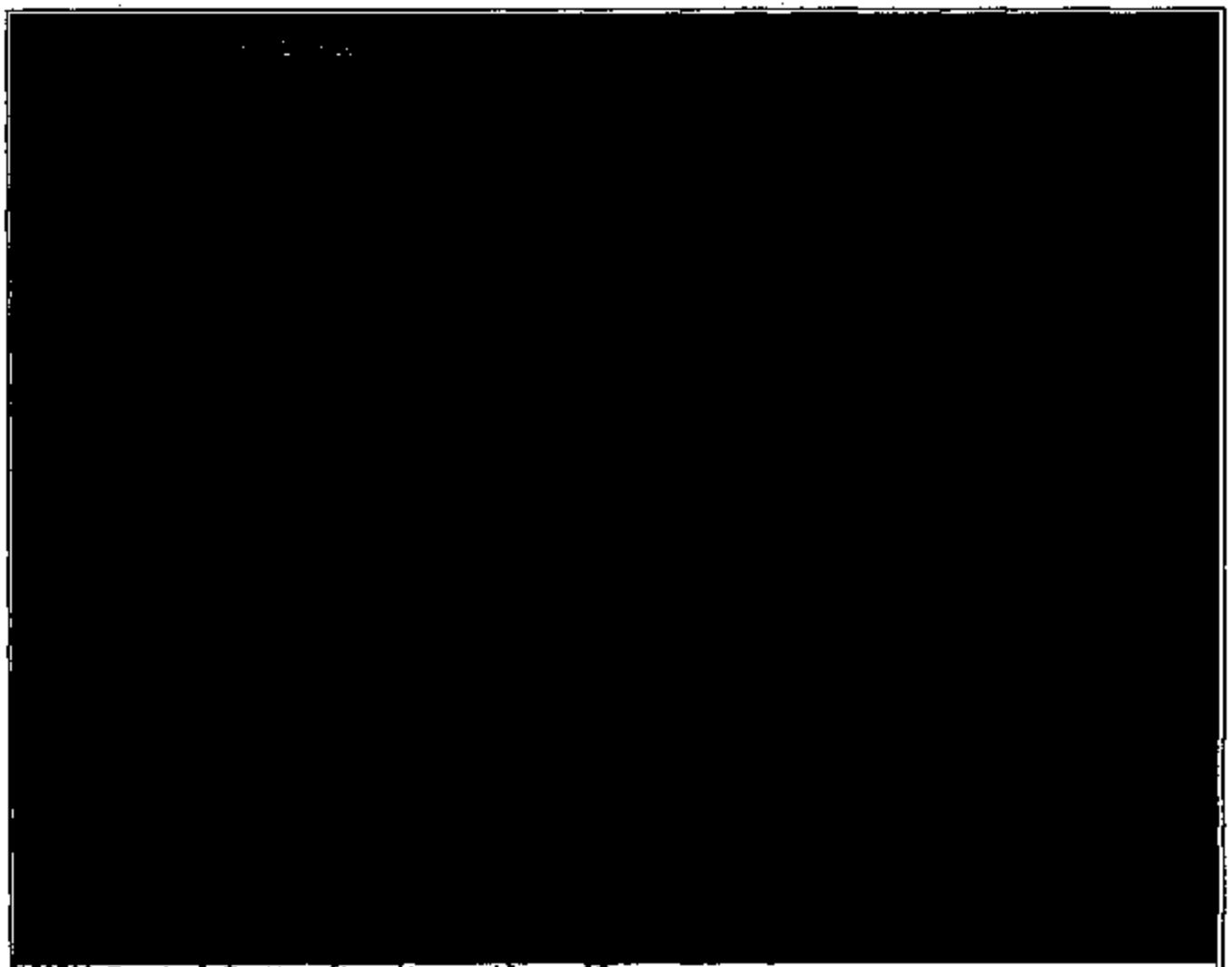
150709 Terminal Cavity after disassembly se 08

3713 7441

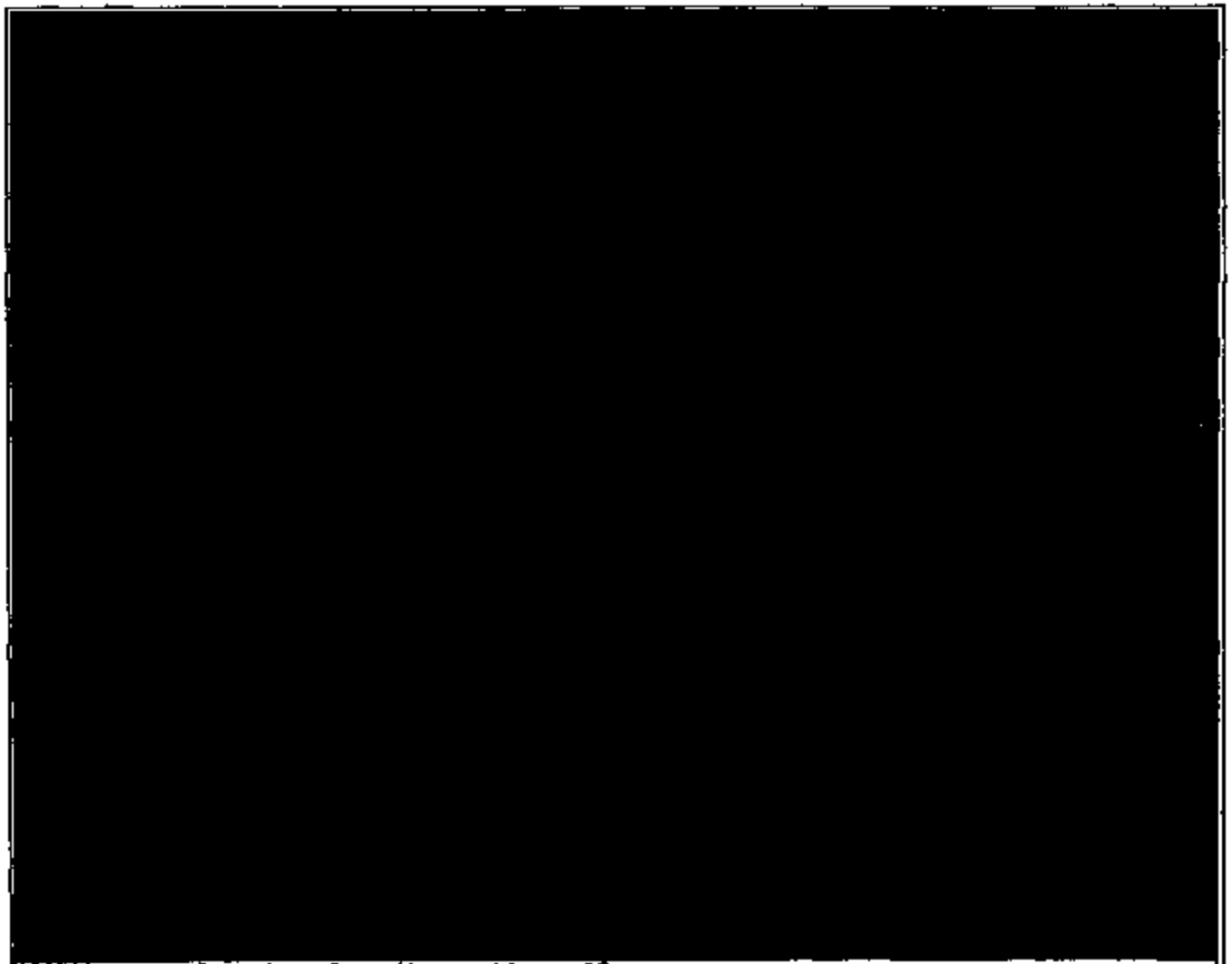
150709 Terminal Cavity after disassembly se 09

150709 Terminal Cavity after disassembly sa 10

3713 7449



150709 Terminal Cavity after disassembly se 12



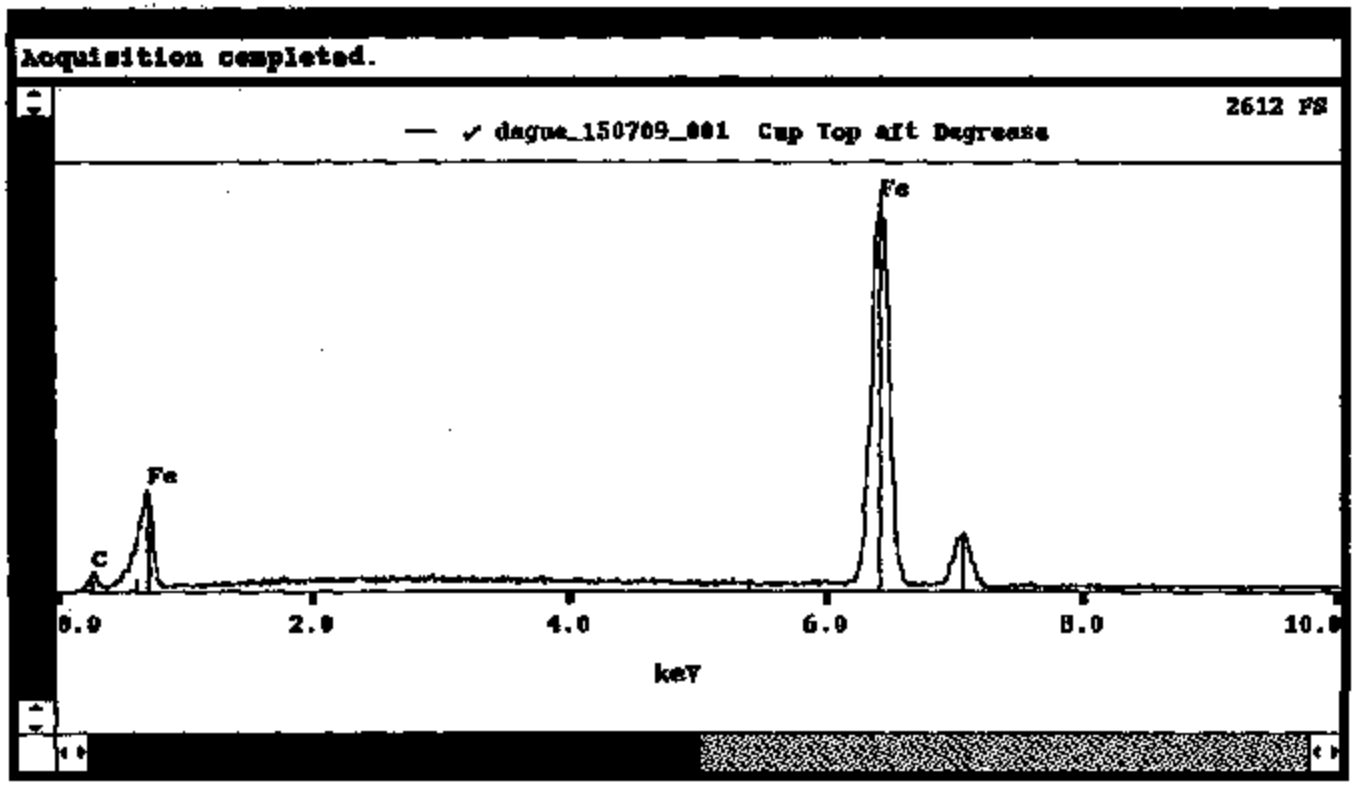
150709 Terminal Cavity after disassembly se 12

interlock @ full thickness of stationary contact corner

3713 7445

150709 Terminal Cavity after disassembly pa 13

3713 7446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2612 FS
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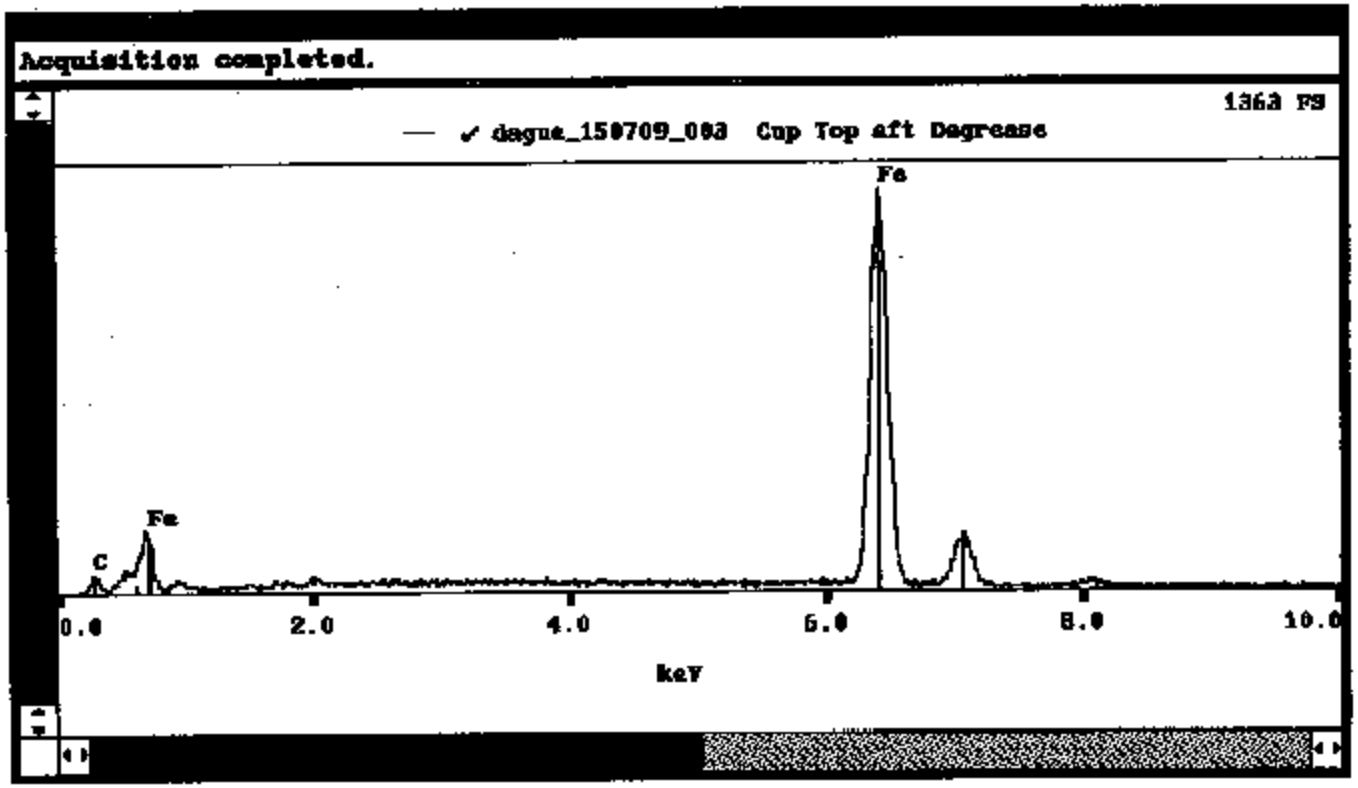
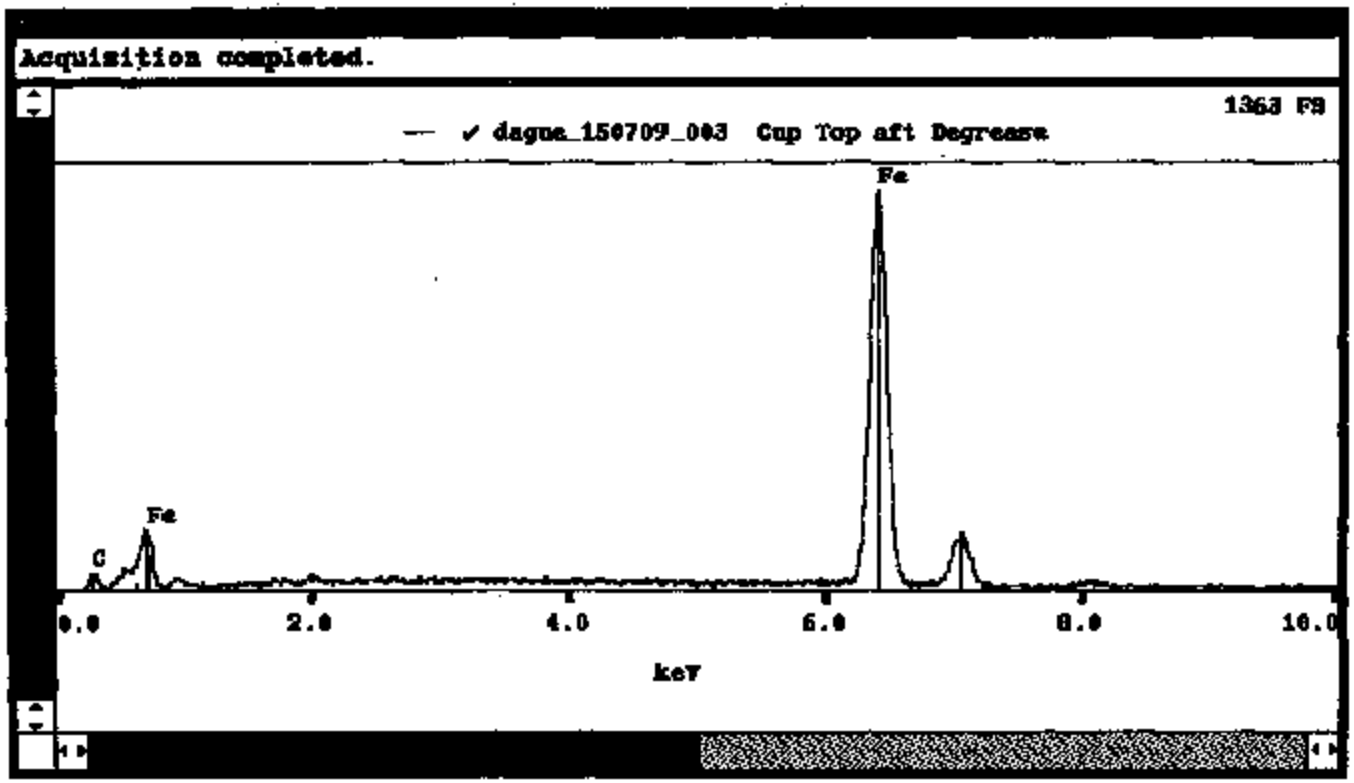
Fe
Fe
C
0.0
2.0
4.0
6.0
8.0
10.0
keV


Acquisition completed.
1363 PS
✓ dague_150709_003 Cup Top aft Degrease
Fe
Fe
C
0.0
2.0
4.0
6.0
8.0
10.0
keV

3713 7448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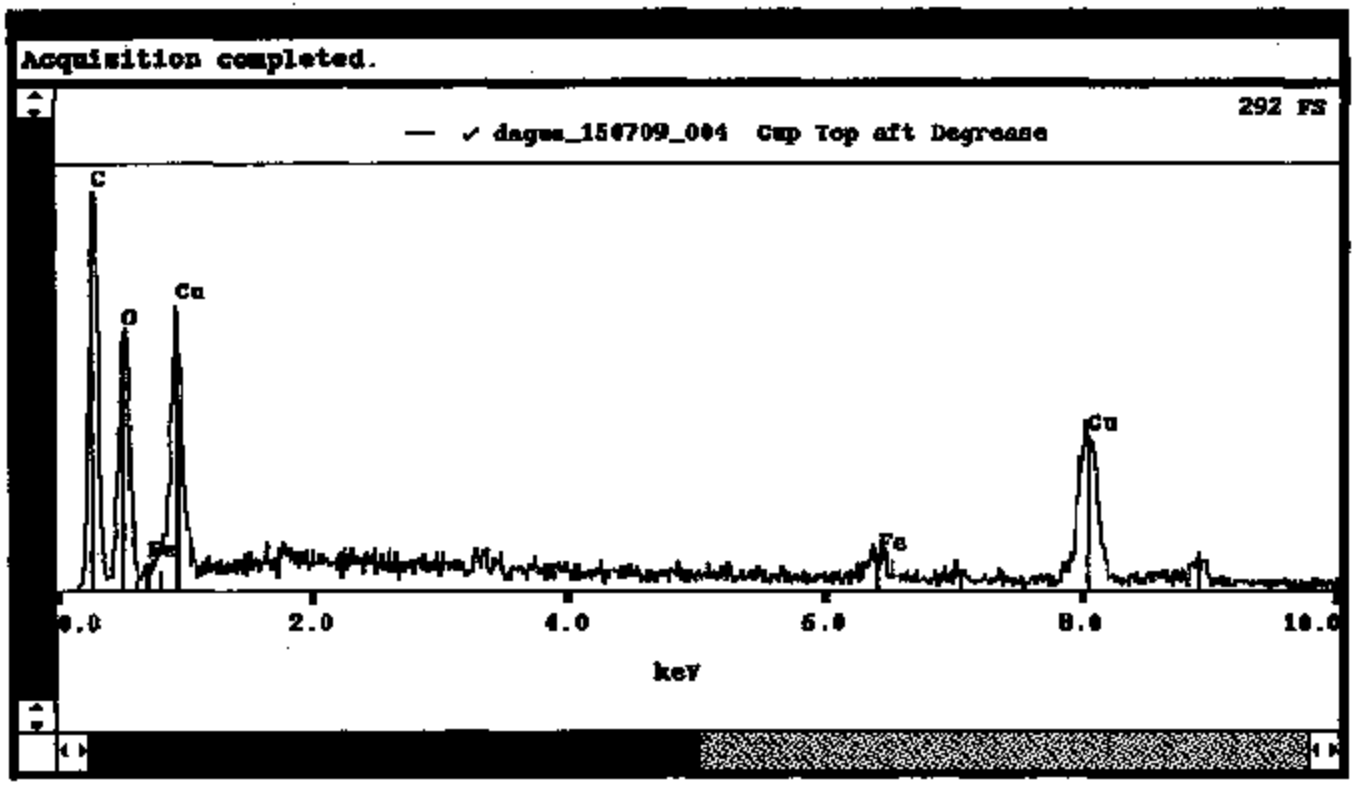
1363 FS
✓ dagne_150709_003 Cup Top aft Degrease
Fe
Fe
C
0.0
2.0
4.0
6.0
8.0
10.0
keV

