HIGHLIGHTS

Stephen B. Offiler

Week Ending 06/02/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EX3423

OVERVIEW: The business end of this program has been receiving significant attention. History of device configurations, cost estimates, and customer interface is being assembled by Marketing in order to prepare for a business meeting with Ford next Wednesday. To support Mfg. Eng.'s need to send out tooling and process RFQ's, the print package is being updated and characterization tests are being run on prototypes.

ISSUES: Final device/tooling cost estimates have been through several iterations since the program's inception; lack of personnel continuity makes it necessary to reassemble the facts in order to present the correct picture coherently to Ford. Manual vs automatic switch assembly has large impact on either piece price or tooling cost. Also affecting functionality and cost of the device are decisions made by Ford along the way, such as increasing proof and burst pressure and dragging beads on the connector. Program Milestone items will be discussed with Ford as well.

PRINT PACKAGE: Design of terminals for automated assembly is underway. Modifications to the base model are being developed in parallel. The various disc seat configurations are being marked-up; Karl Wenner's crimp ring idea is being put on print; and the rest of the prints are being updated as needed. Mfg. Eng. estimates that at the present rate, we will have quotes back in-house around 07/08, allowing a design review before shutdown.

SAMPLES: We are partially through the task of updating inventory and collating prototype cost information. The plan is to prepare for build of sample quantities in the hundred's and to charge the customer what they really cost TI to build.

TESTING: To determine if overpressure will be needed to stabilize devices in production, we ran a quick test on 15 prototypes. We discovered very little difference in act/rel characteristics on parts with zero, one, and three 800 psi overpressure cycles. In production, it looks like we'll be able to check devices on the first cycle with no overpressure. It remains to-be-determined how high we can push the pressure rate. (We use approx. 50 psi/sec in our lab tests.)

PRESSURE SWITCH DATA Form 21605 **TEST NO.** 15-10-35

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
CCPS	6/9/99	SBO	

PERFORMED BY	DATE STARTED	DATE COMPLETED	APPROVED BY
J. [illegible]	6/9/99	6/11/99	

PROJECT TITLE: Cruise Control Pressure Switch

CUSTOMER: Ford

PURPOSE OF TEST: 50 pc. sample order. These pcs will be added to test 15-15-15 and sent to Ford.

PROCEDURE: Build with [illegible] Kapton seals. Proof test, calibrate, mv Drop test.

Device #	Force Accept	Trans Data	Proof	Act	Rel	Mv Drop	Disc		
[illegible]-01	255	213	Test	138	129	9.3	lot 4		
02	190	217		138	130	5.2	lot 4		
03	215	219		139	131	8.3	lot 4		
04	215	212		136	129	7.2	lot 4		
05	215	213		137	130	8.9	lot 5		
06	240	216		146	136	7.0			
07	230	215		130	119	7.4			
08	200	214		127	121	7.5			
09	180	215		132	123	7.5			
10	195	210		133	128	7.0			
11	200	211		142	136	6.1			
12	185	214		140	137	7.5			
13	185	214		130	121	6.2			
14	165	216		126	120	5.6			
15	235	217		139	131	7.2			
16	235	216		131	124	6.5			
17	125	212		143	131	6.2			
18	190	212		134	125	6.1			
19	265	212		137	127	6.0			
20	205	214		141	132	6.9			
21	210	214		136	127	6.4			
22	210	215		139	130	6.0			
23	195	213		137	129	6.5			
24	215	214		129	121	5.7			
25	190	213		147	136	7.1			
26	185	217		142	134	7.2			
27	185	210		131	124	8.2			
28	175	214	Pass	135	128	7.0			

TI-NHTSA 000385

HIGHLIGHTS
Stephen B. Offiler
Week Ending 06/09/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EX3423

OVERVIEW: The Marketing meeting at Ford went very favorably for us. Piece price in a range somewhat above the original $1.75 and tooling in the ballpark of $1.25KK was presented along with the history of why/when changes took place.

SAMPLES: At the above meeting, Gary Klingler expressed an immediate need for 50 additional samples. His goal is to replace all of the stop-gap 57PS samples we sent with the actual device. We have been counting *all* samples against the standing P.O. for 200; Ford has not. Gary still expects to receive a total of 200 *CCPS's*: fifty be received on 05/01; fifty as requested ASAP; then the balance of one hundred in a couple of weeks. I plan to hand-deliver 50 to Joe Schuck when he is in Attleboro next Monday.

SPECIFICATIONS: I received a Fax from Joe today which shows the results of a Ford test of brake pedal force required to deactivate our switch, as follows: Econoline, 9.0 lbs; Grand Marquis, 9.5 lbs; Aerostar, 11.0 lbs; Taurus 3.8 liter, 13.5 lbs; and Continental FN9, 14.0 lbs. The intent of our device, from a cruise control system standpoint, is to switch between 5 and 10 lbs. pedal effort. Therefore, it looks like our actuation pressure needs to drop to a lower value TBD. I do not know if this will require any tightening of our tolerance, presently at +/- 50 psi. I do not know if these numbers carry any statistical significance, and which switches (57PS or CCPS) yielded these results. Also, I see a problem on the horizon: different carlines have different power-brake systems, which means little correlation between pedal effort and system hydraulic pressure. We may ultimately need to sell devices in several different calibrations. We need to dig into this, in detail, ASAP.

CONNECTOR: The topic of the connector design was discussed at the Ford meeting. We have moved closer to obtaining official permission from Ford to dictate changes to the connector which allow terminal rotation. Frank Janosi wants to see a print of our connector changes; I need to get together with someone from Chassis Electrical (Joe is working on who) to ensure that changes we make are acceptable from the standpoint of the mating connector. We must try to keep the changes small enough that requalification is not required.

PRINT PACKAGE: I'm close to completing the task of putting the various design configurations on paper, in order to send them out for quotes. This has taken longer than expected, and will push forward the date of the next Design Review to just before shutdown.

TESTING: I've discovered some bad news regarding construction of our cycler: the environmental chamber earmarked for this program turns out to be heat-only. In order to perform the two key tests that truly determine sealing performance (Impulse and Temp Cycle) I need hot and cold capability. We're looking into ways around this problem, such as plumbing the cycler into another chamber and time-sharing with other programs using the same chamber.

DISC MEETING: We held another meeting with Ted Ballard and Jeff Mahon. They committed to building some discs to try to duplicate Dave Brown's efforts.

PRESSURE SWITCH DATA Form 21605 TEST NO. 11-15-05

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
CCRS	6/11/99	SBU	6/17/99
PERFORMED BY	**DATE STARTED**	**DATE COMPLETED**	**APPROVED BY**
J. Palmerico	6/11/99	6/15/99	

PROJECT TITLE: CRuise Control Pressure Switch

CUSTOMER: Ford

PURPOSE OF TEST: To correlate brake line pressure to actual force applied to brake line

PROCEDURE: Build 5 devices, stabilize and characterize. Send to Ford to be installed & cycle. Use this to see how much leg force is needed to actuate switch.
- All Pieces Lot 5
- Mark actuation on each device.

Device #	Force (lbs)	Travel (in)	Report	Act	Rel	ΔV Drop			
11-15-01	195	212	PASS	138	130	6.6			
02	205	215	PASS	139	129	6.3			
03	215	214	PASS	129	125	6.4			
04	250	211	PASS	132	134	6.9			
05	175	213	PASS	136	134	7.0			

Device	Force	Image Dia	Disc	Proof	Act	Rel	Av Drop
16-01-86	190	211	Lot 6	1635	135	119	5.2
87	180	216	↓	↓	125	118	5.3
88	190	217	↓	↓	129	124	4.5
89	185	214	↓	↓	139	133	4.9
90	195	213	↓	↓	143	139	4.4
91	165	213	↓	↓	131	127	4.4
92	230	212	Lot 6	↓	127	124	5.6
93	210	214	Lot 7	↓	137	131	4.6
94	190	213	↓	↓	135	128	5.1
95	215	217	↓	↓	140	127	5.5
96	195	213	↓	↓	132	129	4.5
97	130	215	↓	↓	129	125	4.3
98	205	212	↓	↓	136	131	4.3
99	135	214	↓	↓	124	119	5.8
100	205	216	Lot 7	1635	126	130	4.3

PRESSURE SWITCH DATA Form 21605 **TEST NO.** 19-01-100

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
CCPS	5/14/99	SPO	

PERFORMED BY	DATE STARTED	DATE COMPLETED	APPROVED BY
J. DiDomenico	5/15/99	5/20/99	

PROJECT TITLE: Cruise Control Pressure Switch

CUSTOMER: Ford

PURPOSE OF TEST: Customer samples

PROCEDURE:

Device	[illegible] (9)	[illegible]	Disc	Proof	Act	Rel	ΔV Amp
19-01-01	170	212	Lots	Pass	130	125	7.5
02	225	214			128	123	7.6
03	225	216			129	125	7.3
04	200	215			132	128	7.4
05	175	215			134	128	7.0
06	215	215			128	121	7.5
07	325	216			136	130	7.2
08	190	216			135	129	7.3
09	225	216			126	121	6.4
10	190	215			131	127	7.3
11	205	213			134	127	7.5
12	230	214			127	130	6.3
13	210	216			134	128	7.0
14	210	213			137	132	6.5
15	195	214			134	129	6.5
16	200	214			131	125	6.1
17	190	214			135	127	6.7
18	220	215			133	127	6.9
19	185	215			136	129	6.2
20	190	214			131	125	5.8
21	208	217			140	134	6.2
22	175	215			135	127	6.3
23	150	213			122	117	7.1
24	220	212			140	133	6.7
25	200	214			135	130	6.4
26	190	211			132	125	5.9
27	180	212			134	127	5.6
28	165	212	Lots	Pass	134	[illegible]	[illegible]

TI-NHTSA 000390

HIGHLIGHTS

Stephen B. Offiler
Week Ending 06/16/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EX3423

SAMPLES: Fifty parts were built ASAP at Gary Klingler's request. They were shipped earlier this week to Farmington Hills so Joe may hand-deliver them. We are working on the balance of 100 now. Disc seats are being modified by the Model Shop, expected soon. The devices should ship next week. We will be placing an order to R. W. Jacques for crimp rings, approx. 200-300 (T-B-D) at $2.10/each. The rest of the inventory looks okay.

CUSTOMER ISSUES: As mentioned last week, it looks like Ford may need to change the actuation and release specifications. To support this, we have constructed 5 samples which were stabilized, characterized, and stamped with the actual actuation value. Ford will use these to correlate pedal effort with system pressure.

Joe has gotten approval on the connector changes from Frank Jarosi and Gary Klingler, but is getting resistance from the person actually responsible for design, Ron Frontera. Joe has plans to bring together Frank, Gary, and Ron to move this situation forward. As soon as agreement is reached, I will need to settle all technical issues of the design change with Ron. I will be involving Norm Roy as soon as possible also.

A thread cap will in fact be required; the issue of the O-ring on the hexport is up for negotiation. We will provide Ford with incremental cost information. We will keep abreast of developments regarding the threads on the 57PS. They are looking into geometry changes which would make caps unnecessary. These changes could potentially apply to the CCPS as well.

Jeff has pulled together information on the cost of building CCPS samples. The bottom line is in the neighborhood of $30, which counts Jeff, Dave Brown (for the disc) and the Model Shop, plating, and piece prices from suppliers. It does not comprehend engineering time or development/testing expenses.

TESTING: Short-term, we've identified several design issues which require testing to resolve. These are: the idea of gasket elimination; the design of the disc support area of the Disc Seat; life testing of the AFCC discs; and the overcurrent test requested by Ford. Long-term, of course, much more testing will be required for validation.

Don Ekberg has helped identify a hot/cold chamber in Life Test which is not in use 100%. We will plumb our cycler, still undergoing final construction, into this chamber and share its use. We've identified action items needed to get the cycler up and running, including wiring a 30-amp/125-volt service, and building a structure to support external hydraulic equipment.

HIGHLIGHTS

Stephen B. Offiler
Week Ending 06/23/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH FX3423

OVERVIEW: Issues which are presently the pacing items in completing the design include the connector, the act/rel spec, and various tests which are paced by the cycler build. The connector and the spec are strongly customer-dependent; we must firm up these issues with Ford thru Joe Schack as soon as possible.

CUSTOMER ISSUES: Joe had a meeting with personnel from Ford Light Truck. George Randall is the Cruise Control Project Engineer, and Nehru Modi is the supervisor of LT Brake Eng (Frank Jancsi equivalent). They'd like 100 samples in August. Charlie & Joe will communicate the $50/ea sample cost. Modi is insisting that we provide a hexport which mates to an SAE J512 double-flare tube fitting; Randall does not agree.

Regarding the soon-to-be-changing specifications, Joe has info from both LT and Dick McQuee in Pass Car Brake that there is NO residual pressure, contrary to previous input from Jancsi. No residual pressure means relaxed release spec and allows a wide tolerance on the actuation spec, as well as a fairly wide disc differential which may get us into a step-action disc design.

SAMPLES: The balance of 100 parts owed to Klingler will be completed by mid-next week (originally planned for today). These plus the 100 for LT will leave me with enough inventory to build 43 devices for internal testing. Hopefully this will carry us until we begin to get soft-tooled production-intent parts.

DESIGN ISSUES: I'll have the print matrix complete and ready to send out for quote by early next week. This matrix covers all possible design configurations; quotes will be used to determine the most cost-effective configuration. As part of the print matrix, I am looking into the tube-fitting hexport design even though this issue is up in the air.

TESTING: Work continues to progress on the cycler build. At this point I estimate another 3 weeks to completion. We've identified the physical location; I've placed a work order to have 125VAC/30Amp service provided at this location. Jeff is busy constructing the heavy-duty framework for the isolator piston assembly and the bleed/fill tank. These are located outside of the cycler cabinet. Don continues to progress with the hydraulic and electrical work. We have a 125VAC/30Amp outlet close enough to Don's work area so that he may do debug work before Facilities actually installs the outlet.

HIGHLIGHTS

Stephen B. Offiler

Week Ending 06/30/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EX3423

OVERVIEW: The final 100 samples were shipped to Ford, completing their order for 200. We are working from two angles to resolve the issue of the connector design for automated terminal insertion. A matrix of prints covering various design options for the production device has been prepared to go out for quote, to determine the most cost-effective configuration.

CUSTOMER ISSUES: Regarding Ford Light Truck, the customer wishes to evaluate the feasibility and cost of our device with an SAE J512 flare fitting rather than the O-ring. I have reviewed the SAE spec, and drawn up a sketch of our hexport with this feature. This will go out for quote with our other prints. They've requested 100 samples between 08/10/89 and 10/01/89; it remains to-be-determined whether they want the standard O-ring hexport (available now), or the tube-fitting hexport (not available before 09/01/89).

We have not moved forward regarding the new actuation & release spec. I plan to contact Gary Klingler directly to discuss his plans on this issue. I do not suspect that it's high on his priority list, but he may not realize that it's definitely holding us up. We'll support this any way we can.

On the connector issue, Joe and Charlie met with Ron Frontes at Ford this week. He'll take a look at the design changes required to the mating connector in order to mate with our rotated terminals. His attitude seems negative, however. He claims that rotating the terminals will result in a significant increase in overall size, making the connector large enough to interfere with our crimp operation. If this does finally prove feasible, Ron also mentioned the possibility of extending this design change to the 57PS brake switch as well.

DESIGN ISSUES: I've been looking into a terminal design proposed by Tom C. This involves inserting the terminals in our preferred orientation, then twisting them so they end up in Ford's preferred orientation. This quarter-twist also serves to replace the staking operation. I have sketched the design and turned it over to Mfg. Eng. for critique. If the idea flies, then the Ron Frontes concerns expressed above go away because we'll be able to use the present mating connector unchanged.

The various potential design configurations of the hexport, disc seat, and crimp ring have been sketched out and are ready to transfer to Purchasing to go out for quote. Keith Roberts and I plan to meet with Jack Kearns as soon as possible.

TESTING: Don Ekberg is close to readying the cycler under construction for power-up and debug. Jeff is making progress on constructing the external hydraulic equipment. It now looks like we're paced by Facilities installing the required 125V/30A service at the final location. Gene Graiko informs me that we're scheduled for 07/24; the cycler will be ready 1-2 weeks before this date. I'd like to get our priority boosted if I can.

HIGHLIGHTS

Stephen B. Offiler

Week Ending 07/07/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EX3423

OVERVIEW: We've made progress in reducing the number of design possibilities in the print matrix. We're close to sending out prints for quotes. Several customer issues remain; it looks like these can reach a resolution in about the same timeframe that quotes come back and a firm cost estimate is generated.

CUSTOMER ISSUES: I contacted Gary Klingler to discuss his plans to determine the actuation and release spec. He is in the process of setting up testing, including reserving Econoline and Town Car test vehicles, obtaining the necessary measuring equipment and technicians. He will perform tests to determine pedal effort vs. system pressure on these cars, which are the lead platforms. He estimates this will take 3-4 weeks. This effort will determine the actuation spec. We need to understand "residual pressure" in the system before we can set a release spec. Gary and Joe Schuck are working on this.

We have not made progress in determining whether Light Truck wants the O-ring hexport or the SAE J512 flare fitting. This is probably because a different set of opinion exists within Light Truck. To meet their sample needs in the 08/10 to 10/01 timeframe, we should kick off APCC or an outside house to build a couple hundred J512 hexports soon. We must somehow help Light Truck make up their mind.

Another outstanding customer issue is the decision on who adds the O-ring. This will affect our cost estimate by about a nickel and tooling by about $45K.

MFG/MECH ISSUES: We had a very good meeting with the Mechanization people (John Kourtesis, Ed K. and Steve McCooey) where we ironed out several outstanding design and mechanization issues. The question of pin sorting vs. mechanical calibration was put to rest in favor of cal.; the potential problem of gasket mis-location will be avoided by using a thicker gasket and a deeper gland; and regarding the terminal twist idea, we generated a couple of promising new ideas which I will prototype as soon as possible. Some outstanding questions, such as which disc seat/crimp ring combination to use, will be answered by quoting all options and choosing the most economical.

DESIGN ISSUES: After making some minor revisions to the print package which reflect inputs from the above meeting, Keith, Jack Kearns, and I will sit down to begin the quoting process on those parts not quoted earlier. Quotes from suppliers and from Mechanization will help determine the final design configuration. This is expected to take about 4 weeks. A design review is planned to follow, about mid-August.

TESTING: I'd still like to get the cycler essentially complete before shutdown, so when Facilities hooks us up we can do final debug and begin to run tests over the shutdown period. For tech support, Jeff will be around for the first week.

HIGHLIGHTS

Stephen B. Offiler

Week Ending 07/14/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EX3423

OVERVIEW: The matrix of prints covering all design configurations was completed and transferred to Purchasing to go out for quote. Completion of the cycler should allow us to address the backlog of testing over shutdown.

QUOTES: The print matrix includes two terminal designs (so far); four disc seat variations using four different processes for a total of sixteen; four hexports; three crimp rings; and one design of all other parts. We expect this process to take 4-6 weeks. The purpose of quoting many variations is to find out which design is the most economical; any combination is expected to work.

DESIGN ISSUES: The idea of twisting the terminals is in the process of being prototyped; therefore this design is not yet included in the print matrix. If it proves feasible, sketches will be created and sent out for quote as well.

For the Program Review, another variation on the gasket gland design will be considered. This design deepens the gasket gland; therefore confidence in proper gasket placement is increased. It is more amenable to manufacturability, however, it adds a tolerance to the gasket-compression stack-up and a second operation which adds cost to the hexport. We plan to consult with Elco's technical specialist Ken Carlson on the cost issue.

Tentative date for the next Design Review is 08/23. This assumes we've received all tooling and process quotes and have firm direction on the production design.

TESTING: To meet the goal of finishing the cycler by 07/21, we met this morning to organize priorities. Don has some minor electrical work to do, plus programming the STI. We have decided to bypass the cycle counter temporarily, since the documentation supplied is poor and we need to experiment with it. Jeff has essentially completed construction of the heavy-duty frame which mounts the isolation cylinders and bleed/fill tank. Meeting the 07/21 date looks good.

FMEA: We are presently meeting once a week, making good progress on the Design FMEA. This will need minor editing once we lock in on a production design. Process FMEA to follow.

DISC DEVELOPMENT: After we settle on actuation and release spec's with Ford, we'll need to kick off development of a new disc. Dave Brown will be doing this work, sometime mid to late August.

HIGHLIGHTS

Stephen B. Offiler

Week Ending 07/21/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EX3423

DESIGN ISSUES: Significant efforts are being placed on the twist-terminal prototypes. I have designed terminals, to be made by wire-EDM out of .025 brass CDA 260; bases, to be milled out of mat'l TBD; and a special tool to grip the terminal and twist about the appropriate geometric axis.

A couple significant problems have been encountered. The model shop is working with limited personnel for only the first week of shutdown, and they're completely out the second week. The other problem is material for the base. It is desired to use the same mat'l as the production molding resin, which is thermoplastic polyester PBT 30% glass-fill. This will allow the proto to very accurately model the production version. However, after contacting several different plastics suppliers, I cannot locate bar or rod stock suitable for machining. This means a substitute will be used, such as Ultem or Nylon.

No action yet on the idea of inviting Elco's guru Ken Carlson for consultation on the hexport/gasket gland design.

CUSTOMER ISSUES: We've received communication from Ford Light Truck. They have assigned a part number to us, XFZTA-9C968-AA1. They have also sent a request to their purchasing people for 100 parts. George Randall has marked up an envelope print (dated 7/11/89) which we received yesterday. He has requested 6 parts undergo a quality audit of sorts... a "PIST" (percentage inspection within tolerance) and a "PIPC" (percentage of points w/ Cpk greater than 1.0) on specific "Significant Characteristics" which he called out on the env. print. These three are: actuation, release, and the threads. They are requiring the SAE J512 hexport. The date requested for this is 08/10/89 (!) Joe Schuck informs me that the date is very critical for the quality audit: the balance of the 100 can be shipped between 08/10 and 10/01. Regardless, I've geared up to create J512 hexports. It looks like KMS Machine Works can do the work by 08/03, which will give us time to plate and still hit 08/10. Tom C. has asked me to pursue two issues: why is 08/10 so critical: and can we use O-ring hexports instead? I attempted to contact Randall, will continue to do so.

I planned to follow up with Gary Klingler on the status of his testing... he was unavailable. Will continue to try to reach him.

TESTING: The cycler is nearly done... a couple hydraulic lines seems to be all that's left. Since I did not check with Don today, I plan to come in tomorrow and see what's left to do to get it running.

PRESSURE SWITCH DATA Form 21605 TEST NO. 20-13-06

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
CCPC	7/19/99	SBO	

PERFORMED BY	DATE STARTED	DATE COMPLETED	APPROVED BY
J. DiDomenico	7/29/99	8/7/99	

PROJECT TITLE: ERAISE Control Pressure Switch

CUSTOMER: Ford

PURPOSE OF TEST: To test wires for thermal cycle per Design Validation spec.

PROCEDURE: Build 5 devices per msgd. Thermal cycle per design validation spec.

- leaks after 14 cycles

ALL Wires Lot 2.

Device	Force	Travel (in)	Proof	Act	Rel	Mu drop	Observations: In Bag	Observations: Around crimping
20-13-01	200	.413	Pass	116	126	7.1	Slightly wet	dry
02	150	.318	Pass	139	139	8.9	wet	wet
03	250	.311	Pass	135	131	7.2	Soaked	soaked
04	210	.309	Pass	140	135	7.5	Dry	slightly wet
05	200	.316	Pass	129	125	7.3	Soaked	soaked
06	200	.314	Pass	130	125	7.2	Dry	Dry

HIGHLIGHTS

Stephen B. Offiler
Week Ending 07/28/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EX3423

CUSTOMER SAMPLES: I spoke with Ford regarding the need for samples for Light Truck on 08/10, and the need for special SAE J512 hexports. Key decision-makers were unavailable; I spoke with someone who furnished information only. I confirmed they need 6 samples, with J512 hexports, with special quality-assurance paperwork, on 08/10 or ASAP thereafter, not to slip past 08/28. The balance of 94 would be due 10/01. An order was placed for these hexports from KMS Machine Works, due 08/03. Then, they need to be plated. If all goes well, we may hit close to 08/10.

DESIGN ISSUES: I have completed the drawings for the twist-terminal prototypes. Still need model shop time to construct... this could be a problem, since they are back from shutdown 08/07, understaffed for the first week.

UTC has done a layout of our previously-requested terminal rotation and decided it's feasible, given a terminal centerline spacing of .24". A new tool of this design will cost Ford $190K, which they're apparently willing to spend. Polarity tab changes cost in the $10K neighborhood.

Ford would like to know by August 15 what terminal orientation we'll use. I'll try to get the twist proto done for this date, but it'll be close.

TESTING: The long-awaited cycler is up and running as of this week. Final plumbing, bleed, and initial wave-shape adjustment were completed. A thermal cycle test needed to finish the Design Validation write-up is now in progress.

PLANS:

- Call Gary K. to follow-up on his testing progress, needed to set act/rel spec.
- Optimistically assuming success on the twist concept design of both production-intent terminals and base is needed ASAP to go out for quote. If possible I will be spending some learing-curve time with the new ME computer program, Pro-Engineer.
- Need to get details of Ford's prototype quality requirement, PIST

PRESSURE SWITCH DATA Form 21605 **TEST NO.** 19-01-10

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
EX-3423	8/11/99	SBD	8/11/99

PERFORMED BY	DATE STARTED	DATE COMPLETED	APPROVED BY
J. DiAmerica		8/11/99	

PROJECT TITLE: CRUISE control Pressure Switch

CUSTOMER: Ford

PURPOSE OF TEST: Sample build of prototype CCPS devices.

PROCEDURE: Build 10 devices w/special Flair fitting for parts. Characterize per usual. Send to QC for inspection before shipping to Ford

all discs Lot 7

Device	Force	[illegible]	Proof	Act	Rel	MvDw
19-01-01	210	214	Pass	140	134	10.4
02	210	212		142	135	11.0
03	230	213		148	143	11.1
04	250	214		149	144	9.5
05	175	213		154	139	9.6
06	200	211		129	125	8.9
07	190	215		140	136	9.5
08	225	213		139	132	9.3
09	200	212		145	137	8.8
10	240	212	Pass	145	129	9.0

TI-NHTSA 000400

HIGHLIGHTS

Stephen B. Offiler

Week Ending 08/11/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EK3423

OVERVIEW: Significant efforts have been required to fulfill Ford Light Truck's sample needs, including meeting a brand-new quality requirement. We should ship on time. Major outstanding program issues such as terminal orientation, mfg. processes, cost estimate, and testing are being addressed.

CUSTOMER SAMPLES: Joe Schuck has contacted the sample build co-ordinator at Ford Light Truck, and we've confirmed Ford must receive samples on 08/17 so as not to jeopardize their 08/21 vehicle build. We are presently in no danger of missing 08/17. We've finally received the P.O. for these parts.

Hexports with the required SAE J512 inverted-flare feature were received on-time from KMS Machine Works and transferred to plating ASAP. After plating, B11 Inspection discovered threads too large. After stripping, they were confirmed to be manufactured improperly. We've chased the threads and checked them individually with calibrated gages. A small lot was transferred back to plating immediately with a request for priority. We've received these parts and are presently assembling 10 devices, which will be transferred to Quality to undergo a study of envelope-drawing dimensions per Ford's new prototype quality requirement called P.I.S.T.

MECH/MFG/CUSTOMER ISSUES: Twist-terminal prototypes have been sketched and transferred to the model shop. The job is estimated at 40 hrs and the model shop is short-staffed this week. The proto's will serve to demonstrate feasibility of the concept. The fall-back solution is to change the terminal orientation, which requires Ford to change their connector. They want an answer on this by 08/15.

Gary Klingler is late in completing his tests of pedal effort vs. system pressure, promised 08/02. He is unavailable until 08/14 due to vacation.

Keith Roberts has set up a meeting with Mechanization for Wednesday 08/16 at 2:00 in the Bld 20 Mech. Conf. Rm. The purpose is to review their conceptual layout of the assembly and testing process. This meeting should be treated as a "Process Design Review." All outstanding issues should be addressed at this meeting to allow Mechanization to complete the design in detail, which allows an accurate tooling estimate.

TESTING ISSUES: Construction of this program's dedicated cycler was completed at the beginning of shutdown. Excellent work by Don Ekberg and Jeff DiDomenico; the cycler worked upon start-up with no debug and minimal fine tuning !

Thermal Cycle of devices with 80-durometer gaskets commenced immediately. (Previous Design Validation testing was conducted on 70-duro.) The new equipment allowed us to follow the Ford spec. exactly, whereas compromises needed to be made when borrowing APT equipment earlier. All 80-duro devices undergoing this test failed, about 60% of the way through the test. Analysis shows no internal damage at all; the hypothesis is non-permanent low-temp compression set of the gasket. Corrective actions are being put in place, and another Thermal Cycle test will commence ASAP.

TITLE: Overcurrent Test to Failure

DATE: 14 August 1989

REQUESTED BY: Gary Klingler, Ford Motor Co.

PURPOSE: To placate any concerns that may arise at Ford regarding a catastrophic failure of the hydraulic system caused by OCPD damage from excess current.

PROCEDURE:

1) Build two devices using 80-duro gaskets and 2 po. Kapton (or use devices already existing).

2) Install both on manifold in cycler with wire leads running outside oven.

3) Soak at +121 C until ambient and fluid are at that temperature. Use thermocouples that have been calibrated.

4) Connect a large power supply (40 amp minimum) to one of the switches along with a calibrated shunt (50 mV = 50 amps). The shunt will give a readout of current, as well as indicate when the contacts are opening and closing.

5) Pressure-cycle relatively slowly. (0.1 Hz like the thermal cycle test should work well). Start with 2 amps flowing through the device, allow to cycle about 10 times. You should observe zero current when pressure is applied, and test current when pressure is released.

6) After 10 cycles, increase by 2 amps and cycle 10 more times. Continue to increase by 2 amps until failure occurs. Failure is defined as abnormal switching or fluid leakage.

7) Repeat the test with the other device.

8) Record the current level at which failure occured for each device.

9) Disassemble and inspect each device. Record observations, photo as necessary.

Device #1 At 31 amps contacts were sticking open sometimes. At 34 amps the contacts welded closed

Device #2 sticking open at 39 amps

HIGHLIGHTS

Stephen B. Offiler

Week Ending 08/16/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EX3423

CUSTOMER SAMPLES: The six devices for Ford Light Truck were shipped today, via overnight air, directly to Ford in order to arrive by the promised date (08/17). These devices underwent Ford's new prototype quality inspection called P.I.S.T. They were required to be within tolerance on 85% of the env. dwg. dimensions; all six barely made it. Most out-of-spec dimensions were on and around the connector. We owe them 94 devices which must be delivered by 10/01. No problem.

MECH/MFG ISSUES: A meeting was held today to review the concepts developed by Mechanization. They have laid out a fully-automated line using three basic machines: switch ass'y; calibration (to replace pin selection); and crimp/pressure test/code. We need to respond to Ford quite soon with firm device and tooling costs. Mech. will have $$ for us in a couple weeks. We added to their conceptal layout another piece of Kapton, on top of the gasket; testing to-date indicates this is necessary to prevent gasket-extrusion failures. We also moved the addition of the thread cap and O-ring to the very end of the process. A major outstanding issue is the pressure-test profile, which Keith Roberts is working on.

The model shop is presently working on the parts to prototype the terminal twist concept, upon which the entire Mechanization concept is based. I expect this to be complete by early next week.

QUOTES: Purchasing has received about 90% of our RFQ's. We plan to tabulate the quotes in a matrix format in order to decide which design configuration is most cost-effective. This should take place next week.

DFPS CONNECTOR: I've been asked to aid in the conceptual design of a switch assembly which uses industry-standard 1/4" spade terminals, which is readily adaptable to various existing mating connectors designed for spade terminals and to flying-leads. I plan to use the new CAE package "Pro-Engineer" for this. I've contacted Chip Cobb, and he will be giving me the official introduction to the software next week.

PRESSURE SWITCH DATA FORM 21605 **TEST NO.** 21-U-02

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
EX 3423		SBO	

PERFORMED BY	DATE STARTED	DATE COMPLETED	APPROVED BY
J DiDomenico	9-21-99	9-21-99	

PROJECT TITLE: Cruise Control Pressure Switch

CUSTOMER: Ford

PURPOSE OF TEST: To test our switch's resilience to overcurrent resulting from a battery short

PROCEDURE: On next Page

Device #	[illegible]	Pin	Act	Rel	[illegible]	[illegible]			
21-U-01	250	212	137	137	47	[illegible]			
02	240	213	134	131	41	[illegible]			

Irregular switching at 24 amps. Dead short at 34 amps.