3713 7449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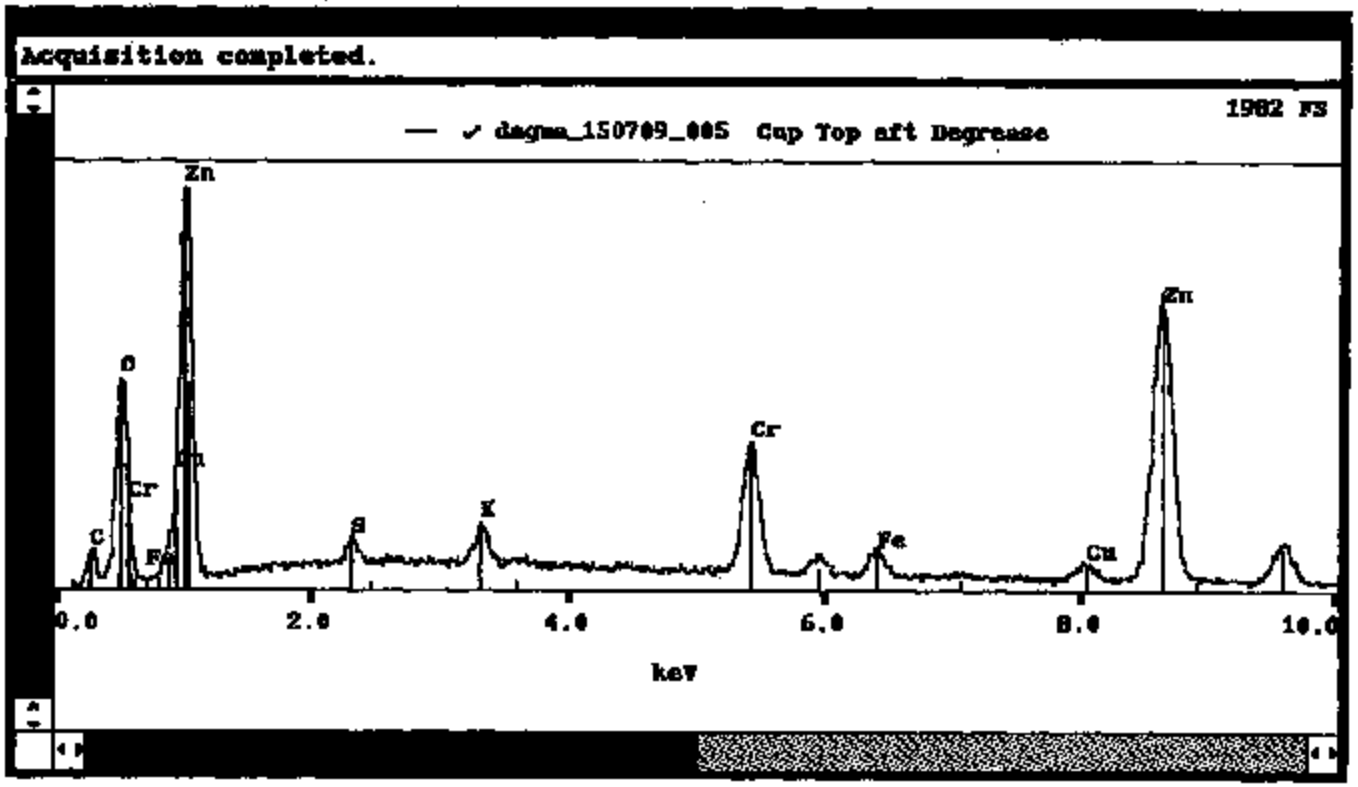
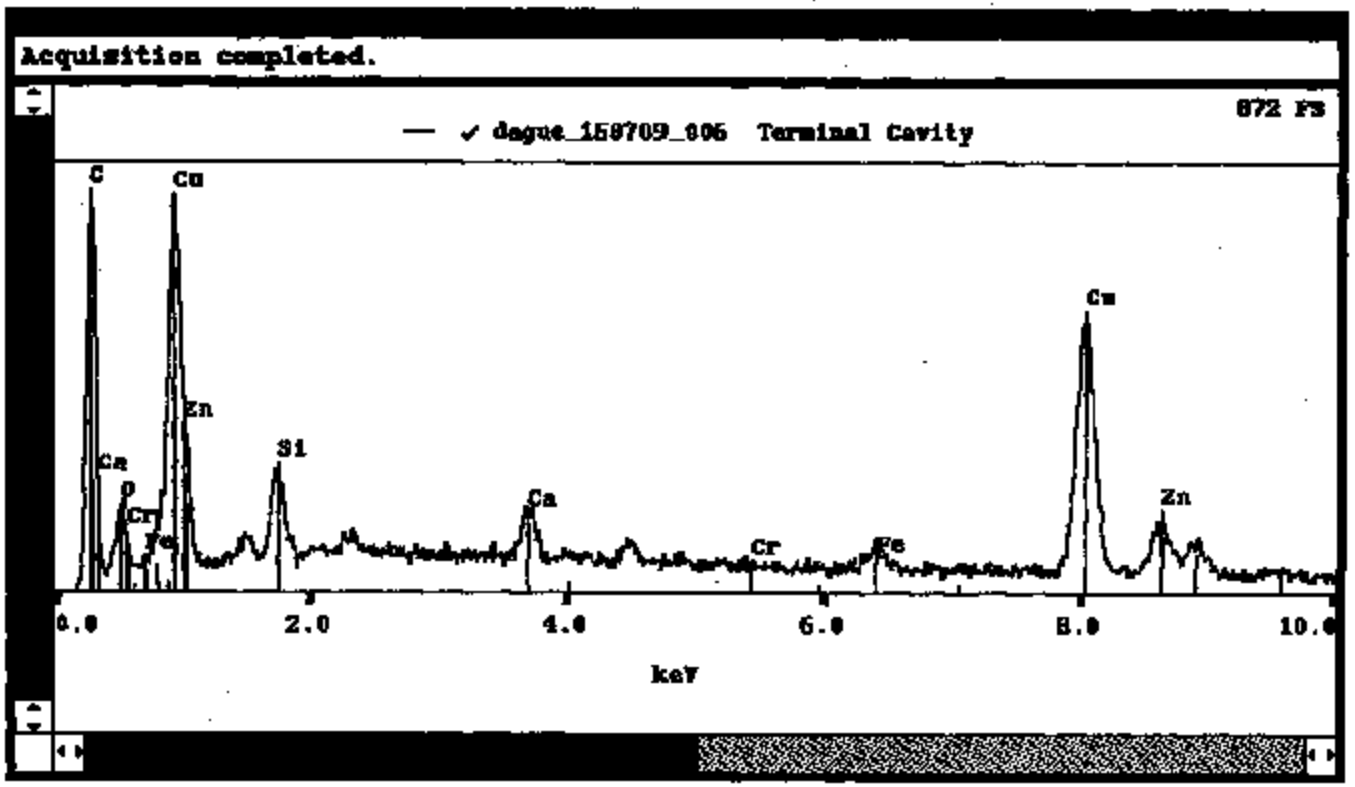
292 FS
✓ dagus_150709_004 Cup Top aft Degrease
C
O
Cu
Fe
Cu
0.0
2.0
4.0
6.0
8.0
10.0
keV

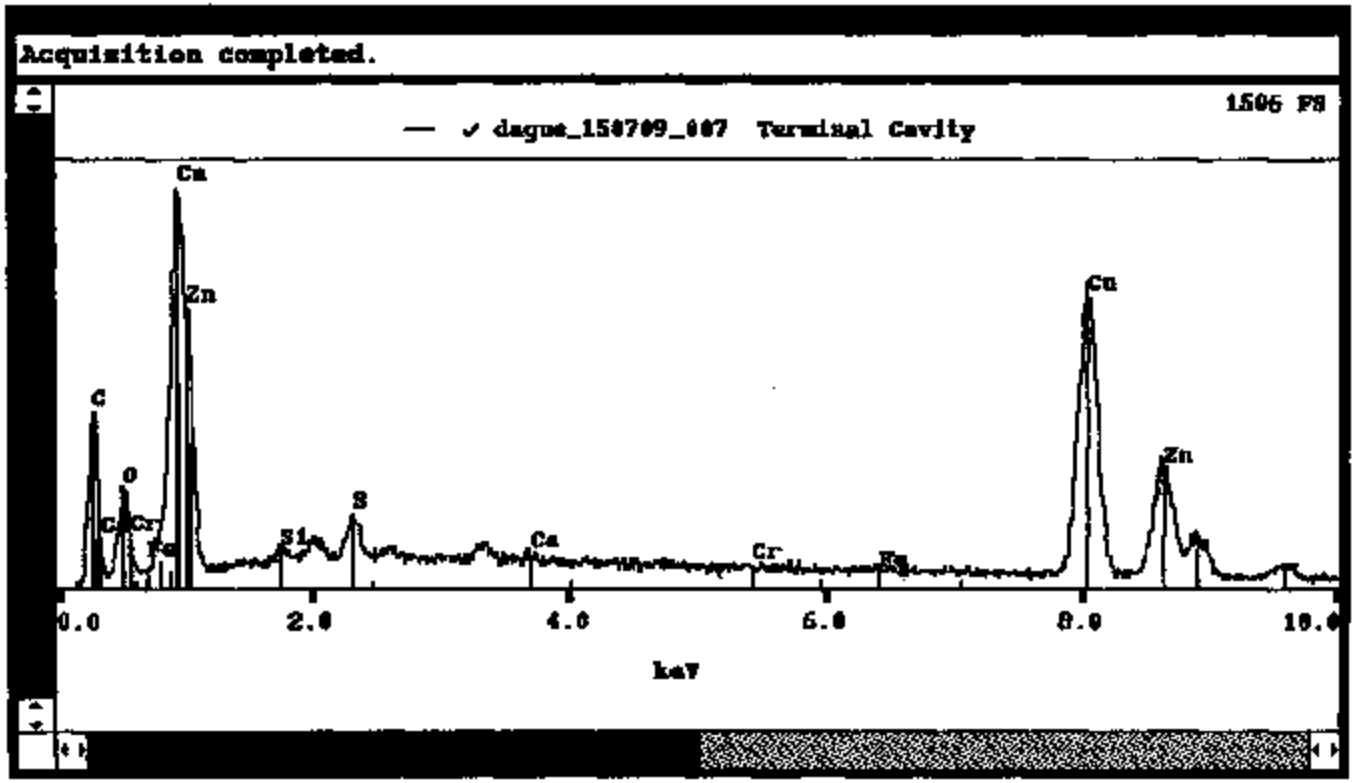
3713 7450


Acquisition completed.
1982 FS
— ✓ dagma_150709_005 Cup Top aft Degrease
Zn
O
Cr
C
Fe
S
K
Cr
Fe
Cu
Zn
0.0
2.0
4.0
6.0
8.0
10.0
keV

8713 7461


Acquisition completed.
— ✓ dague_158709_006 Terminal Cavity
872 FS
C
Cu
Zn
Si
Ca
O
Cr
Fe
Ca
Cr
Fe
Cu
Zn
0.0
2.0
4.0
6.0
8.0
10.0
keV

3719 7452


Acquisition completed.
1506 F8
✓ dagus_150709_007 Terminal Cavity
Ca
Zn
C
O
Cr
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S
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Cr
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2.0
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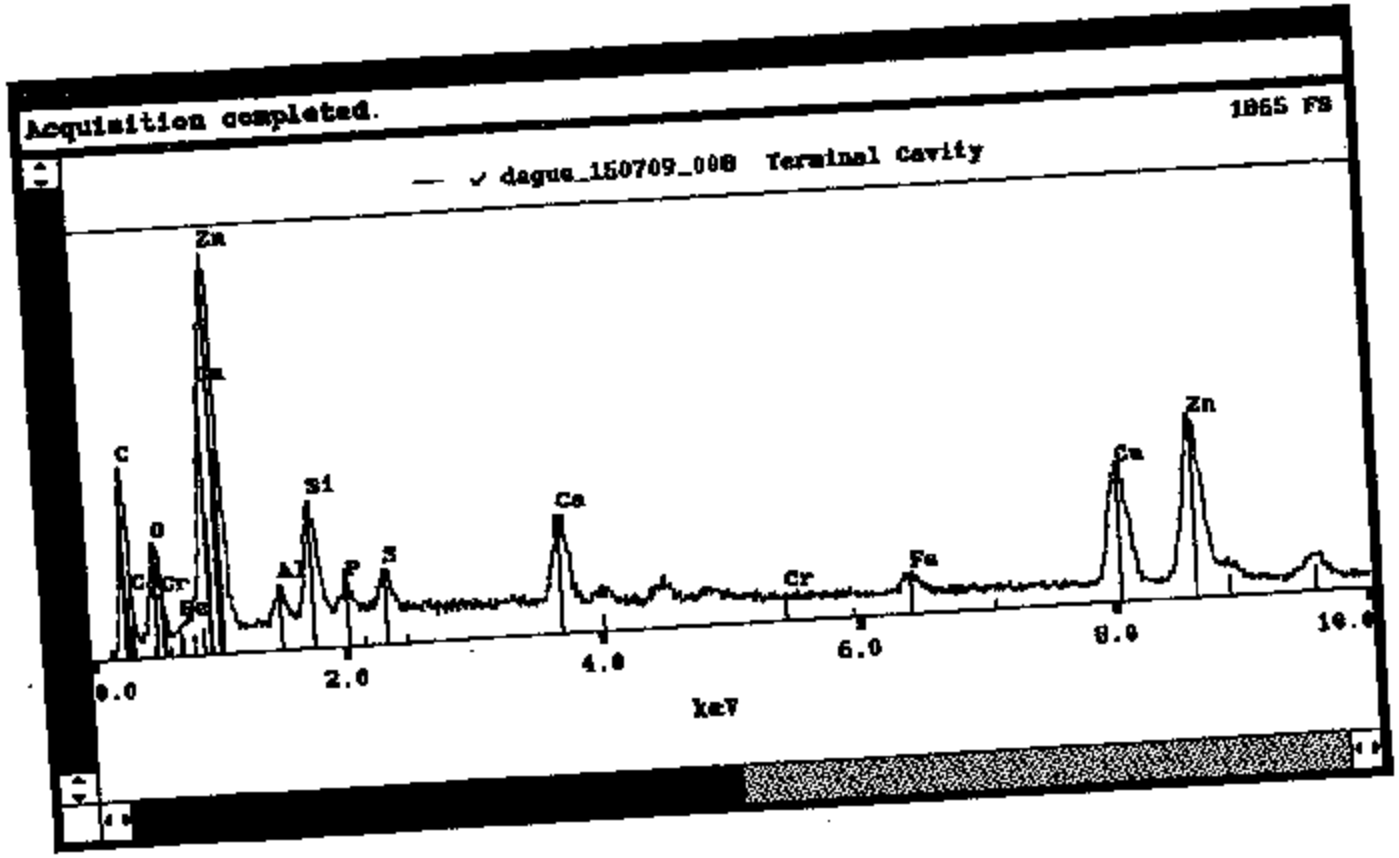
6.0
8.0
10.0
keV

3713 7453


Acquisition completed.
1865 FS
dagus_150709_008 Terminal Cavity
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C
O
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Cr
Fe
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Zn
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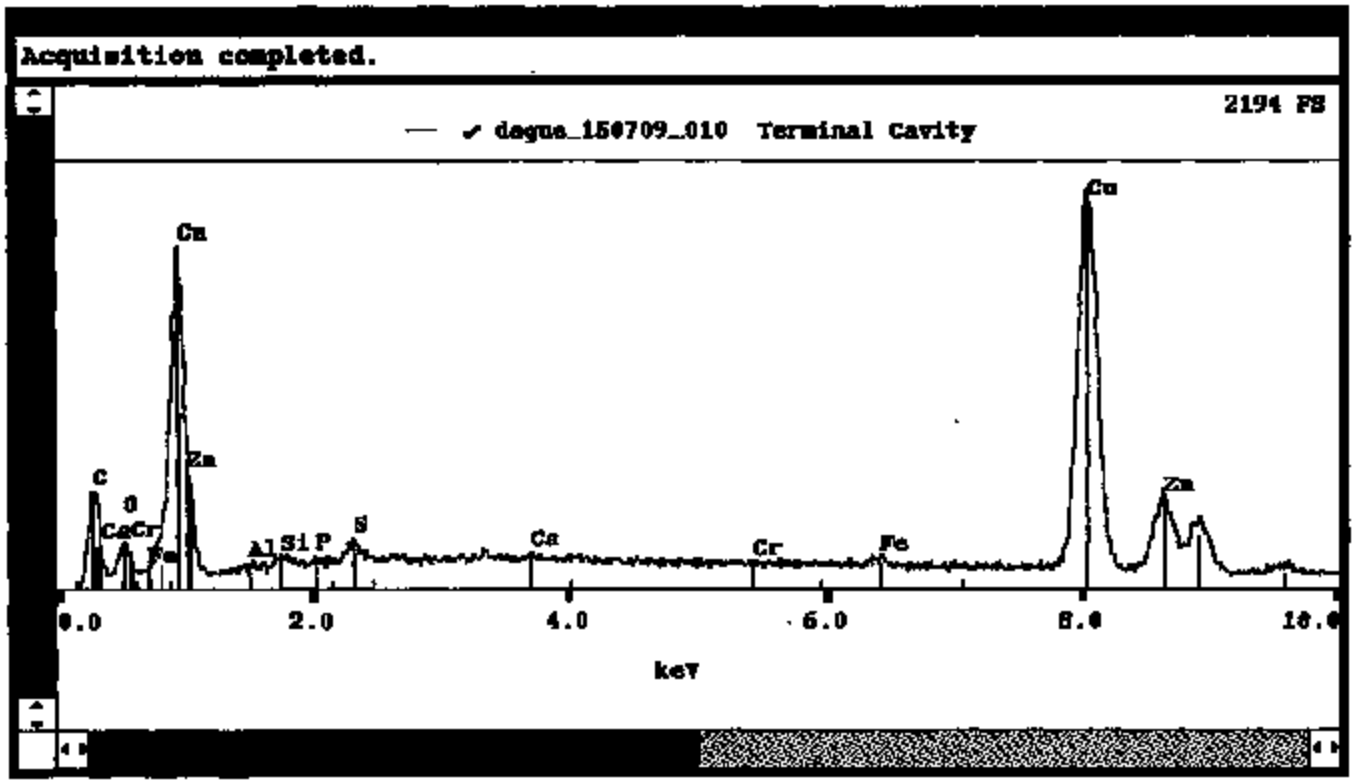
4.0
6.0
8.0
keV

3713 7454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✔ dagua_150709_010 Terminal Cavity
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Zn
C
O
Ca
Cr
Fe
Al
Si
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Ca
Cr
Fe
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Zn
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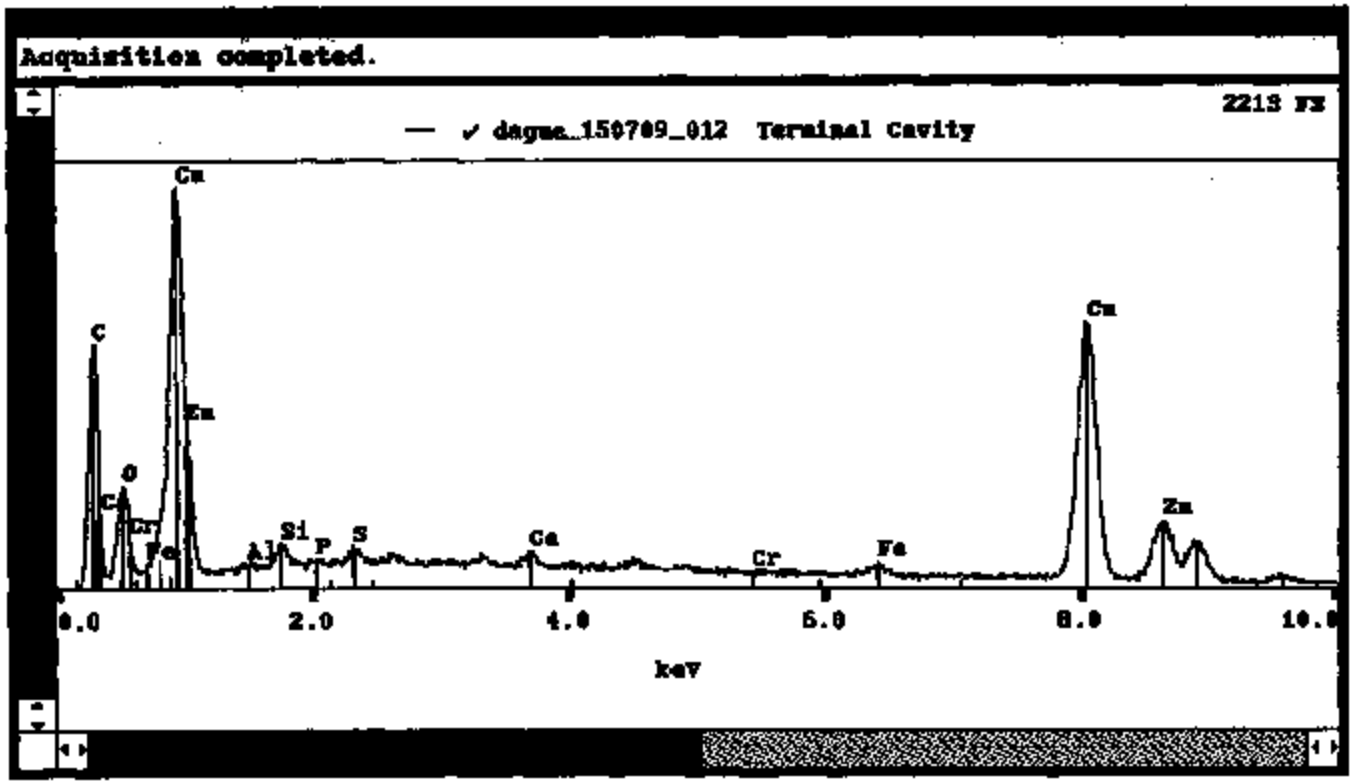
2.0
4.0
6.0
8.0
10.0
keV

3713 7456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C
Zn
O
Cr
Fe
Al
Si
P
S
Ca
Cr
Fe
Cu
Zn
0.0
2.0
4.0
6.0
8.0
10.0
keV

3713 7456

→ withdraw brake fluid that exists in cavity

I.R. tes

- Review Ford's Analysis data that they are bringing in.
- Examine threads and determine if it is OK to just chase the threads to get a good seal or should we remove material for analysis.
- Pressure Leak Test the device (15 minute static-hold, air-pressurized test). 5psi max
- Decide if we should remove any material or try any other analysis before we start disassembling the device. OK
- Do a practice decap using the below procedure on a deliberately fractured part (to mimic the condition that the returned device will be in) before performing it on the real sample. Bryan, you and I could do this now.
- Procedure to remove aluminum crimp ring
- Use aluminum foil (or plastic if Ford prefers) to mask the analysis surface.
- Also create a paper/tape shield to further reduce chance of contamination during cutting of crimp ring.
- Place a piece of tape over the area to be cut.
- Cut crimp ring using jewelers saw or Dremel cutoff wheel in one of the two areas indicated on optical photo.
- Cut corners of ring at 180 degree orientation
- unfold crimp ring ——— Outer shell Al. photograph
- Optically examine revealed surfaces. Take optical photographs (Digital camera with macro lens plus instant microphotography) and document observations where appropriate. Examine the following areas
  - Inside surface of crimp ring.
  - Seal area and underside of base
  - Top of cap
- Start SEM-EDX (Scanning Electron Microscope with Energy Dispersive Analysis of X-rays) analysis on the inside of the ring and on various surfaces of the plastic base.
- Reprotect the top surface and remove the cap. Bryan had originally suggested just using an end mill to remove the cap. I wouldn't, however, go all the way through with the end mill. I would leave some material behind as a shield. I would suggest then bending the cap off.
- Optically document all revealed surfaces starting with cap.
- Meanwhile, start SEM-EDX analysis on top side of cap. Particularly focus in on the edges of the ceramic pin guide and on the indented ring that lines up with interior wall of the switch cavity. Particularly look for evidence of corrosion or arcing.
- Decide if we should try to flake off any of the overlaying debris to try to examine the underlying metal surface.
- Proceed to perform SEM-EDX analysis on other component surfaces revealed by removal of cap.
- Non-destructively probe inside of the grommet to determine its resilience which will give us an indication of the temperature that it saw. Another indication might be the depth of the indentations left by the grommet seal rings in the wire.
- Decide if it makes sense to further examine the mating connector or grommet seal.

Regards,

Al

END-OF-FAX

ANALYSIS OF STATIONARY CONTACT
CRACKS
CORROSION
NOT USEFUL - DEFINICIONES (CONFUSING TO MATERIAL)
• WHAT HAPPENED TO MOVING CONTACT? MELTED OFF?
• WHY IS CONTACT THICKNESS IN EXAMPLE THICKER THAN EVIDENCE?

1-7-99 @ T.I.

Base - Material changed ~ 94(?)(?)
46515
"Neil C. Douglas to detail" when changes were made.

~~77PSI Test of~~
~~77PSI~~ - Cellanex
need print # 46515

Material > Cellanex

(?) ~~There is a possibility a more explosion sample was given to me prior to Christmas.~~ NOT TRUE. sample OK.
• The material may never have survived based upon where the switch was mounted ie m/c vs p.v.

Lab Pressure test 100 psi = 5.V max
1 psi = .050V

psi		
.5	3 min hold	hold = static constant press. no press. drop.
1.0	1 min hold	
2.0	1 min hold	
3.5	leak at quick connector need to re-test	
5.0		

Rerun new fixture (after break)
same cal. 100 psi = 5.0V max.
1 psi = 0.050V.

psi		
3.5	1 min hold!	
5.0	5 min hold! @ 0.250V.	

1-7-99 @ T.I.

Connector after separation

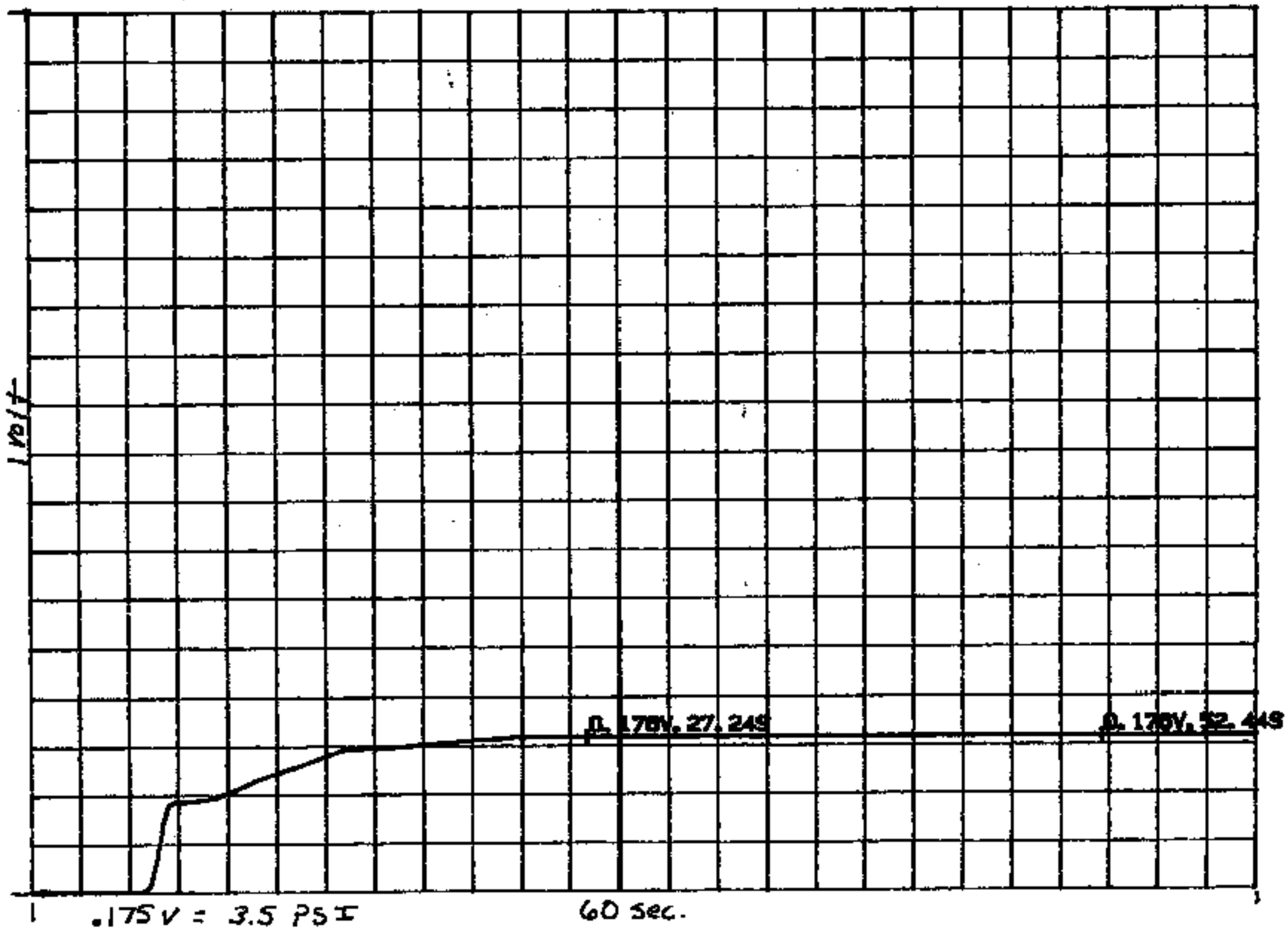
- Continuity check:
  + between stationary contact & wire terminals both showed continuity
  + between terminals: continuity bet. them

Question: Did they move after/during the fire?

Ans. NO as T.I. X-rays terminals are separated but "pyrolyzed carbon" apparently permits a continuity between them.

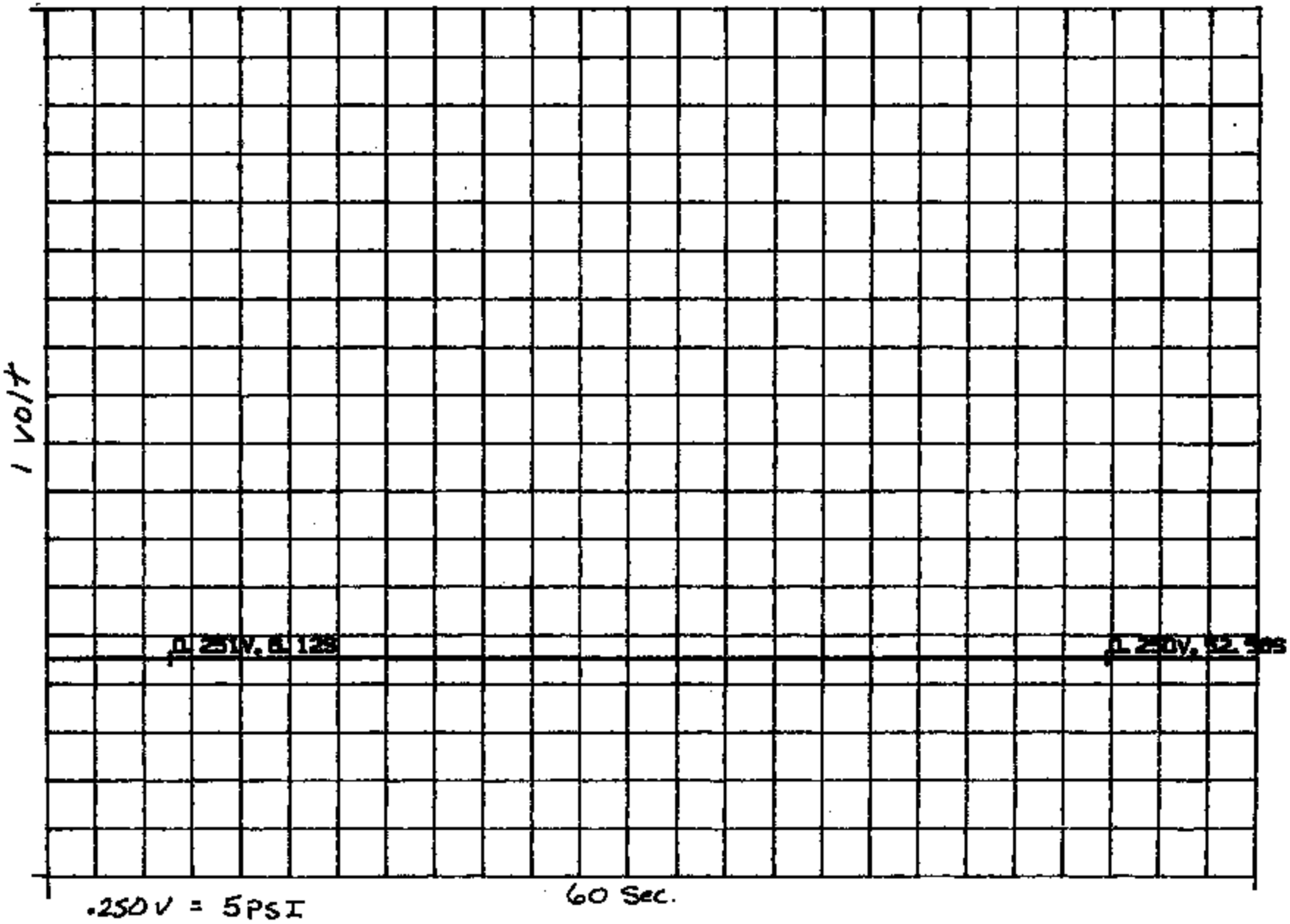
Note 1/12/99 The orange wire > stationary contact (+)
LG/R " > spring contact (++)

Test 1 3.5 PSI / 60 sec



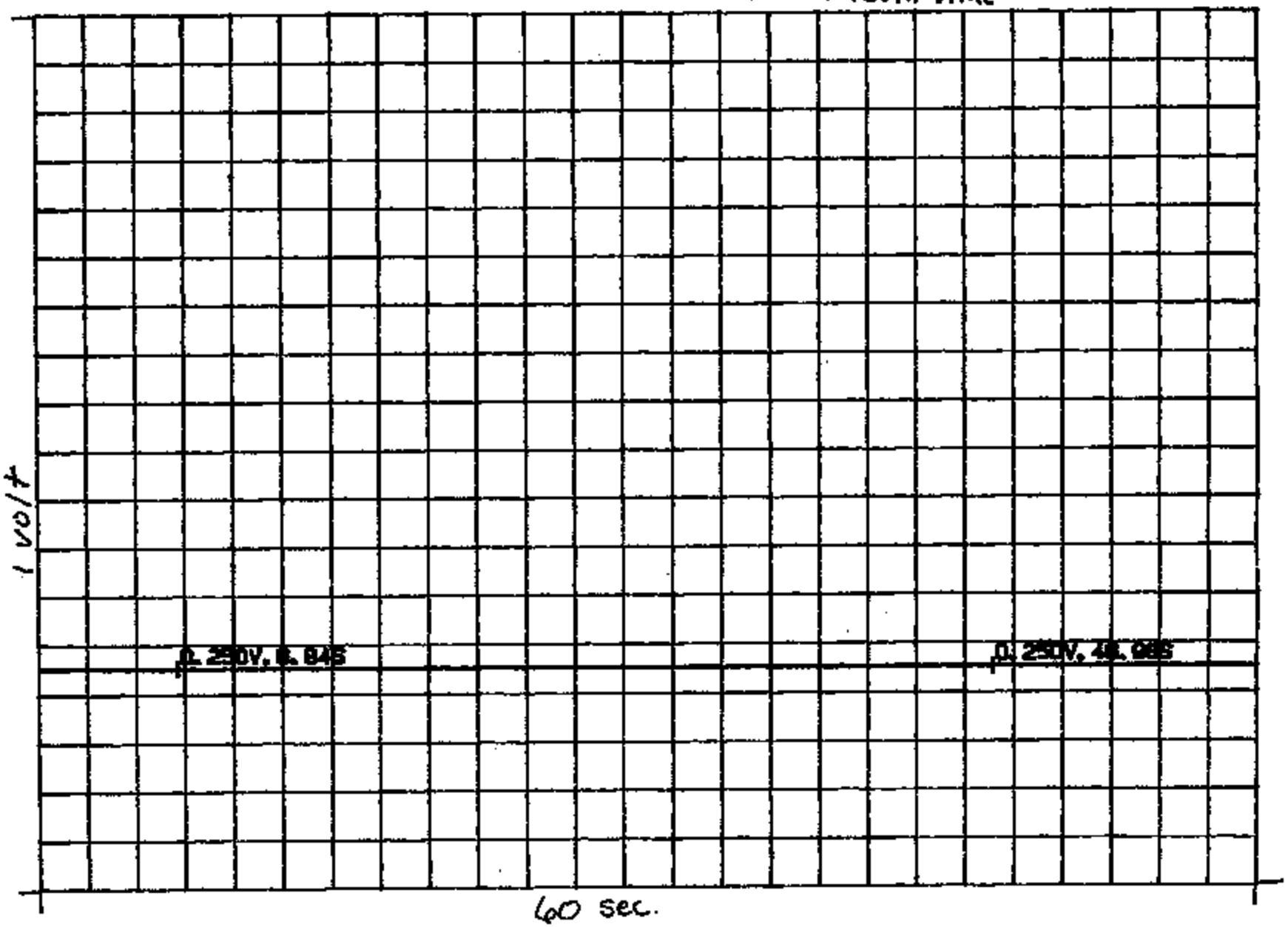
3713 7460

Test 2 5 PSI / 1.0 sec



3713 7461

Test 3 5 PSI / 5min hold - 1 min. Plot
6 min total Time



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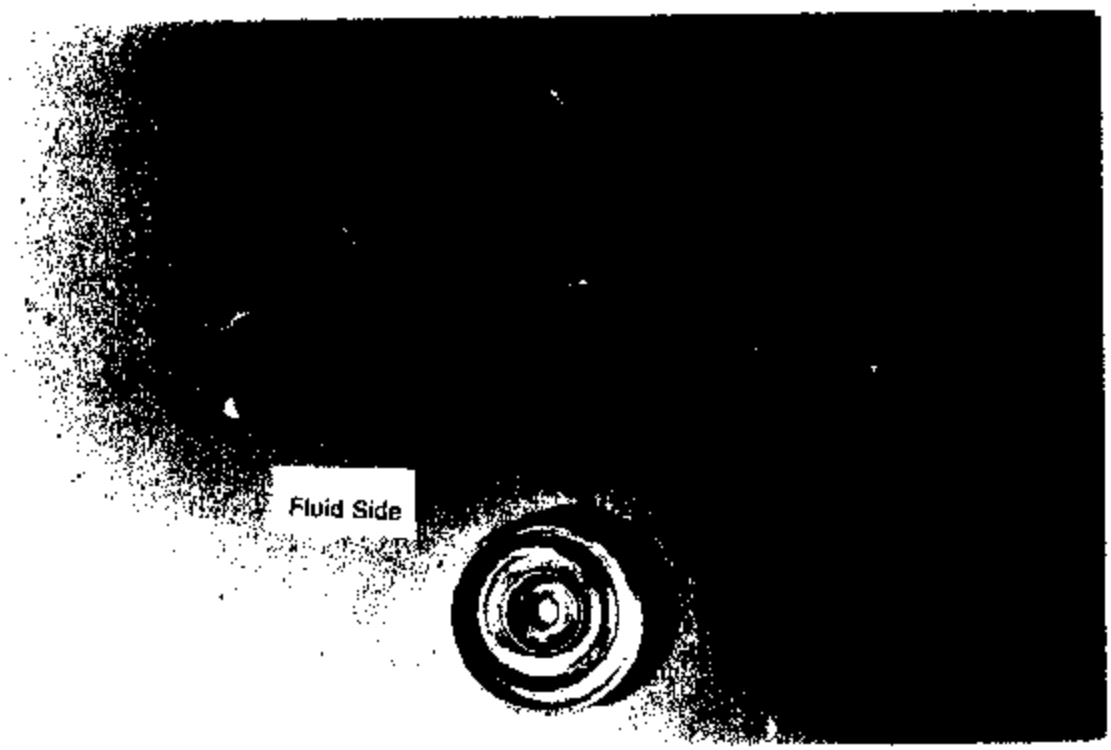
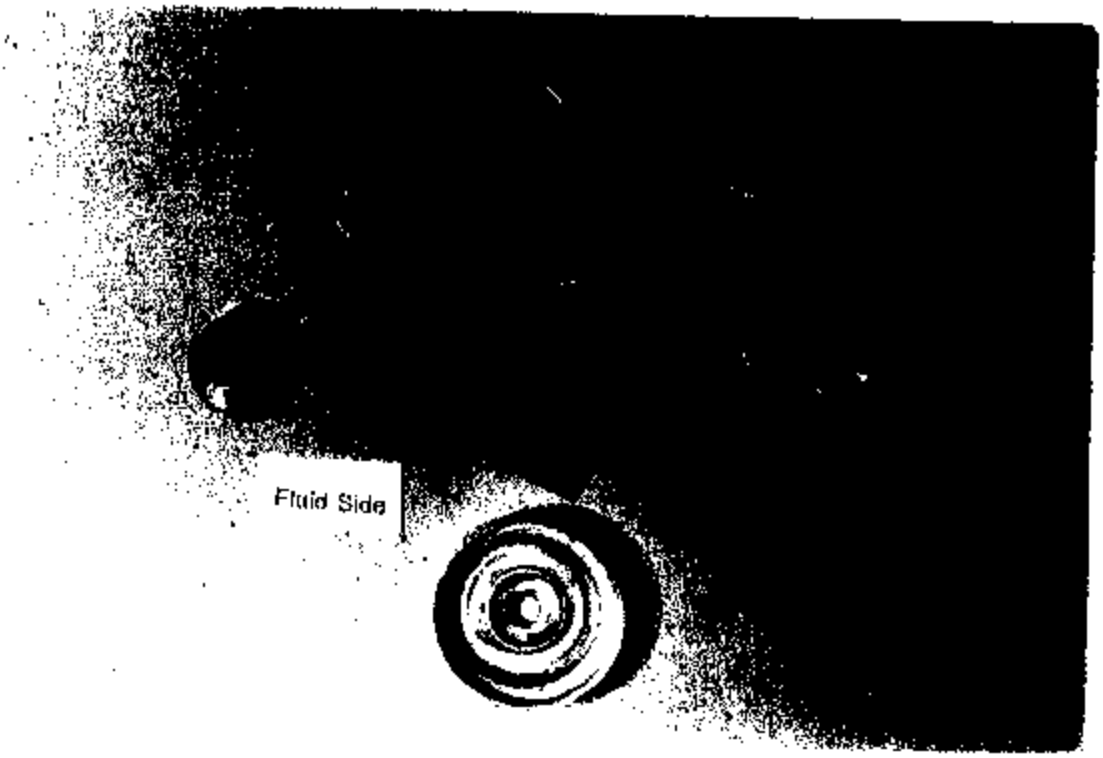
3713 7463





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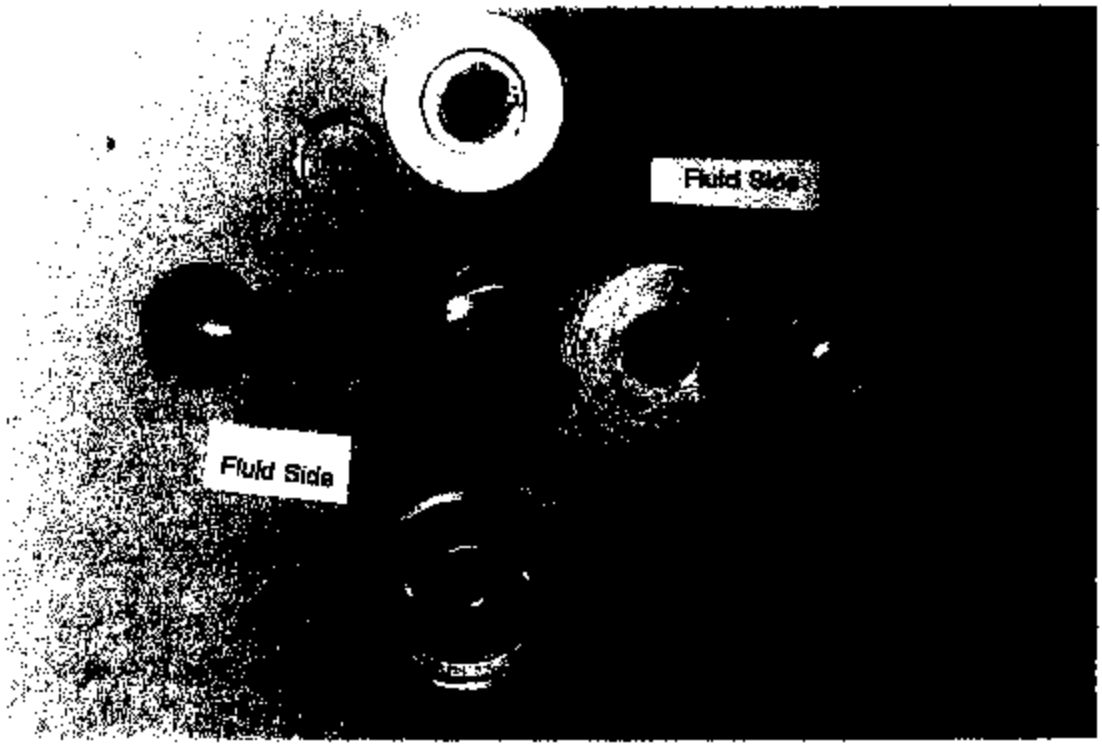

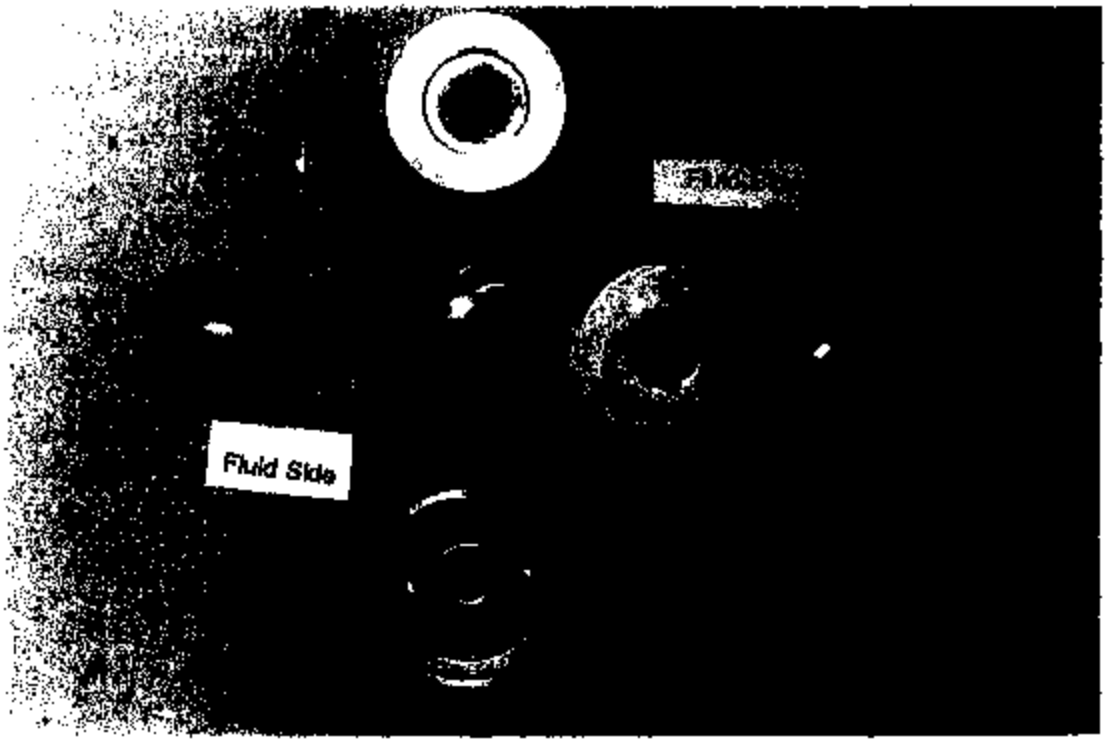

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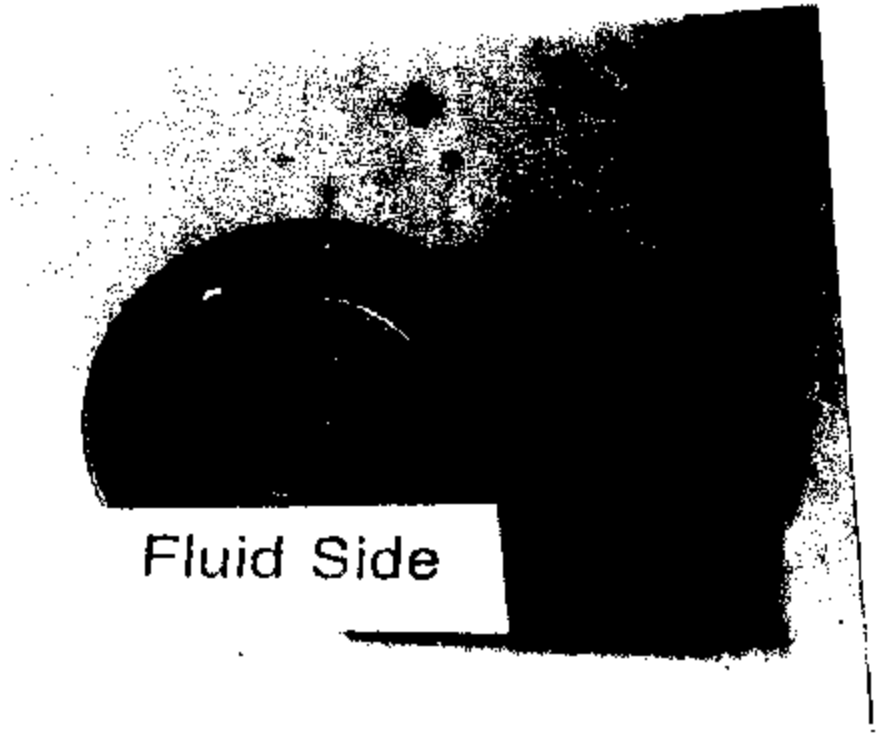