PRESSURE SWITCH DATA Form 21605 TEST NO. 22-15-06

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
Ex 3423		SBD	

PERFORMED BY	DATE STARTED	DATE COMPLETED	APPROVED BY
J. D. Dontaico	8/14/89	9/9/89	

PROJECT TITLE: Cruise control pressure switch

CUSTOMER: Ford

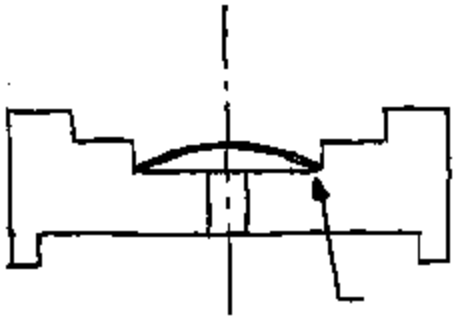
PURPOSE OF TEST: Test disc life with stepless disc seat.

PROCEDURE: Assemble devices and impulse test per design validation spec.

Device	[illegible] at start	Force	[illegible]	Proof	Act	Rel	[illegible]
22-15-01	.004	170	211	Pass	129	115	4.6
02	.005	190	218	↓	131	124	6.0
03	.004	190	212		114	111	6.0
04	.006	240	209		141	132	5.4
05	.004	190	212		119	115	5.1
06	.005	205	214		142	137	6.1

	10K		75K		130K		[illegible]K	
Device #	Act	Rel	Act	Rel	Act	Rel	Act	Rel
22-15-01	131	127	132	128	132	128	139	126
02	141	132	141	132	141	137	143	133
03	113	113	118	113	117	110	116	113
04	141	133	141	126	141	134	141	132
05	120	115	121	116	123	115	125	117
06	136	131	136	131	137	131	137	130

DISC SUPPORT "BUMP" ELIMINATION STUDY



"FLAT DISC" IS ALSO MAXIMUM DISC TRAVEL. THEREFORE, TO OBTAIN .010" CONTACT LAP, WE NEED TO PIN AT +.005

BUILD 5 DEVICES USING MODEL-SHOP MODIFIED DISC SEATS WITH NO BUMP

STABILIZE DEVICES, CHARACTERIZE ACT/REL (NOTE: NO PROOF OR HV)

PLACE ON CYCLER, RUN 2 Hz @ 121°C, NO NEED TO POWER DEVICES (2 Hz = 120/min = 7200/hr)

RECHECK ACT/REL @ 10K, 25K, 150 K, 500 K

1ST	INTERVAL	10K	1.4 hrs
2ND	"	25K	3.5 hrs
3rd	"	95K	13.2 hrs
4TH	"	370K	51.4 hrs

EXHIBIT NO. 65

HIGHLIGHTS

Stephen B. Offiler
Week Ending 08/25/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EX3423

OVERVIEW: Based on conversation with the customer, it looks like significant effort on their part is required to arrive upon actuation and release specifications. Special samples are needed for test purposes. We shipped four emergency devices to Light Truck (J512 hexport), to be followed by 40 next week. We have completed our prototype of the twist-terminal concept.

CUSTOMER SAMPLES: We received an unexpected, urgent request from Ford Light Truck for a few samples ASAP. I contacted George Randall to clarify. It turns out the 6 "P.I.S.T." samples sent last week will not be used sequentially, but throughout a 69-vehicle build. The very first was a P.I.S.T. vehicle built on 08/24, but the next is a non-P.I.S.T. scheduled for 08/28 for which George needed a non-P.I.S.T. pressure switch. We sent four devices overnite to address this need. George also gave me a rundown of vehicle build dates to allow me to calculate when we must ship samples. Jeff has prepared another 40 devices which will go out Monday; this will suffice until mid-September.

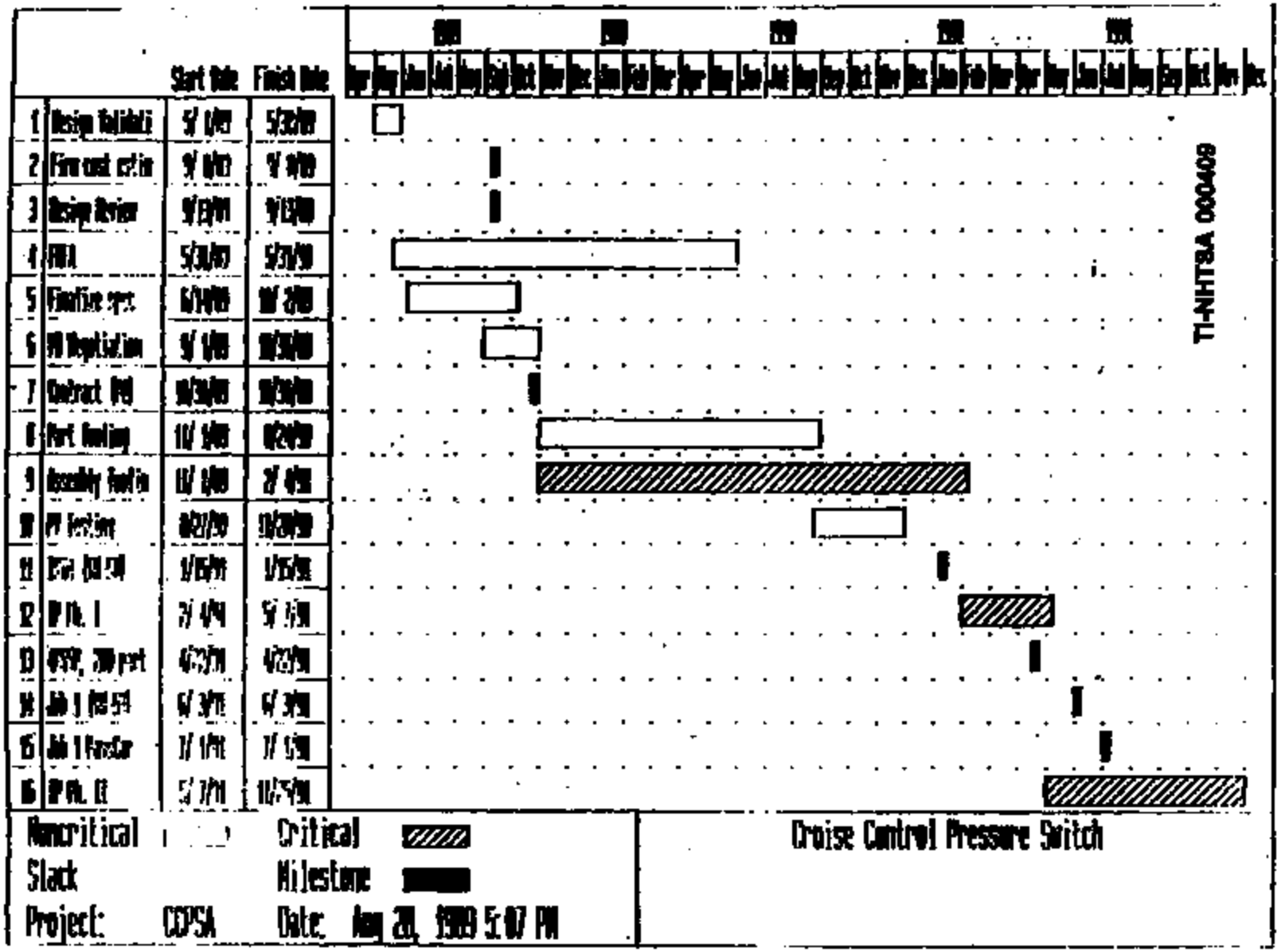
SPECIFICATION: We also received a request for samples from Gary Klingler, needed ASAP. He has discovered an inconsistency between pass-car and light truck brake-light-switch actuation, which is causing harsh cruise control cancellation on light truck only. It looks like the light-truck version will need a higher actuation pressure than pass-car. He has requested a family of 5?PS's which cover an actuation range of 150 psi to 250 psi for testing purposes. My own estimate is at least several weeks before we have a firm actuation and release specification(s).

TESTING: We completed an over-current test to failure as requested by Gary Klingler. The purpose was to allay any fears which may arise at Ford about hydraulic-system integrity in the event of a short circuit. This is not a Ford spec and no official procedure exists; Gary and I developed a test procedure over the phone. Two devices were run in the cycler at 121 C, switching at 6 cycles/min. One at a time, current was increased in 2 amp increments until something happened. One device was run to 34 amps; it finally experienced meltdown of the plastic housing and went short-circuit. The other began switching erratically at 28 amps and the test was aborted. Predictably, absolutely no damage was done to the hydraulic section of the switch.

We are presently working on a disc life test to determine if the 0.003" disc support bump is necessary, or if we can use no bump which is easier to manufacture. Six devices will be run in the cycler for 500K cycles, 0-1450 psi, 121 C.

MFG ISSUES: During pin-gaging, we have begun to measure the amount of spring deflection before continuity loss. For measurement in production, Mechanization wishes to lightly probe to the spring, not to push down to the point of continuity loss. If the deflection is predictable and consistent, this won't be a problem.

The model shop has completed the parts to prototype the twist-terminal concept. The concept seems to work well. We've learned that the terminal design should include a selective weakening at the point of bend so it bends reliably at the same point every time.


Start Date
Finish Date
TI-NHTBA 000409
Noncritical
Slack
Project: CDPSA
Critical
Milestone
Date: Aug 28, 1989 5:07 PM
Cruise Control Pressure Switch

TEXAS INSTRUMENTS

TO: JOE JORDAN
FR: CHARLIE DOUGLAS

SJ: FORD SPEED CONTROL DEACTIVATION SWITCH

F2VC-9F924-BA IS THE SWITCH WE WILL START PRODUCTION WITH. WITHIN 3-6 MONTHS OF JOB 1, WE WILL CONVERT TO F2VC-9F924-AA. CURRENT PRICING (WHICH WILL PROBABLY CHANGE BY +/- $.10) IS AS FOLLOWS

F2VC-9F924-BA ... $3.11
F2VC-9F924-AA ... $2.19
} PRODUCTION PRICES

TOOLING IS PAID FOR BY FORD. ISIR FOR THE BA SWITCH WILL OCCUR DECEMBER/JANUARY WHILE FOR THE AA SWITCH IT WILL BE JUNE/JULY. SINCE THE MAJOR DIFFERENCE BETWEEN BA AND AA IS PROCESS (MANUAL VS FULLY AUTOMATED), I WOULD NOT EXPECT PITTC TO HAVE TO PERFORM 2 ISIR'S AS TI WILL HAVE TO (HOWEVER, AS I STATED, YOUR QA DEPT. WILL HAVE TO CLOSE WITH FORD ON THIS ISSUE).

JOB 1 FOR TI IS CURRENTLY SCHEDULED FOR LATE MAY/ EARLY JUNE 1991. IF YOU NEED ANY ADDITIONAL INFORMATIO PLEASE LET ME KNOW.

REGARDS, CHARLIE

TI-NHTSA 00041

PH # (508) 699-3657
FAX # (508) 699-1598

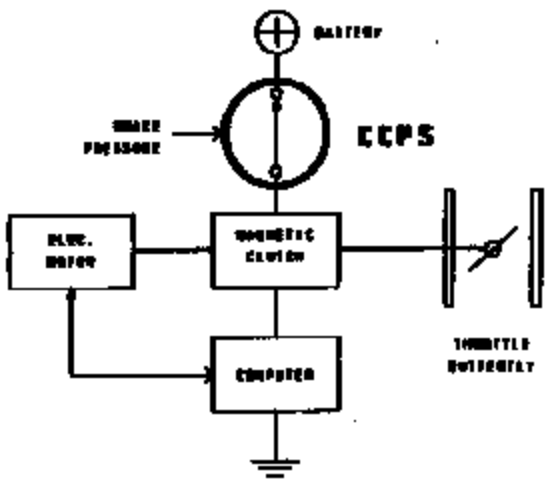
FORD SWITCH COMMODITY TEAM VISIT
CRUISE CONTROL PRESSURE SWITCH

OVERVIEW

THE CCPS IS A REDUNDANT SAFETY DEVICE IN A NEW, VACUUM-LESS ELECTRONIC CRUISE CONTROL DESIGNED BY FORD.

FUNCTIONALLY, IT REPLACES THE PRESENT VACUUM DUMP VALVE BY DE-ENERGIZING A CLUTCH WHICH CONNECTS THE THROTTLE TO AN ELECTRIC ACTUATOR.

IT IS PLUMBED INTO THE BRAKE LINE. WHEN THE DRIVER APPLIES PRESSURE TO THE BRAKE PEDAL, THE NORMALLY-CLOSED SWITCH OPENS, DISCONNECTING THE ACTUATOR FROM THE THROTTLE BUTTERFLY.



SPECIFICATIONS:

ACTUATION:	150 PSI +/- 50
RELEASE:	100 PSI MIN.
BURST:	7000 PSI
CYCLES:	500K, 0 - 1450 PSI, 2 Hz
VOLTAGE:	BATTERY
CURRENT:	0.75 AMP

CLD/dea

FORD SWITCH COMMODITY TEAM VISIT
CRUISE CONTROL PRESSURE SWITCH

BACKGROUND/HISTORY

- o FORD ENGINEERING CONTACTED TEXAS INSTRUMENTS IN 4Q87 TO DEVELOP BRAKE PRESSURE SWITCH FOR FUTURE ELECTRONIC SPEED CONTROL SYSTEM.

- o FIRST QUARTER 1988, TEXAS INSTRUMENTS DEDICATED A DESIGN ENGINEER TO THE DEVELOPMENT OF CCPS.

  - ENGINEER DEDICATED 3+ YEARS PRIOR TO START OF PRODUCTION.

- o TEXAS INSTRUMENTS HAS CONTINUALLY SUPPLIED PROTOTYPES TO FORD SPECIFICATIONS AND TIMING REQUIREMENTS.

  - INCLUDES DELIVERY ON AS LITTLE AS 24 HOURS' NOTICE.

- o TEXAS INSTRUMENTS HAS CONTINUED TO MEET PROGRAM GUIDELINES AS SET FORTH BY FORD.

CLD/DAA

FORD SWITCH COMMODITY TEAM VISIT
CRUISE CONTROL PRESSURE SWITCH

INITIAL PROGRAM GOALS (AS HANDED TO TI BY FORD ENGINEERING)

DEVICE PRICE - $1.75 - $1.90
TOOLING - $700K - $950K

ORIGINAL PREMISES

- USE OF CURRENT PRODUCTION BASE ASSEMBLY WITH METRI-PACK CONNECTOR.
- ACTUATION PRESSURE IN 150 PSI RANGE. TOLERANCE UNDEFINED.
- NORMALLY CLOSED LOGIC.
- NO CREEP REQUIREMENT.
- PROOF PRESSURE 2K PSI.
- BURST PRESSURE 5K PSI.
- NO PIN GAUGING NECESSARY.

CLD/DAA

FORD SWITCH COMMODITY TEAM VISIT
CRUISE CONTROL PRESSURE SWITCH

CHANGES/IMPACT OF CHANGES TO PROGRAM FOUNDATION

CHANGE	TOOLING IMPACT	APPROXIMATE DEVICE IMPACT
USE OF BASE ASSEMBLY WITH METRI-PACK CONNECTOR NOT ACCEPTABLE TO FORD.		
o MANUAL BASE ASSEMBLY WITH FORD DESIRED TERMINAL ORIENTATION	$50K	$.30
OR		
o AUTOMATED BASE ASSEMBLY WITH FORD DESIRED TERMINAL ORIENTATION	$250K	
o ELIMINATE CONVERTER		($.06)
o CRIMP RING FROM .025" TO .050"	$10K	$.08
o RE-DESIGN OF TERMINALS TO PROVIDE FORD DESIRED TERMINAL ORIENTATION.	$50K	$.04

CLD/DAA

FORD SWITCH COMMODITY TEAM VISIT
CRUISE CONTROL PRESSURE SWITCH

CHANGES/IMPACT OF CHANGES TO PROGRAM FOUNDATION

CHANGE	APPROXIMATE TOOLING IMPACT	APPROXIMATE DEVICE IMPACT
PROOF PRESSURE REQUIREMENT MOVED FROM 2K TO 5K PSI.		
BURST PRESSURE REQUIREMENT MOVED FROM 5K TO 7K PSI.		
o ADDITIONAL PIECE OF KAPTON ADDED TO HANDLE BURST REQUIREMENT.	$10K	$.02
o DISC SEAT 40% THICKER TO HANDLE BURST REQUIREMENT.		$.06
o NEXPORT 40% THICKER TO HANDLE BURST REQUIREMENT.		$.06

CLD/BAA

FORD SWITCH COMMODITY TEAM VISIT
CRUISE CONTROL PRESSURE SWITCH

CHANGES/IMPACT OF CHANGES TO PROGRAM FOUNDATION

CHANGE	APPROXIMATE TOOLING IMPACT	APPROXIMATE DEVICE IMPACT
THREAD CAP REQUIRED	$10K	$.02
TOLERANCE DEFINED AS +/-50 PSI		
o PIN GAUGING NECESSARY (ALSO TIED TO CHANGE IN BASE ASSEMBLY)	$100K	
TOTAL IMPACT	$230K	$.52
OR		
TOTAL IMPACT	$430K	$.22

CLD/DAA

FORD SWITCH COMMODITY TEAM VISIT
CRUISE CONTROL PRESSURE SWITCH

CURRENT STATE OF PROGRAM

UTILIZING BASE WITH MANUAL TERMINAL ASSEMBLY:

- o DEVICE PRICE $2.27 - $2.42
- o TOOLING $930K - $1180K

UTILIZING BASE WITH AUTOMATED TERMINAL ASSEMBLY:

- o DEVICE PRICE $1.97 - $2.12
- o TOOLING $1130K - $1380K

CLD/DAA

FORD SWITCH COMMODITY TEAM VISIT
CRUISE CONTROL PRESSURE SWITCH

ENGINEERING INNOVATION/EXPERTISE

- o TRADITIONAL PRESSURE SWITCH MATERIAL/LABOR BREAK-OUT AS FOLLOWS:
  - MATERIAL: 55% - 60% OF TOTAL COST
  - LABOR/OVERHEAD: 40% - 45% OF TOTAL COST

- o CRUISE CONTROL PRESSURE SWITCH MATERIAL/LABOR BREAK-OUT AS FOLLOWS: (GIVEN CURRENT SPECIFICATION)
  - MATERIAL: 72% OF TOTAL COST
  - LABOR/OVERHEAD: 28% OF TOTAL COST

- o TEXAS INSTRUMENTS PRODUCES IN EXCESS OF 10KK DISCS/YEAR FOR SNAP ACTING PRESSURE SWITCHES.
  - 20+ YEARS OF DISC MANUFACTURING EXPERIENCE

- o CRUISE CONTROL PRESSURE SWITCH REPRESENTS BREAKTHROUGH IN AUTOMATED NESTING OF TERMINALS.
  - CCPS REPRESENTS STATE OF THE ART IN SNAP ACTING PRESSURE SWITCH DESIGN AND MANUFACTURE.

CLD/DAA

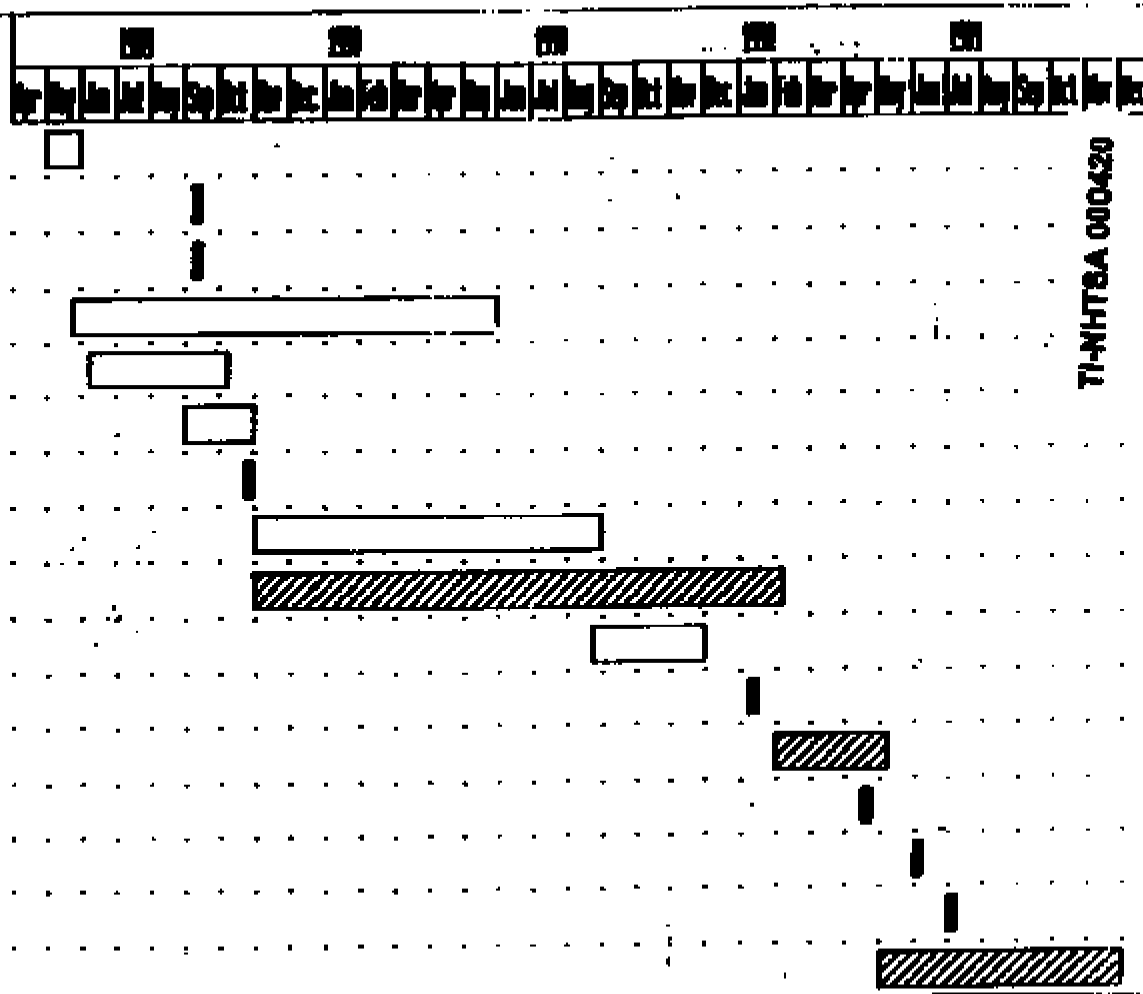
FORD SWITCH COMMODITY TEAM VISIT
CRUISE CONTROL PRESSURE SWITCH

TIMING ISSUES

- IN ORDER TO MEET MY92 PRODUCTION START-UP, IT IS NECESSARY TO ORDER PRODUCTION ASSEMBLY TOOLING NO LATER THAN NOVEMBER.
  - NEED FORD RELEASE TO BEGIN ORDER OF TOOLING.
- TOOLING NEEDS TO BE IN PLACE 3-6 MONTHS PRIOR TO JOB 1.
  - NECESSARY TO HIT IN-PROCESS PHASE I REQUIREMENTS.
  - AN 11/89 TOOLING RELEASE WILL RESULT IN TOOLING BEING IN PLACE 2/91.
  - ASSURES ANY NECESSARY DE-BUGGING WILL BE COMPLETE PRIOR TO JOB 1.

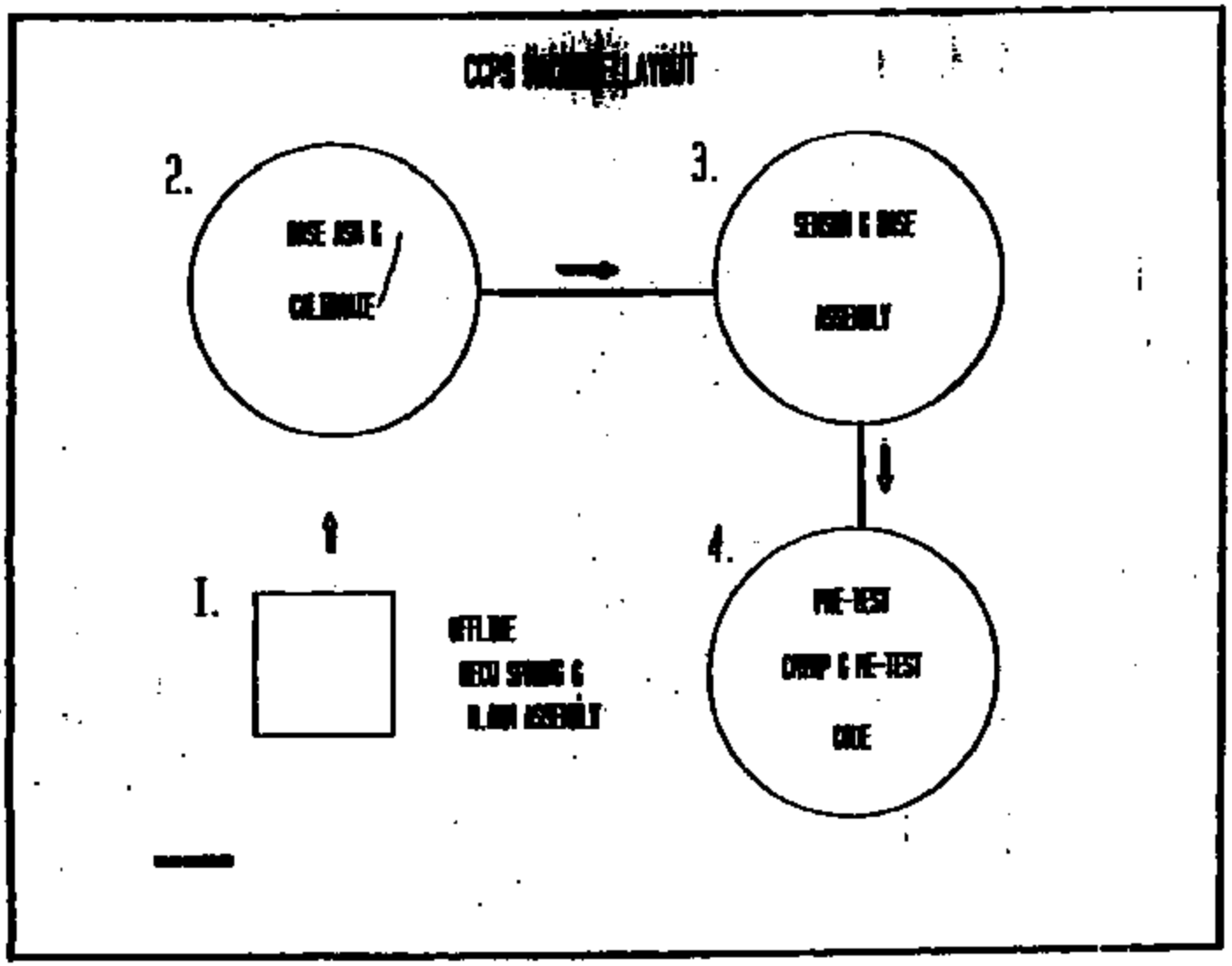
CLD/DAA

		Start Date	Finish Date
1	Design Validati	5/ 1/89	5/31/89
2	Firm cost estim	9/ 8/89	9/ 8/89
3	Design Review	9/13/89	9/13/89
4	[illegible]	5/30/89	5/31/90
5	Finalize spec	6/14/89	10/ 2/89
6	PO Negotiation	9/ 1/89	10/30/89
7	Contract (PO)	10/30/89	10/30/89
8	Part Tooling	11/ 1/89	[illegible]
9	Assembly Toolin	11/ 1/89	2/ 4/91
10	PV Testing	[illegible]	[illegible]
11	[illegible]	1/15/91	1/15/91
12	DV Ph. I	2/ 4/91	5/ [illegible]/91
13	[illegible], 300 part	4/22/91	[illegible]
14	Job 1 [illegible]	6/ 3/91	6/ 3/91
15	Job 1 [illegible]	7/ 1/91	7/ 5/91
16	DV Ph. II	5/ 7/91	10/[illegible]/91