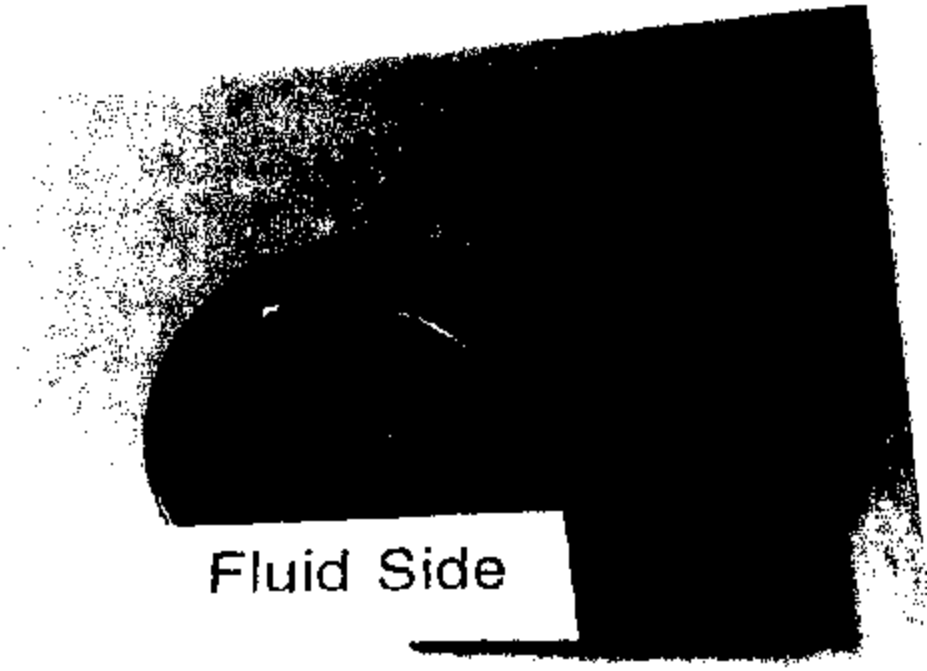

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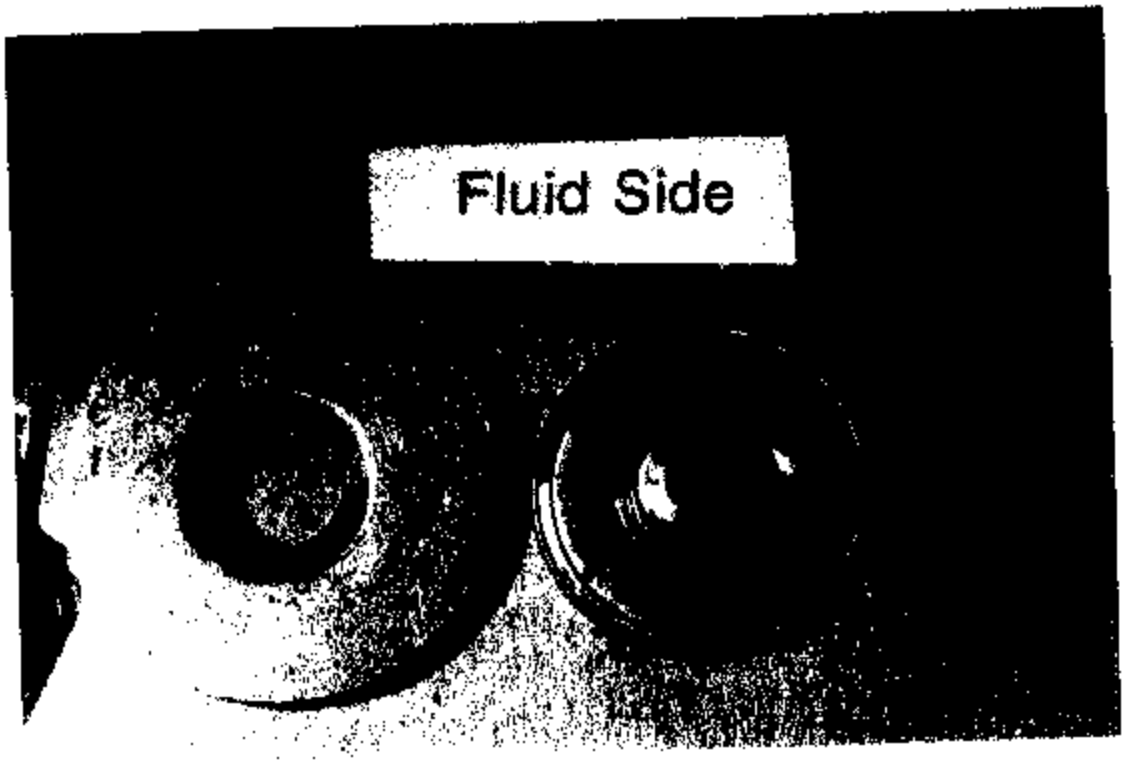

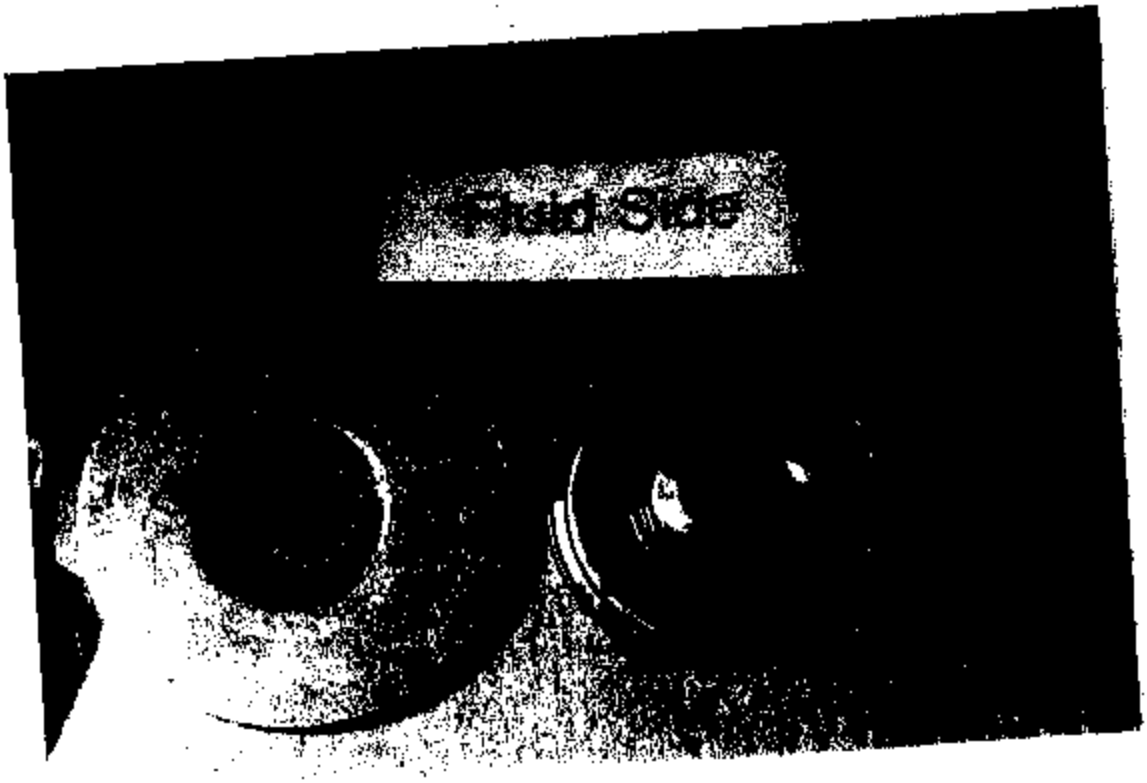

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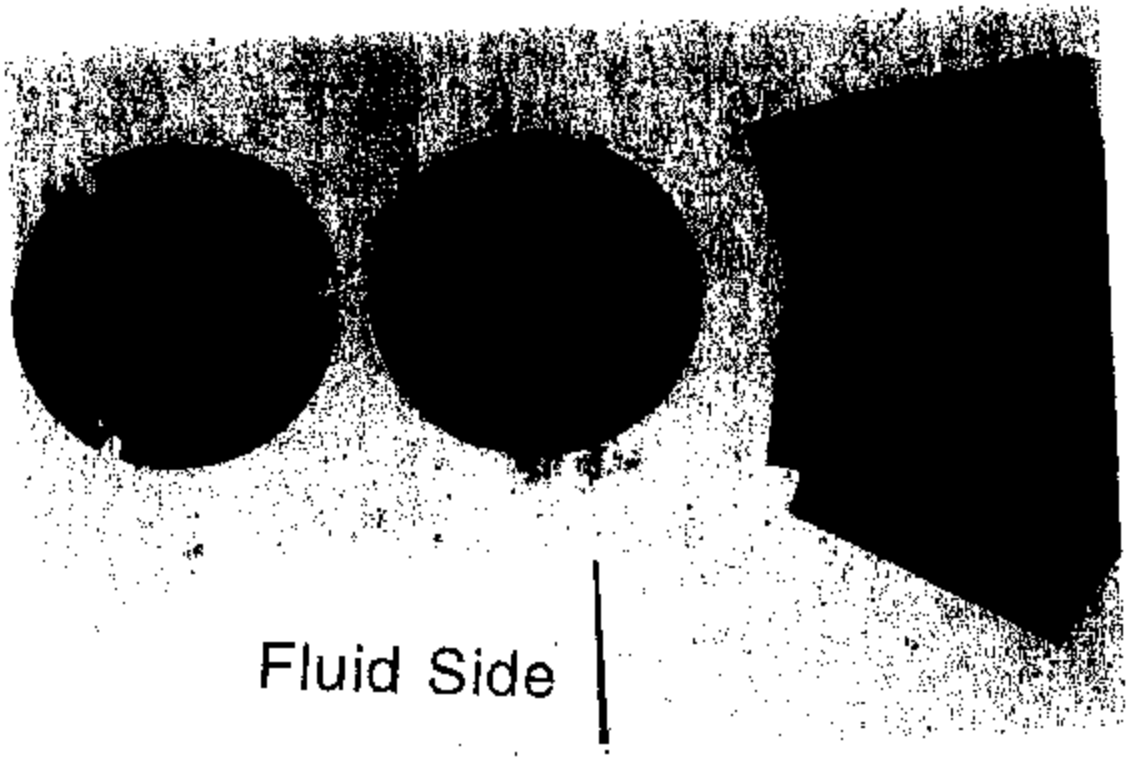

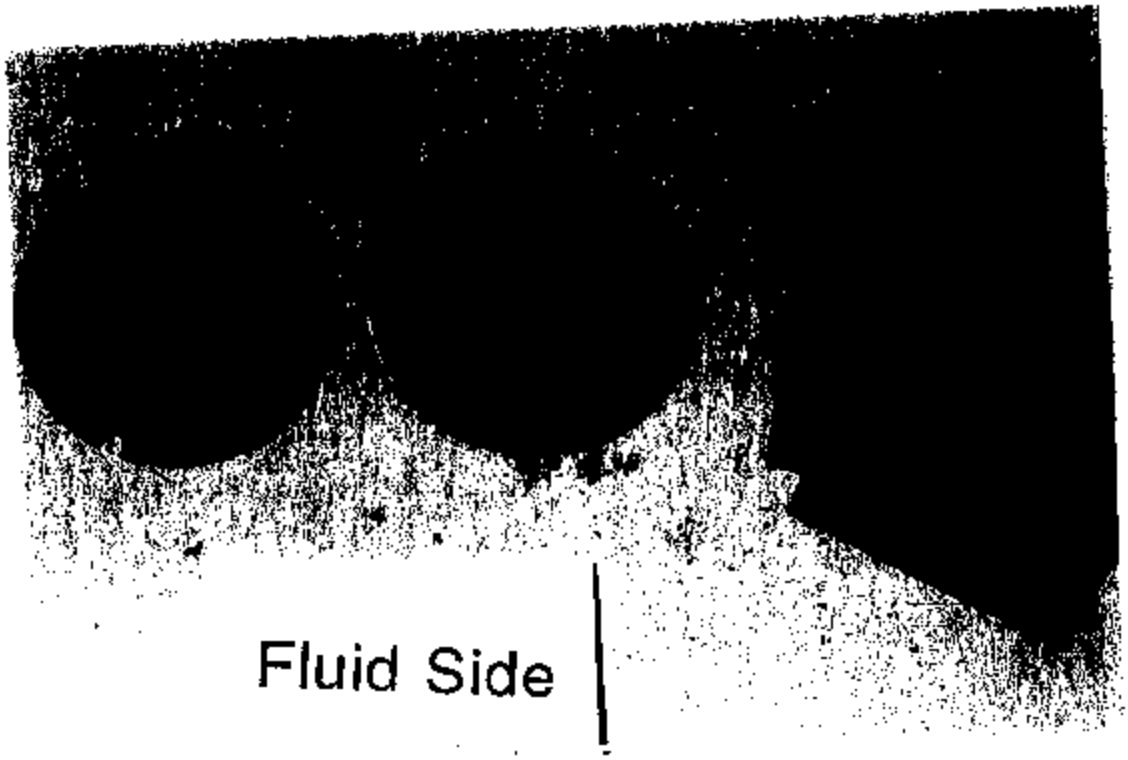

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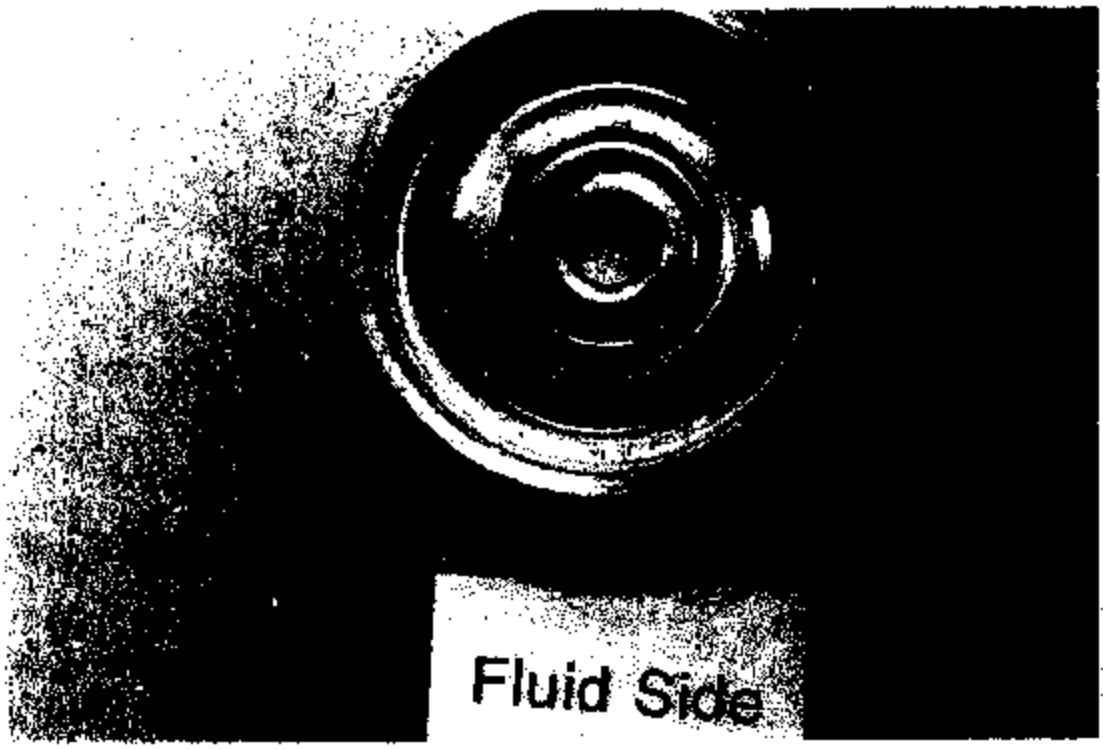

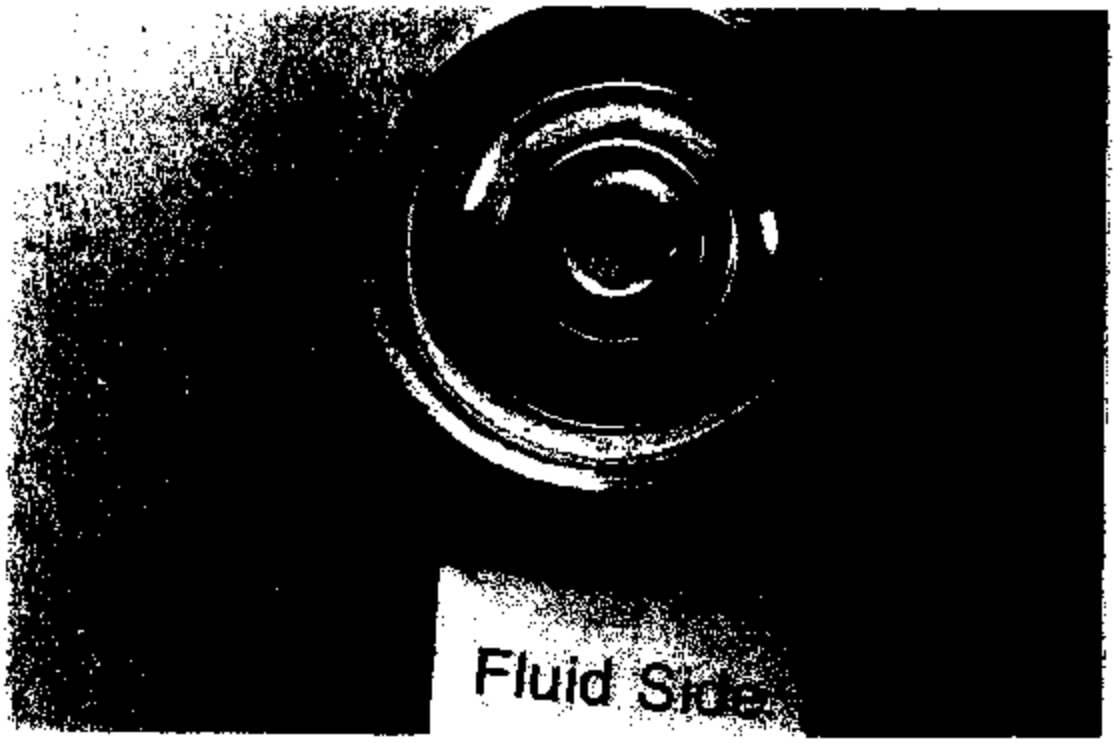

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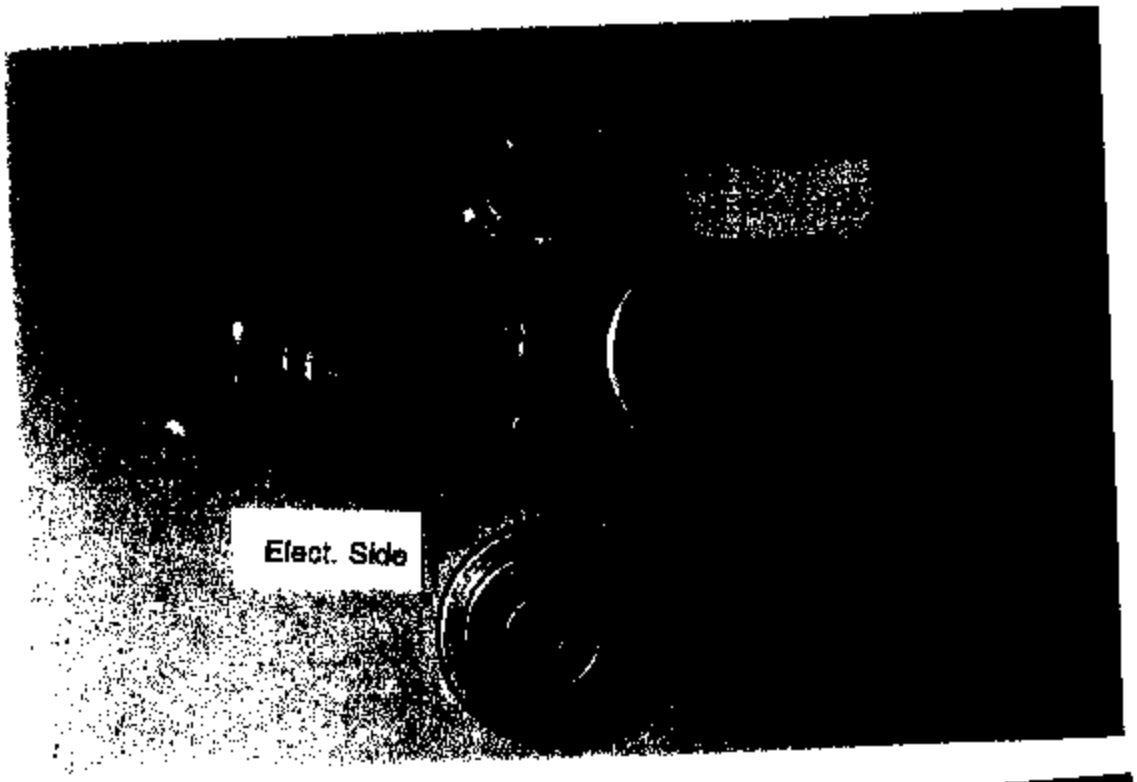

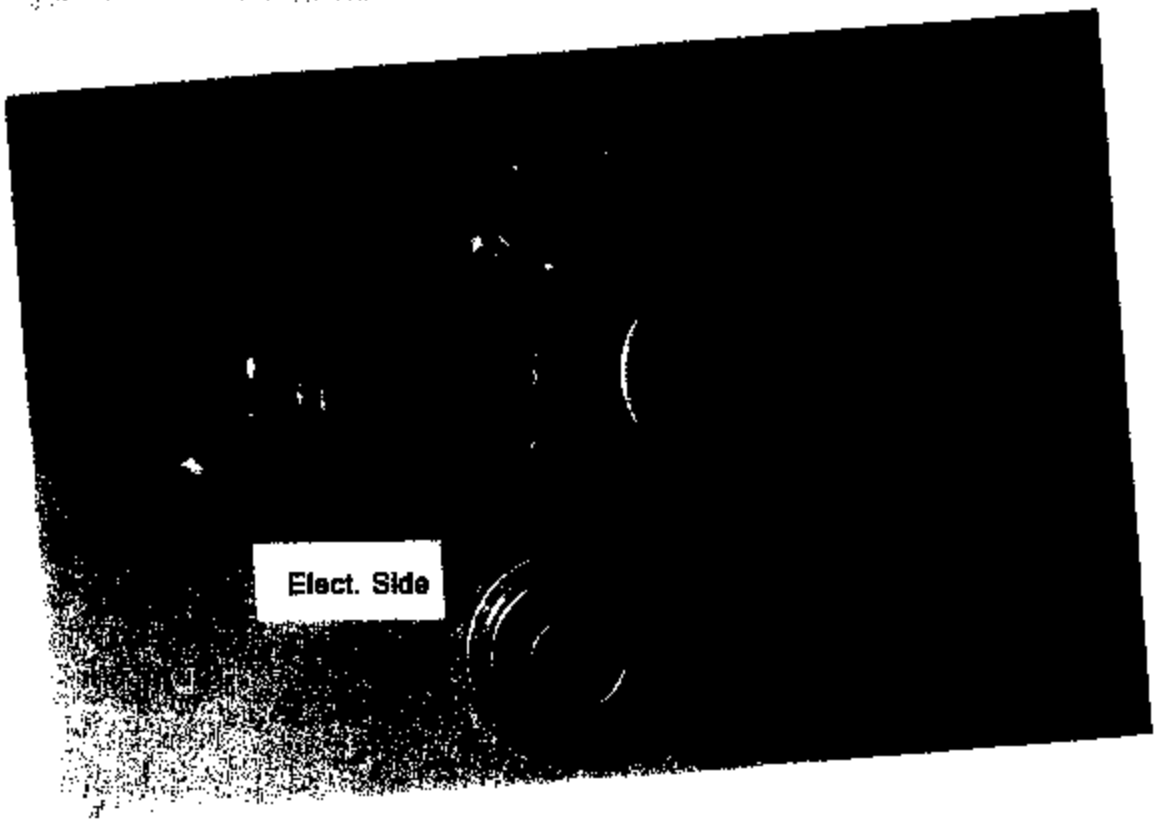

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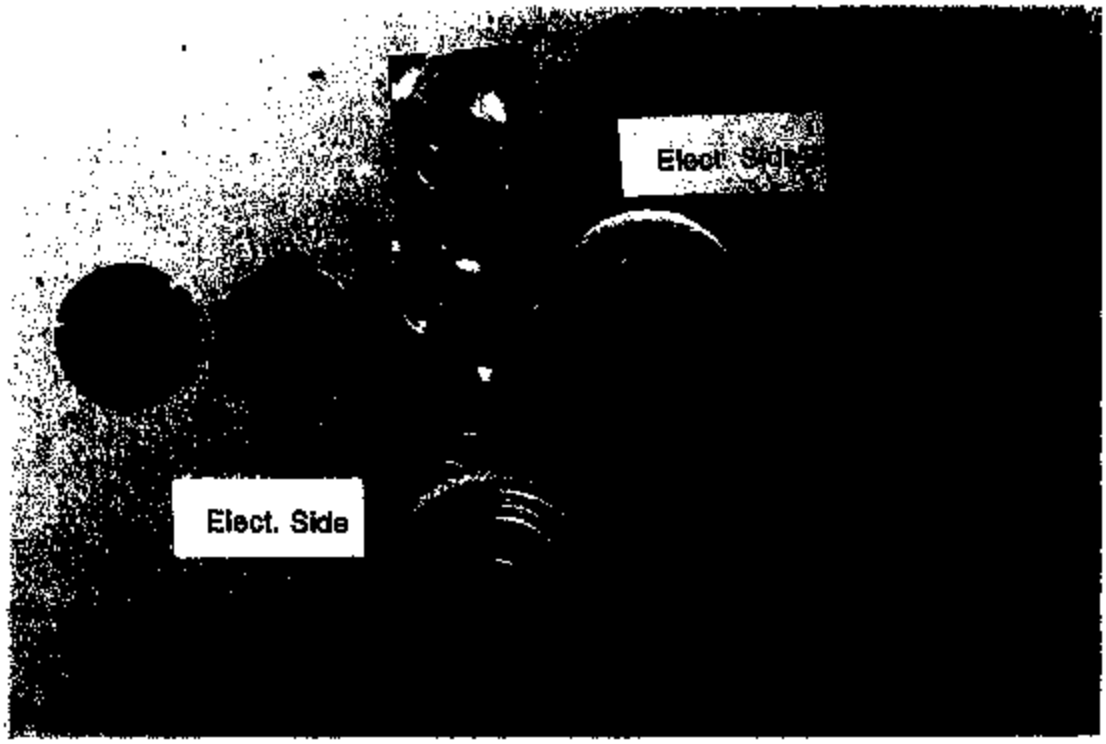