Noncritical
Critical
Slack
Milestone
Project: CCPSA
Date: Aug 28, 1989 5:07 PM

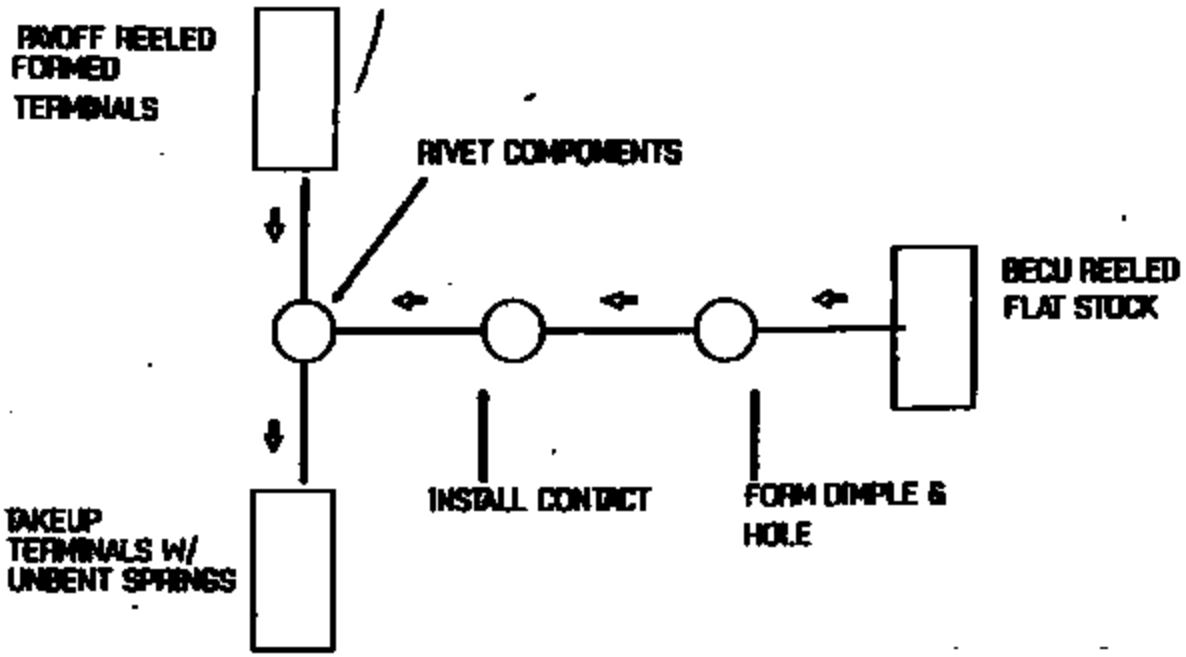
Cruise Control Pressure Switch



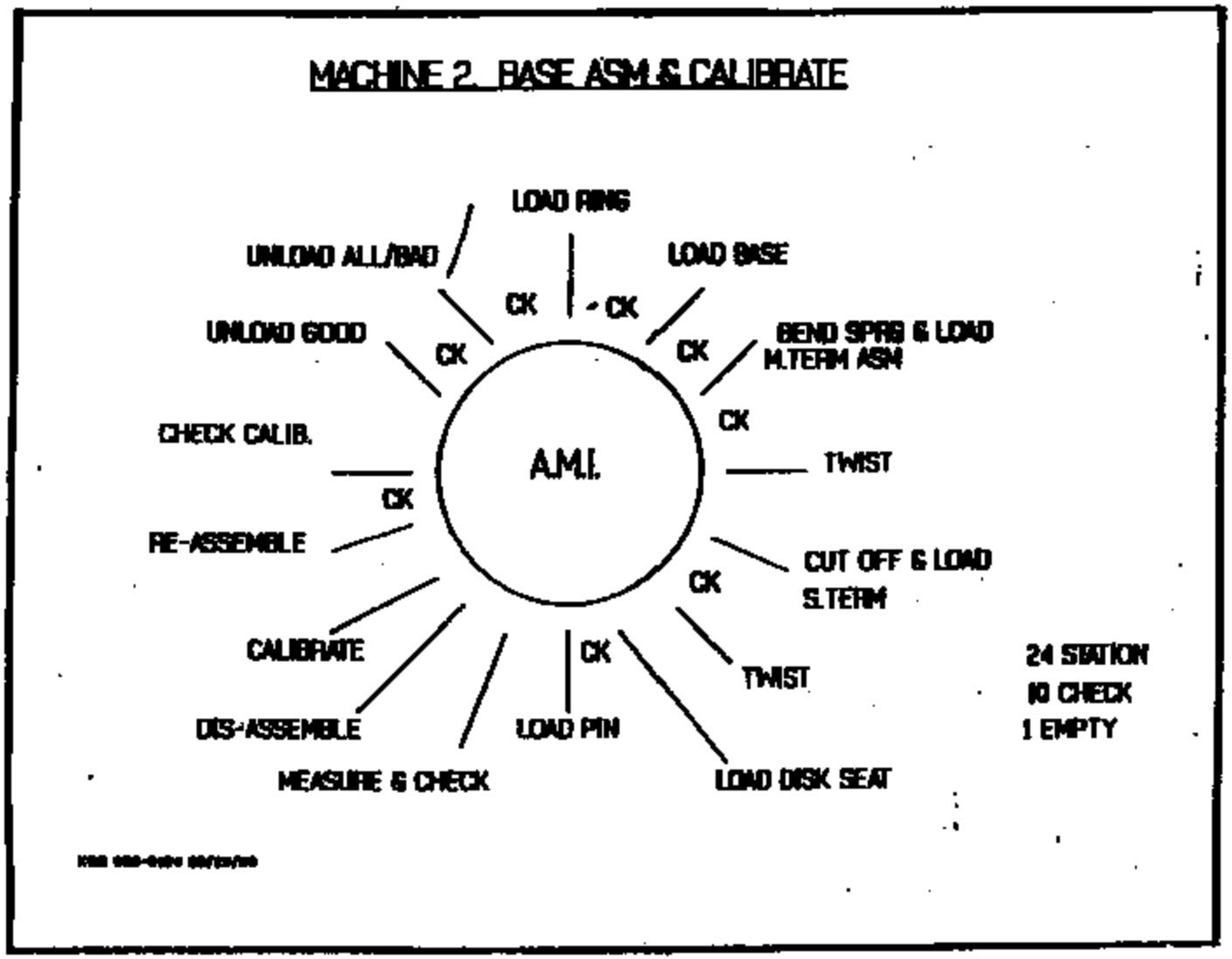
TI-NHT8A 000421

TI-NHT8A 000422

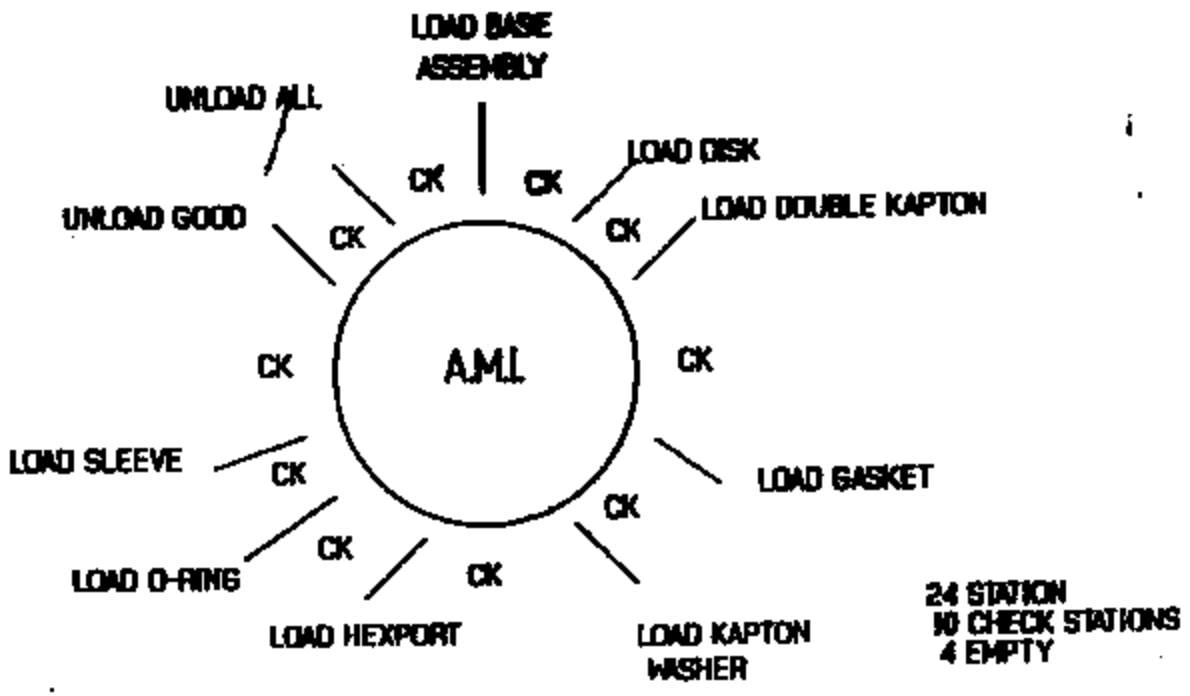
MACHINE I. SPRING ARM TO TERMINAL



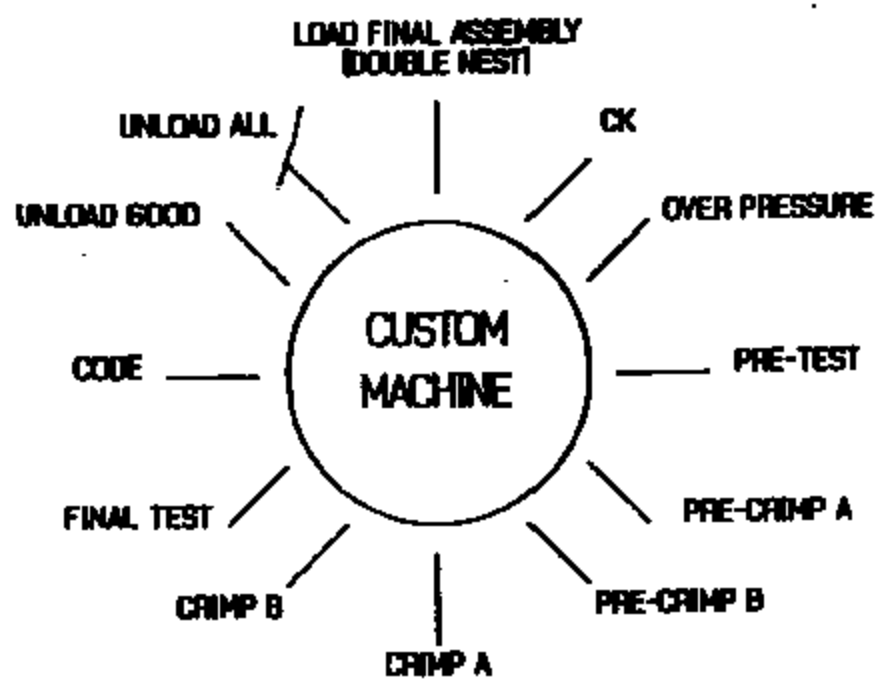
MACHINE 2 BASE ASM & CALIBRATE



MACHINE 3. FINAL ASSEMBLY



MACHINE 4. P.TEST, CRIMP, & CODE



FORD SWITCH COMMODITY TEAM VISIT
CRUISE CONTROL PRESSURE SWITCH

SUMMARY

- TEXAS INSTRUMENTS HAS BEEN ENGAGED WITH FORD ENGINEERING FOR 2+ YEARS AS SOLE DEVELOPER OF PRESSURE SWITCH FOR MY92 ELECTRONIC CRUISE CONTROL SYSTEM.
- TEXAS INSTRUMENTS HAS OPERATED WITHIN AND CONTINUES TO OPERATE WITHIN EXPECTATION RANGE/GUIDELINES PUT FORTH BY FORD.
- CCPS REPRESENTS STATE OF THE ART IN PRESSURE SWITCH DESIGN.
- RELEASE OF TOOLING FUNDS IS CRITICAL TO INSURE JOB 1 IS MET IN MY92.

CLB/BAA

PRESSURE SWITCH DATA Form 21605 **TEST NO.** 24-01-10

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
FX 3422		SBO	

PERFORMED BY	DATE STARTED	DATE COMPLETED	APPROVED BY
JAP	8/30/99	9/1/99	

PROJECT TITLE: Cruise control Pressure switch

CUSTOMER: Ford

PURPOSE OF TEST: Customer samples

PROCEDURE: Build and send

Device #	Force	Spring Deflect	Trans Pin ht	Proof	ACT	REL	AV Drop
24-01-01	230	.005	217	Pass	134	130	3.7
02	265	.006	212	↓	129	125	5.0
03	170	.004	217		129	124	3.7
04	200	.004	217		126	122	4.0
05	185	.009	217		135	130	4.7
06	245	.005	215		130	128	3.3
07	225	.006	214		132	128	4.0
08	195	.005	219		110	106	4.2
09	195	.005	216		115	110	5.6
10	180	.004	213		135	121	4.4

TI-NHTSA 000427

HIGHLIGHTS

Stephen B. Offiler
Week Ending 09/01/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EK3423
(Note: Information herein supercedes hand-written highlights dated 9/1)

SPECIFICATIONS: At Ford's request, I am trying to construct a set of 57PS's with a range of actuations between 150 psi and 250 psi, increments approx 10. I have discs which should cover the range from 150-180, and 230-270. The range 190-220 coincidentally is the most crucial since educated guesses say this the ballpark where the final spec will fall. I must get discs made to cover this range, then get devices built on the production line. This is high priority since we can't arrive upon a finalized specification until this testing is complete.

CUSTOMER SAMPLES: Pitts, the proportioning valve manufacturer who presently buys a 57PS "F" device, has requested 10 devices by 09/15, which is no problem. We also owe Light Truck 50 devices in the same timeframe, which I am holding off as long as possible pending resolution of the spec. issue.

DESIGN: The present seal design using an 80-duro square-cut gasket is inadequate at -40 C, and 70-duro is inadequate at +121 C. We are working on various ideas to improve the sealing system and address manufacturability at the same time. This includes:

1) Capture an o-ring in a dovetail groove in the hexport, which allows assembly without worry of gasket misplacement.
2) Use suction to hold a square-cut gasket and a piece of Kapton to the hexport. (Tom C.'s idea)
3) Use present gasket-in-disc-seat design, adding a piece of Kapton at the hexport interface to prevent extrusion. ("Band-Aid" solution)
4) Assemble upside-down (hexport added first rather than last) which requires the disc to be located and held underneath the disc seat with a magnet or suction.

All four ideas place the Kapton at the hexport/disc seat interface which mimics the 57PS and has been shown to help prevent high-temp extrusion. 70 duro material should therefore be used for low-temp performance.

Ideas #1 and #3 above are going on test today. This test will combine the Impulse test and the Thermal Cycle test so we may obtain high- and low-temp data more quickly.

Six devices survived 500K Impulse test with a zero-overtravel disc seat. Pinning at +.005 gives .010" contact gap. We're looking into the need and desirability of using a concave disc seat to allow more travel. Concern is disc life given the reversed-stress situation.

QUOTES: We are working with Purchasing to obtain prototypes of the Powder-Metal disc seat, and the crimp ring. Both are critical because they directly impact device proof/burst strength.

We'd like to go offshore if needed to find a better price than Elco on the hexport. Jack Kearns tells me he can get help with international purchasing from Dallas.

Since the twist-terminal idea is being accepted, I have created sketches of the production-insert terminals. We will use our present quotes to determine the low-cost supplier, and

work closely with them to refine the terminal design for lowest possible cost.

MFG/MECH ISSUES: I've shown the twist-terminals to Ed K., and plan to send sketches of all the design concepts above to him for critique.

Keith Roberts will organize a formalized Cost Review to cover: status of individual part cost, layout and cost of assembly equipment, and final device cost estimate. Tentative date is 09/20/89.

DFFS INT'L CONN:

PRESSURE SWITCH DATA Form 21605 **TEST NO.** 25-01-04

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
EX 3423	9/1/89	SJD	

PERFORMED BY	DATE STARTED	DATE COMPLETED	APPROVED BY
JAH	9/1/89	9/8/89	

PROJECT TITLE: Cruise control pressure switch

CUSTOMER: Ford

PURPOSE OF TEST: Test captured o-ring design at pressure cavity

PROCEDURE: Build 4 devices per Steve's new captured O-ring design with 2 pieces of 1-3-1 Kaplon. Thermal cycle and impulse test.

Device#	Spring Deflect	Force	[illegible]	Proof	Act	Rel	[illegible]
25-01-01	.005	216	209	Pass	137	128	7.5
-02	.004	110	212	"	136	133	5.5
-03	.004	195	215	"	138	134	7.[illegible]
-04	.006	245	213	"	136	131	5.0

Test data on back

TI-NHTSA 000430

Thermal Cycles

Cycle #	Low Date	Low Time	Low Set	Low Amb	Low FL	High Date	High Time	High Set	High Amb	High FL
1	9-6-99	12:50 P	-41	-42	-40	9-5-99	2:00	50	49	39
2	9-6-99	7:05 P	-42	-43	-41	9-5-99	virtual	cycle	40K inputs	
3	9-6-99	10:05 P	-43	-45	-40	9-6-99	11:30	50	49	39
4	[redacted]									
5	9-6-99	11:40 P	-42	-45	-40	9-6-99	virtual	cycle	40K inputs	
6	9-7-99	10:17 A	-42	-42	-40	9-7-99	11:25	50	48	38
7	9-7-99	1:30 P	-42	-44	-41	9-7-99	virtual	cycle	40 K inputs	
8	9-8-99	10:40 A	-42	-44	-41	9-8-99	11:45	50	49	38
9	9-8-99	2:30 P	-42	-44	-42	9-8-99	virtual	cycle	40 K inputs	
10	9-11-99	9:55 A	-42	-44	-41	9-11-99	11:14	50	46	39
11	9-11-99	1:00 P	-42	-44	-40	9-11-99	virtual	cycle	40 K inputs	
12	9-12-99	8:00 A	-42	-44	-40	9-12-99	12:20	50	47	43
13	9-12-99	2:45 P	-42	-44	-41	9-12-99	virtual	cycle	40 K inputs	
14	9-13-99	9:50 A	-42	-44	-40	9-13-99	11:18	50	49	41
15	9-14-99	1:30 P	-42	-44	-42	9-14-99	virtual	cycle	40 K inputs	
16	9-15-99	10:40 A	-42	-44	-41	9-15-99	11:45	65	64	46
17	9-15-99	1:30 P	-42	-44	-40	9-19-99	9:40 A	124	125	121
18	[redacted]									
19	9-19-99	10:25 A	-42	-44	-40	9-19-99	11:15	53	53	38
20	[redacted]									

Revised	T-Cyc	inputs	Condition	
25-11-01	17	240K	leaked	very slightly
03	14	240K	leaked	slightly
03	3	90K	leaked	slightly
04	16	240K	leak	slightly

PRESSURE SWITCH DATA Form 21605 TEST NO. 26-01-04

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
EX3423	9-1-89	TLO	
PERFORMED BY	**DATE STARTED**	**DATE COMPLETED**	**APPROVED BY**
LAD	9-1-89		

PROJECT TITLE: Cruise Control Pressure Switch

CUSTOMER: Ford

PURPOSE OF TEST: To test Pressure cavity with 70-Duro Gasket, 2pieces of 1-2-1Kapton and Kester washer 9-2-9

PROCEDURE: Assemble w/above parts. Thermal and impulse cycle simultaneously

27 Thermal Cycles
2,469 K impulses
No failures
Test aborted

Device #	Spring Rate	Force	Trans. P.U.	Prop	Act	Rel	ΔV Drop
26-01-05	.005	225	215	Pass	130	126	2.4
06	.005	225	215		119	121	2.8
07	.005	175	213		129	119	6.3
09	.007	190	213		137	123	6.9

Test Data On Back

Device #	After Act	2 wks Rel
26-01-05	131	—
06	131	119
07	119	117
09	25	-

Thermal Cycles

Cycle#	Low: Date	Time	Set	AMB	FL	High: Date	Time	Set	AMB	FL
1	9-5-99	12:50 A	-41	-45	-40	9-5-99	2:00 P	50	49	39
2	9-5-99	4:05 P	-41	-43	-41	9-5-99	virtual	cycle	40K inches	
3	9-6-99	10:05 A	-41	-45	-40	9-6-99	11:30 A	50	49	39
4	9-6-99	1:40 P	-41	-45	-41	9-6-99	virtual	cycle	40K inches	
5	9-7-99	10:17 A	-41	-42	-40	9-7-99	11:35 A	50	49	39
6	9-7-99	1:30 P	-41	-44	-41	9-7-99	virtual	cycle	40K inches	
7	9-8-99	10:40 A	-41	-44	-41	9-8-99	11:45 A	55	49	38
8	9-8-99	2:10 P	-41	-44	-42	9-8-99	virtual	cycle	40K inches	
9	9-11-99	9:55 A	-41	-45	-41	9-11-99	11:19 A	50	41	39
10	9-11-99	1:00 P	-41	-44	-40	9-11-99	virtual	cycle	40K inches	
11	9-12-99	10:00 A	-41	-44	-40	9-12-99	11:20 A	50	47	43
12	9-12-99	2:45 P	-41	-44	-41	9-12-99	virtual	cycle	40K inches	
13	9-14-99	9:55 A	-41	-44	-40	9-14-99	11:10 A	50	49	40
14	9-14-99	1:25 P	-41	-44	-41	9-14-99	virtual	cycle	30K inches	
15	9-15-99	10:40 A	-41	-44	-41	9-15-99	11:30 A	65	60	45
16	9-15-99	1:30 P	-41	-44	-40	9-15-99	8:00 A	125	125	121
17	9-18-99	10:45 A	-42	-44	-40	9-18-99	11:15 A	55	53	124
18	9-18-99	1:25 P	-42	-44	-41	9-18-99	virtual	cycle	100K inches	
19	9-19-99	10:30 A	-42	-44	-41	9-19-99	11:50 A	55	22	42
20	9-19-99	1:30 P	-42	-44	-40	9-19-99	virtual	cycle	40K inches	
21	9-20-99	11:10 A	-42	-44	-40	9-20-99	11:45 A	55	52	45
22	9-20-99	1:40 P	-41	-44	-40	9-20-99	virtual	cycle	40K inches	
23	9-21-99	10:20 A	-41	-44	-41	9-21-99	11:25	55	51	39
24	9-21-99	1:15 P	-42	-44	-40	9-21-99	virtual	cycle	40K inches	
25	9-22-99	11:15 A	-41	-44	-40	9-22-99	11:35	55	77	39

Test Complete!

No Failures

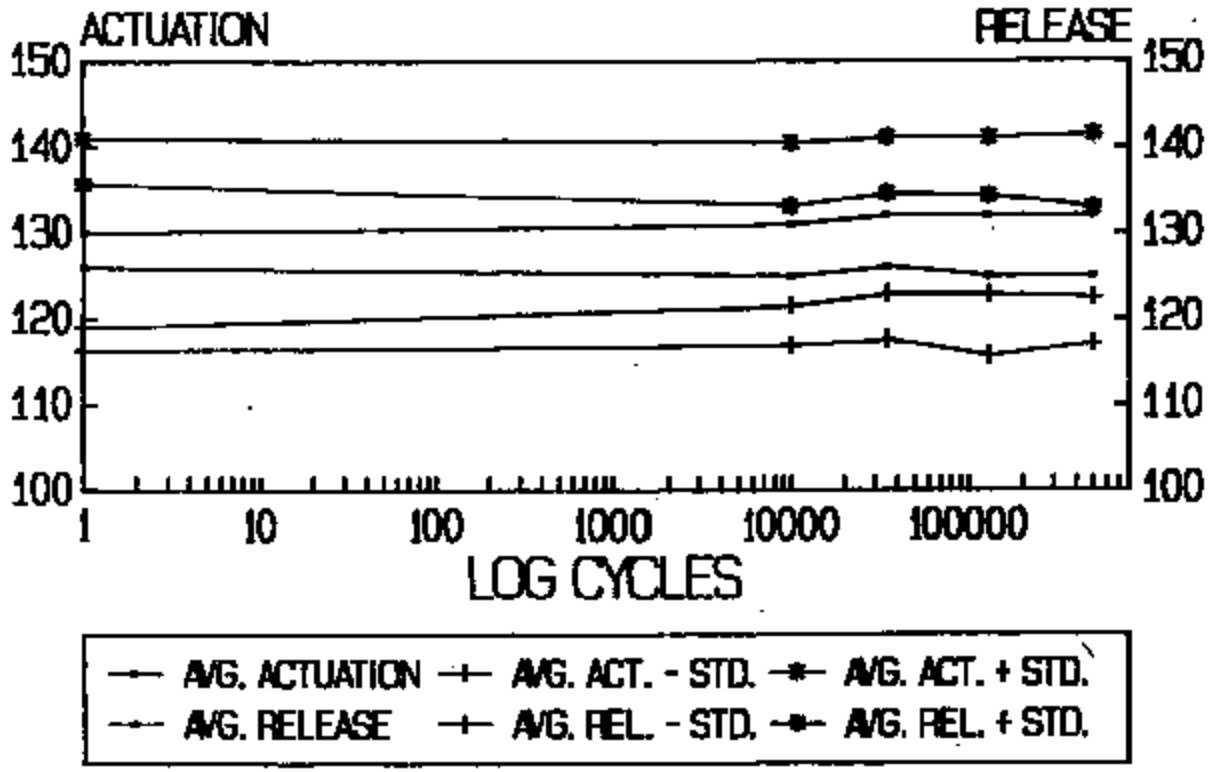
[illegible] to failure				9/11/99
			500K	
Pause for new devices			75K	9/14/99
			1,575K	
Pause for new devices			364K	9/18/99
			1,931K	
Pause for other test			700K	10/1/99
			2,271K	
Pause for other test			8K	10/2/99
			2,279K	
		Pause	25K	10/4/99
			2,294K	
		Pause	23K	10/6/99
			2,317K	
		Pause	118K	10/8/99
			2,435K	

Low — More Thermal Cycles — High

Cycle #	Date	Time	Set	Amb	FL	Date	Time	Set	Amb	FL
36	10/16/99	2:00	-42	-44	-40	10/17/99	9:50	122	124	140
37	10/16/99	3:35	-42	-44	-41	10/20/99	Visual	Cracks	WR	Failed

STEPLESS DISC SEAT

TEST #22-15-06:500K IMPULSE TEST



JAD 9-7-89

HIGHLIGHTS

Stephen B. Offiler

Week Ending 09/08/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH FX3423

OVERVIEW: We are making progress in two key areas: finalization of the production design and finalization of the specification.

SPECIFICATIONS: We've shipped some of the special set of 57PS's with a variety of actuation's from 150 to 300 psi. We're waiting on the disc department to create discs to fill a hole in the range. Ford will use these to help empirically determine the low-end actuation pressure for Light Truck. I plan to discuss this testing with Gary Klingler, and to understand the system impact of a wide tolerance added to the above low-end.

CUSTOMER SAMPLES: Ten CCPS devices were shipped to Pitts this week, at the standard $50/each. Our parts inventory is dwindling as these miscellaneous requests come in, coupled with build of development devices. I'm trying to connect Klingler and George Randall to understand Light Truck's need for their balance of 50 devices, pending resolution of the spec. issue.

DESIGN: As quotes are received, we are beginning to home in on the most cost-effective design. Areas where significant work is required include: powder-metal disc seat; crimp ring; terminals for automatic assembly; hexport; and the sealing system.

The main concern on the PM disc seat is strength, since it directly supports the pressure cavity. We must obtain prototypes to test. Considering the tooling required, proto's will not be cheap. We need to determine exactly where the proto $$ will come from. We have engaged with Norwalk, and plan to check out two other PM houses early next week.

The PM disc seat requires a crimp ring which is somewhat more complex than our present design. Again, the concern is strength, and prototypes built with production-representative processes are needed. Bear in mind that present crimp rings, which have only adequate strength, receive individual hand-built attention by Bob Jacques.

Regarding terminals, we have received quotes from several houses on a couple different designs, neither of which is production-representative. We will use these quotes and past experience to choose a single supplier, then obtain design assistance from this supplier in order to obtain the most cost-effective terminal designs possible.

On the hexport, I am planning a trip for mid-next-week to visit Elco and obtain design assistance from their engineering staff. Our goal is to drive the price lower than the cheapest 57PS hexport by utilizing design features that are cost-effective for Elco to produce.

The sealing system is very significant because features must be incorporated into the design of either the hexport, disc seat, or both, to accomodate it. We presently have two designs on test: 1) O-ring in dovetail gland, and 2) standard gland with extra Kapton to block gasket extrusion. A third design, which uses the same cone principle seen in valve and flare-fitting design, will be prototyped and placed on test ASAP.

Steve Offiler

Ford Crown Vic Test Data

Over Road Brake Test
Lincoln Town Car

Rupert Andrews
Jeffrey Anderson
9/12/89

Lincoln Town Car Over Road Test 9/15/89

File	Description
Front Brake Line	
G2_002.DRW	Slow Steady Brake
G2_003.DRW	Quick Brake On Resume
G2_004.DRW	Brake On Resume
G2_006.DRW	Normal Brake
Rear Brake Line	
GARY001.DRW *	Slow Brake, Bad Clutch
GARY003.DRW *	Resume Brake, Shows Bad Clutch
GARY005.DRW	Resume Brake, Disengages Clutch
GARY006.DRW	Slow Brake, No De-Act
GARY007.DRW	Faster Brake At S.S. Speed
GARY008.DRW	Quick Brake, Pops Clutch
GARY009.DRW	Quick Brake, Pops Clutch
GARY010.DRW	Slow Brake, No De-Act
GARY011.DRW	Resume Brake, Pops Clutch

* Note: Clutch Inoperative In Gary001.drw and Gary003.drw Due To Sil-Jel Deposits On Clutch. Replaced Actuator For Rest Of Testing.

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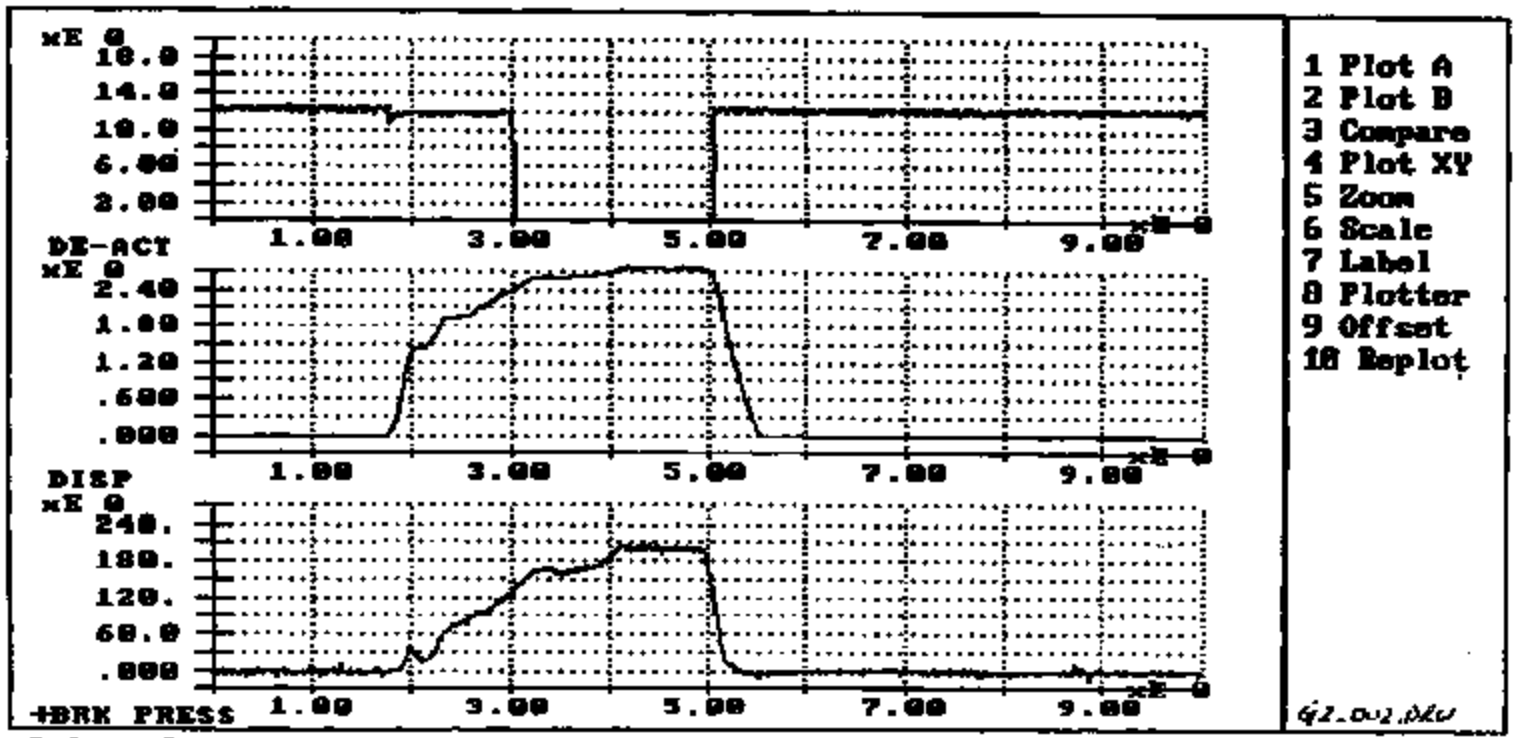

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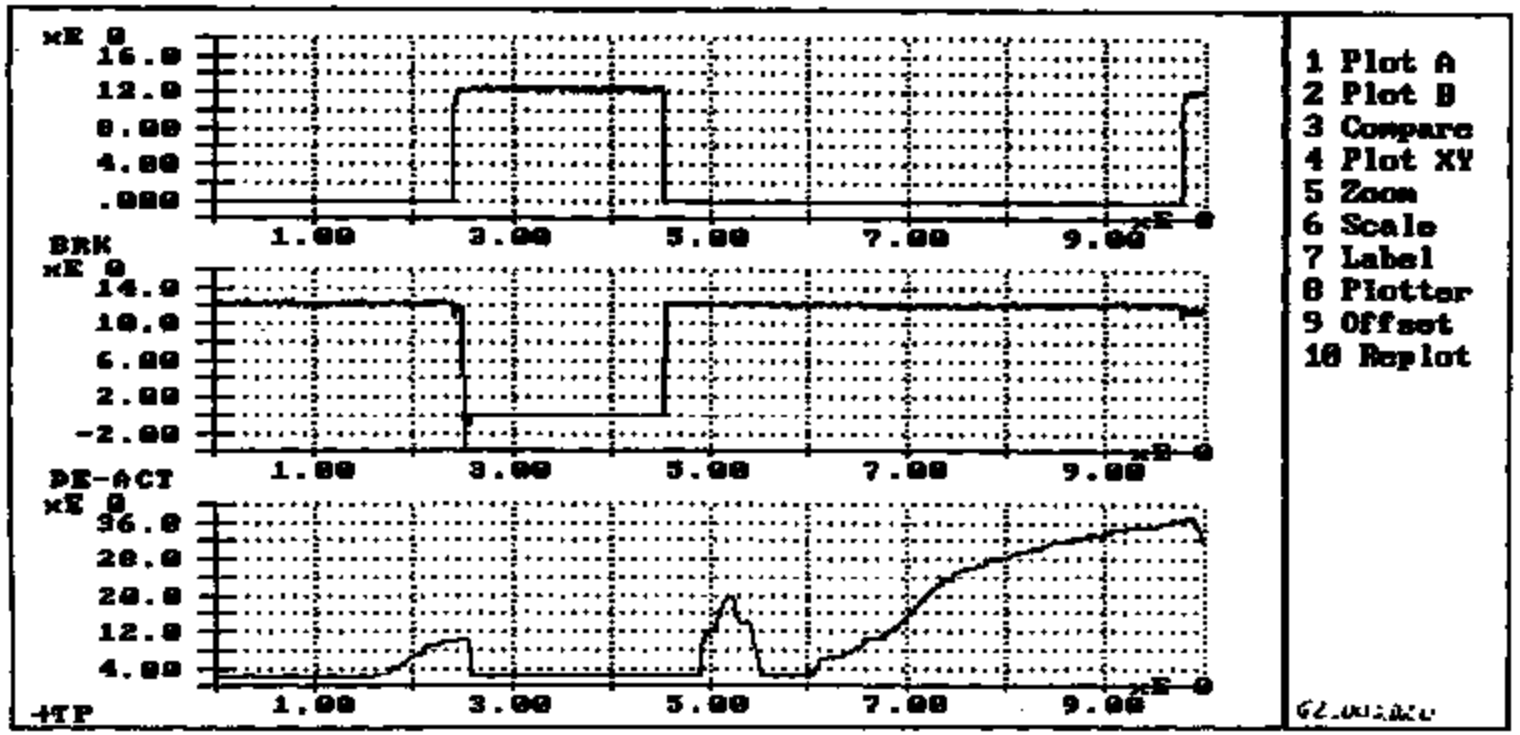

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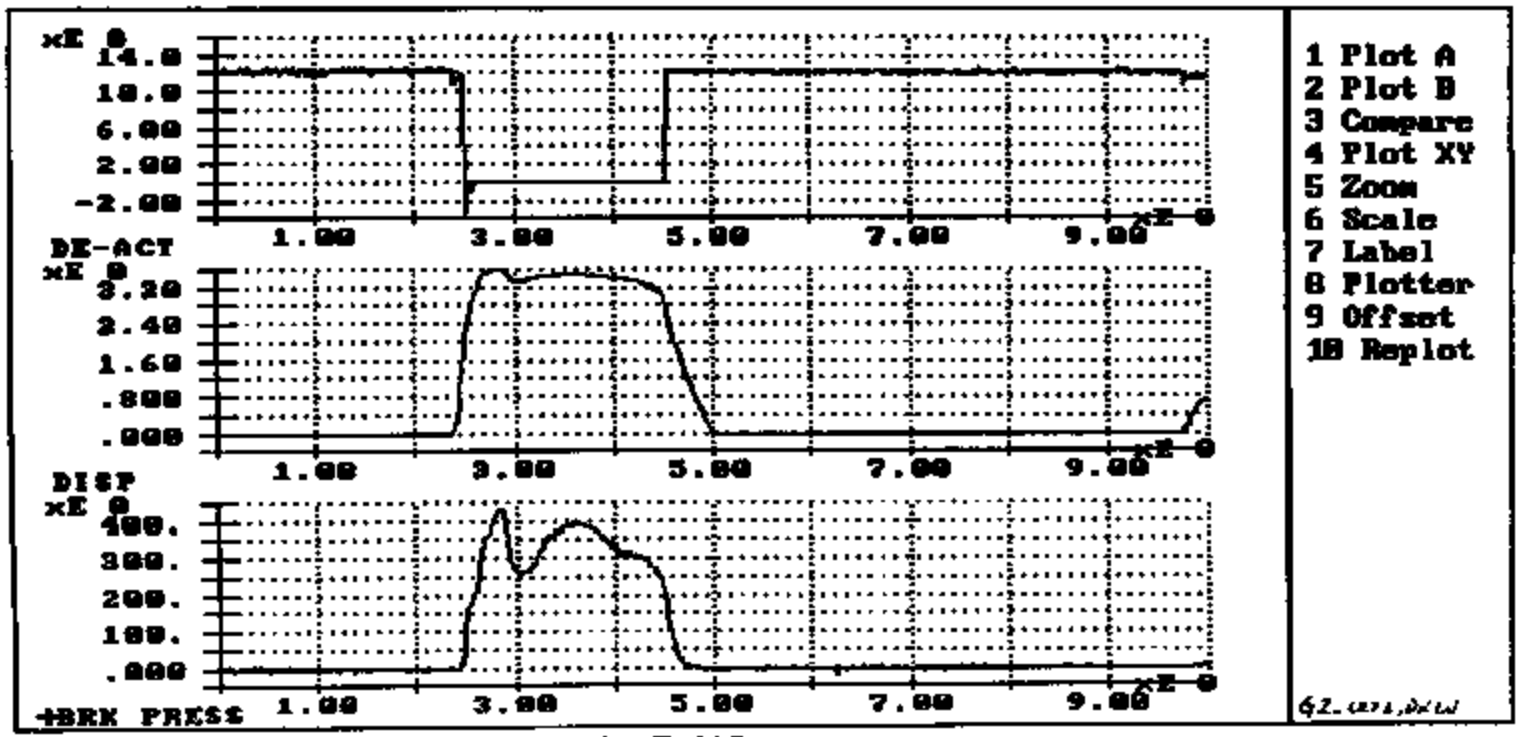

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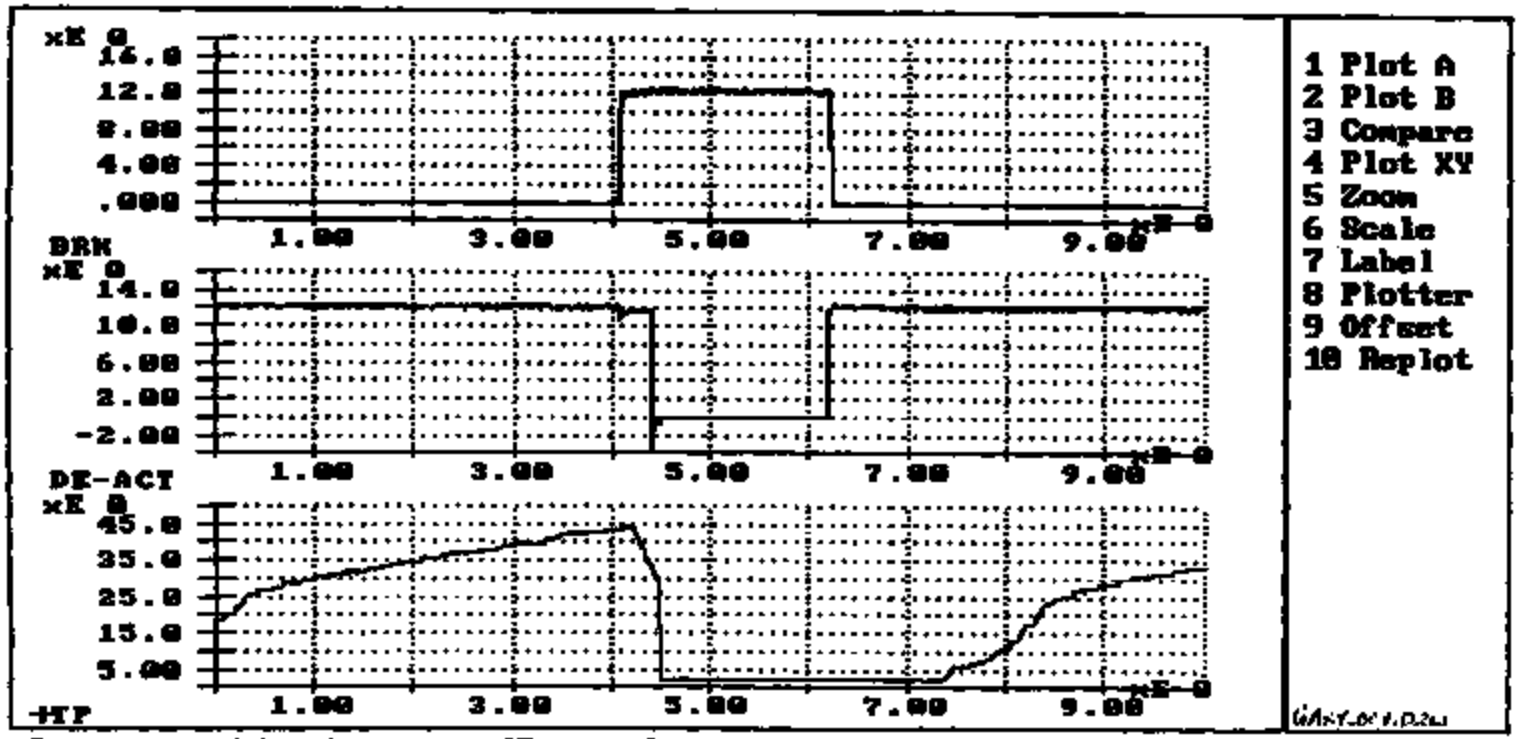

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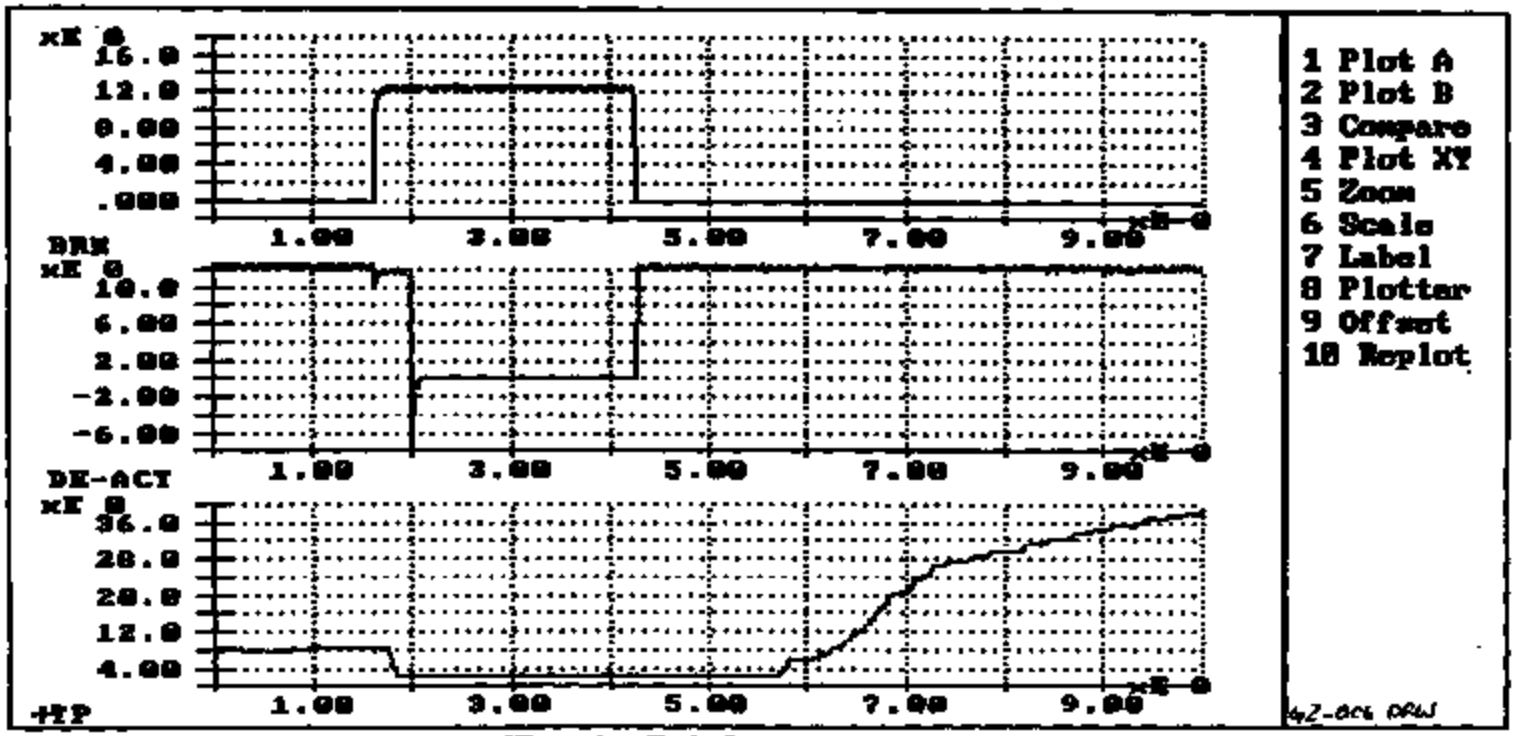

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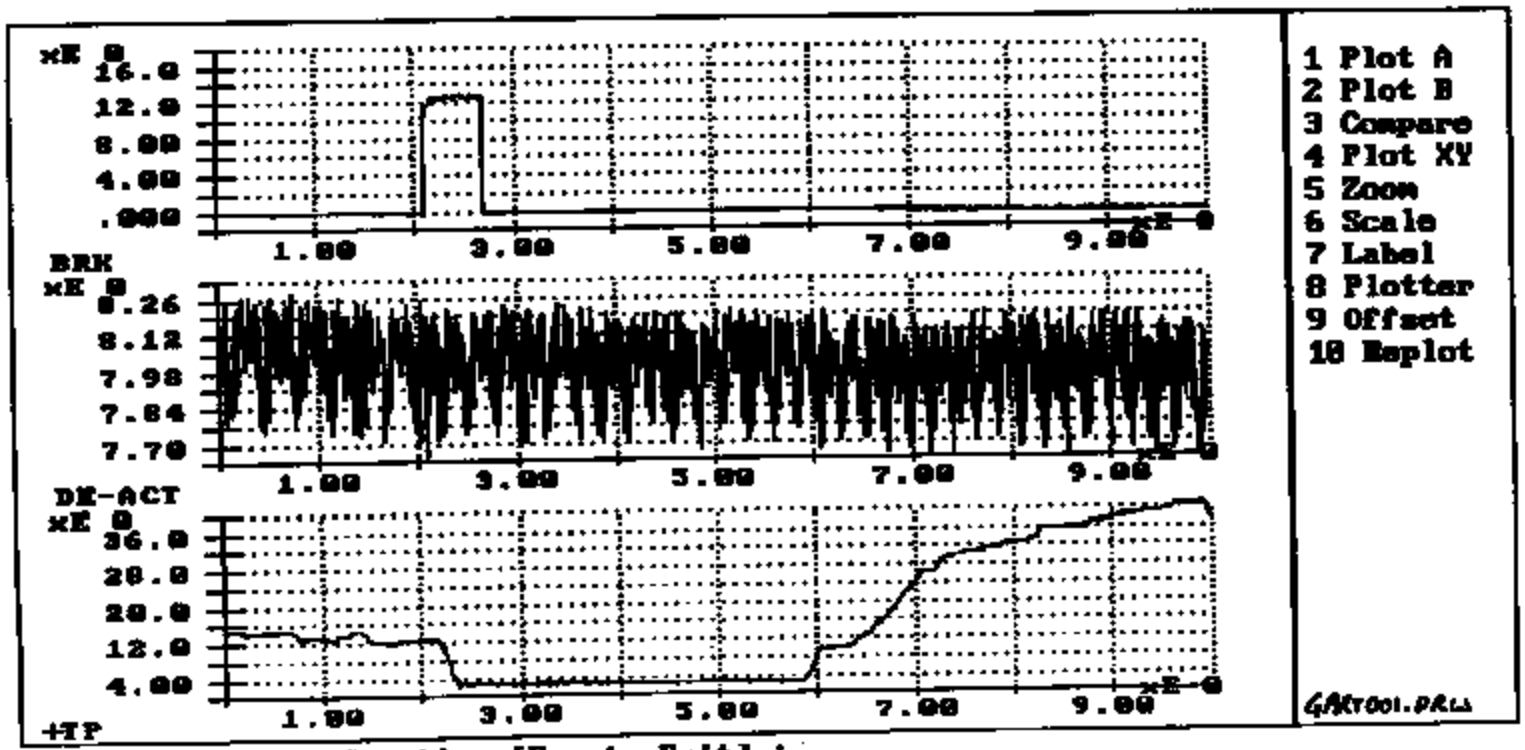

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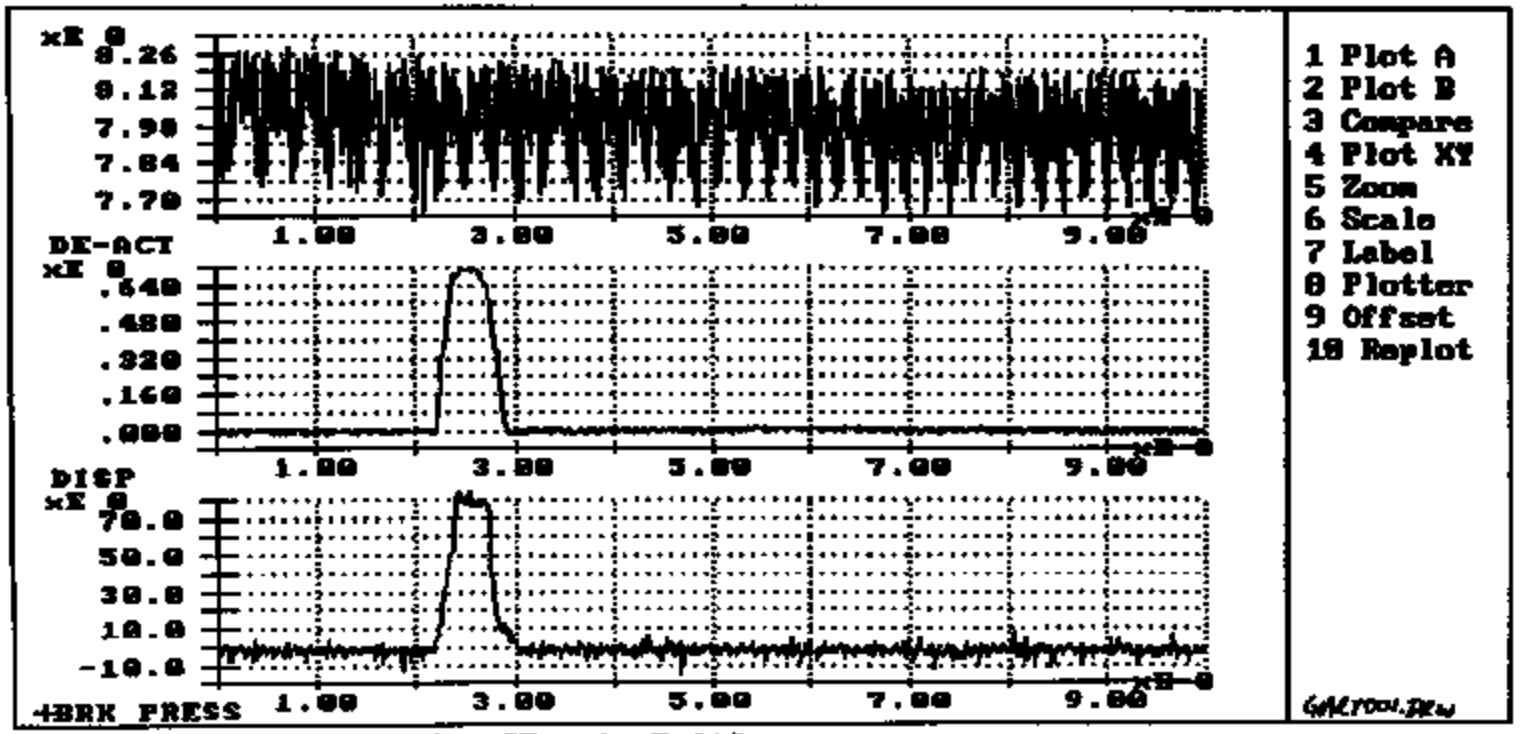

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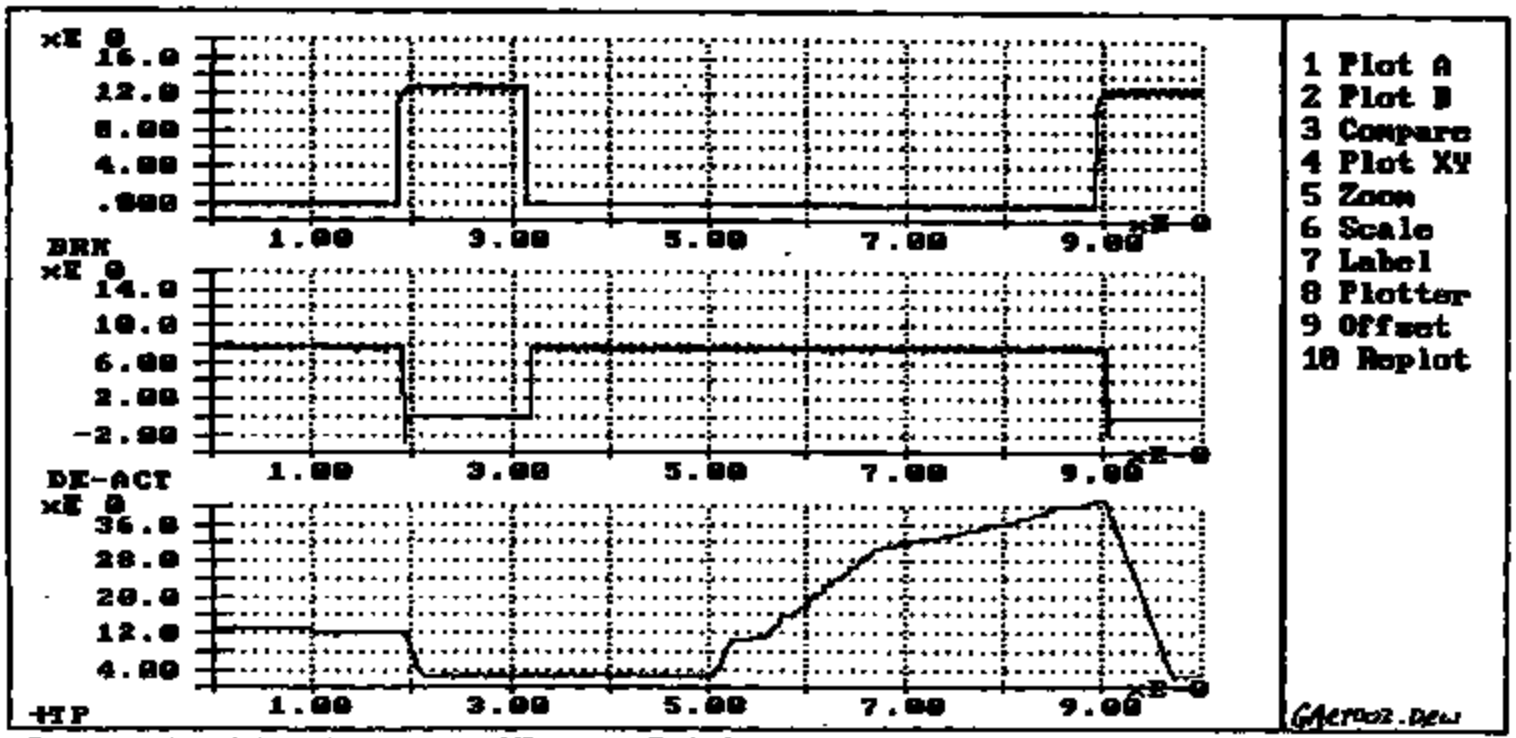

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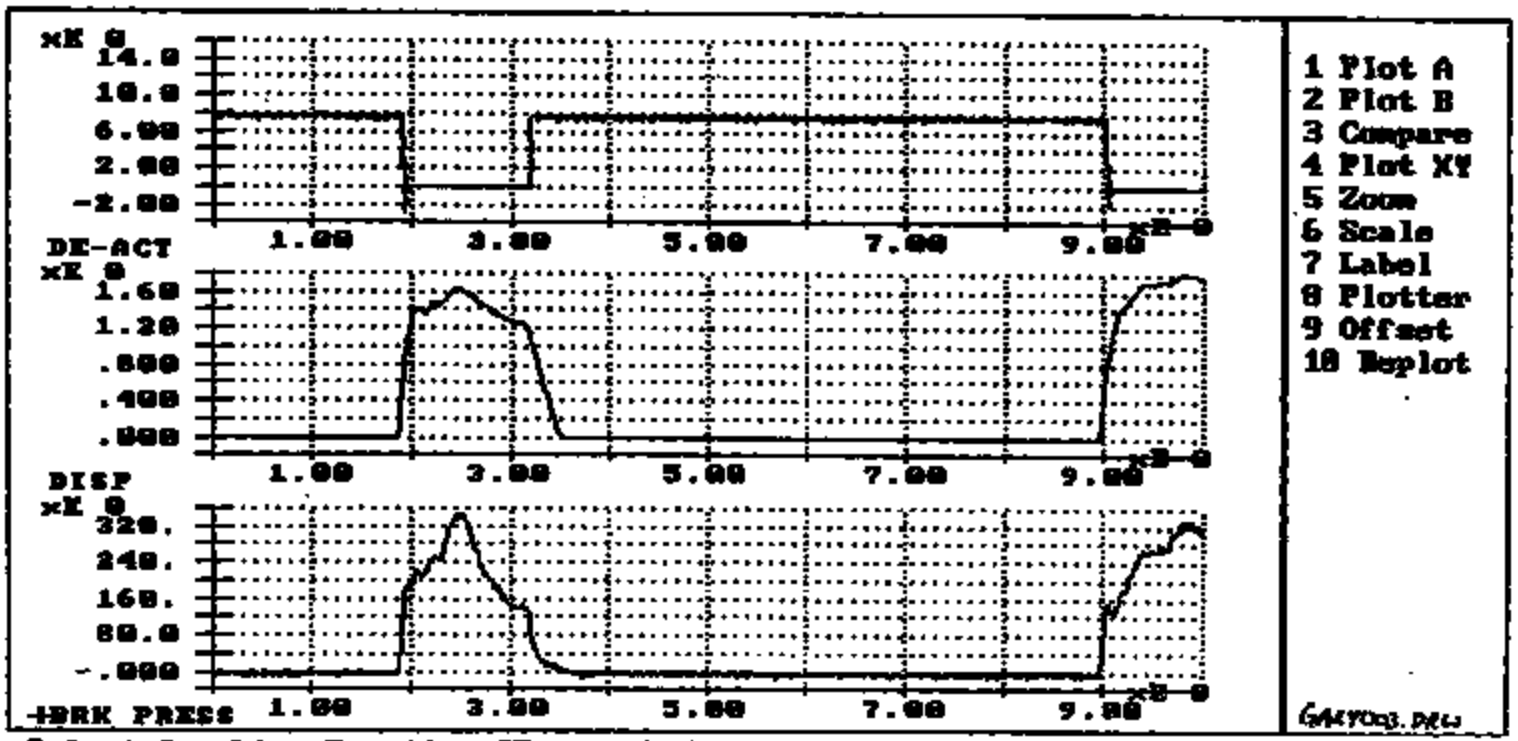

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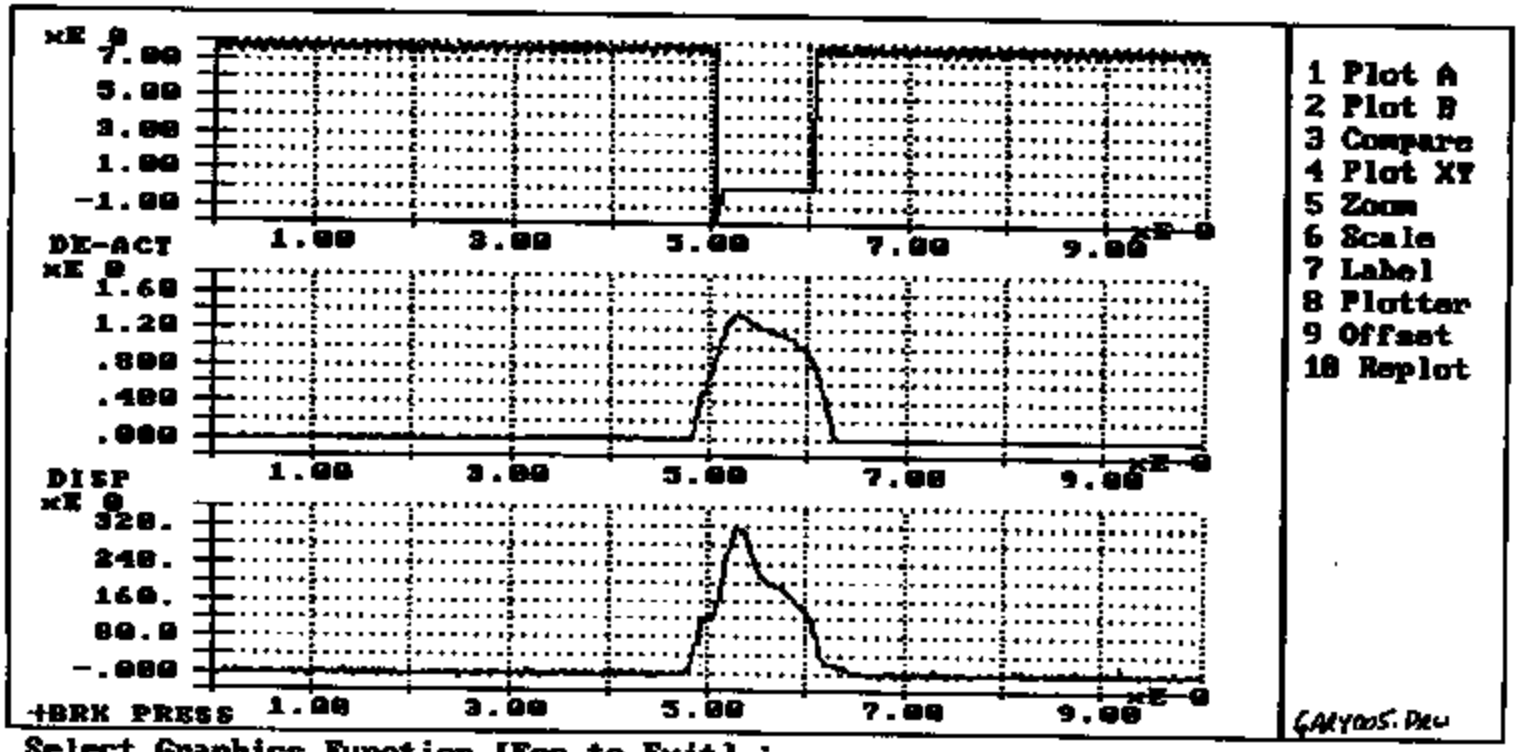

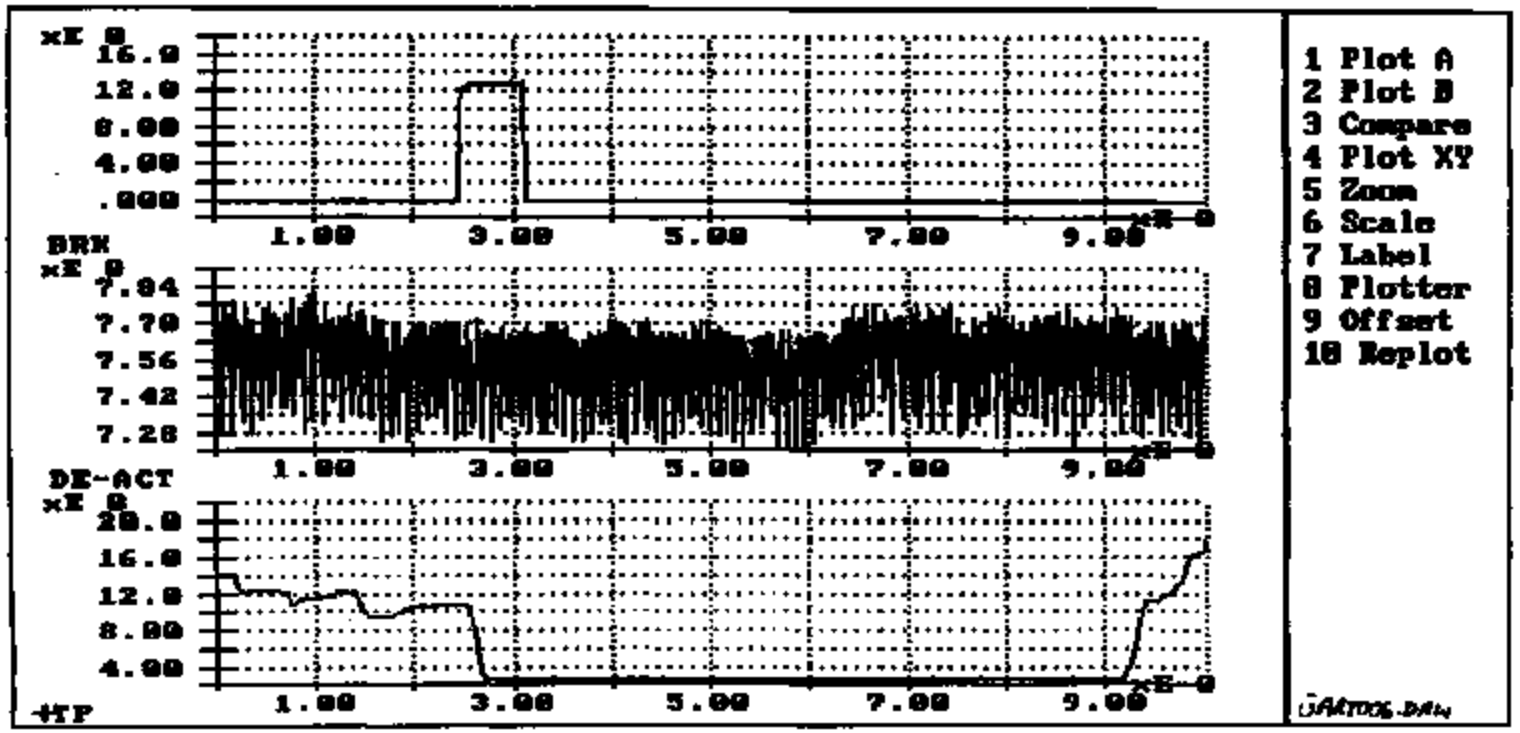

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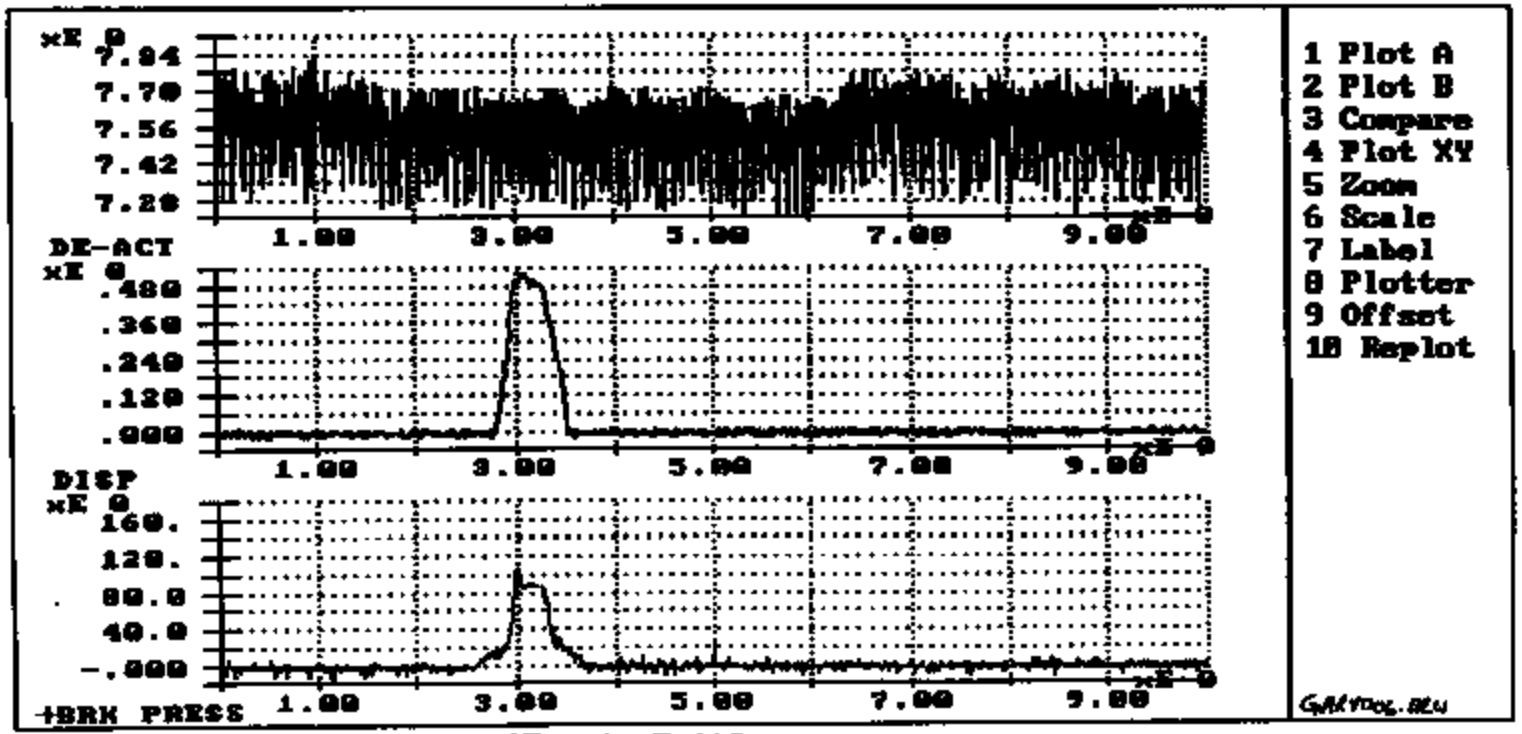