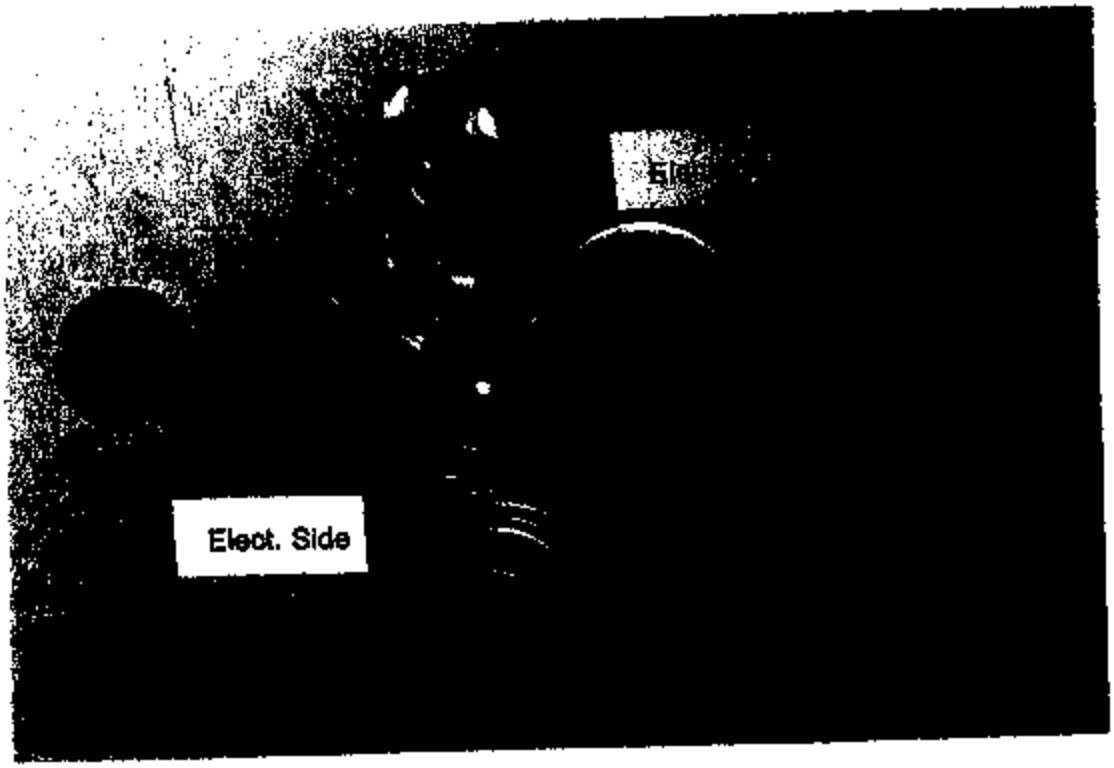

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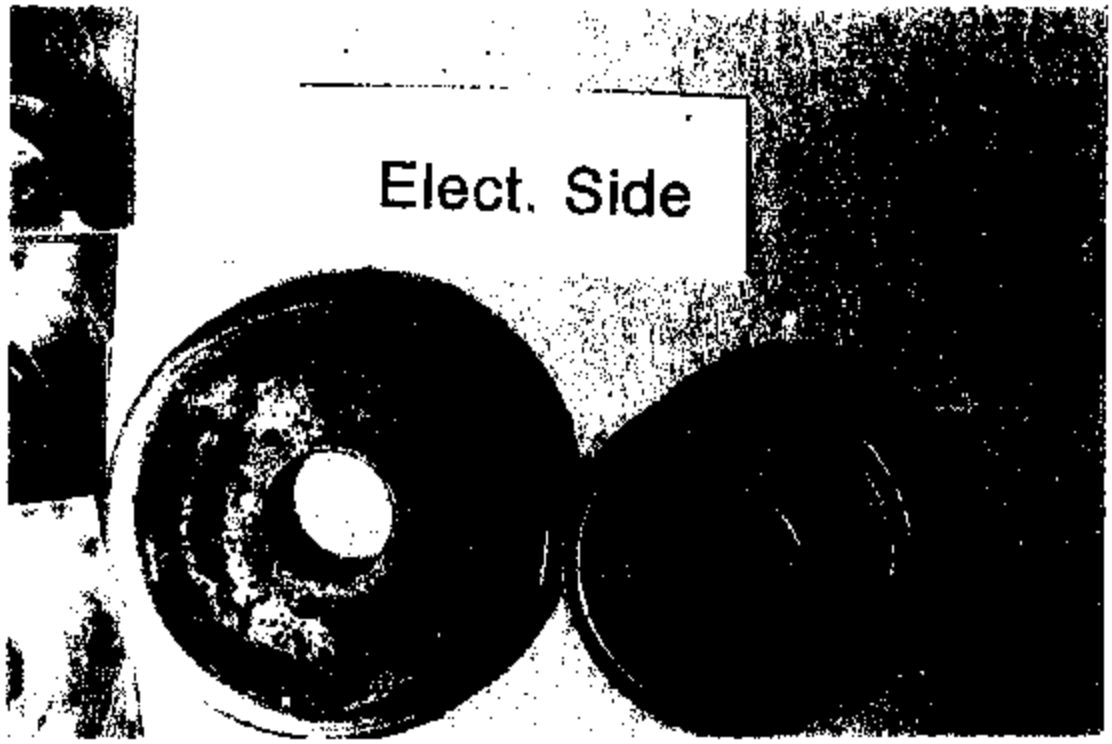
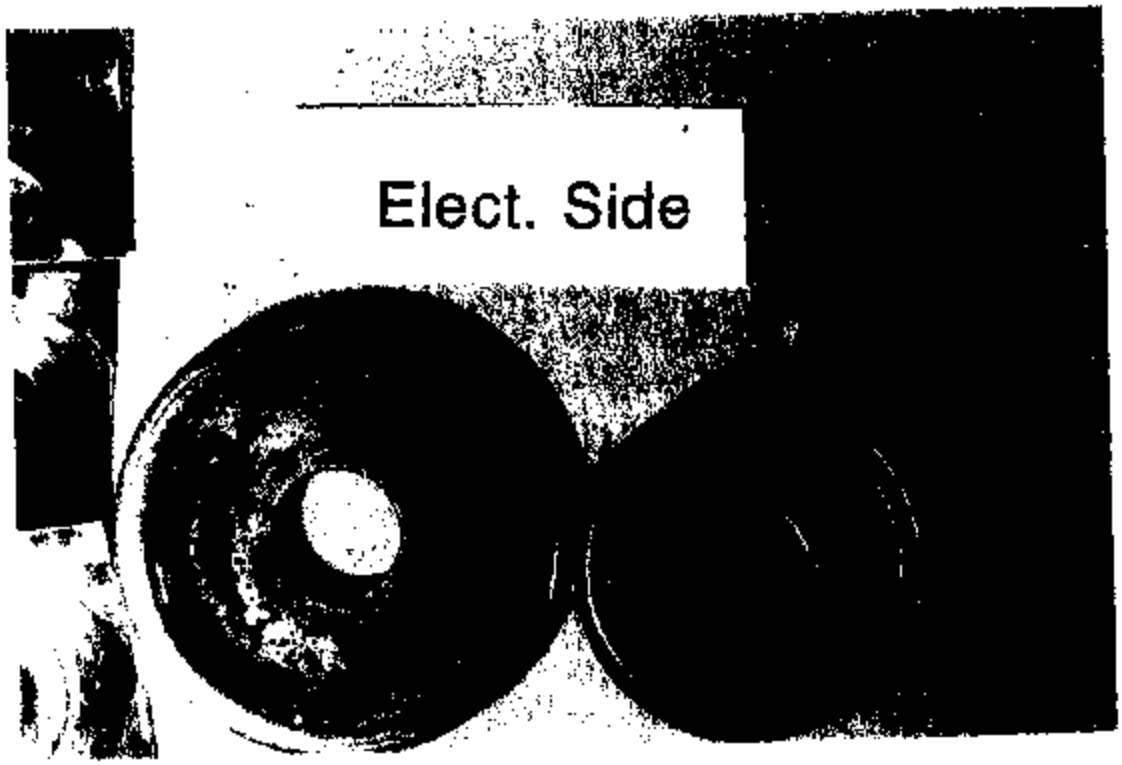
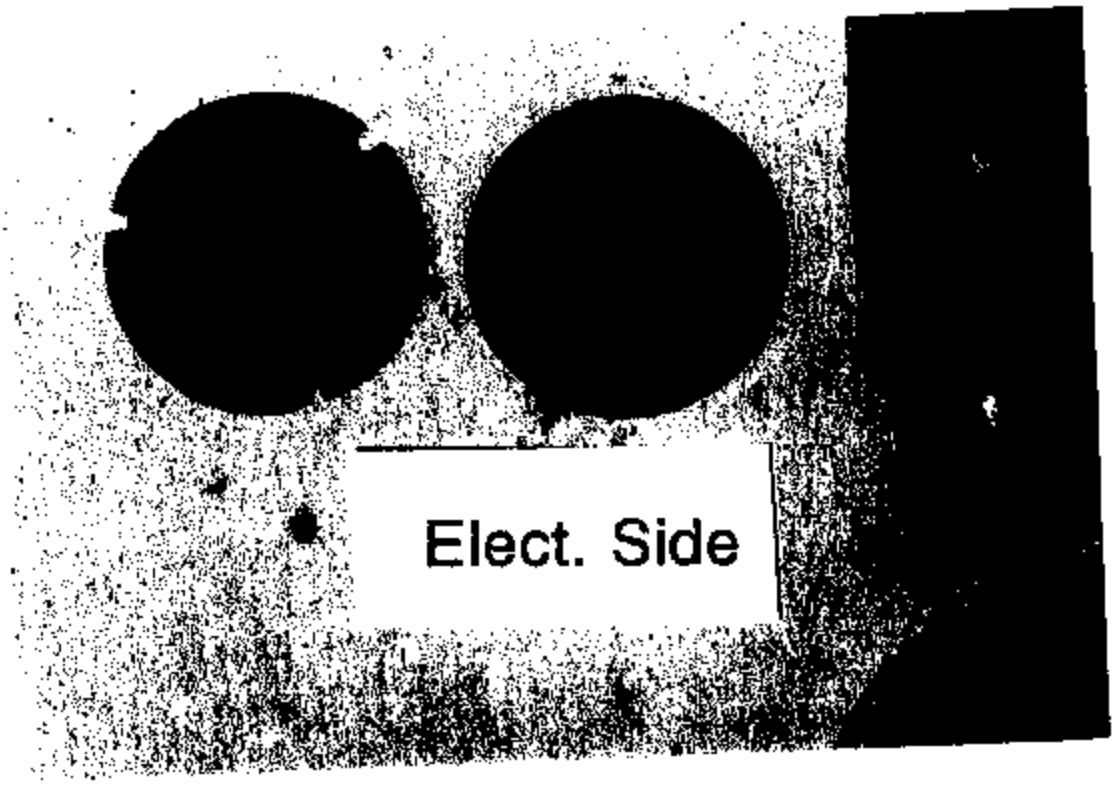
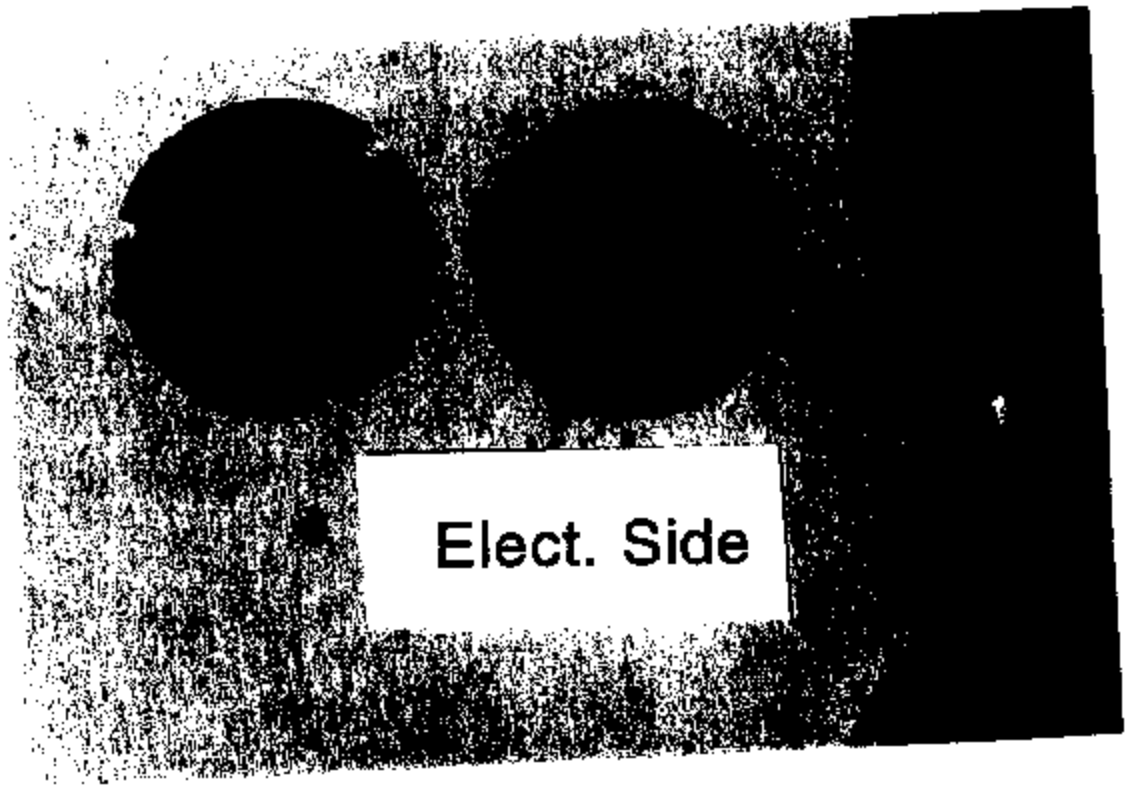

Elect. Side


Elect. Side





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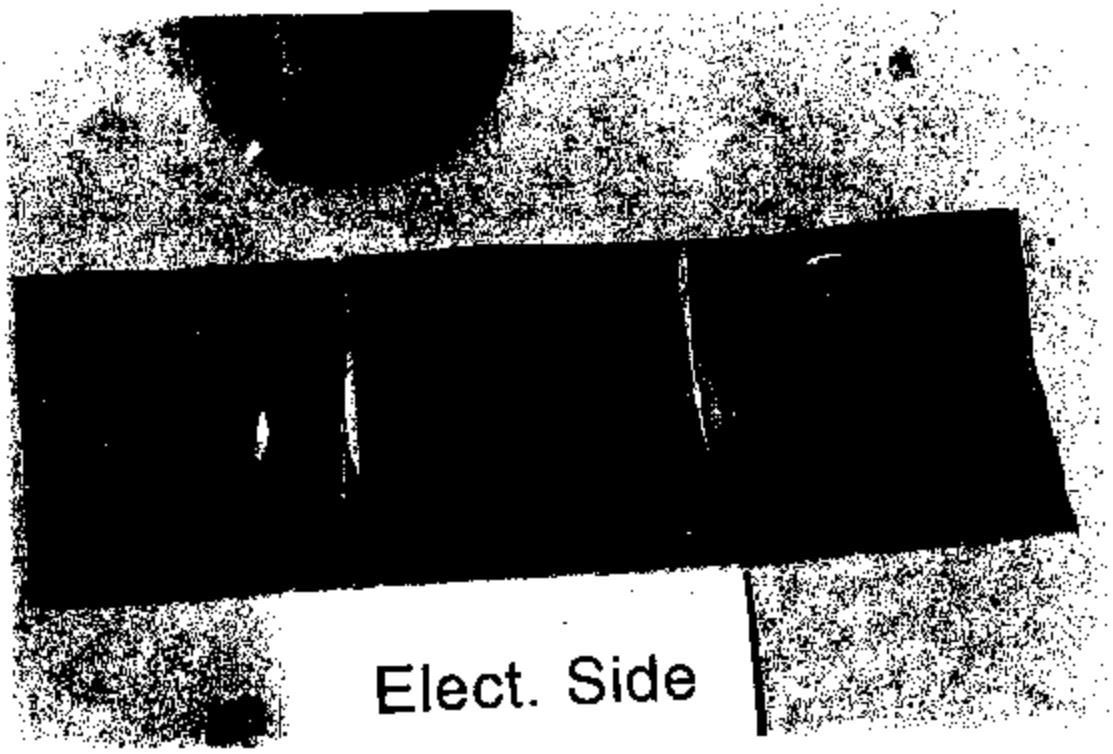

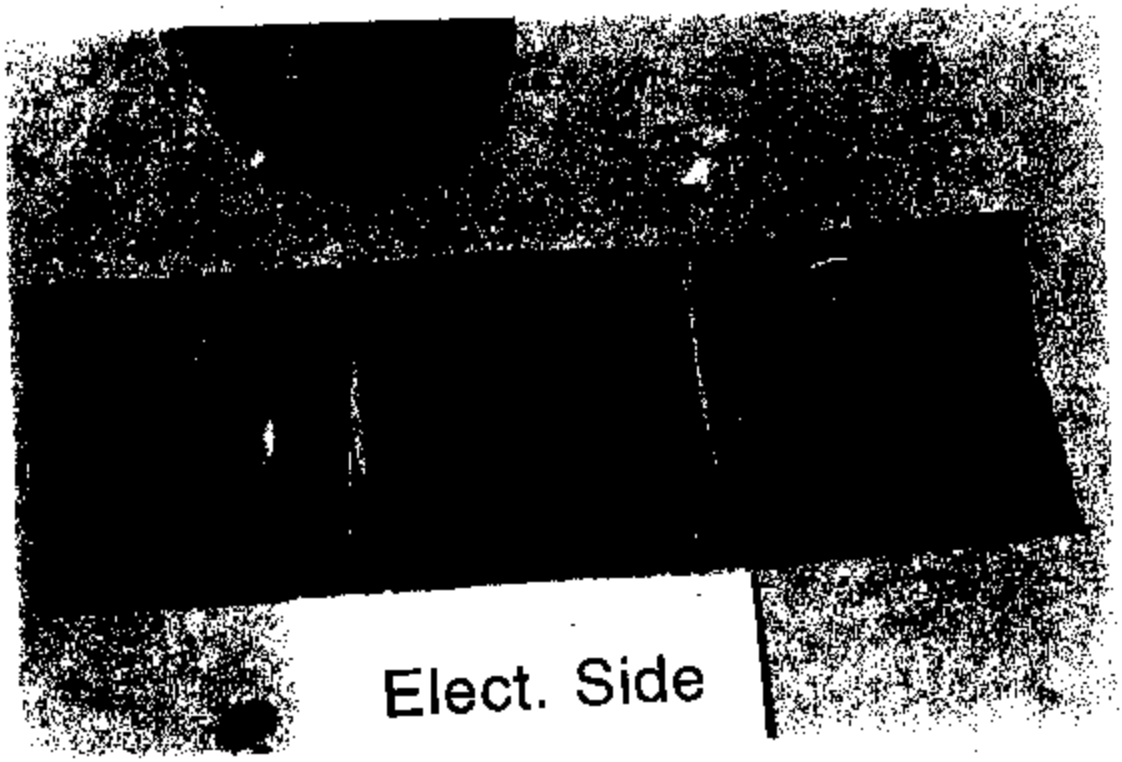

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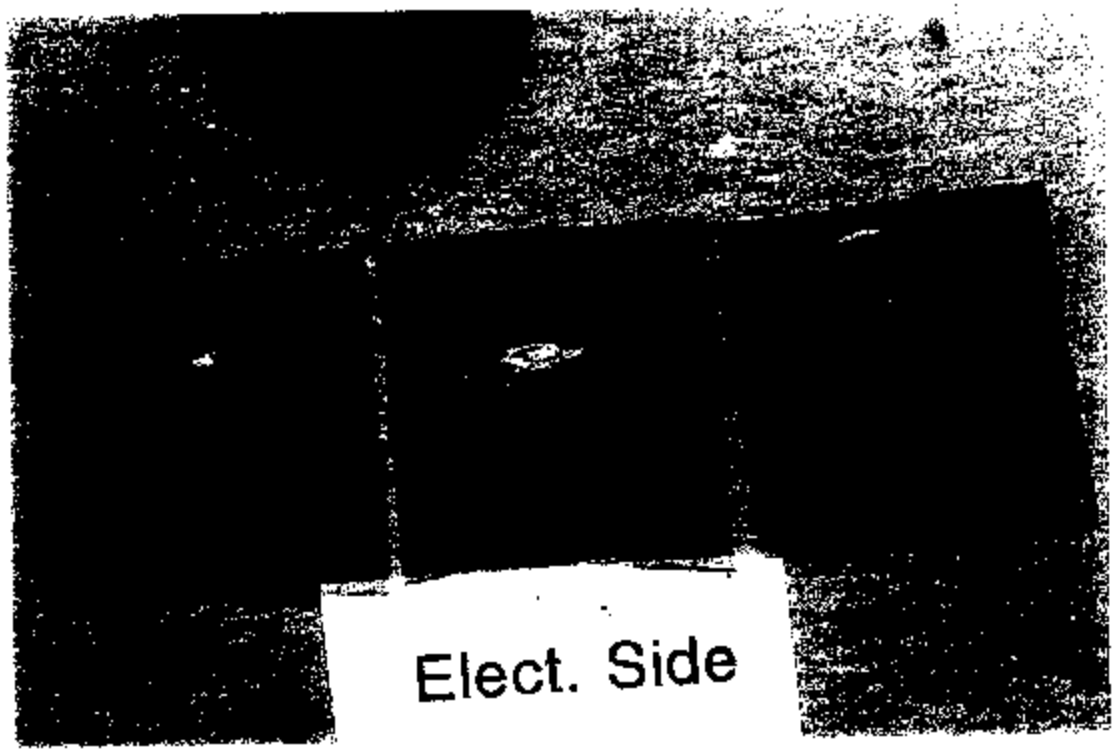