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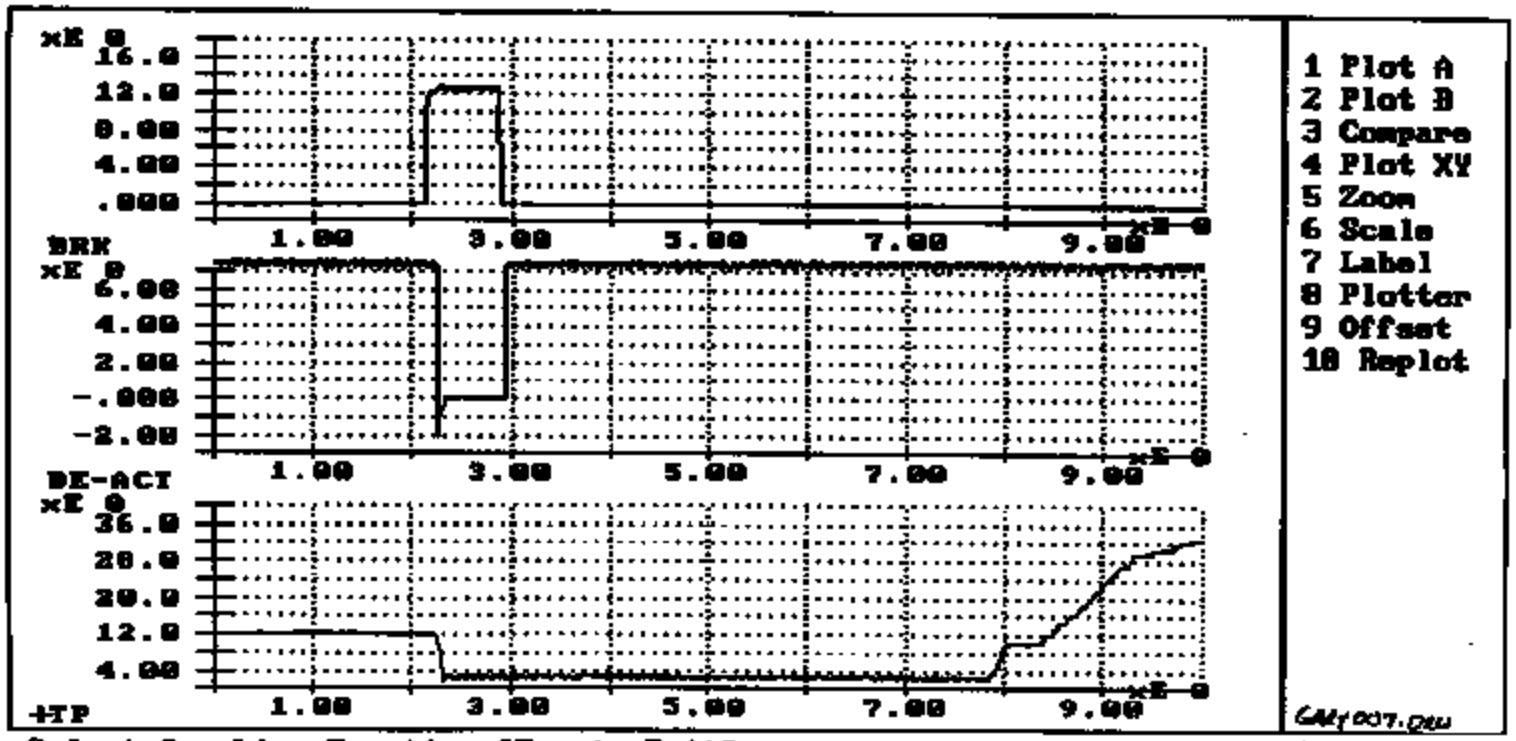

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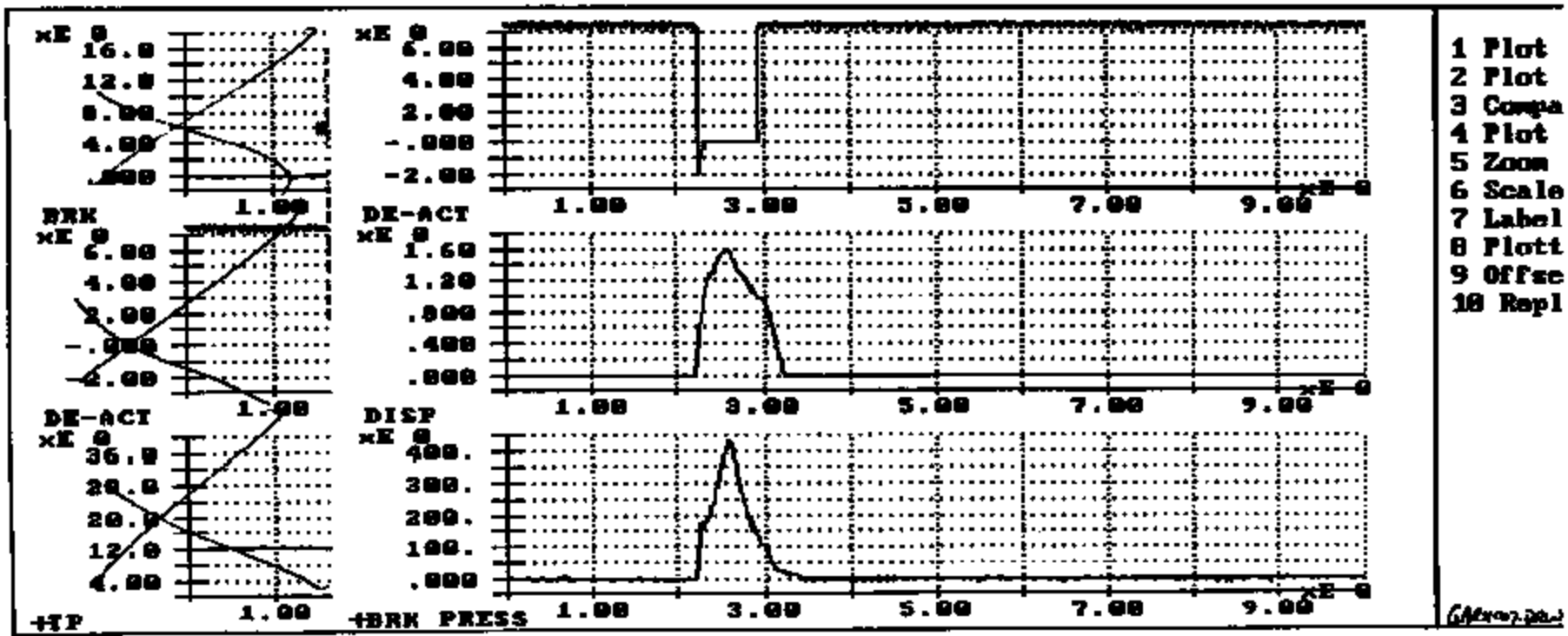

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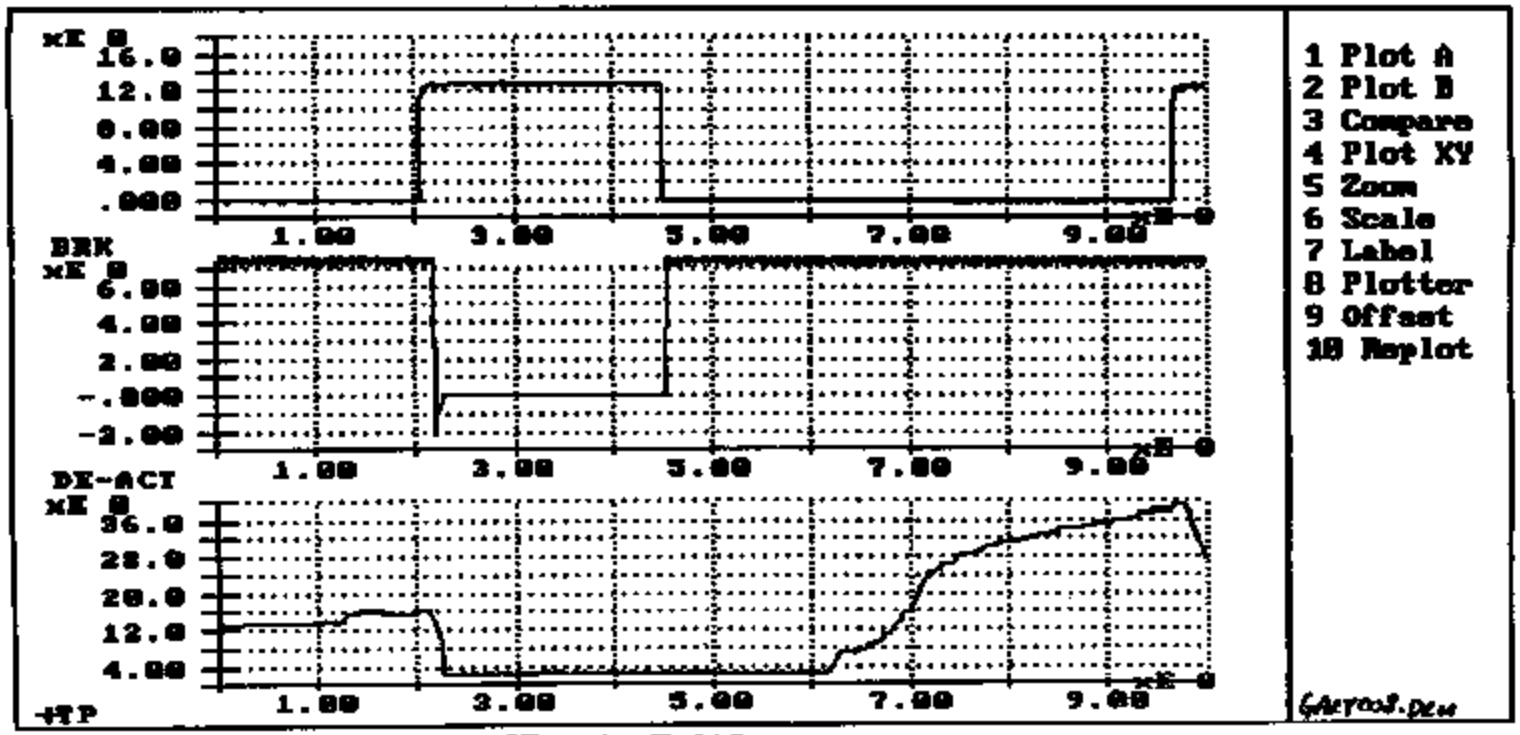

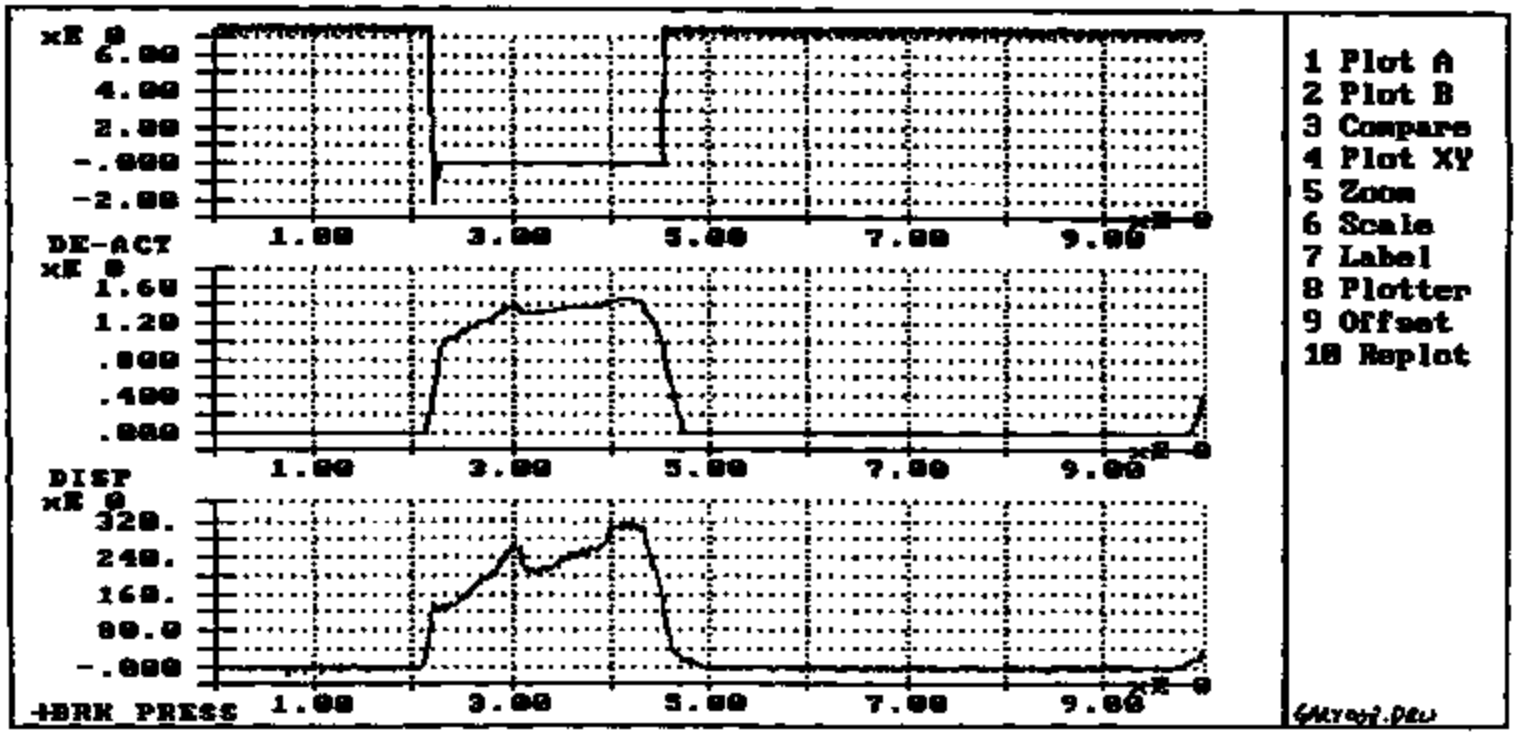

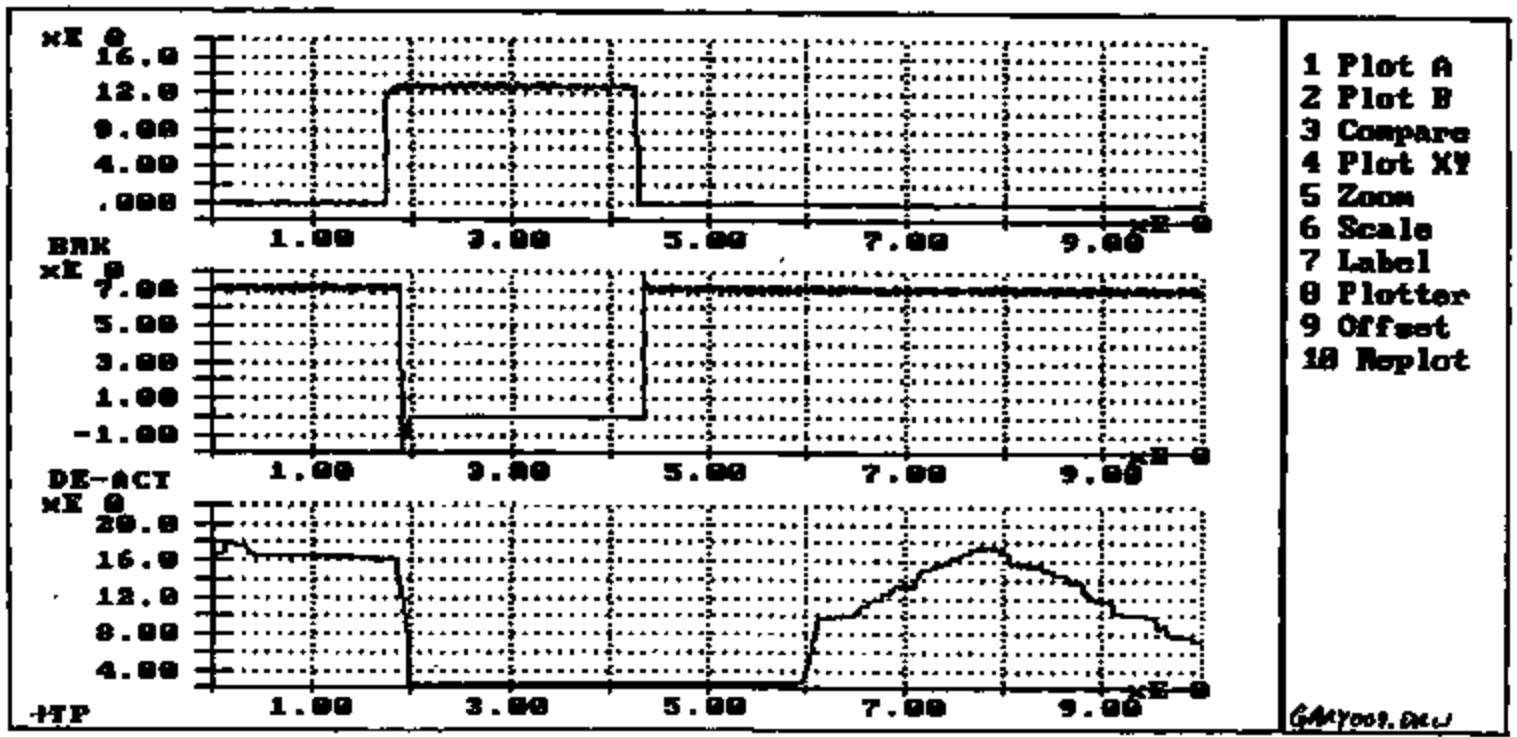

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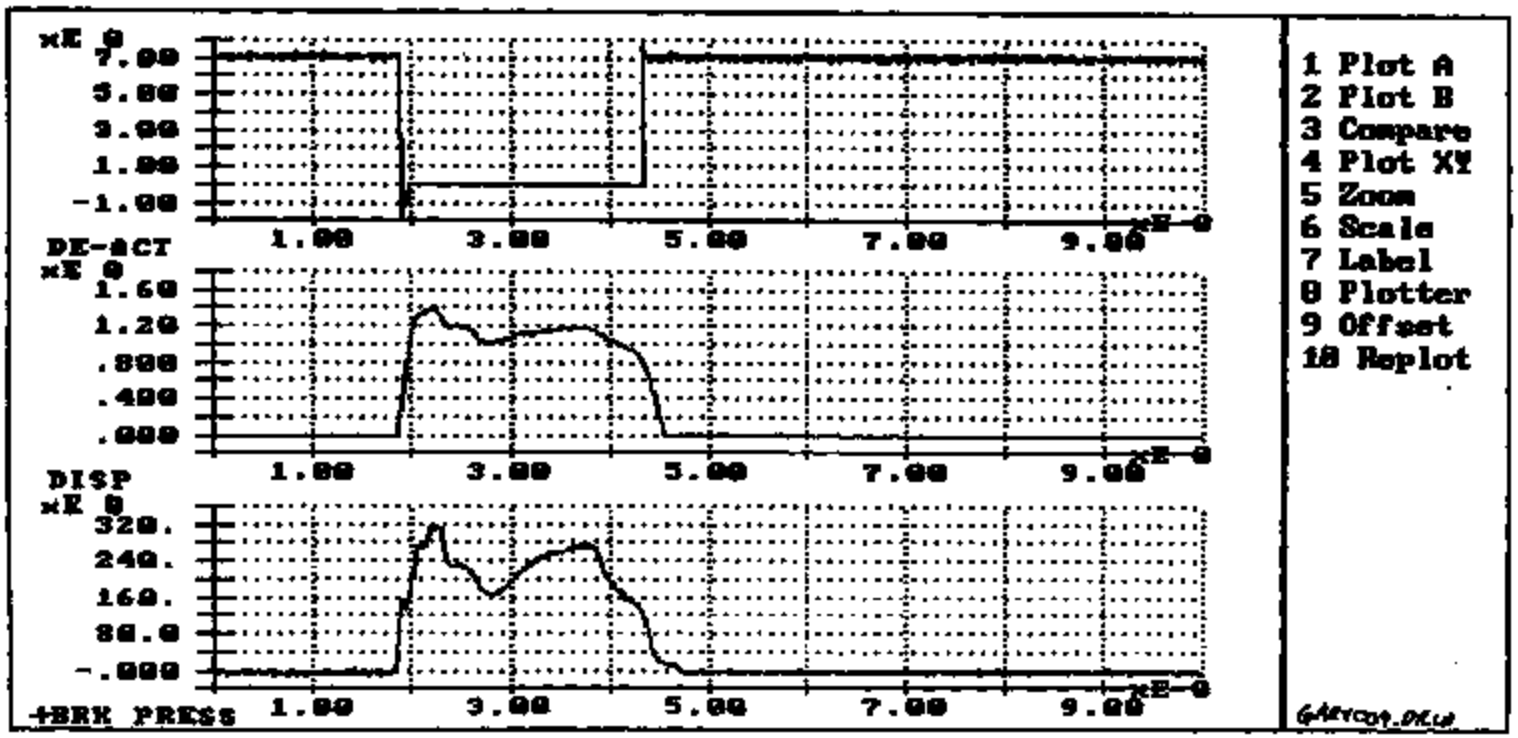

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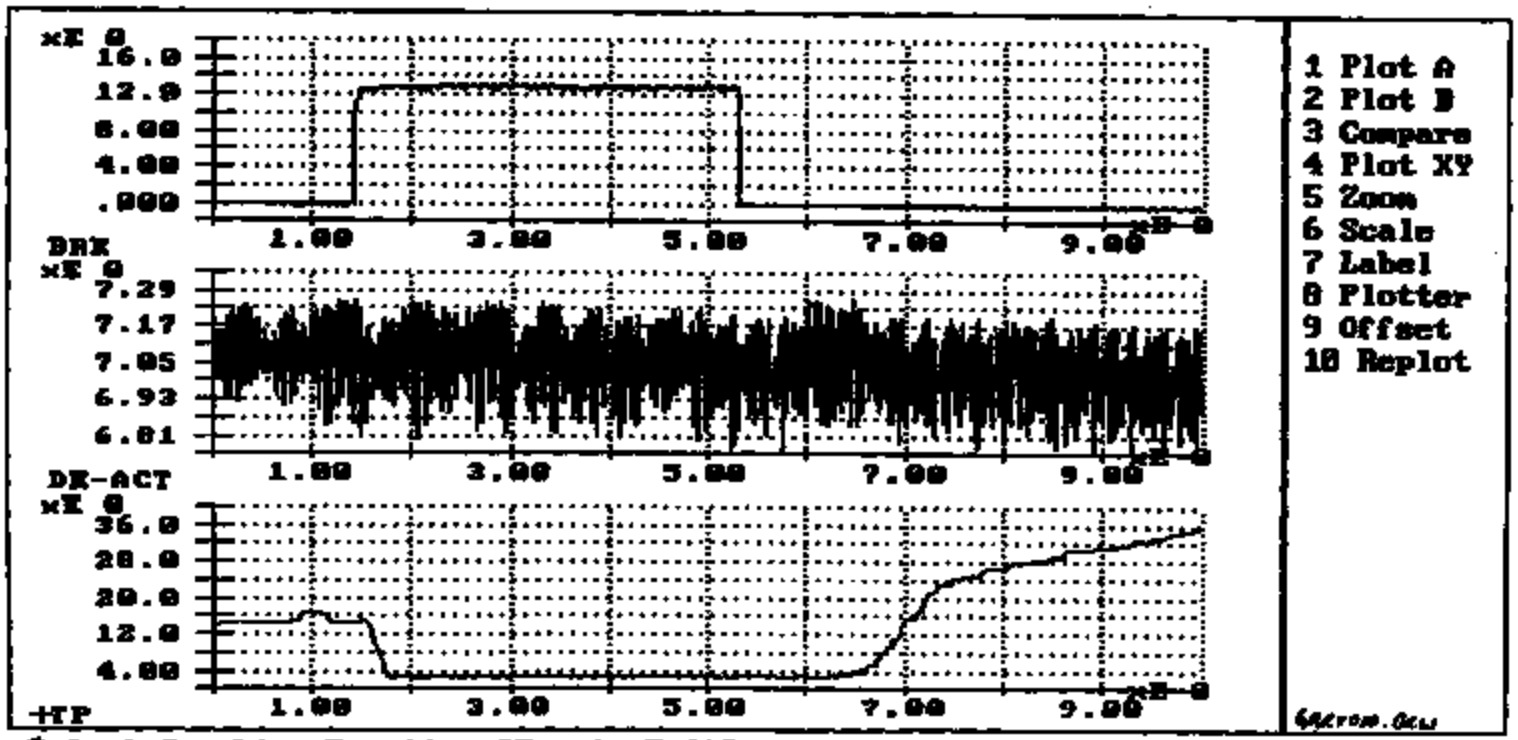

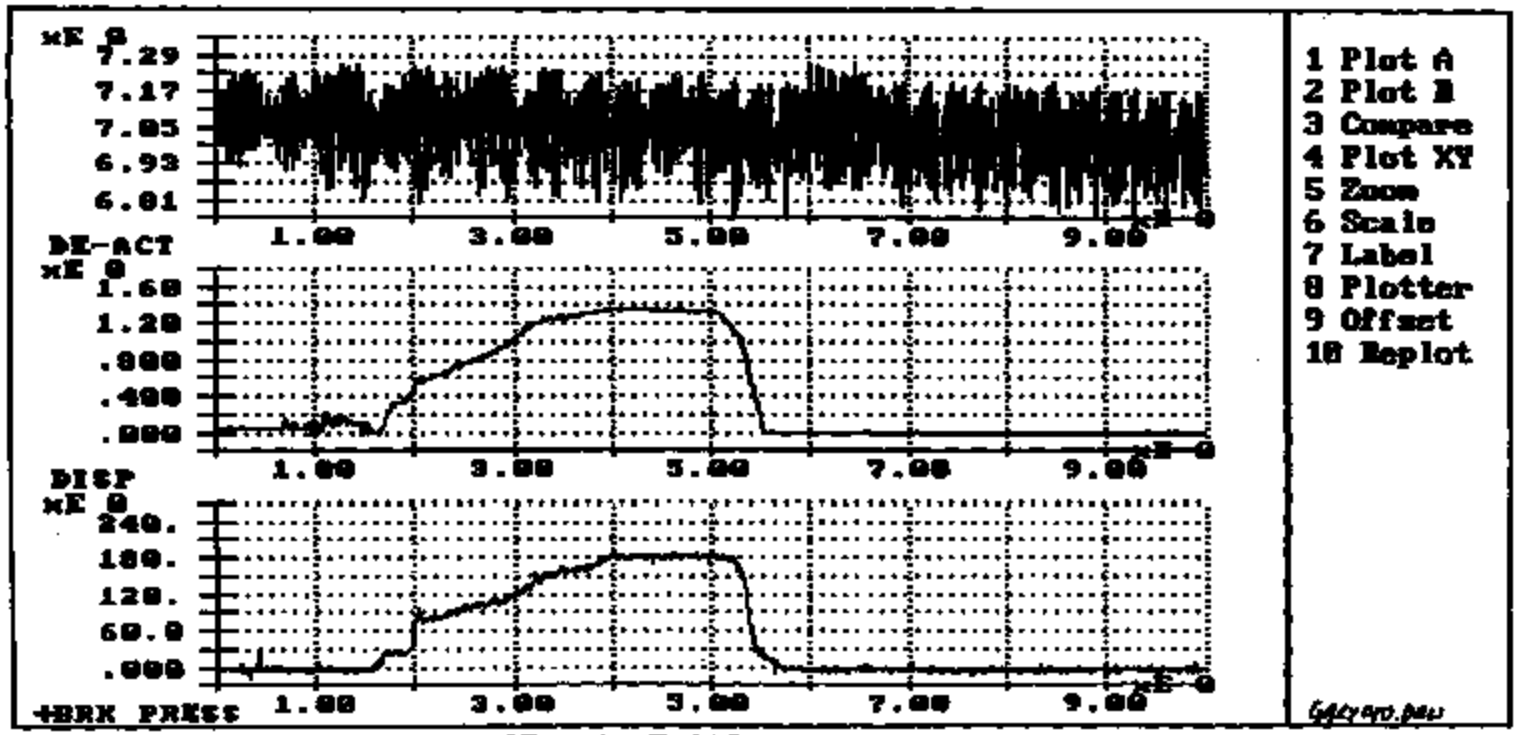

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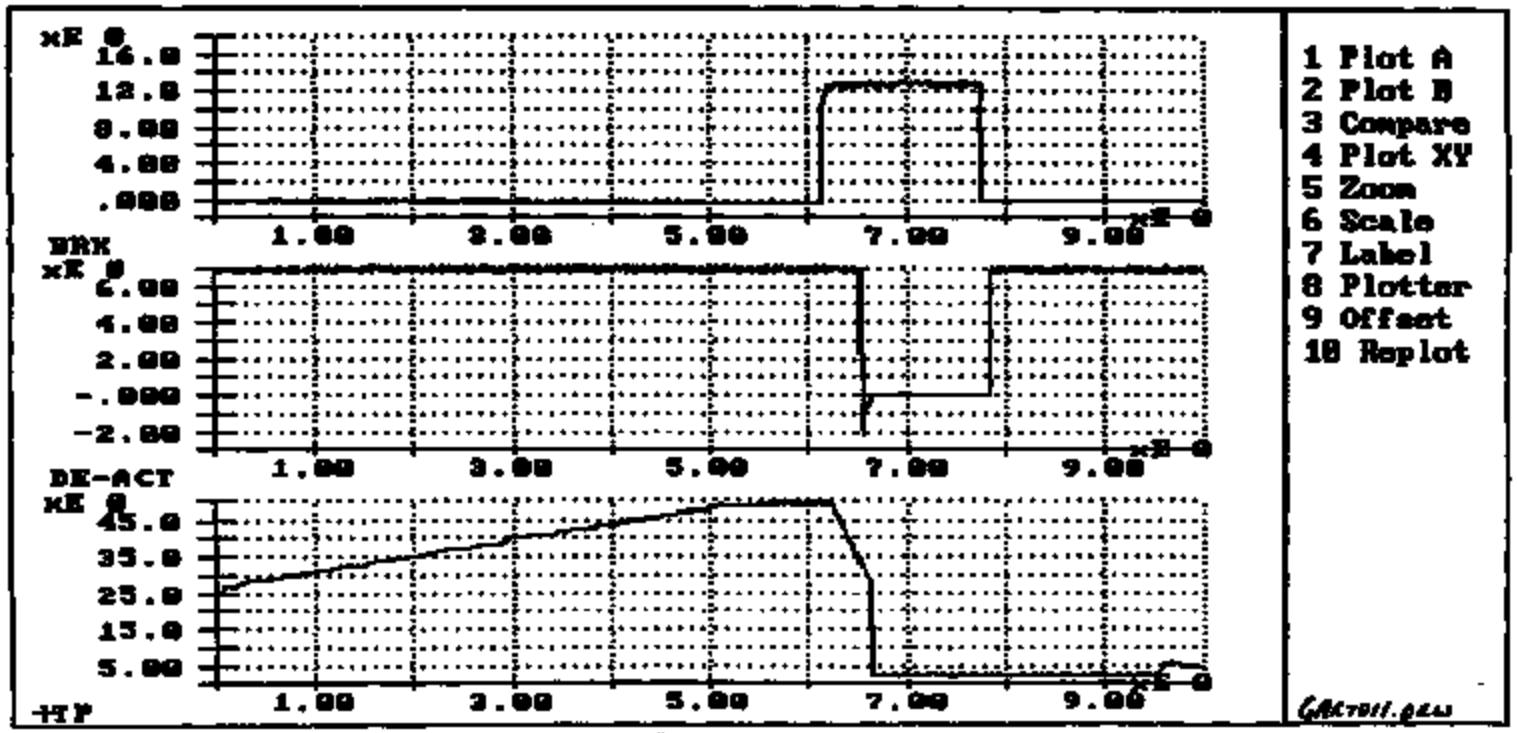

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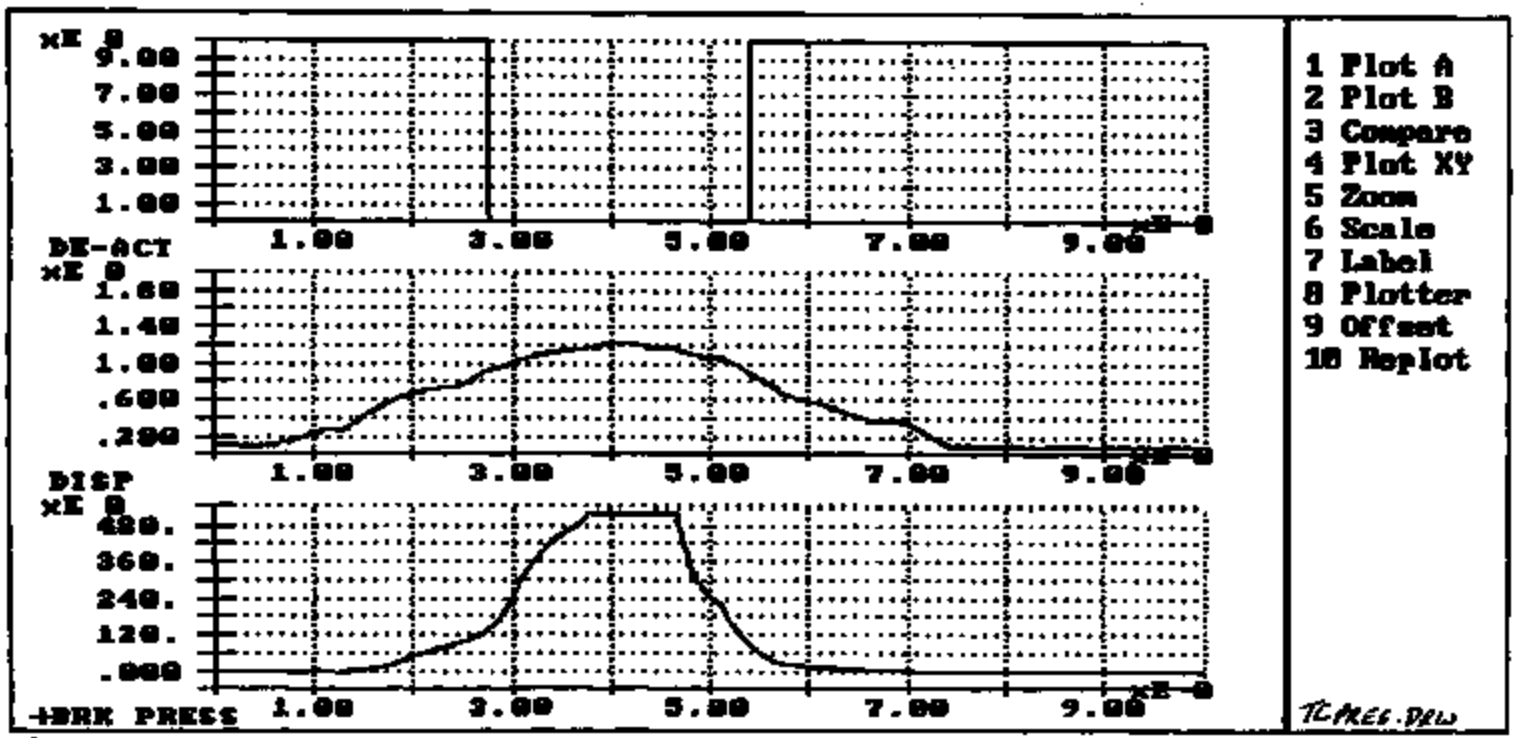
Garage Brake Test
Lincoln Town Car

Rupert Andrews
Kah Oo
8/24/89

Lincoln Town Car Brake Test 8/24/89

File	Description
Front Brake Line	
Old Pressure Switch	
TCPRES.DRW	Normal brake
TCPRE001.DRW	Cycle brake on/off at 0.9"
TCPR1001.DRW	Cycle brake on/off
TCPR1002.DRW	Cycle brake hard on/off
TCPR1003.DRW	Press in/let brake pedal self release
TCPR1004.DRW	De-Act./No Brake
New Pressure Switch	
TCNEW001.DRW	Normal brake
TCNEW002.DRW	Cycle brake on/off at 0.9"
TCNEW003.DRW	Cycle brake on/off
TCNEW004.DRW	Cycle brake hard on/off
TCNEW005.DRW	Press in/let brake pedal self release
Rear Brake Line	
New Pressure Switch	
TCNRR001.DRW	Normal brake
TCNRR002.DRW	Cycle brake on/off
TCNRR003.DRW	Cycle brake on/off
TCNRR004.DRW	Cycle brake hard on/off
TCNRR005.DRW	Press in/let brake pedal self release



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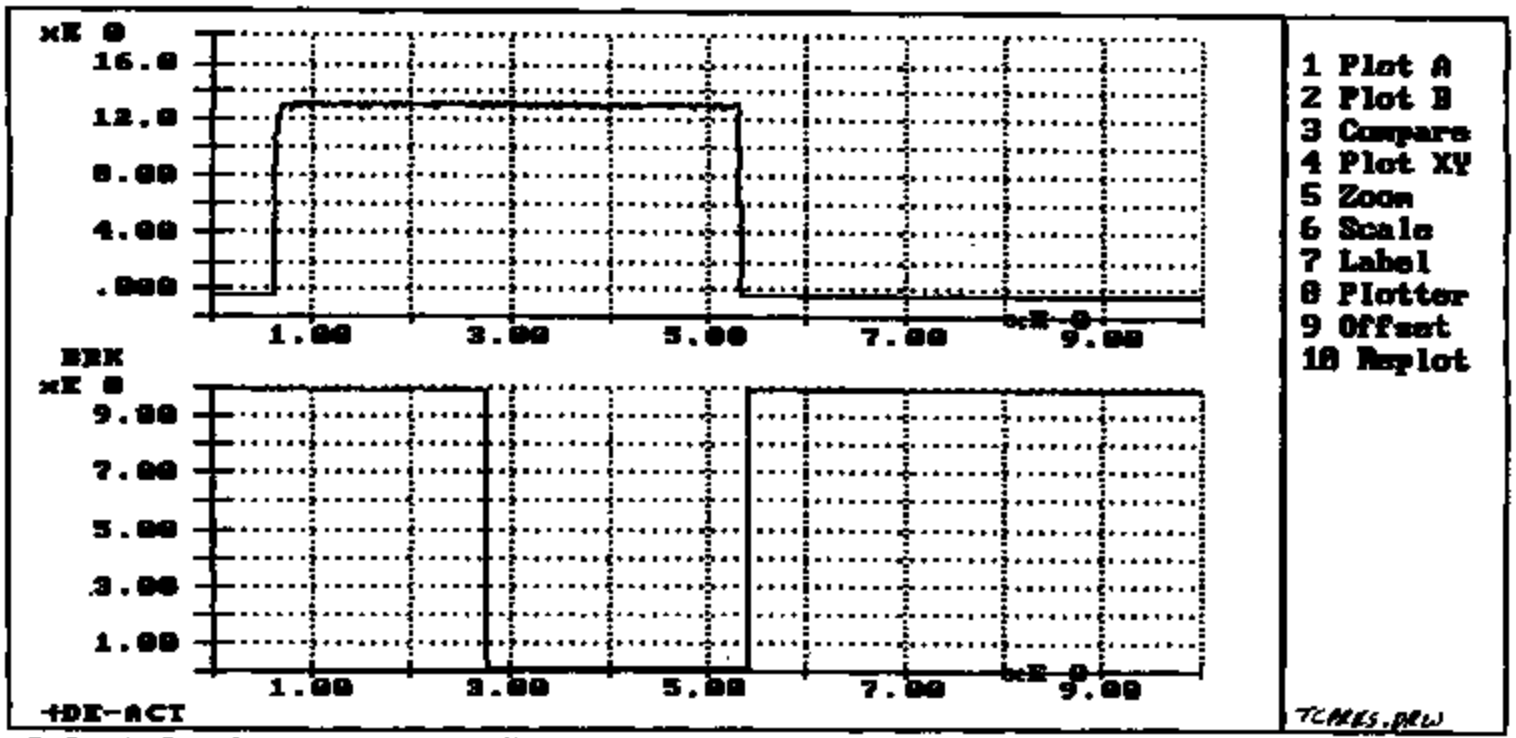

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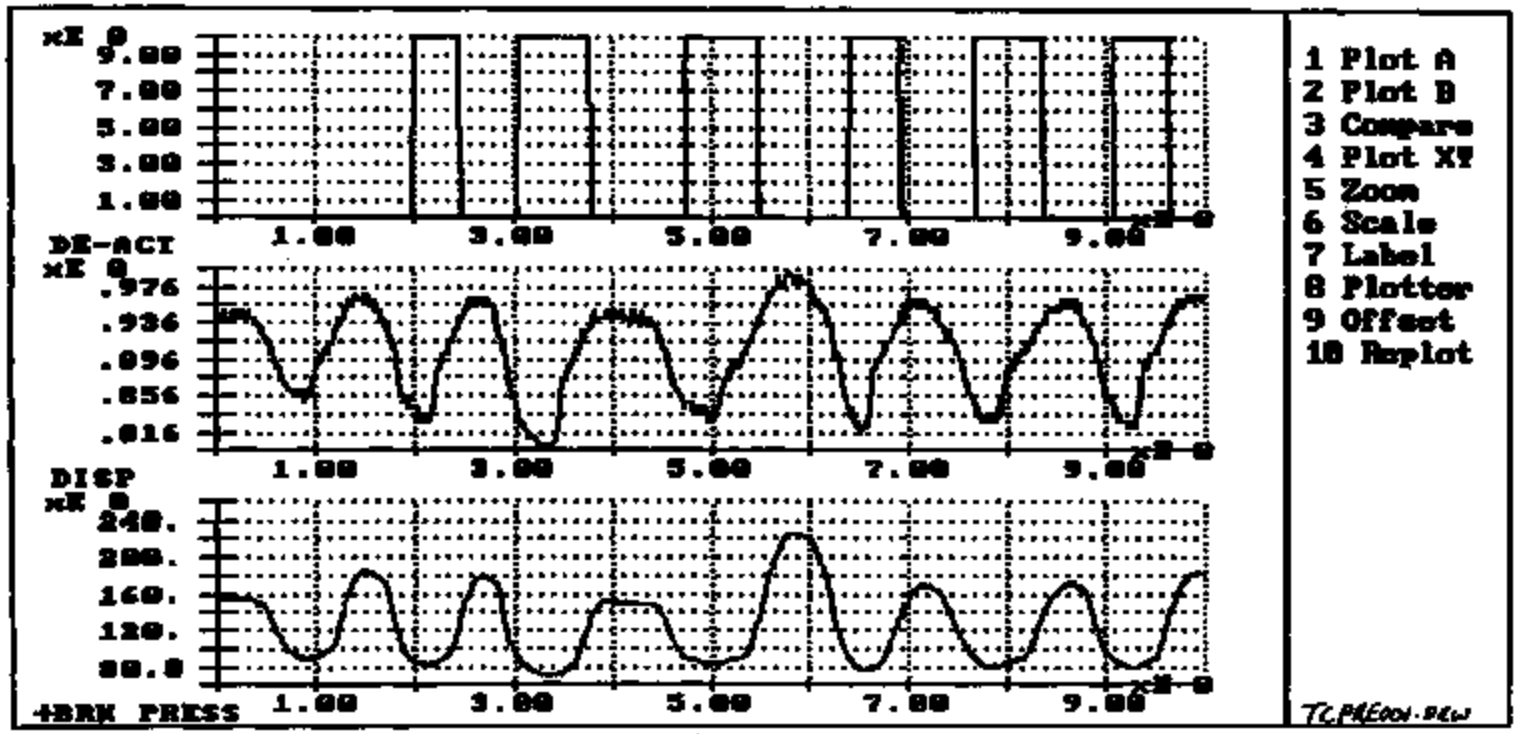
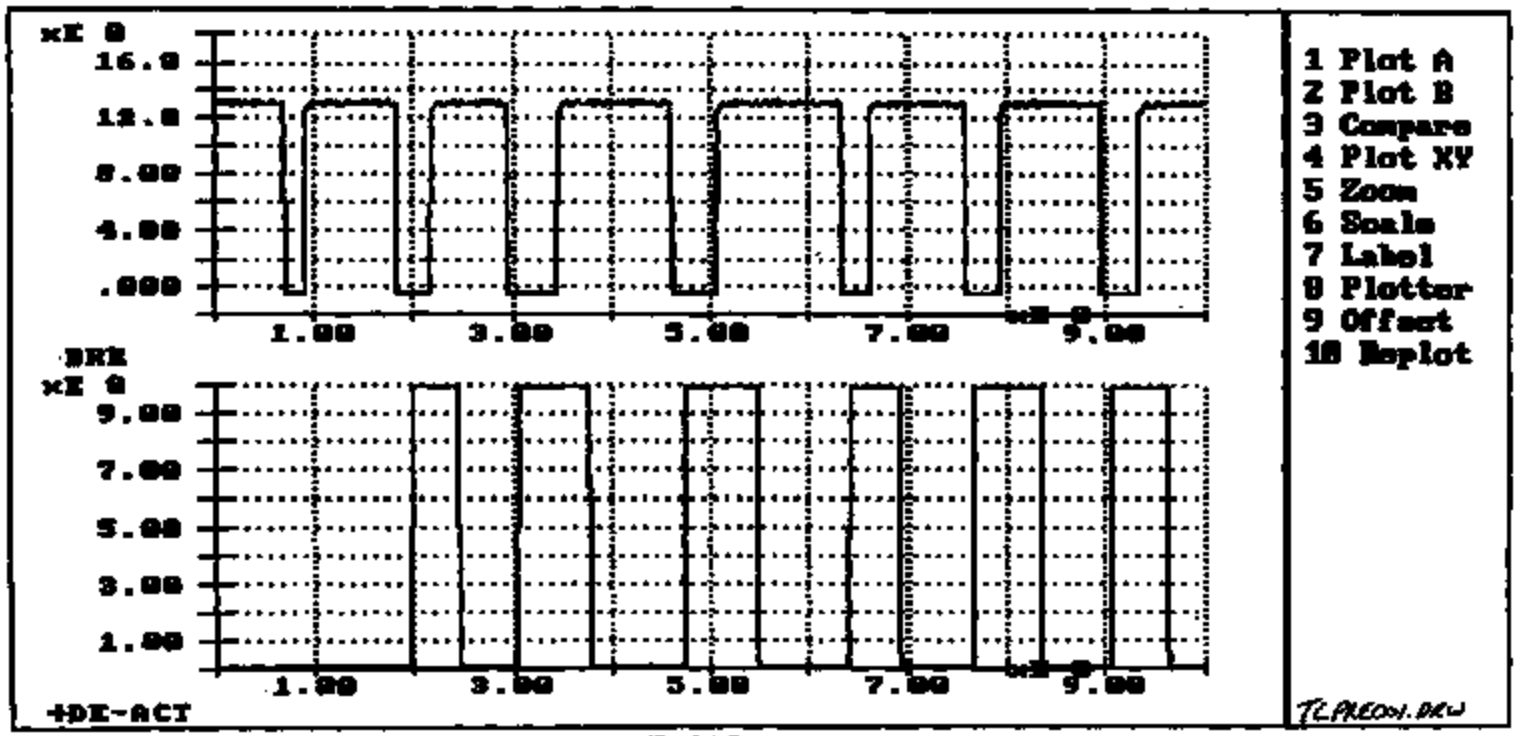


Select Graphics Function [Esc to Exit] :



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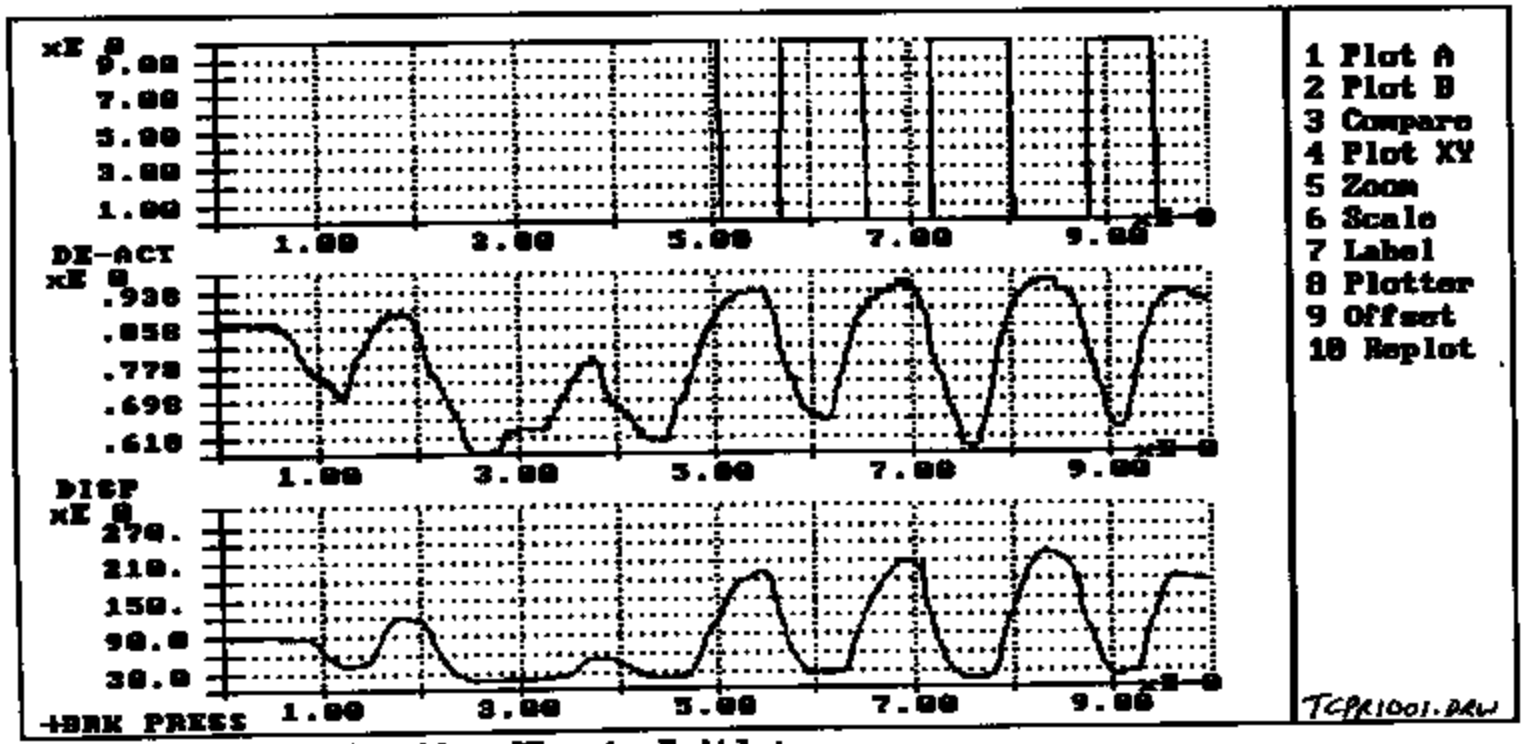

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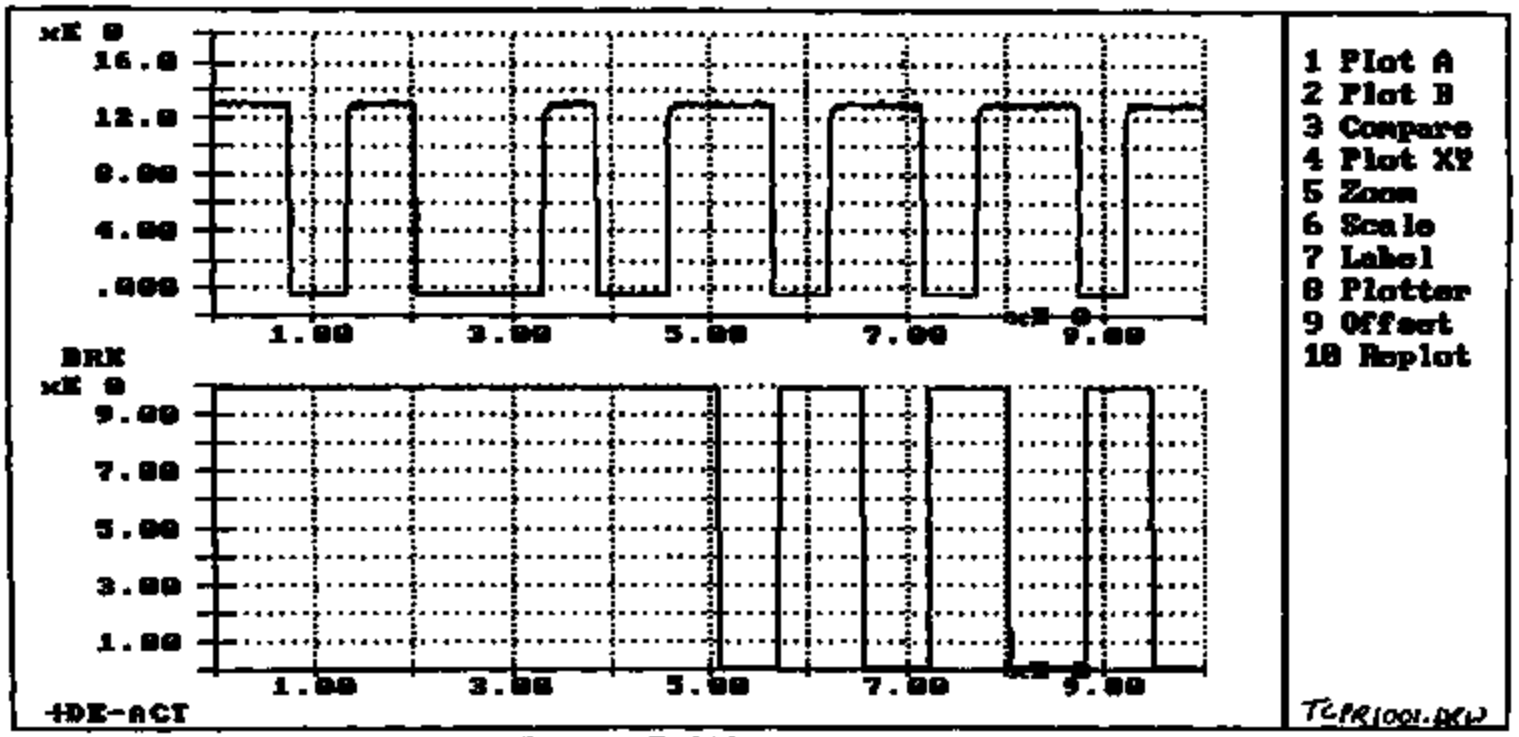

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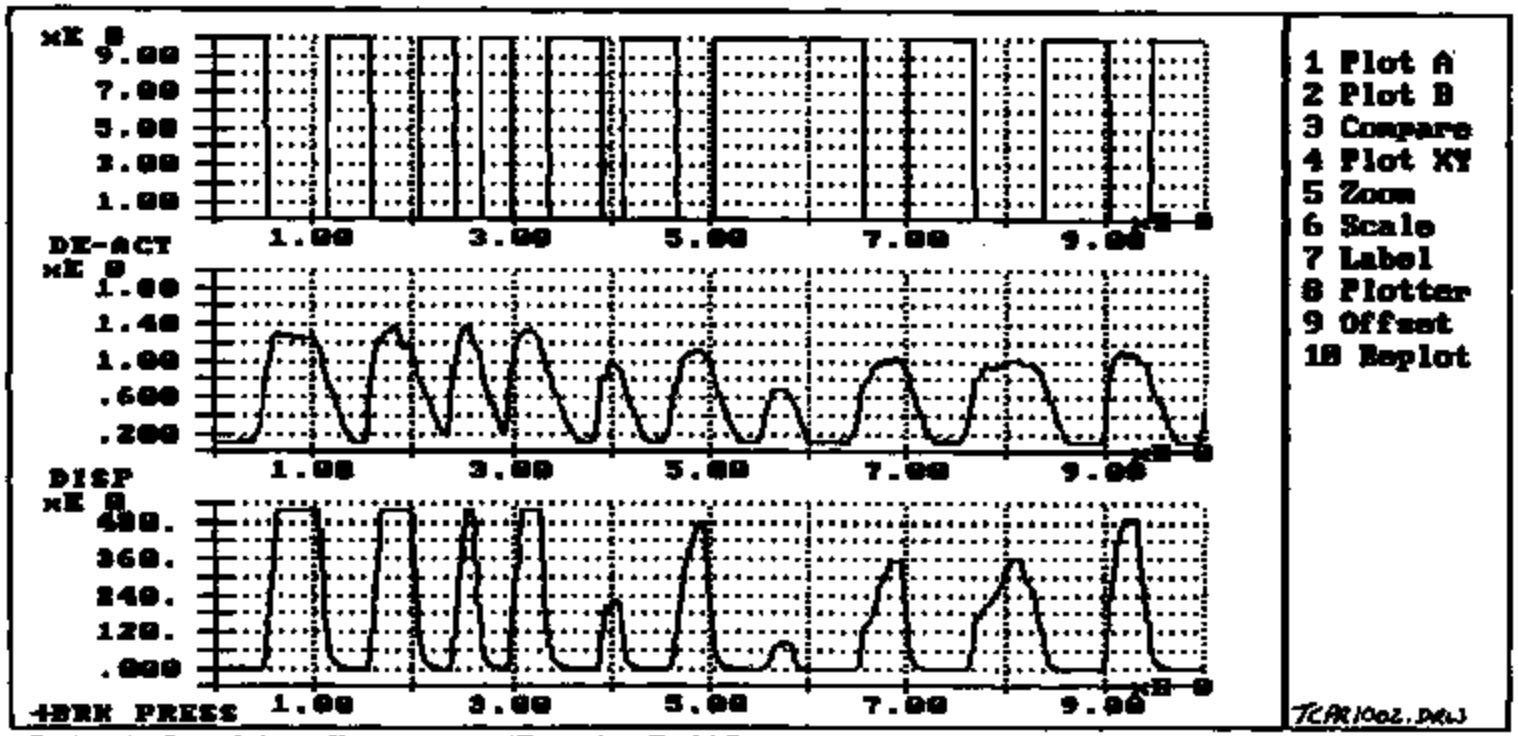

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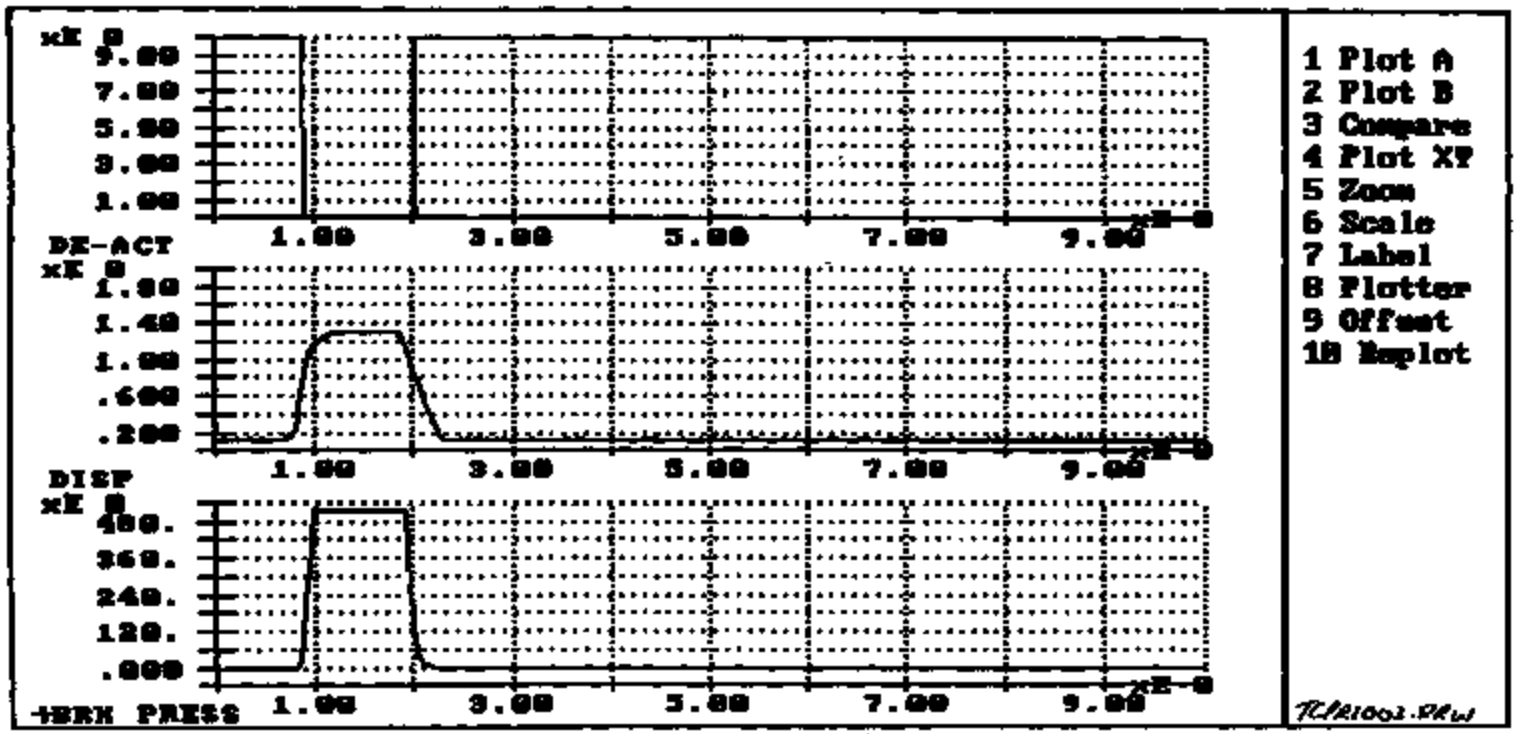
Select Graphics Function [Esc to Exit] :