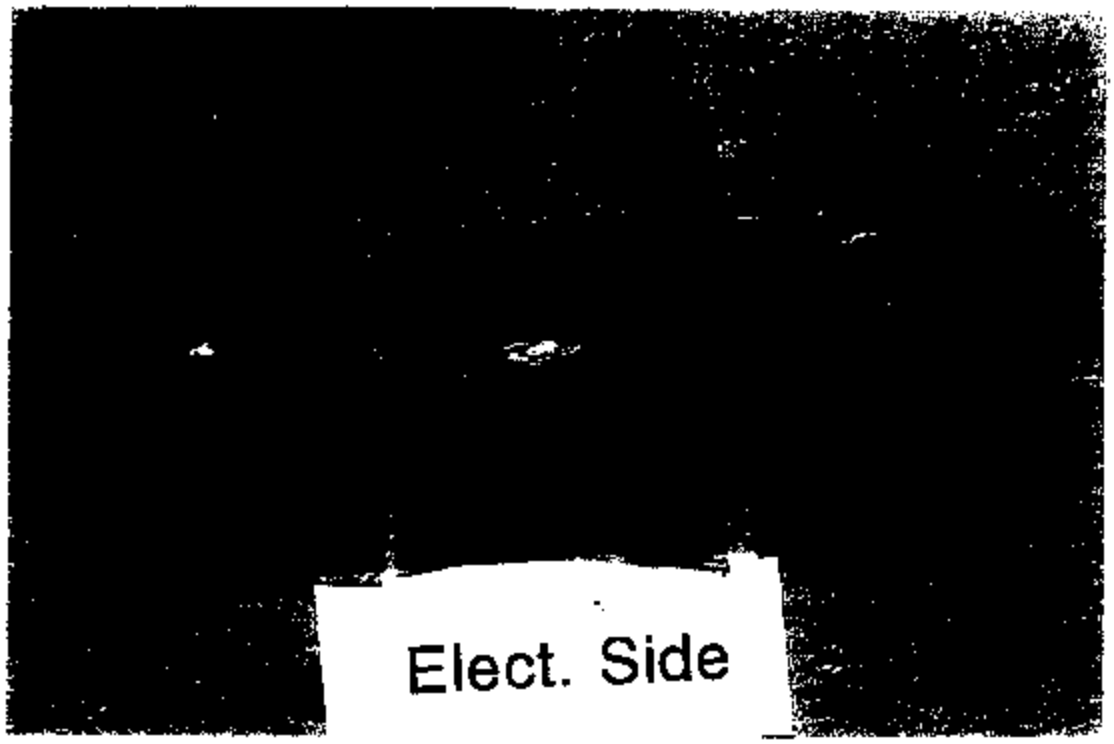

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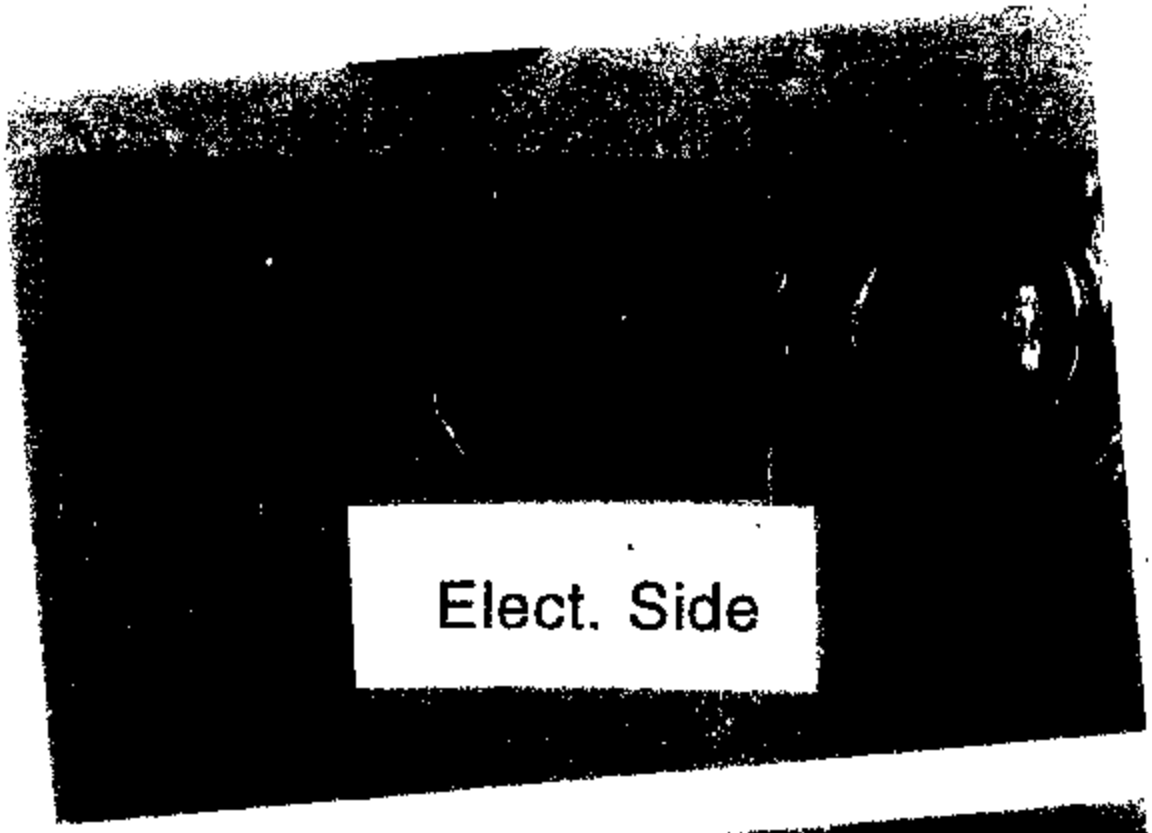

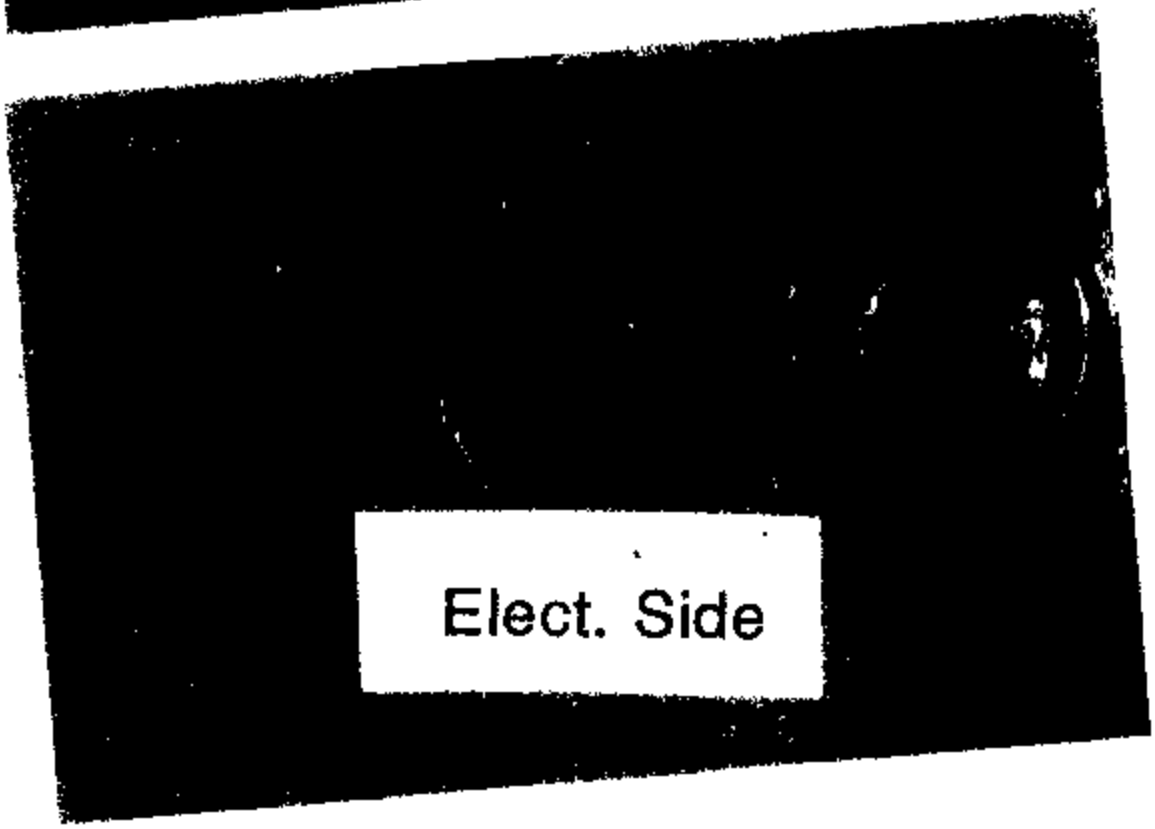

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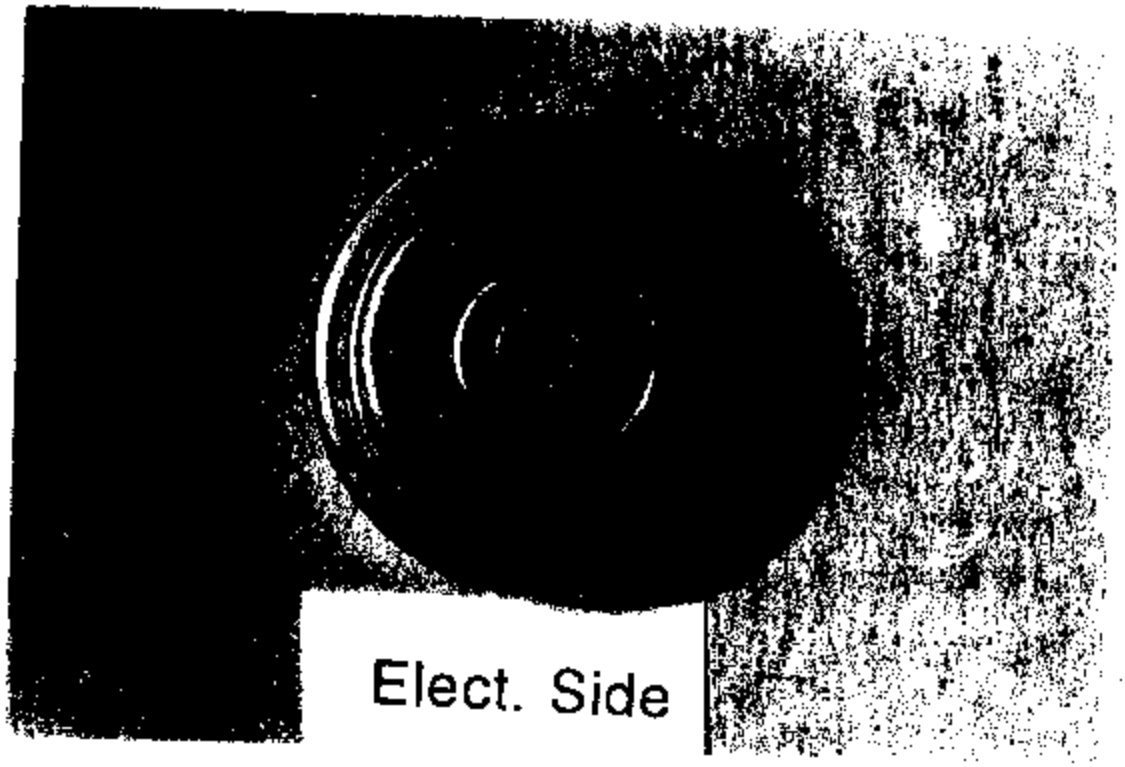

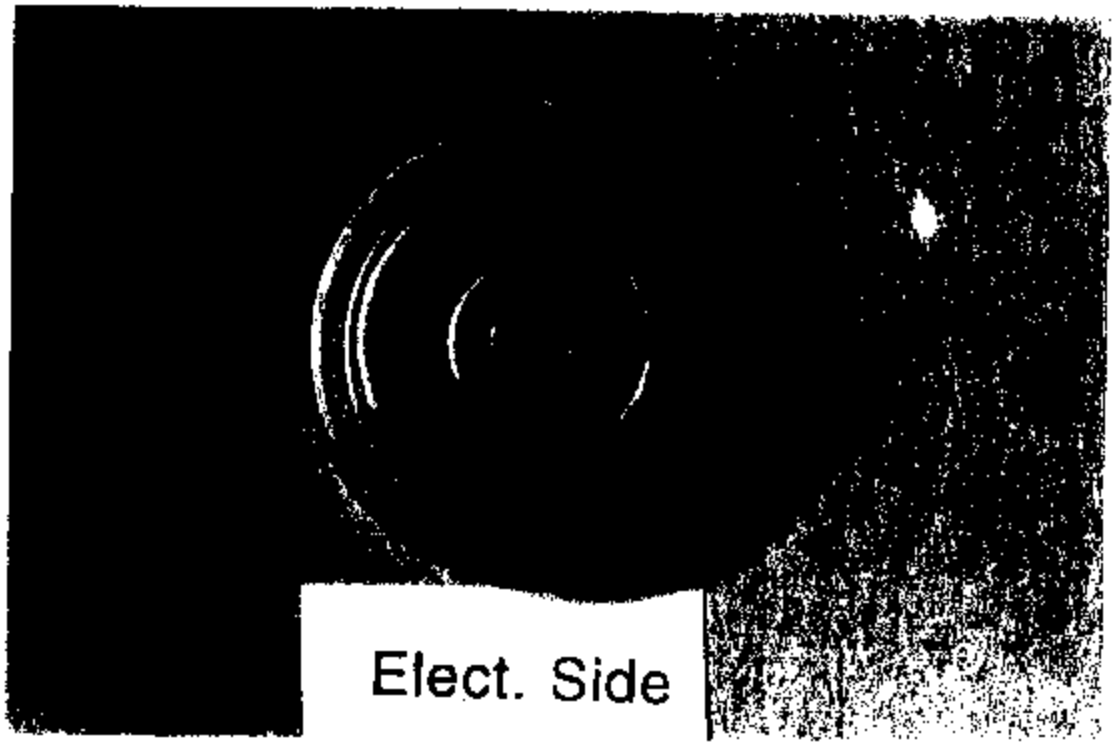

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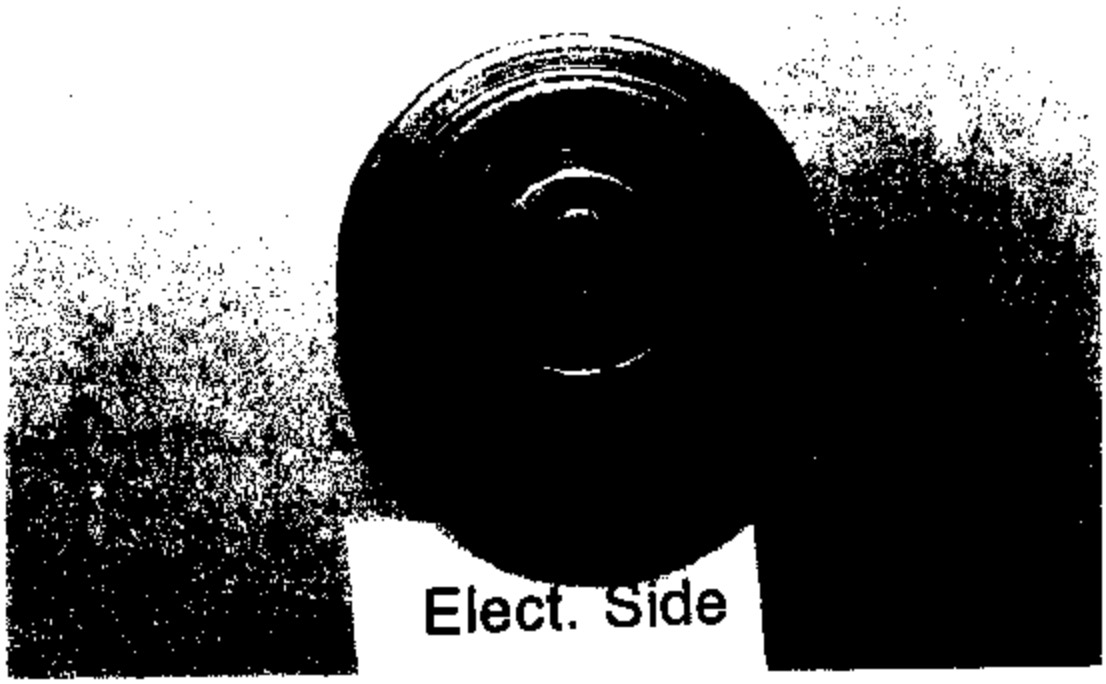

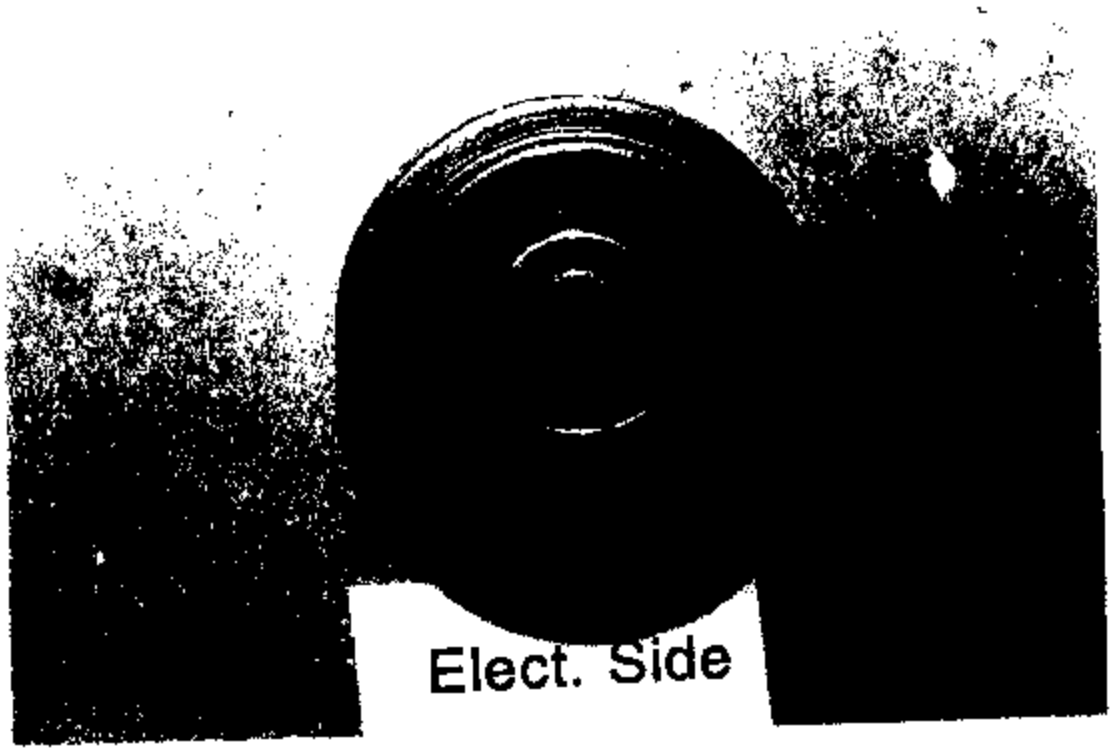

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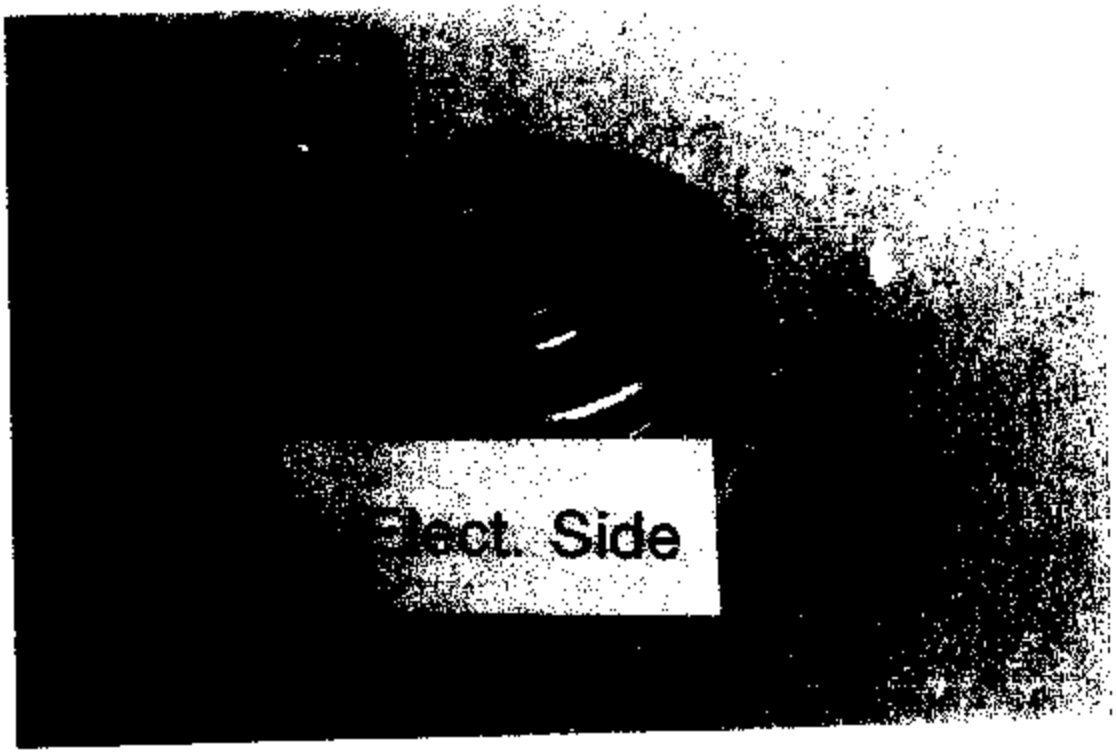

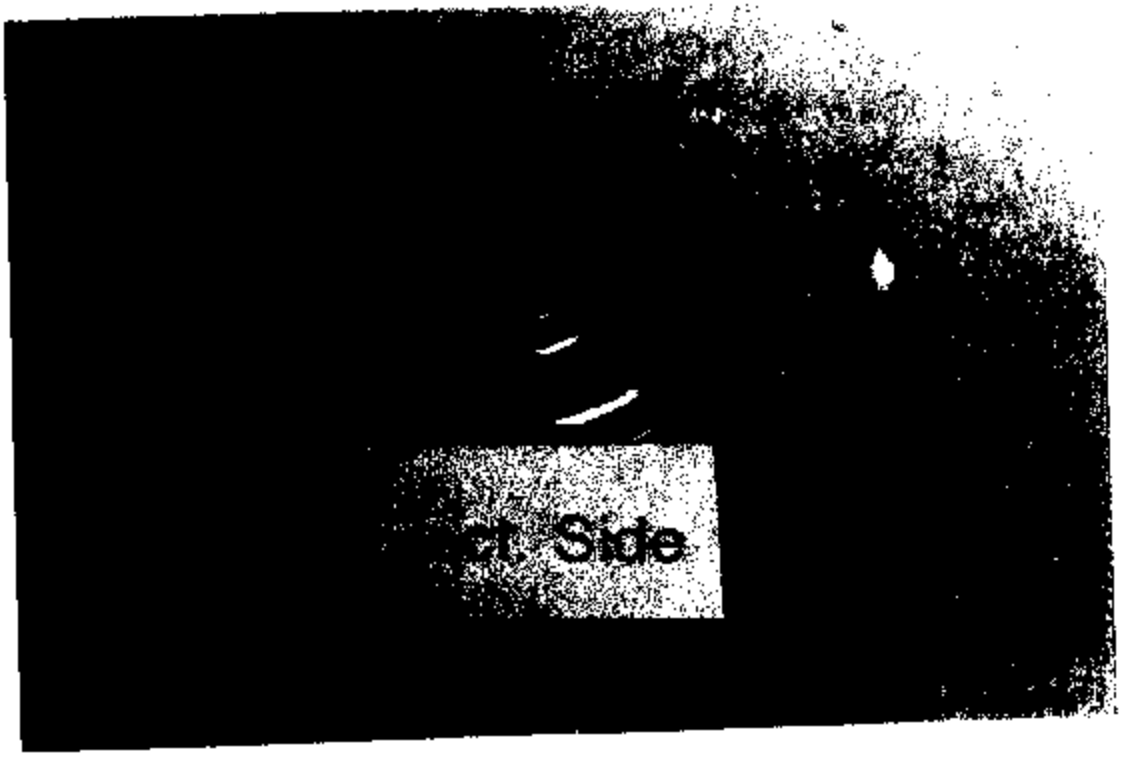

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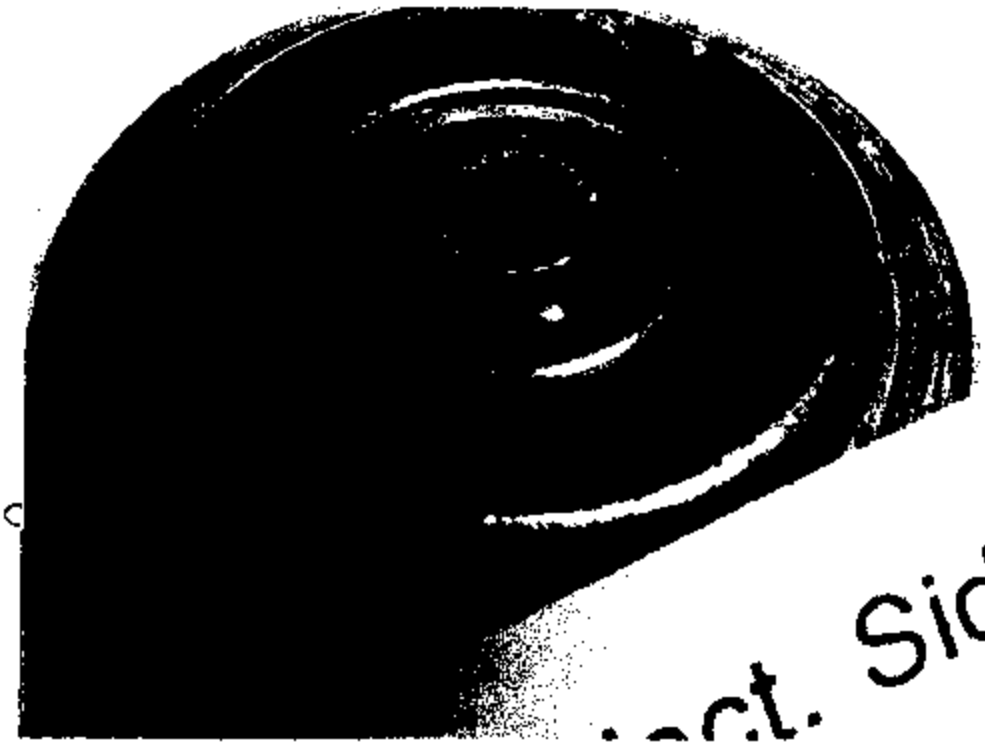