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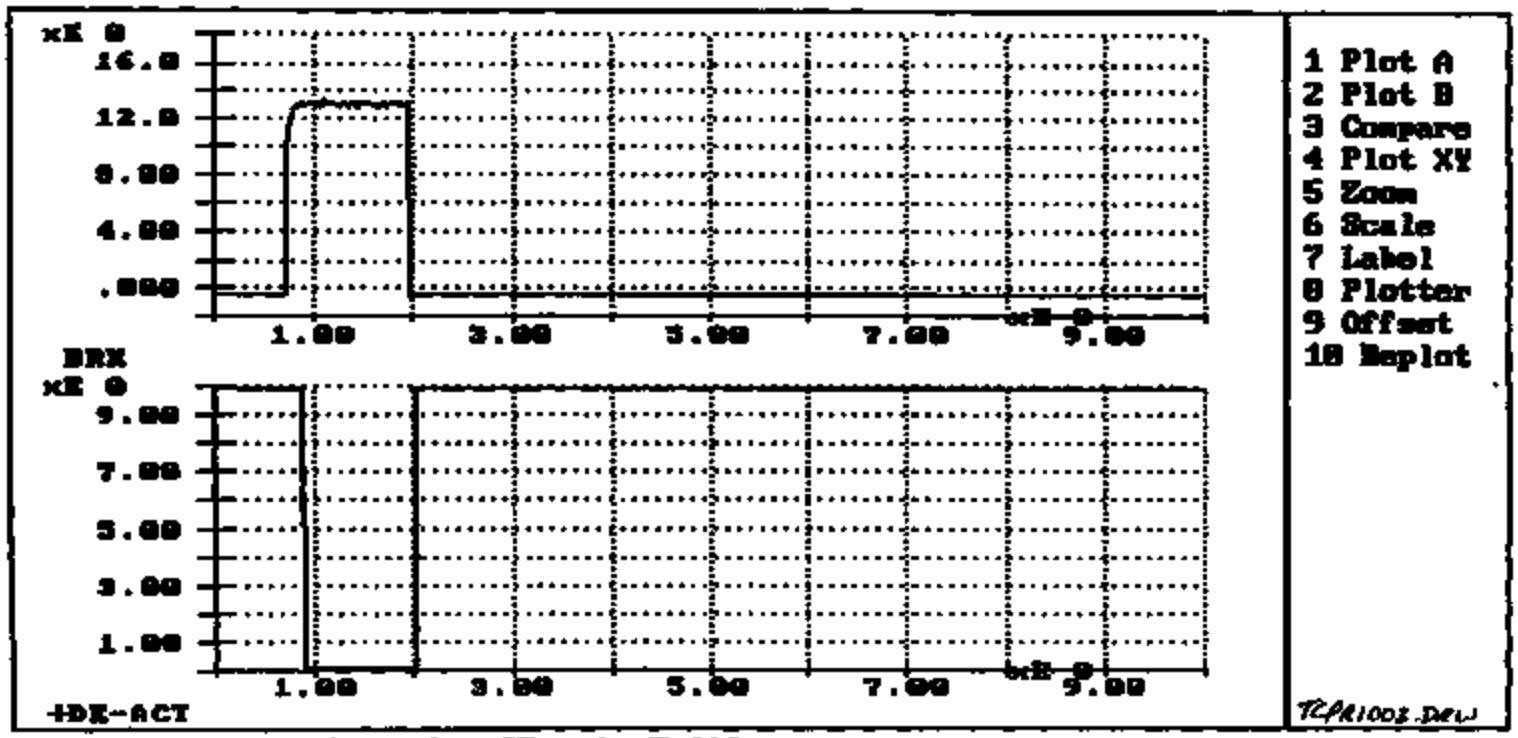
TI-NHTSA 000475



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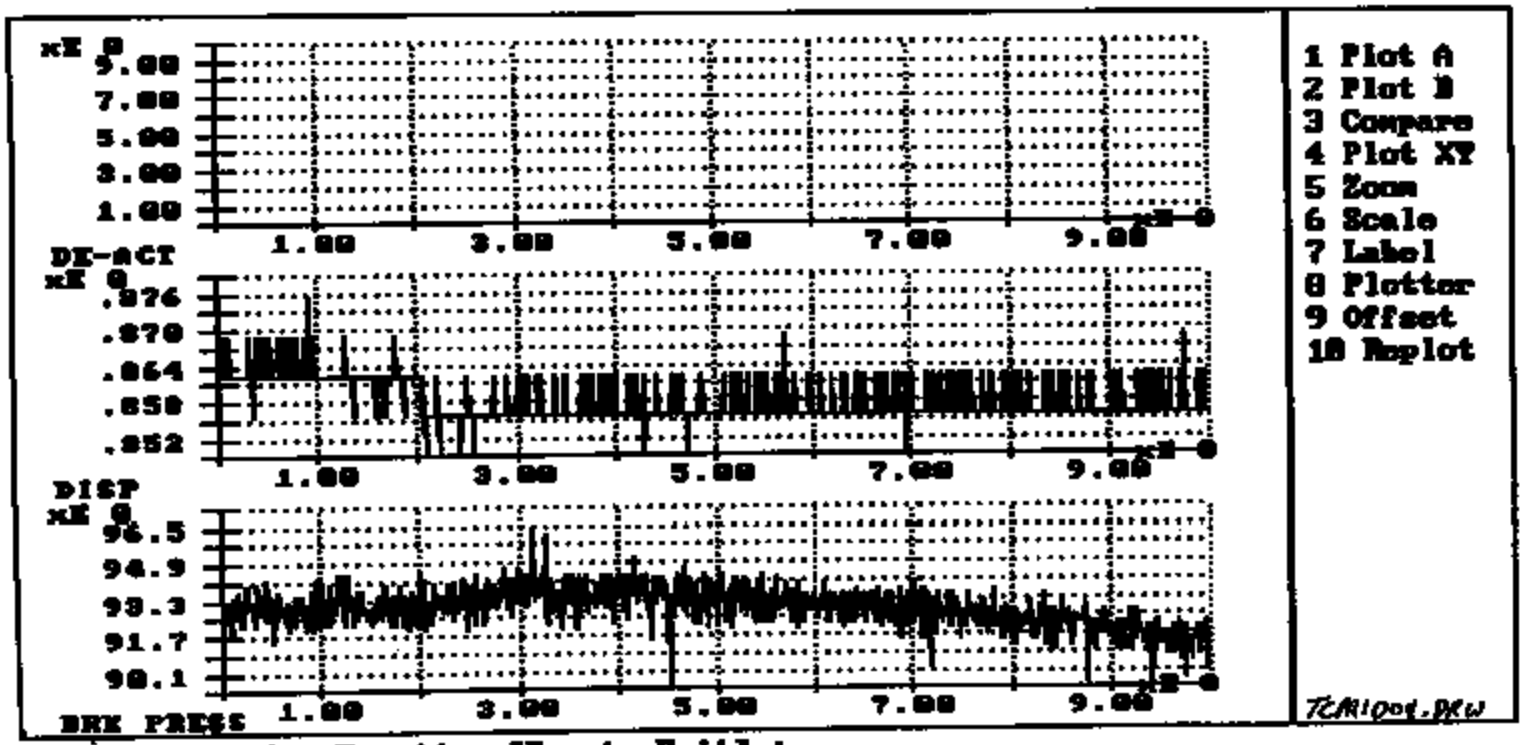
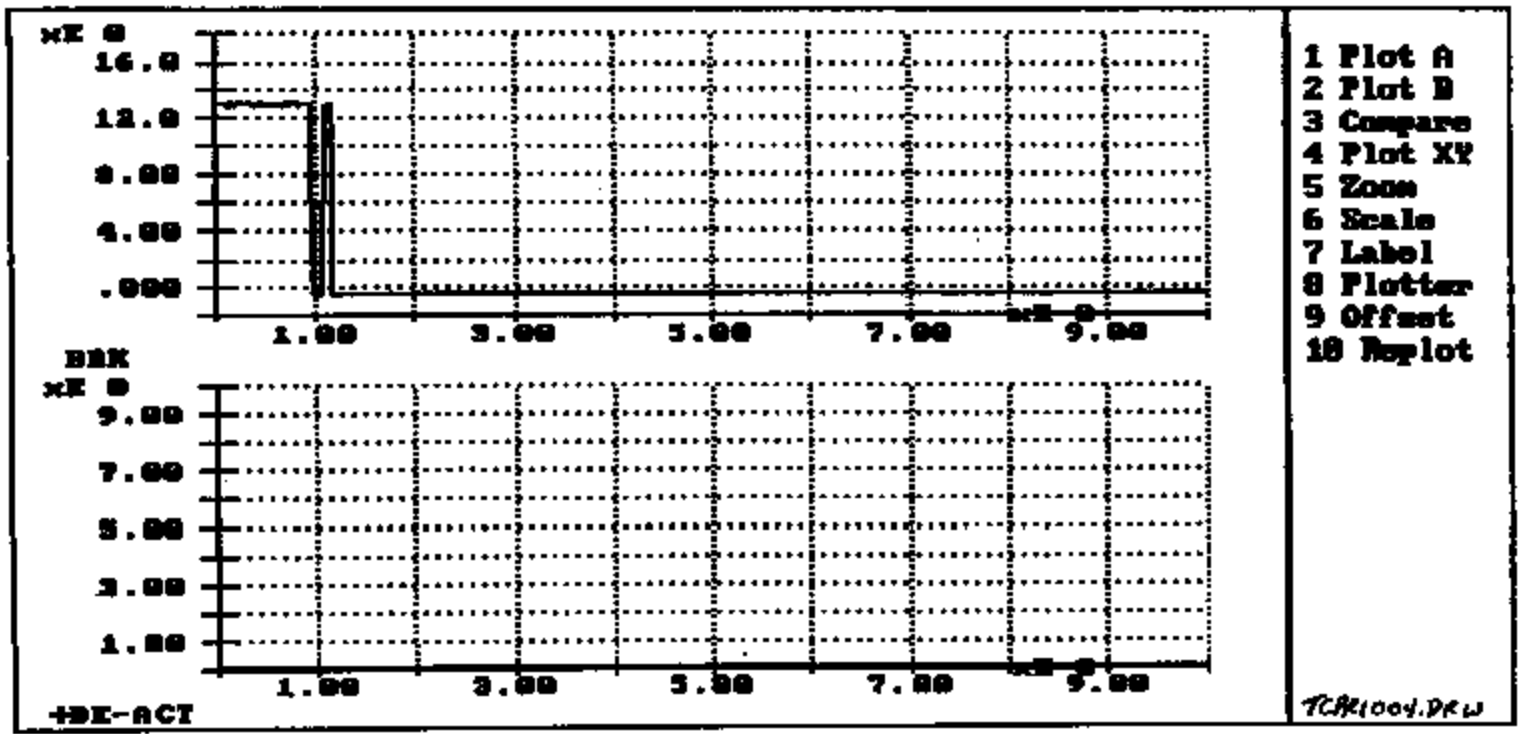


Select Graphics Function [Esc to Exit] :
Scale is ON.



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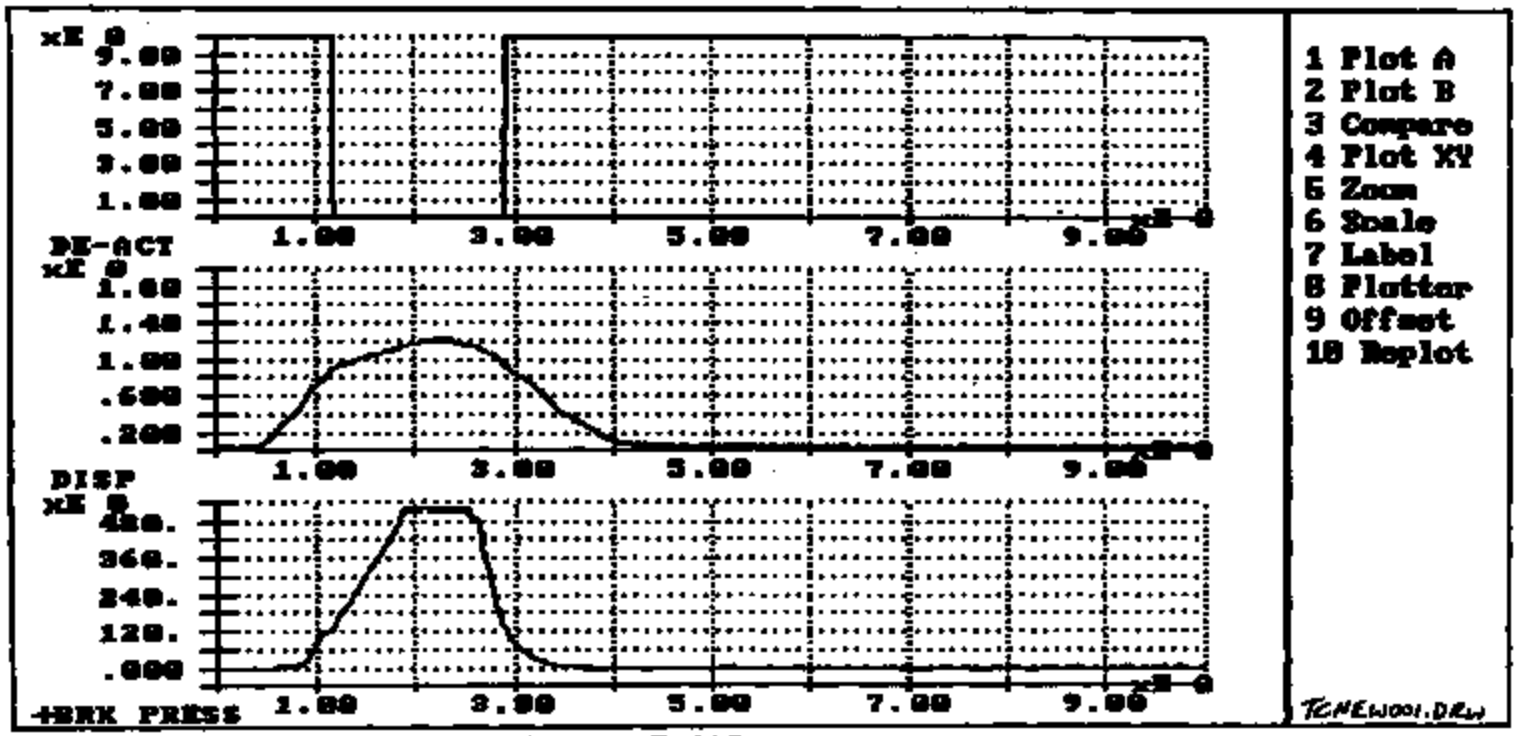
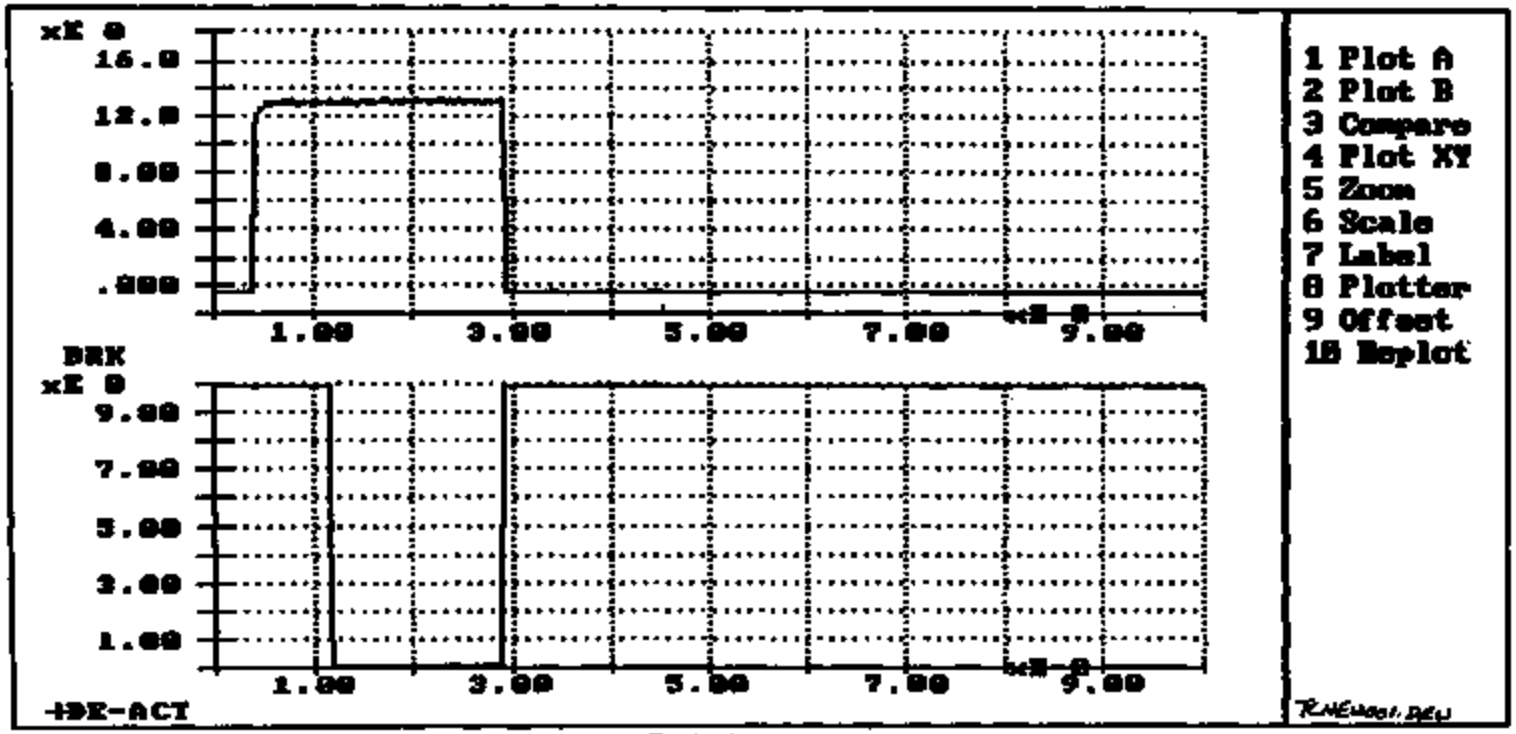
Scale is ON.



Select Graphics Function [Esc to Exit] :
Scale is ON.



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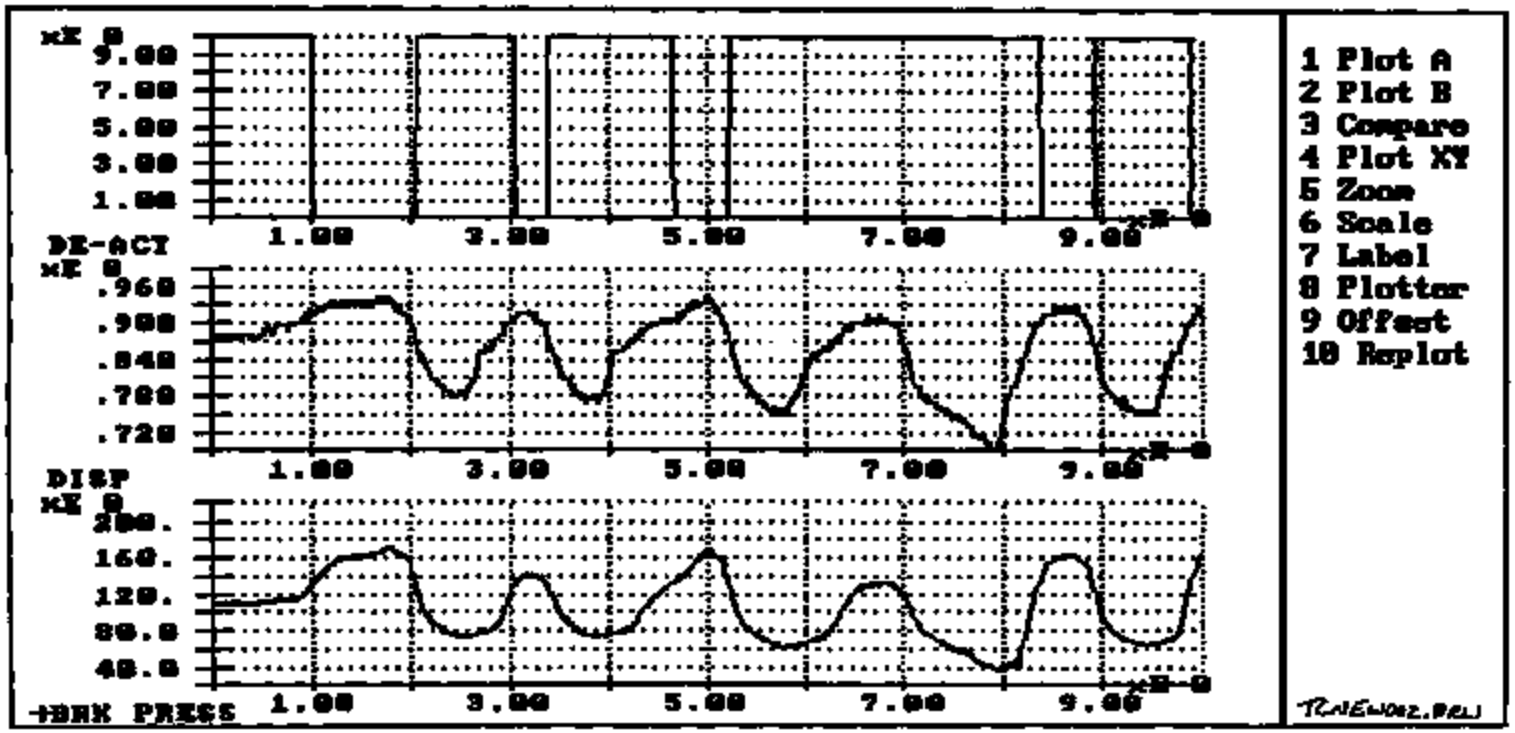
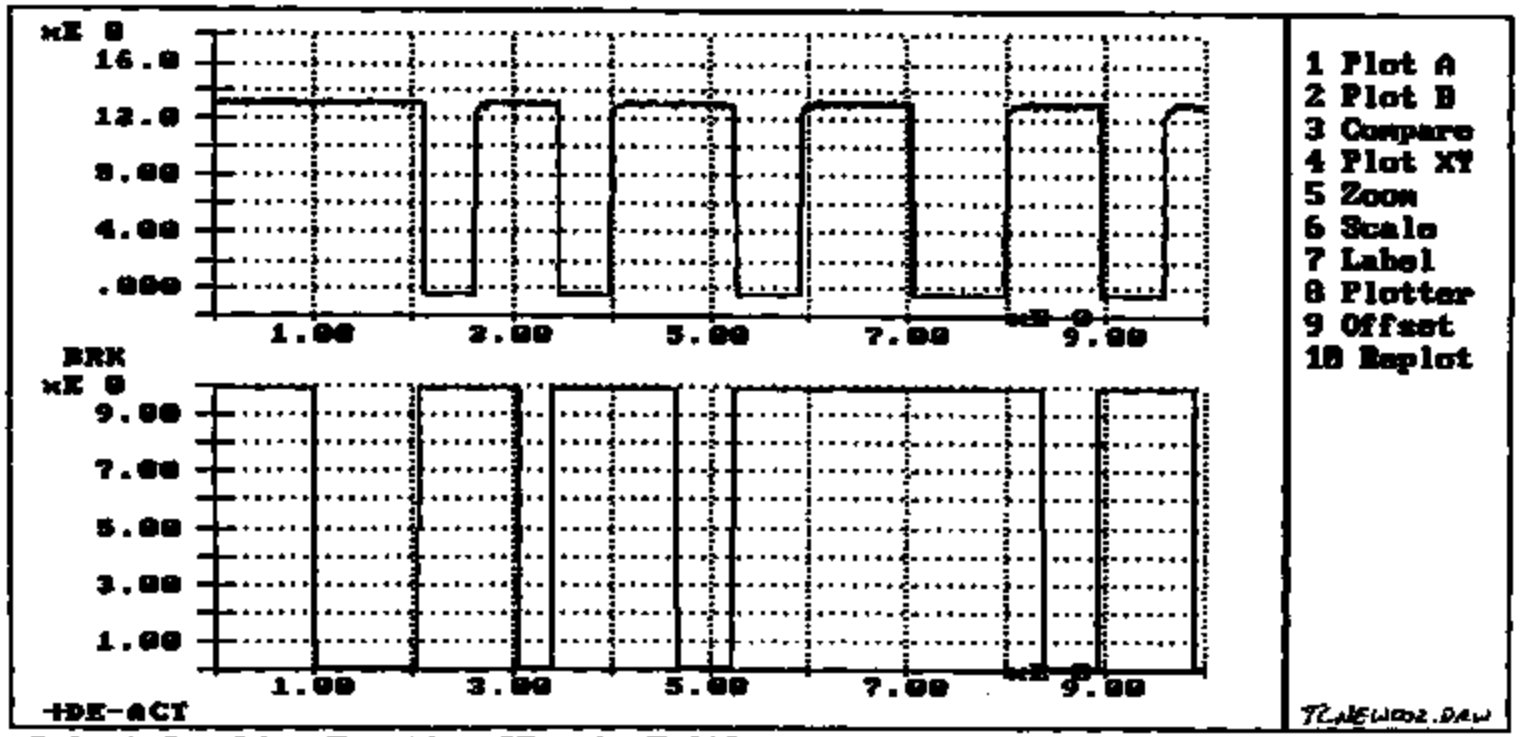
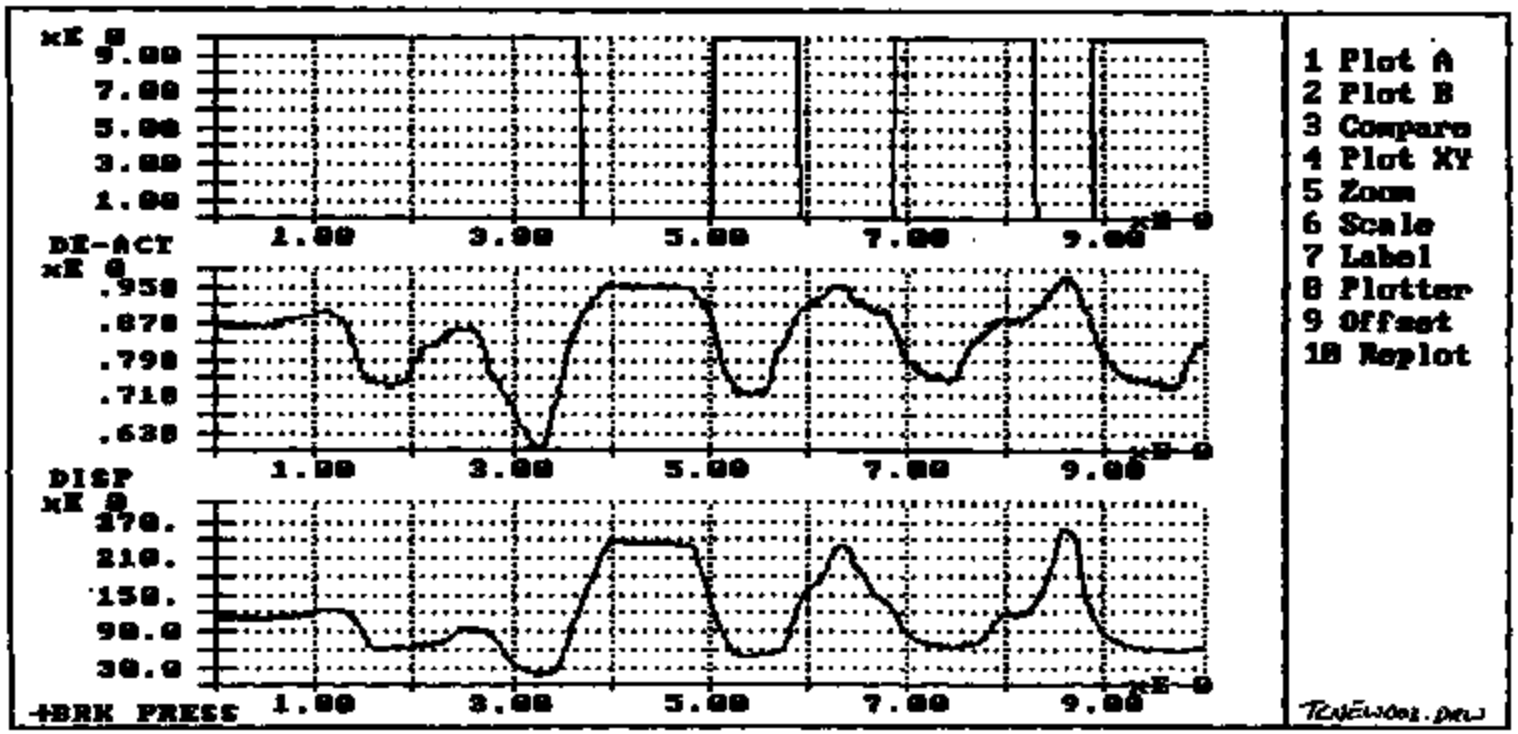
Scale is ON.



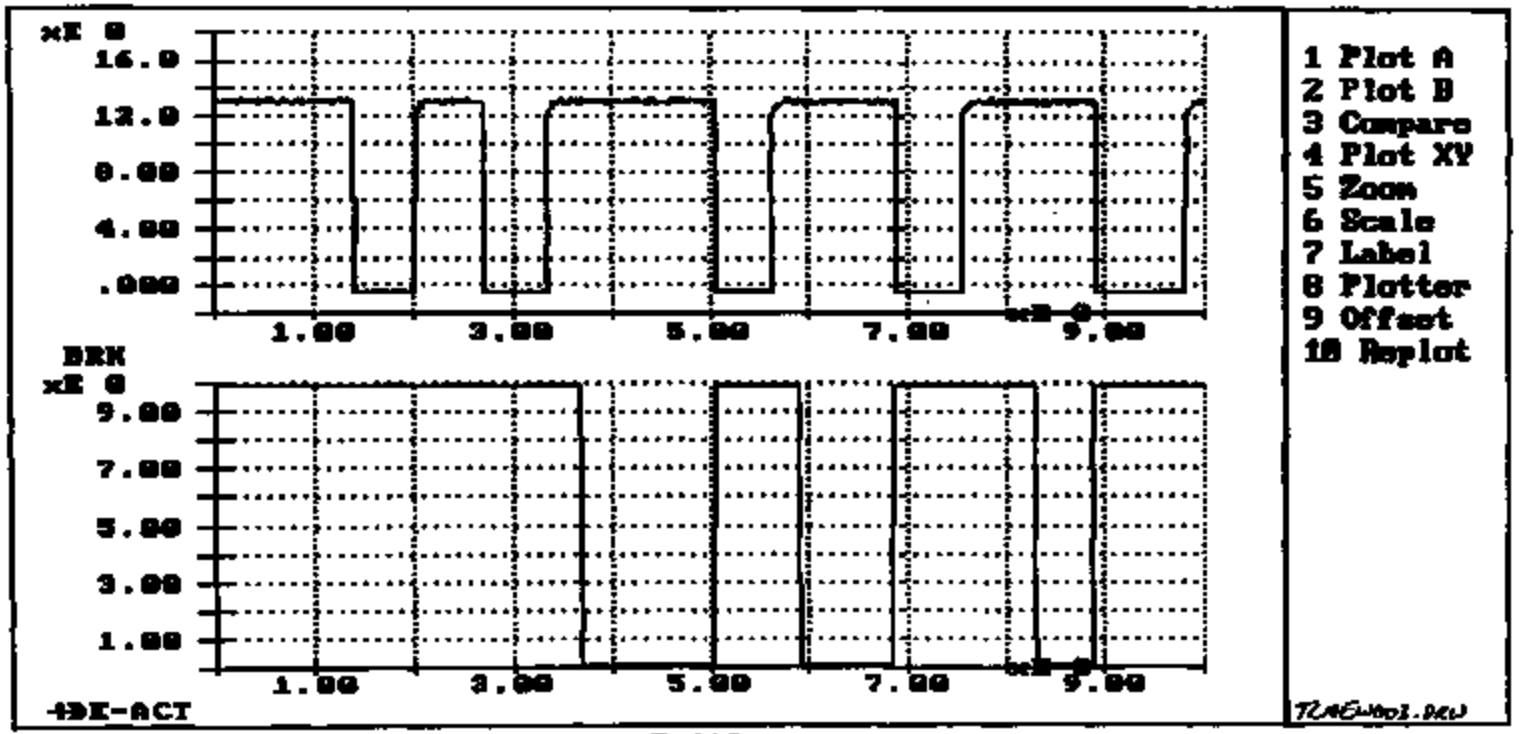
Select Graphics Function [Esc to Exit] :
Scale is ON.