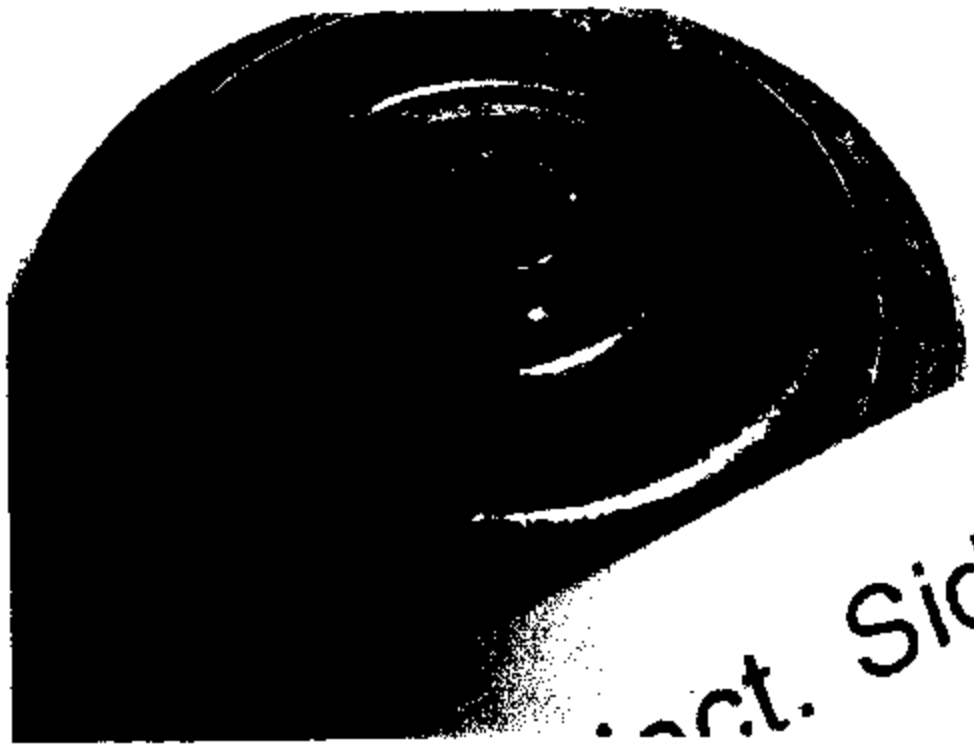

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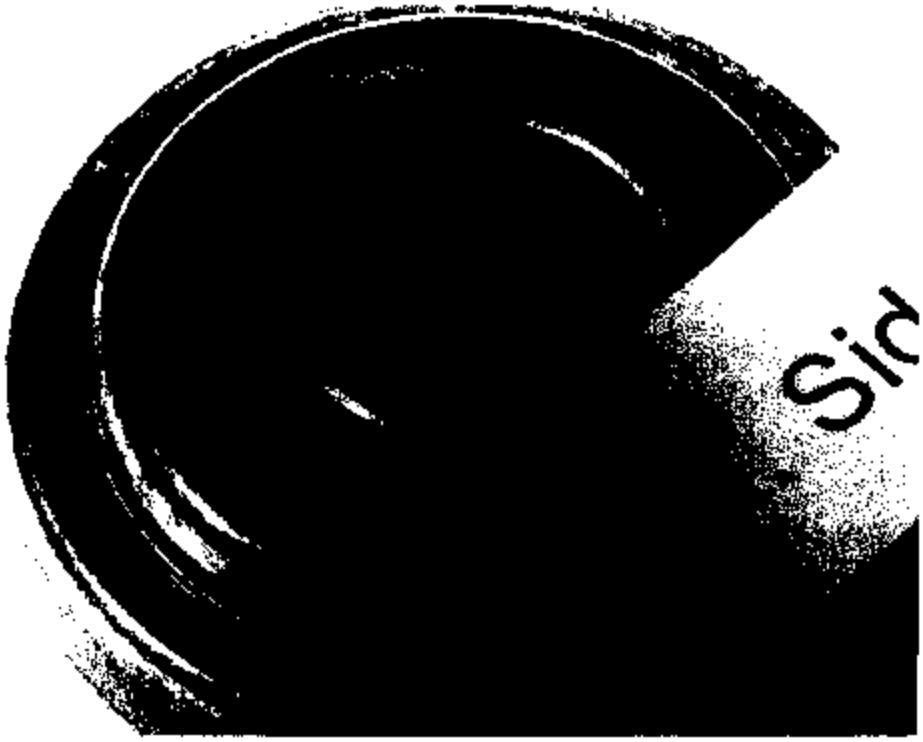
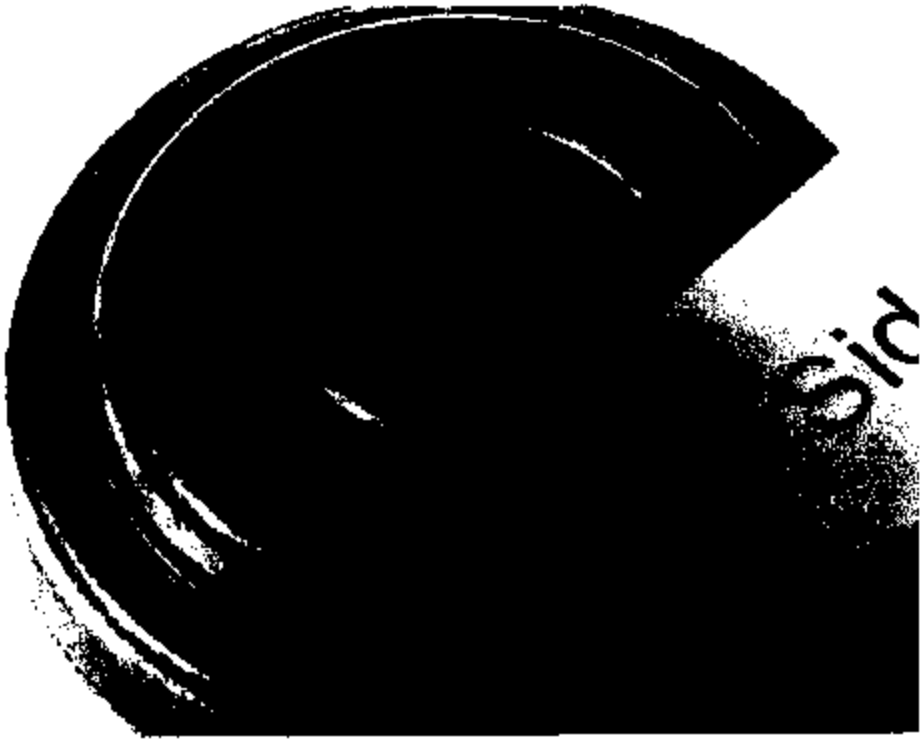
3713 7481

3713 7482





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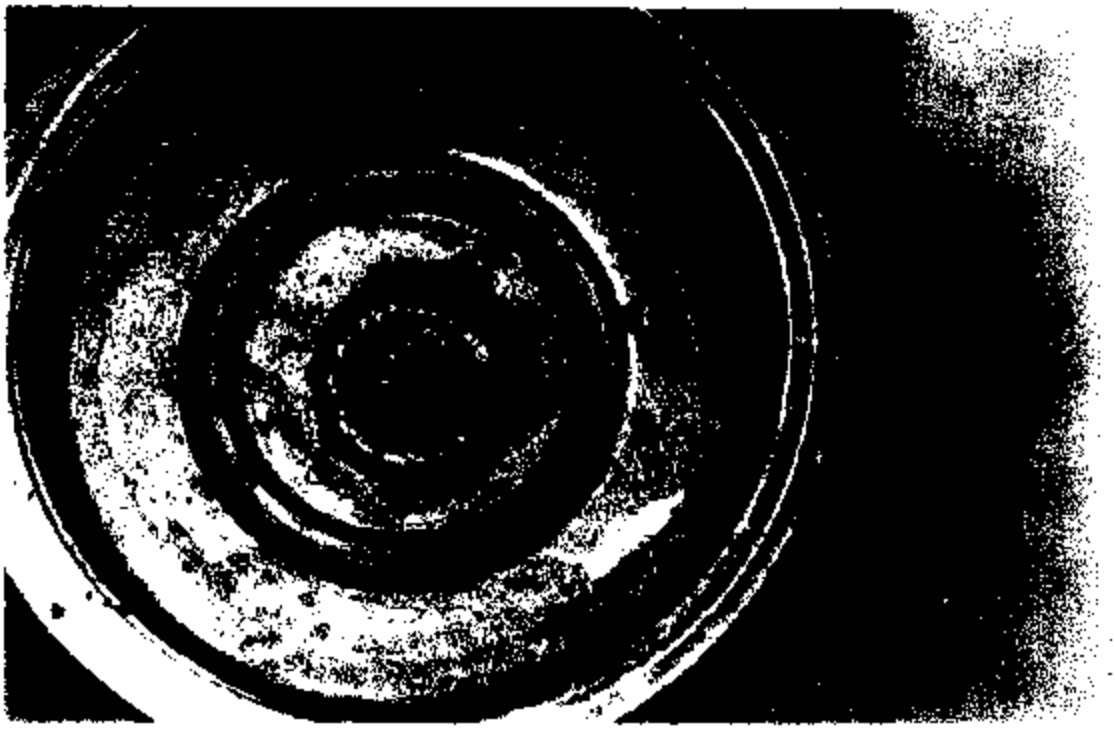

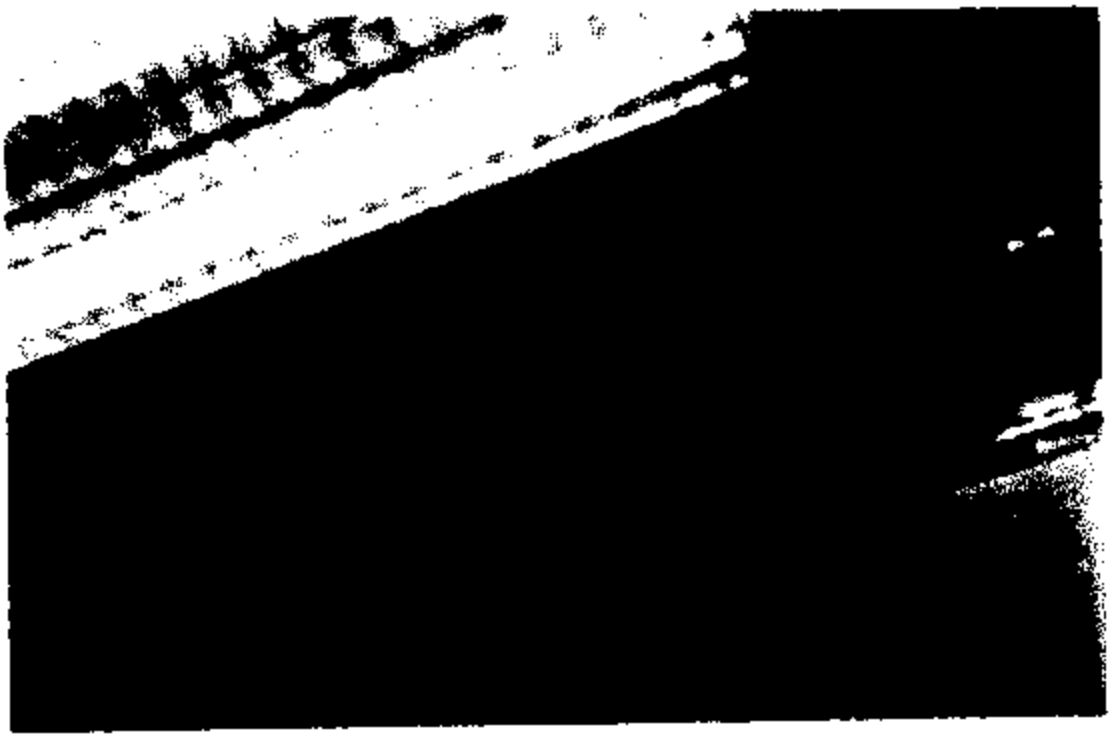

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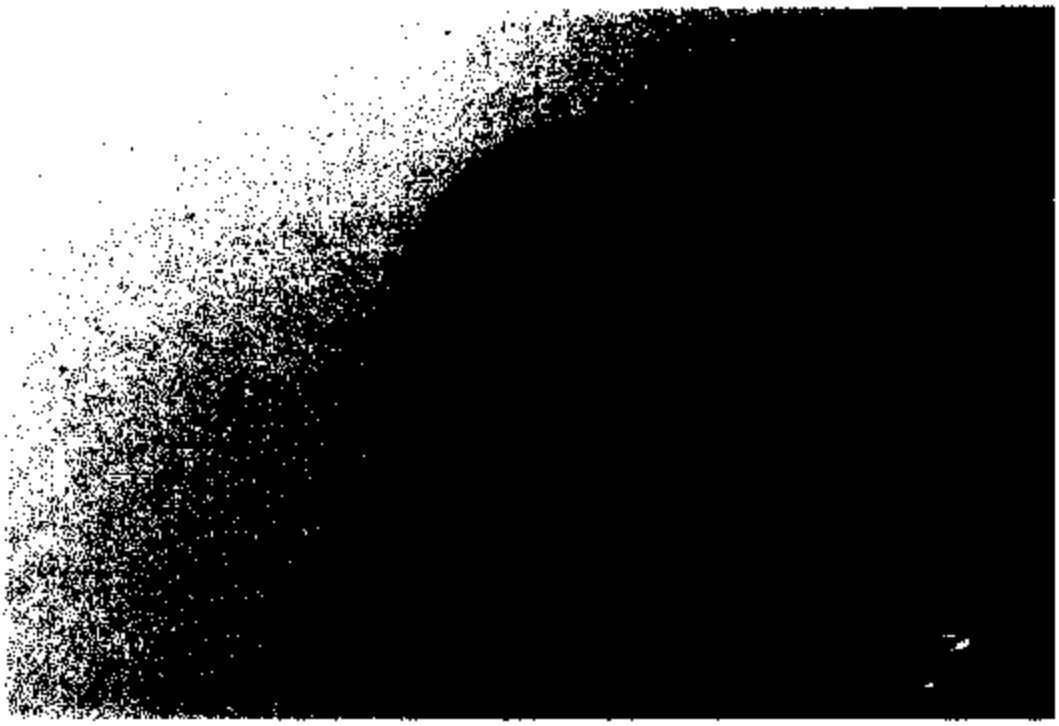

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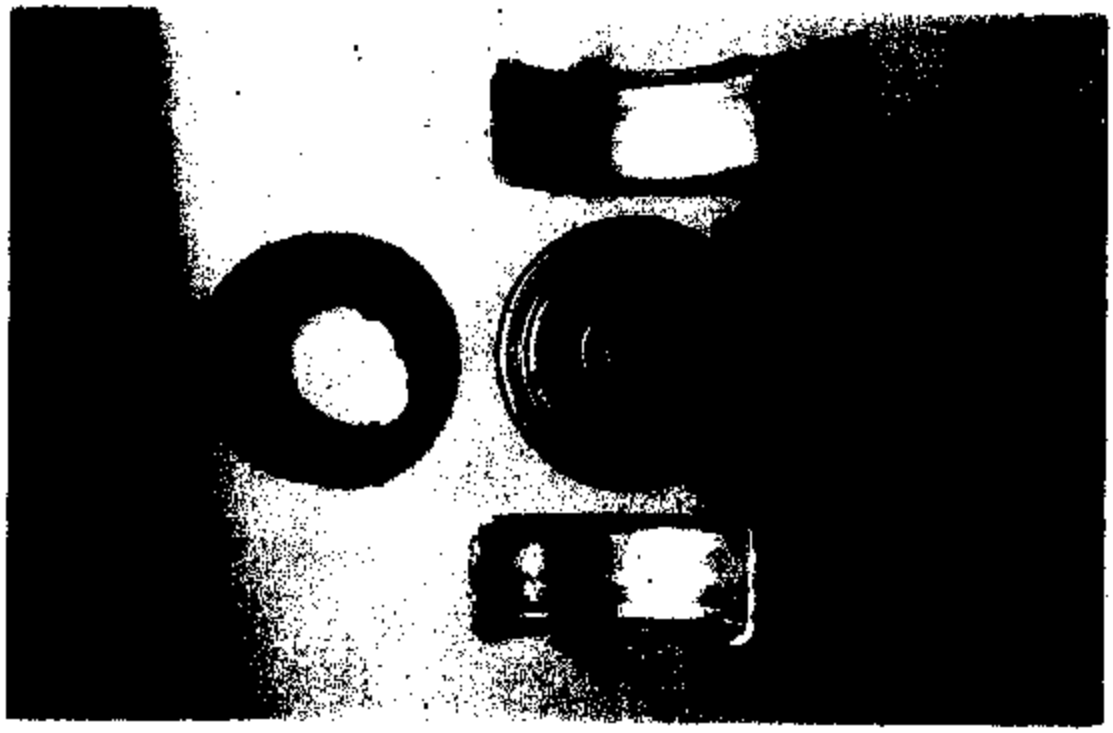

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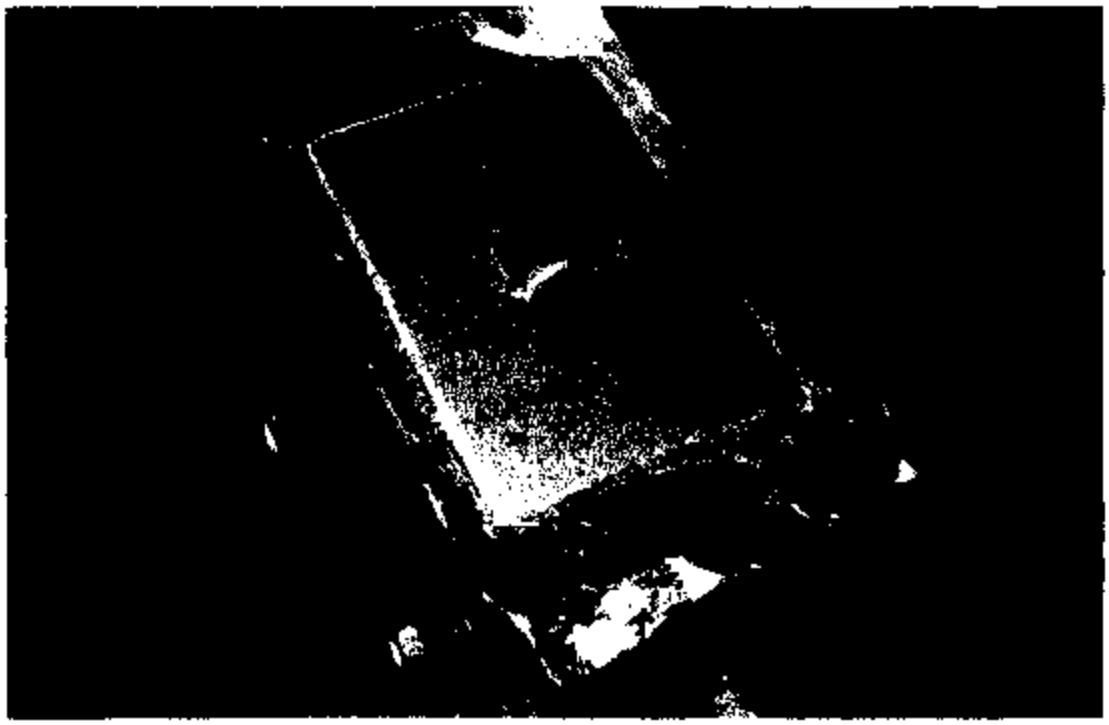

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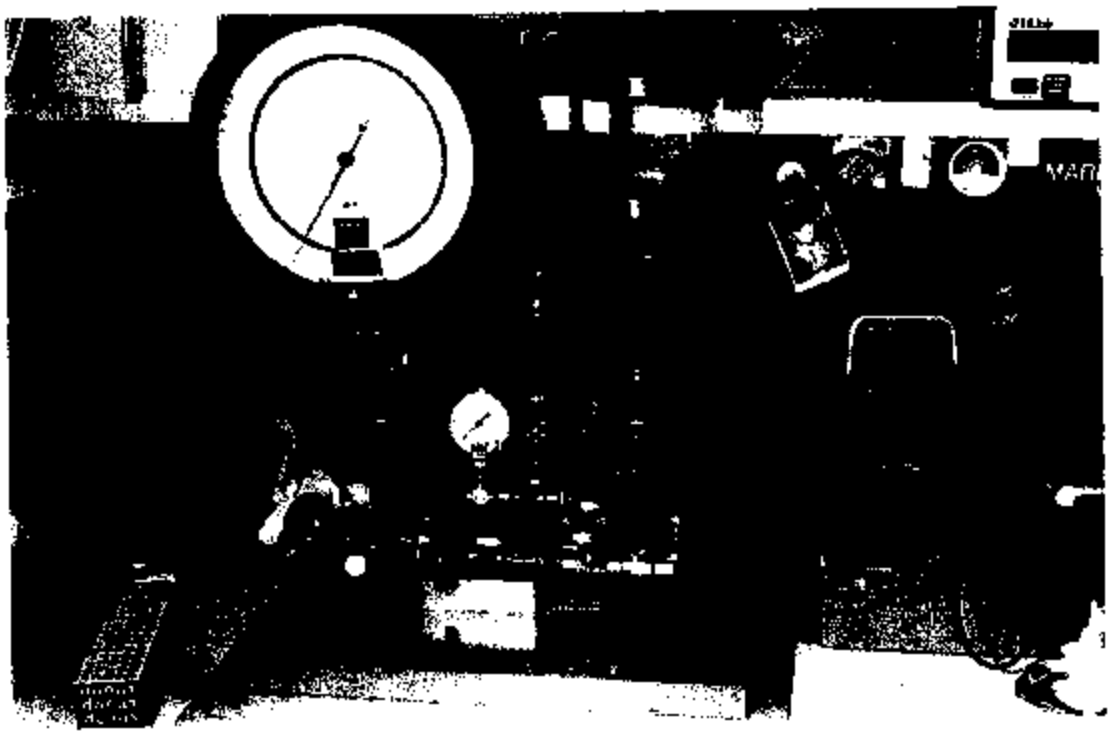

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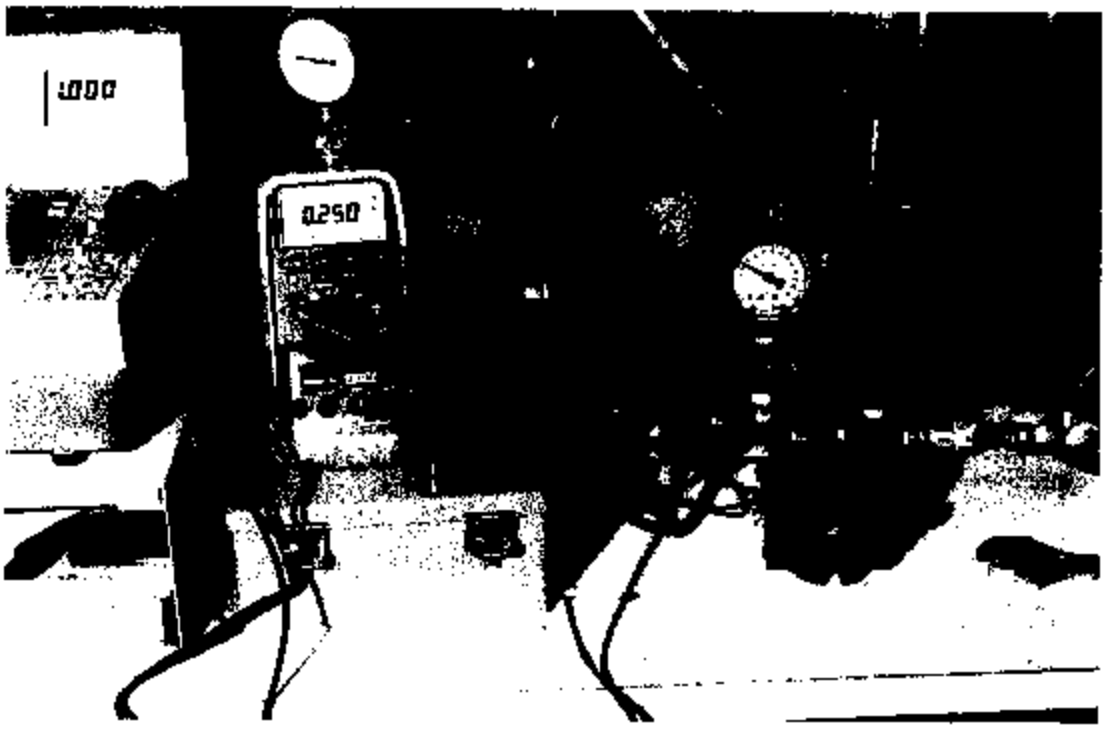

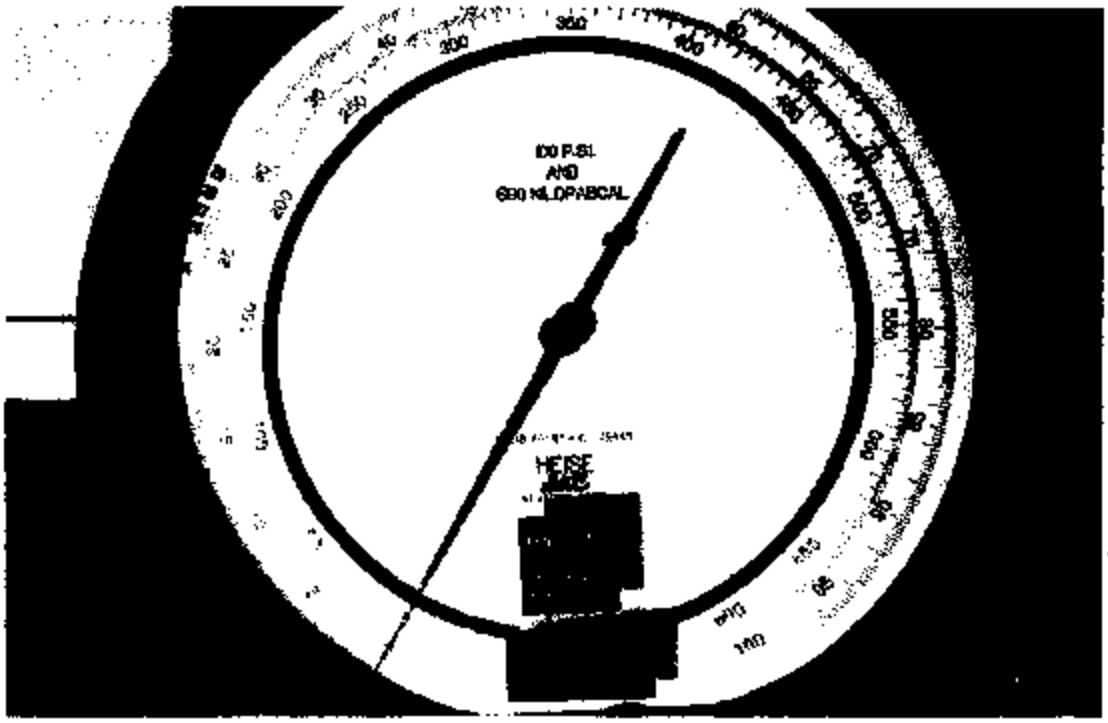

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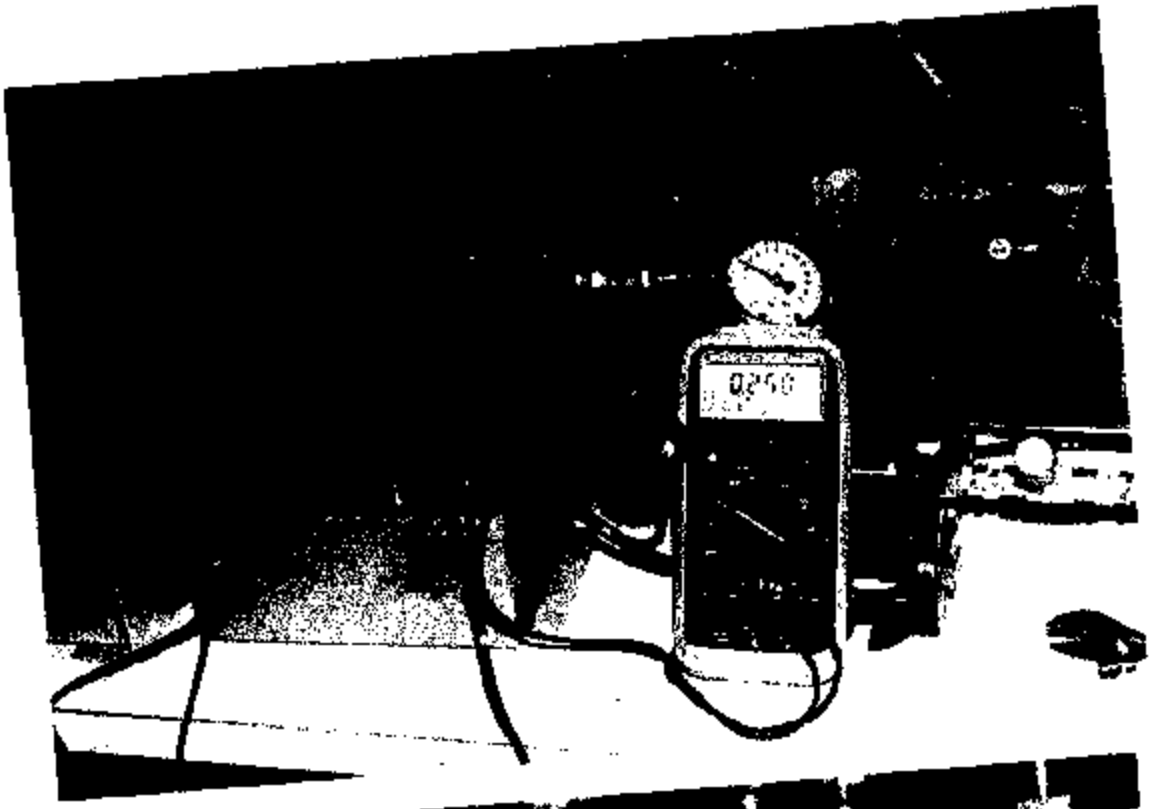

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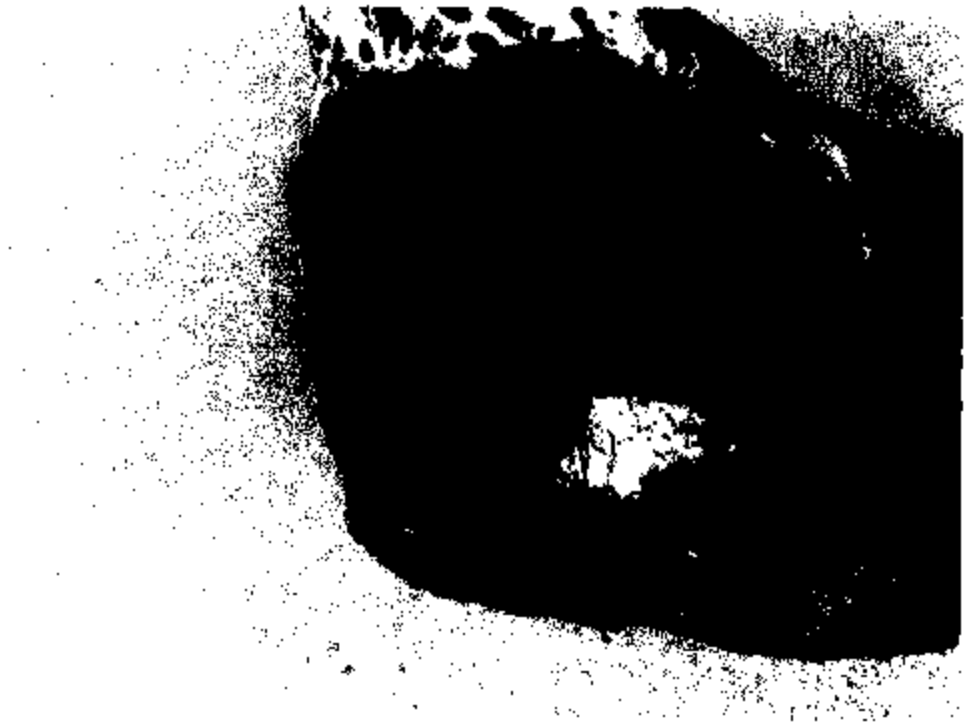

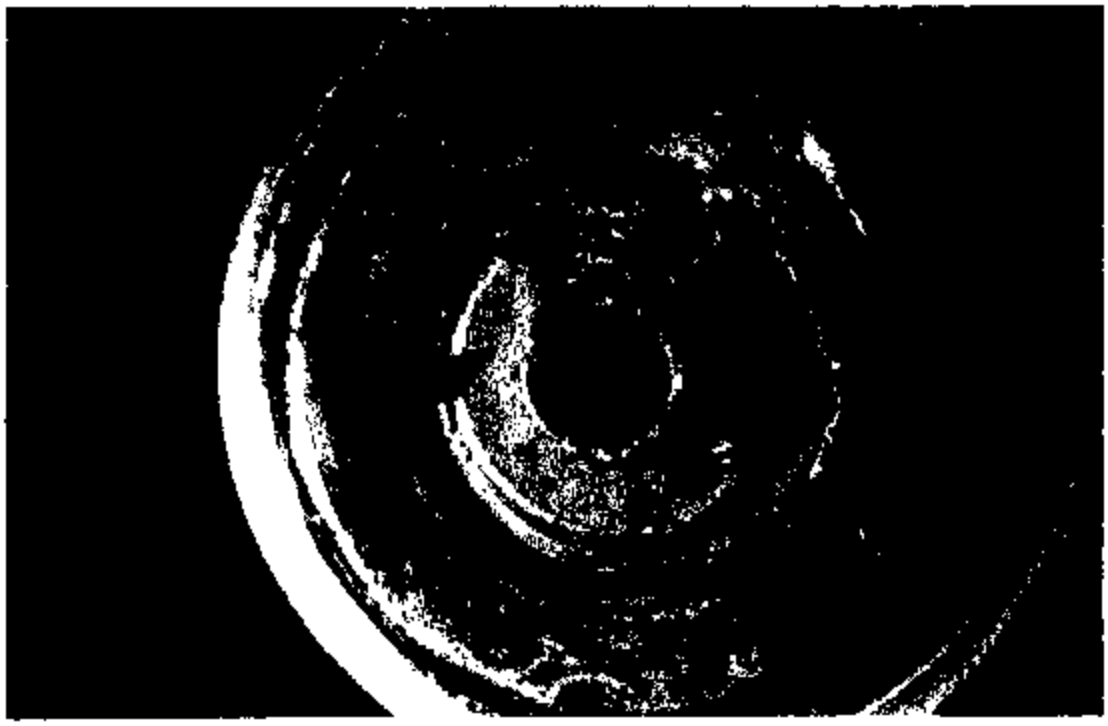

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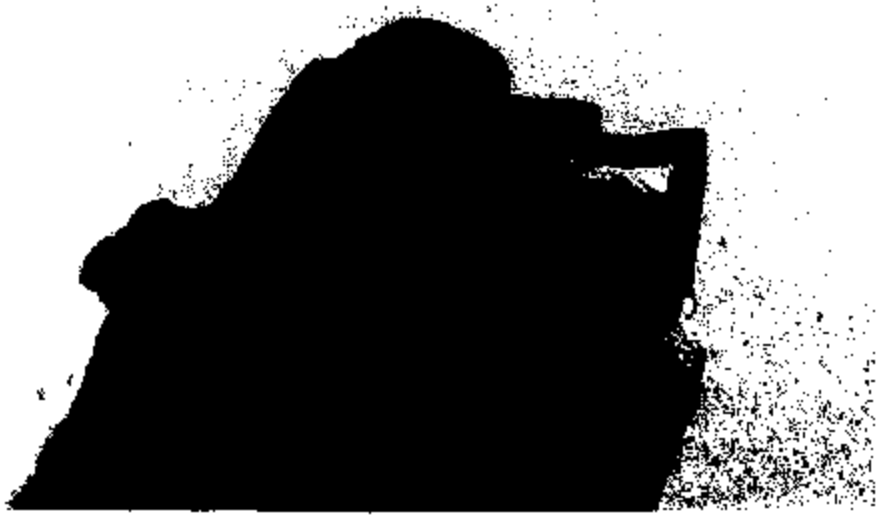

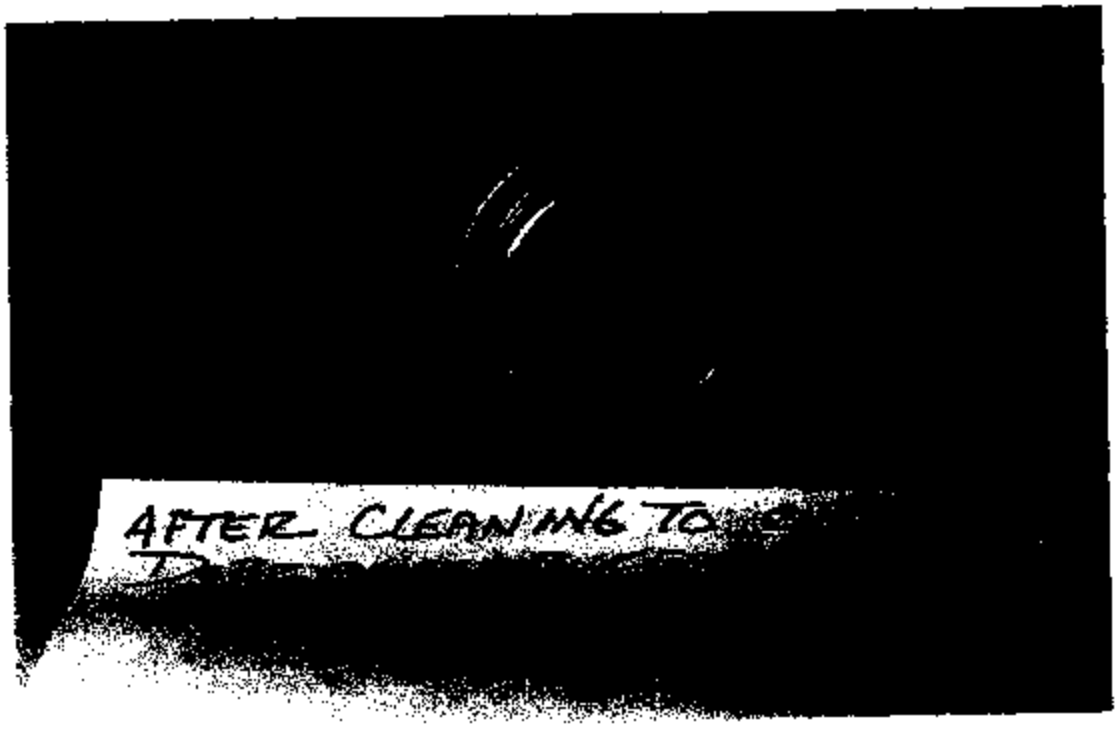

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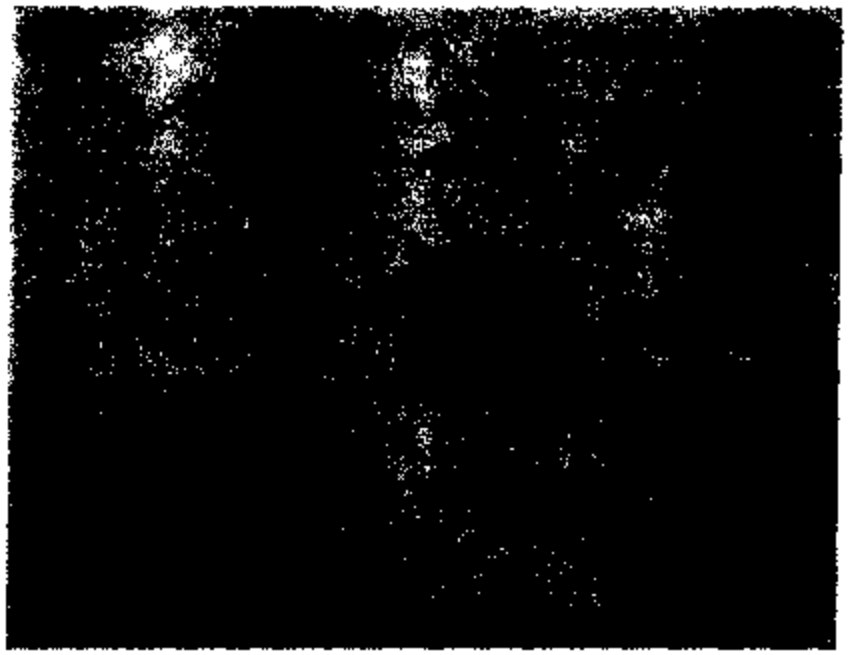

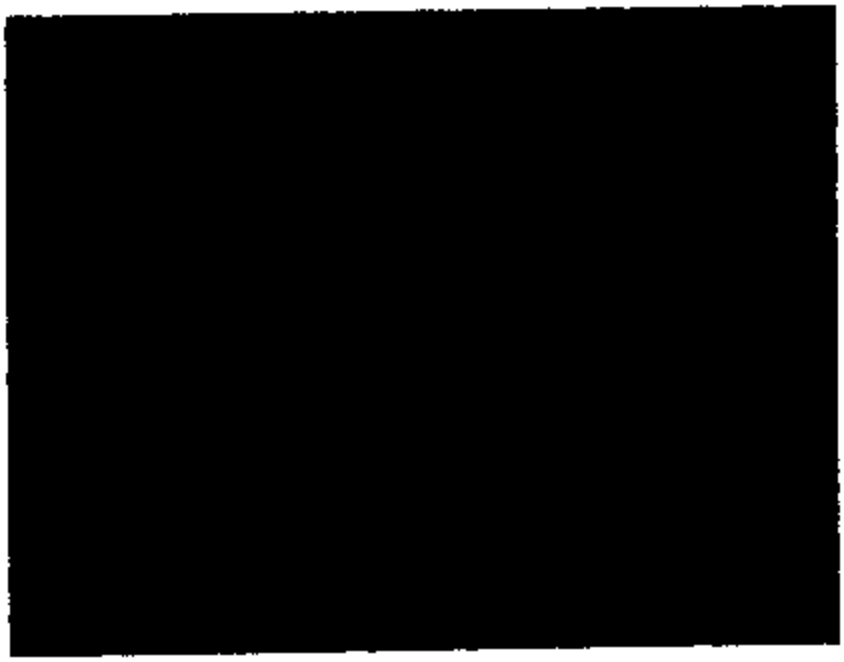

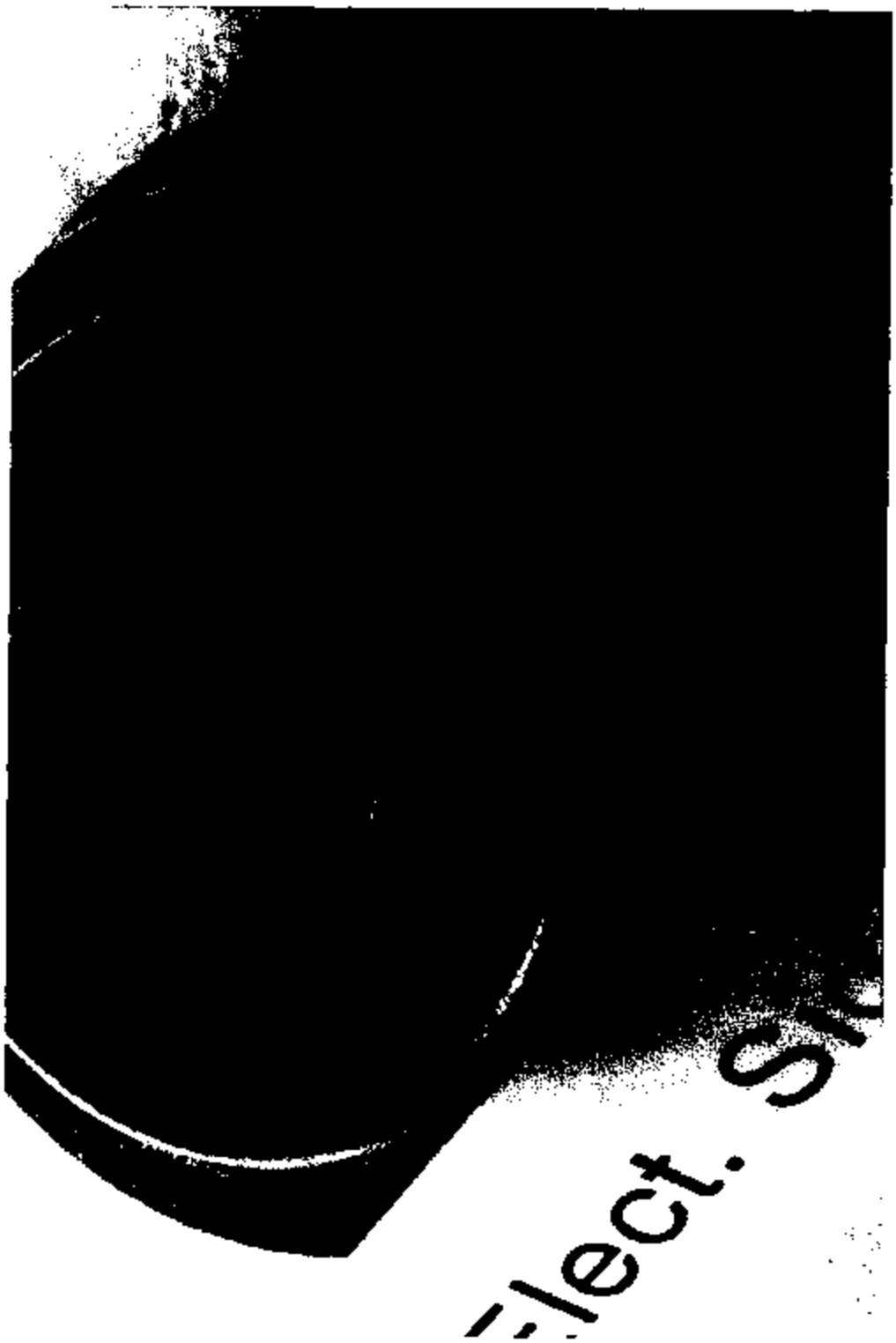

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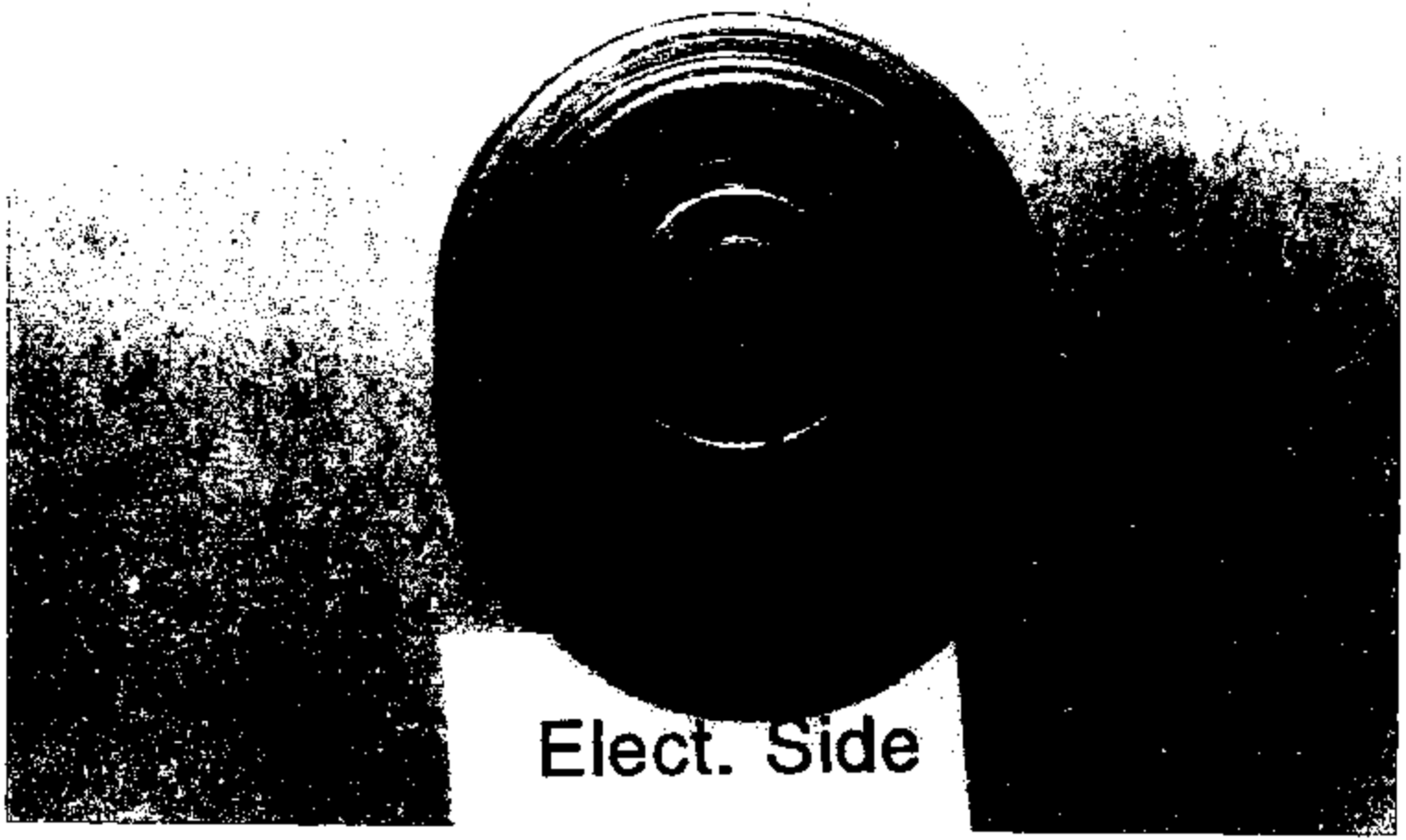

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