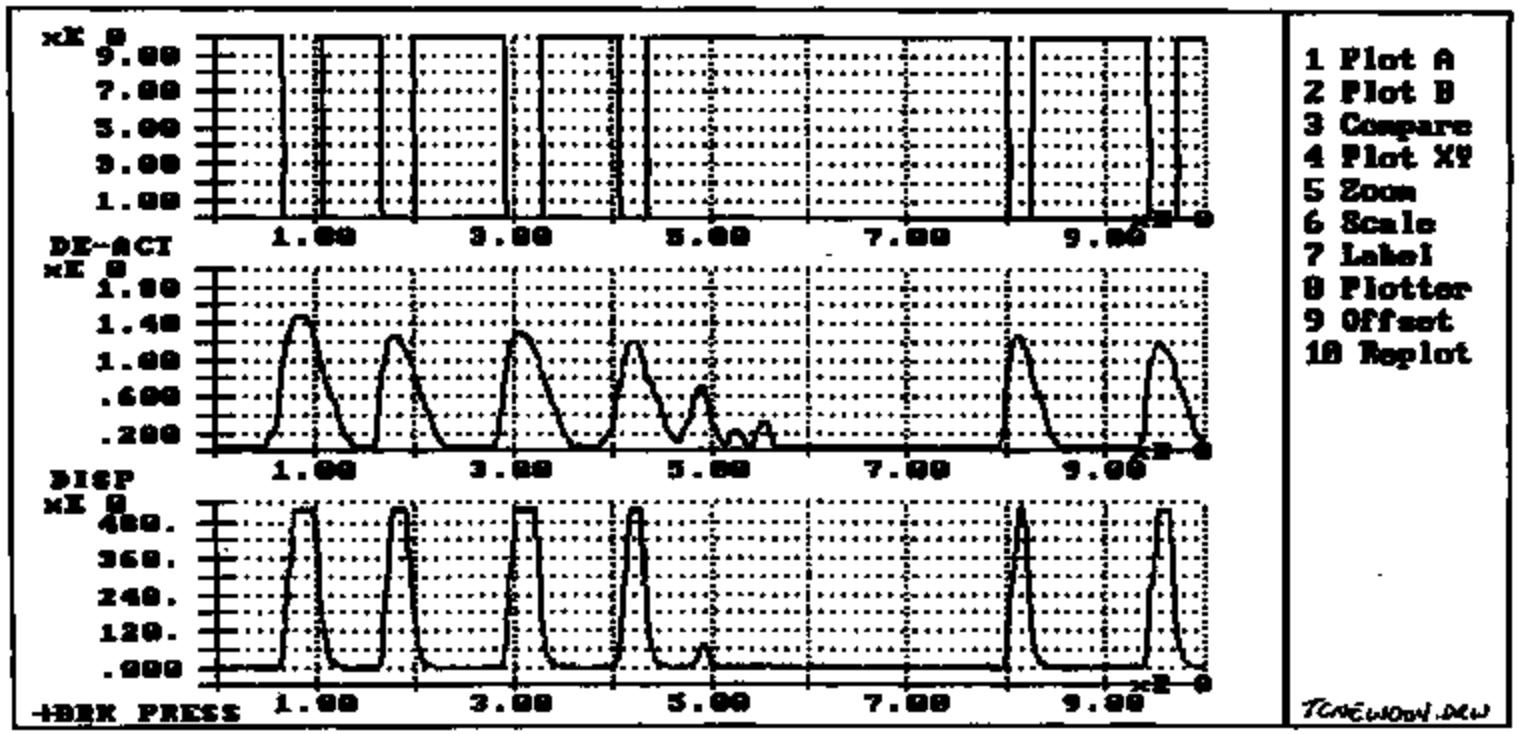
Select Graphics Function [Esc to Exit] :
Scale is ON.



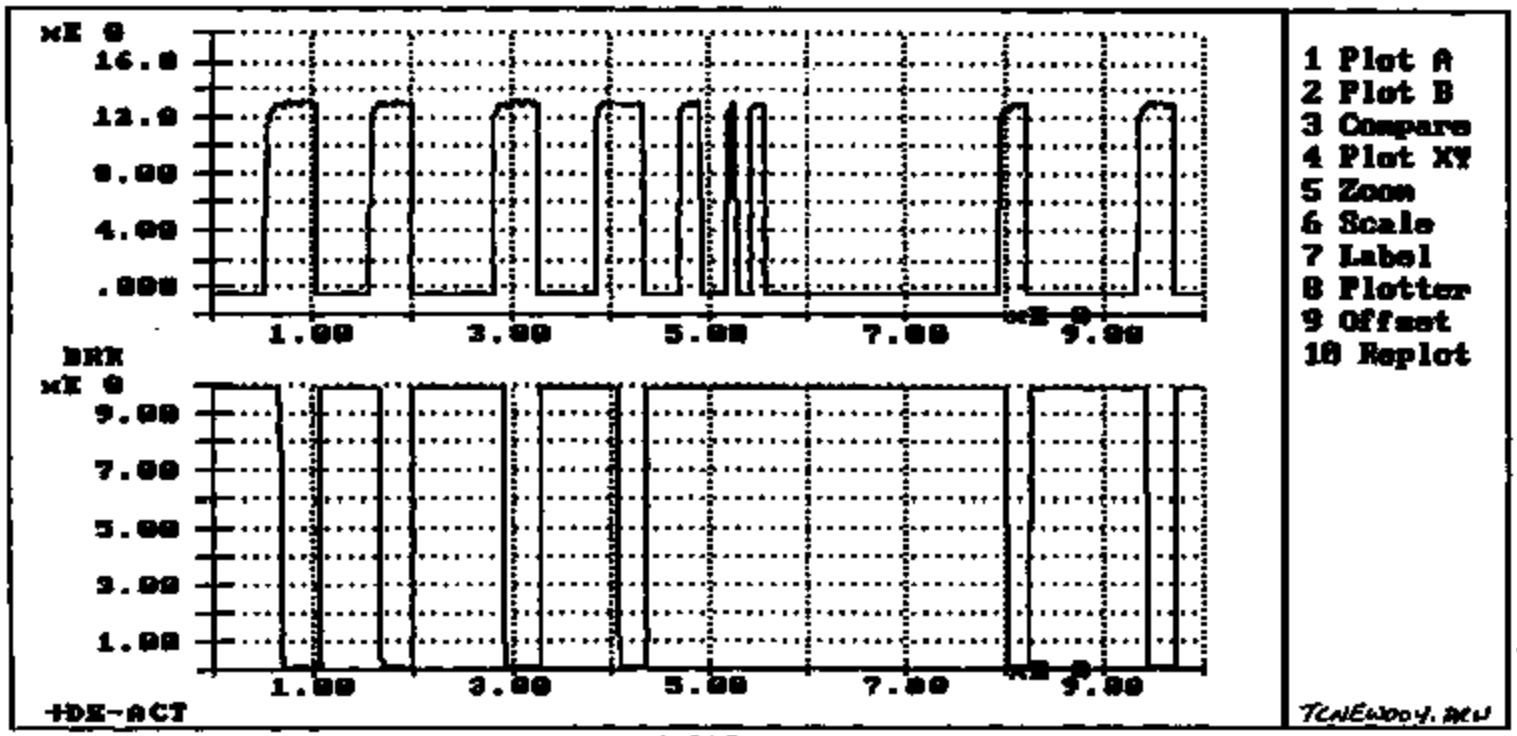
Select Graphics Function [Esc to Exit] :
Scale is ON.



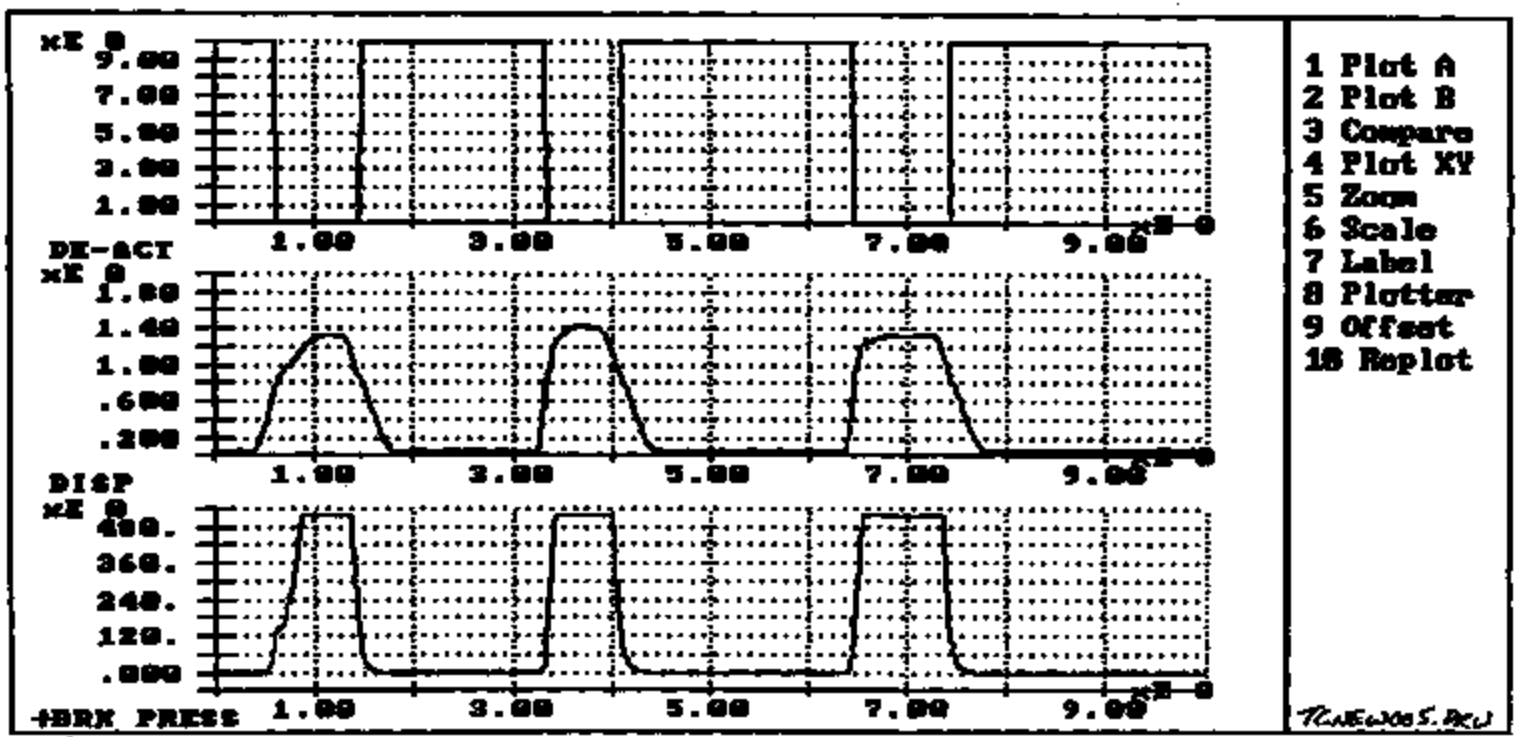
Select Graphics Function [Esc to Exit] :
Scale is ON.



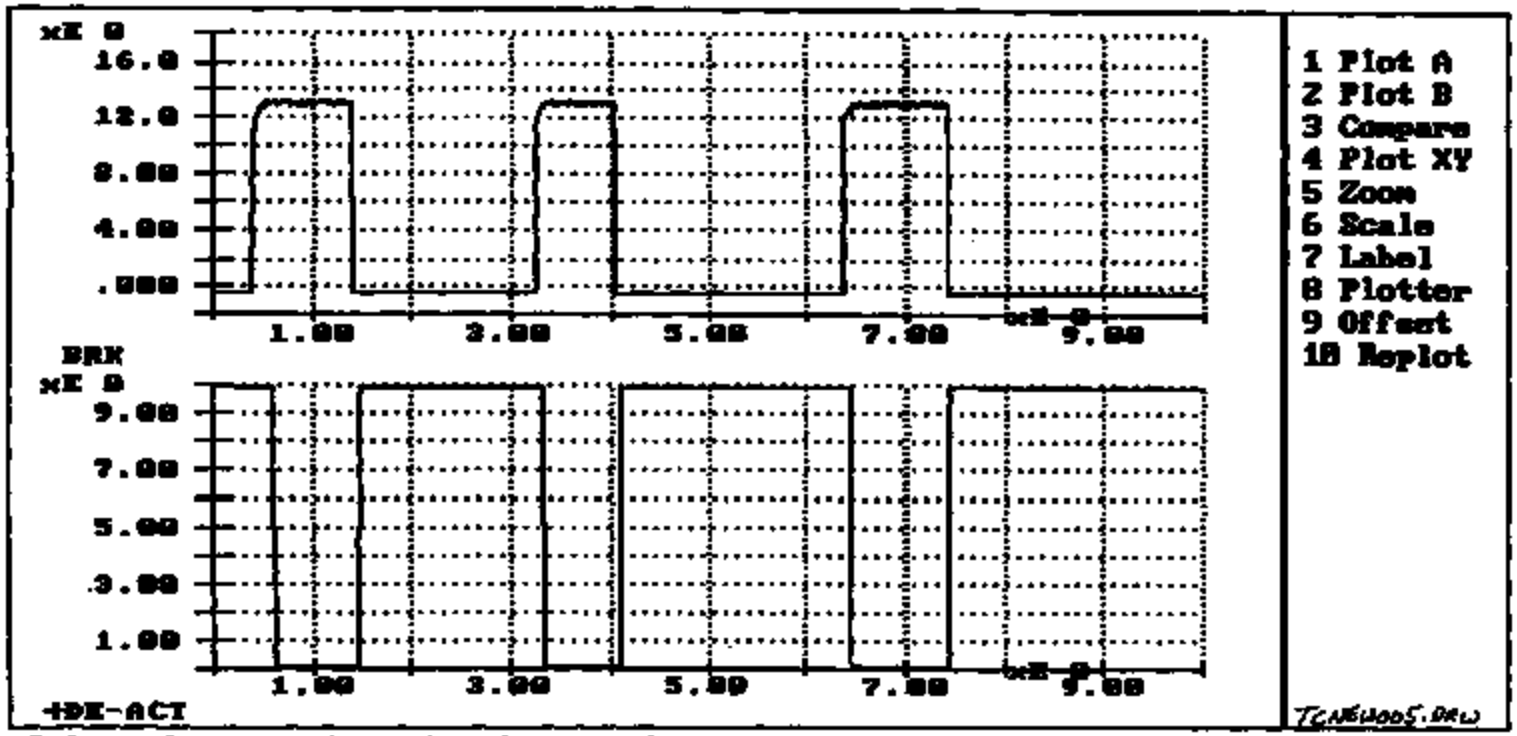
Select Graphics Function (Esc to Exit) :
Scale is ON.



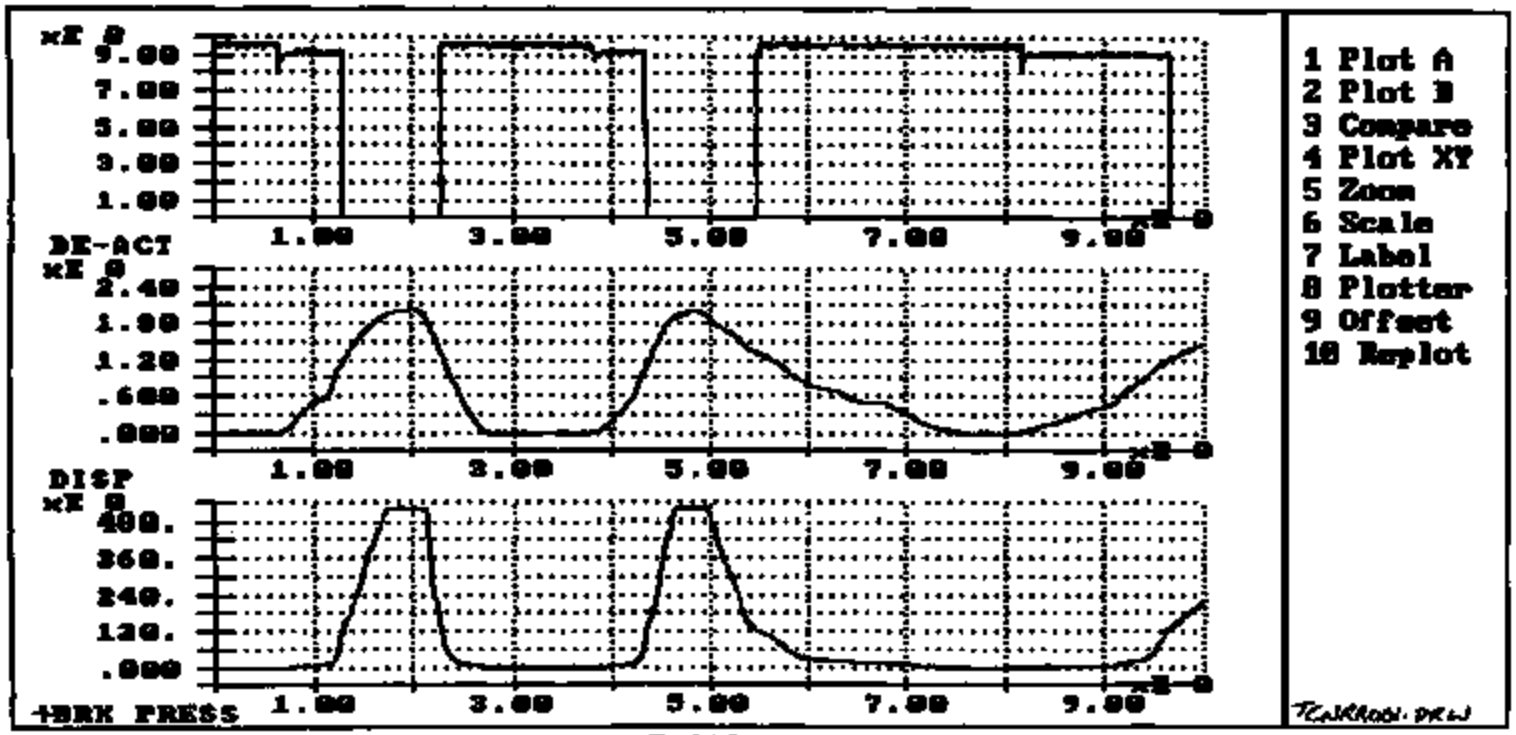
Select Graphics Function [Esc to Exit] :
Scale is ON.



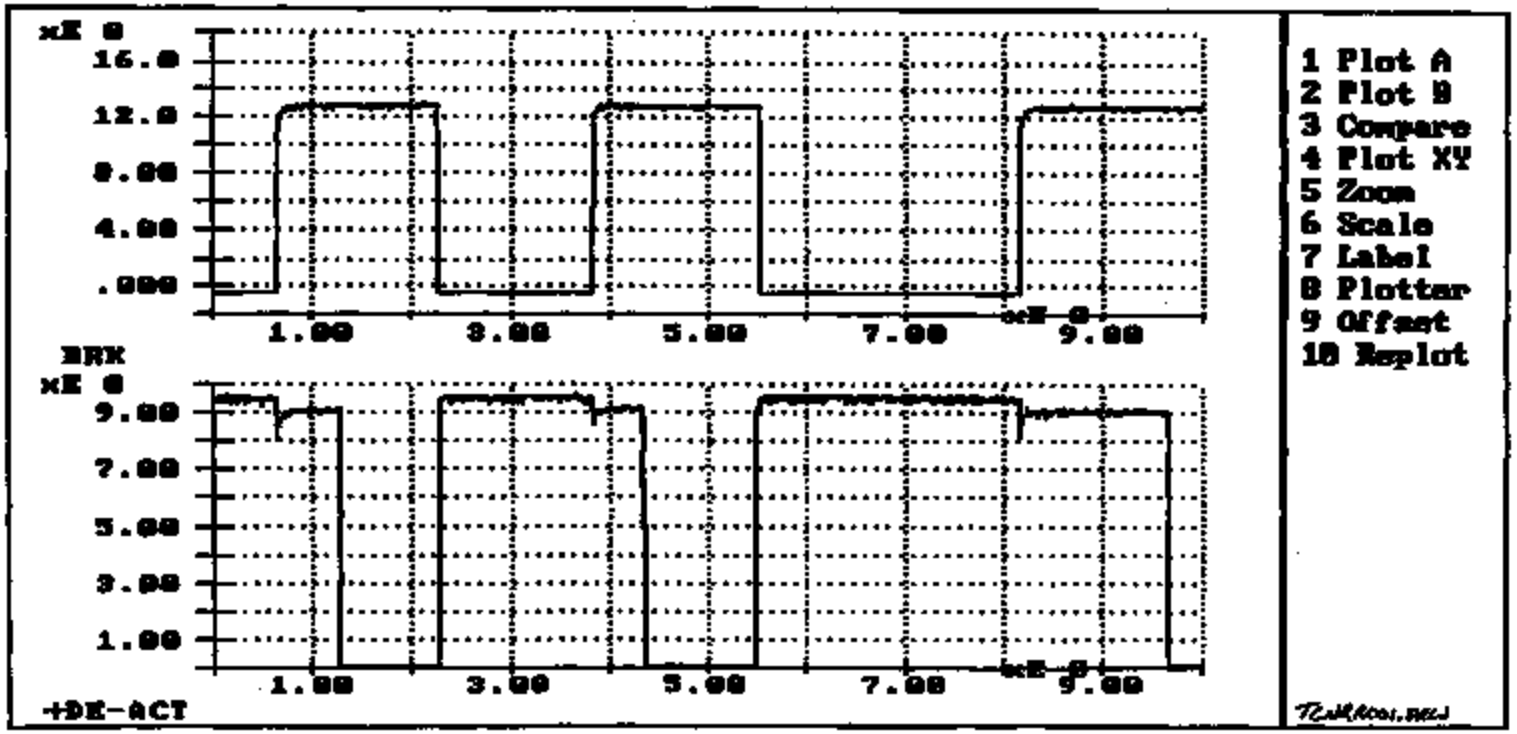
Select Graphics Function [Esc to Exit] :
Scale is Off.



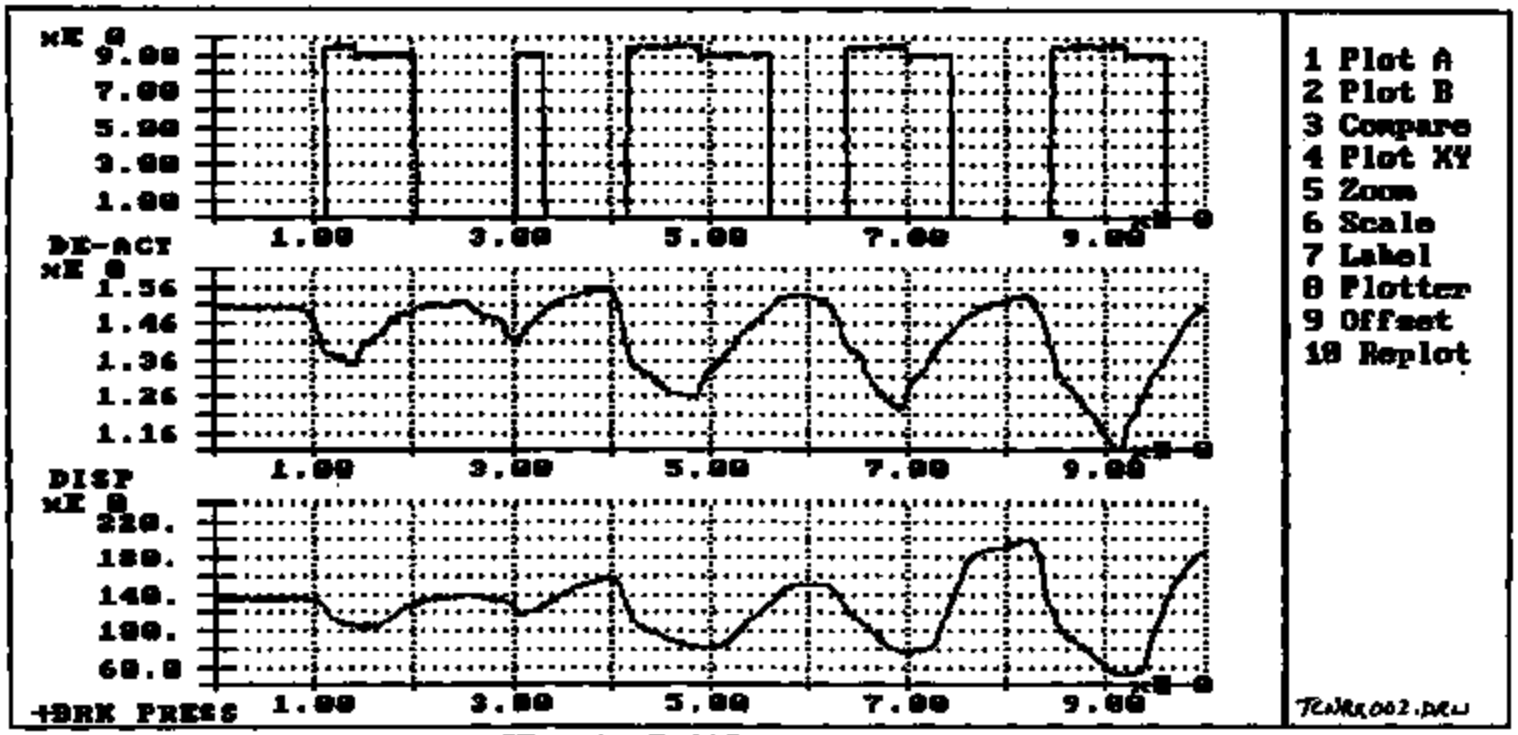
Select Graphics Function [Esc to Exit] :
Scale is ON.

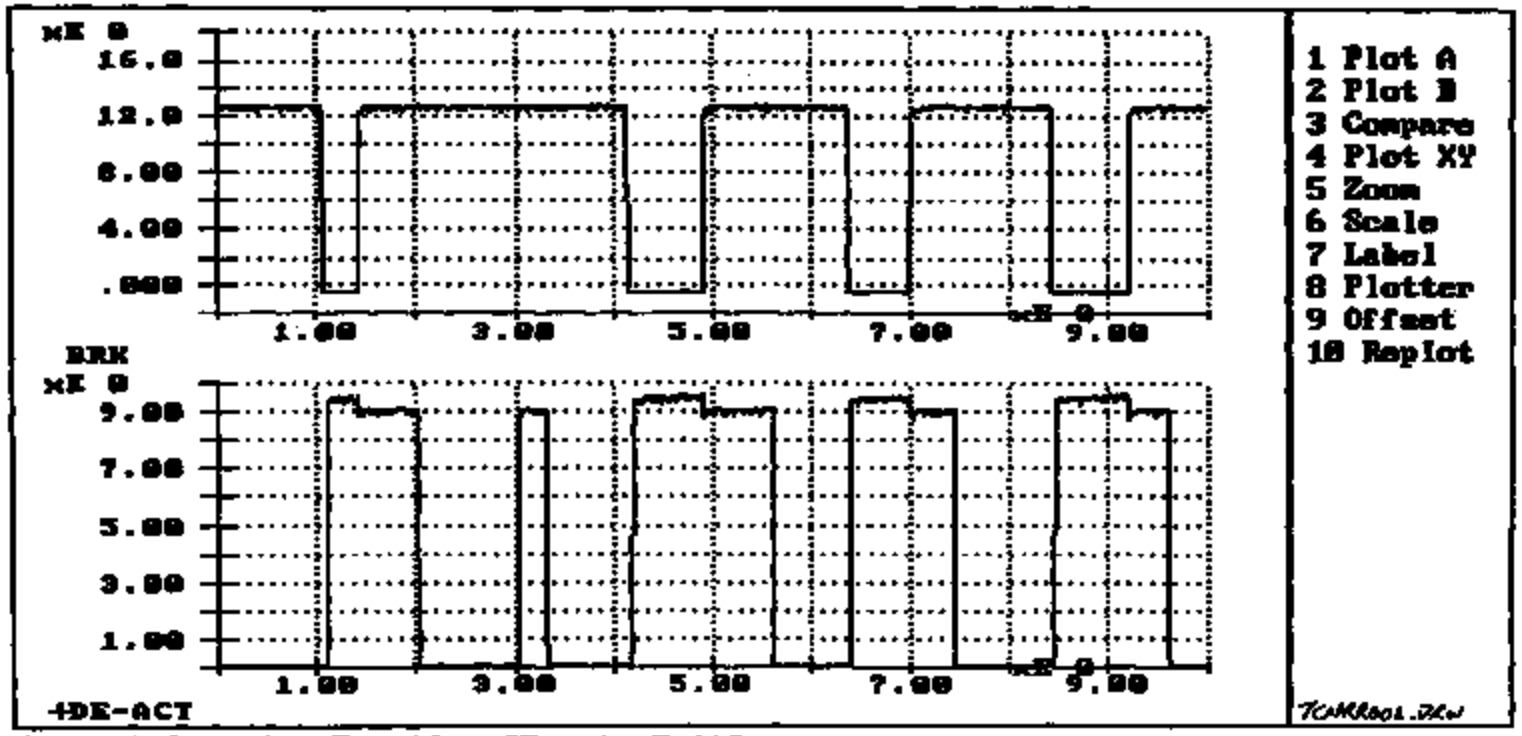


Select Graphics Function [Esc to Exit] :
Scale is ON.

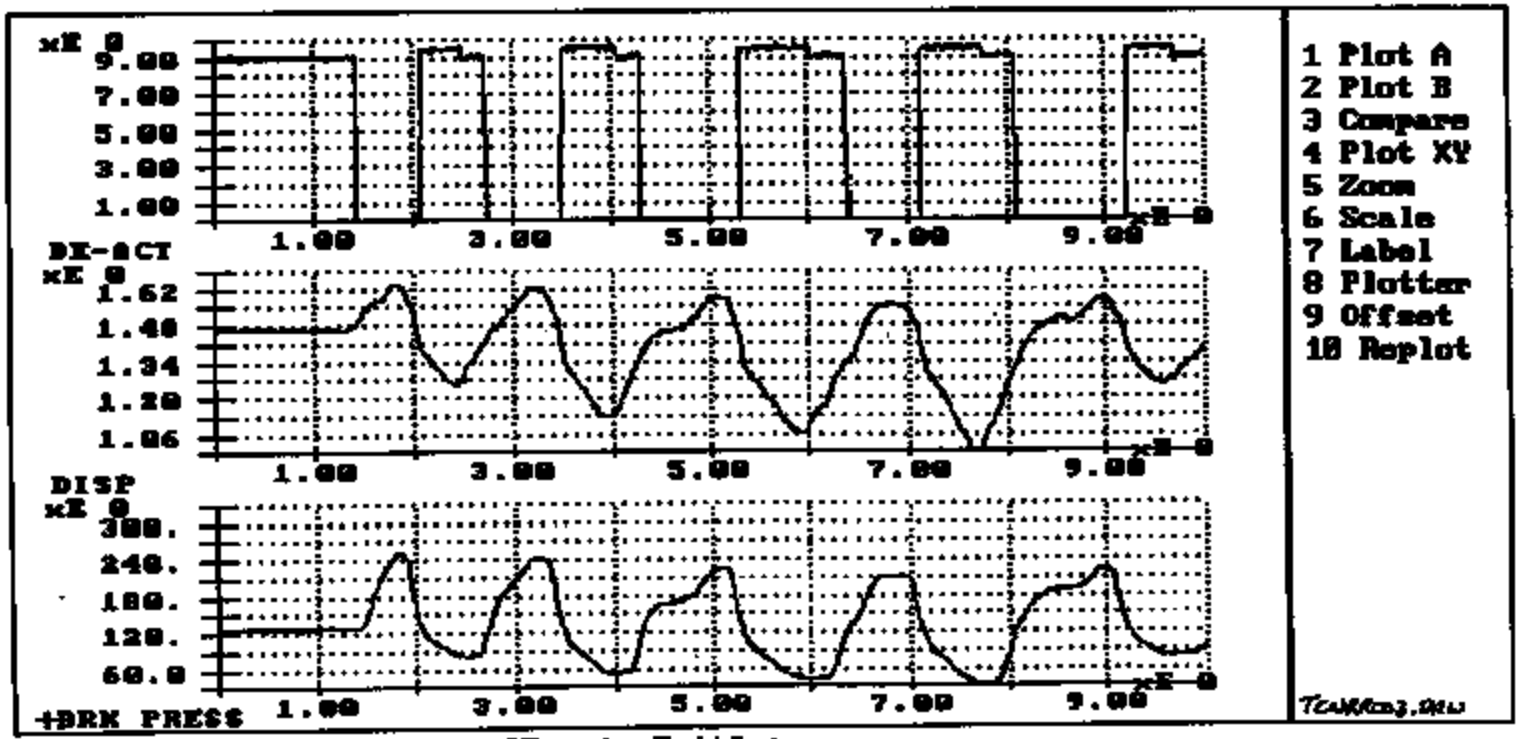


Select Graphics Function [Esc to Exit] :
Scale is ON.





Select Graphics Function [Esc to Exit] :



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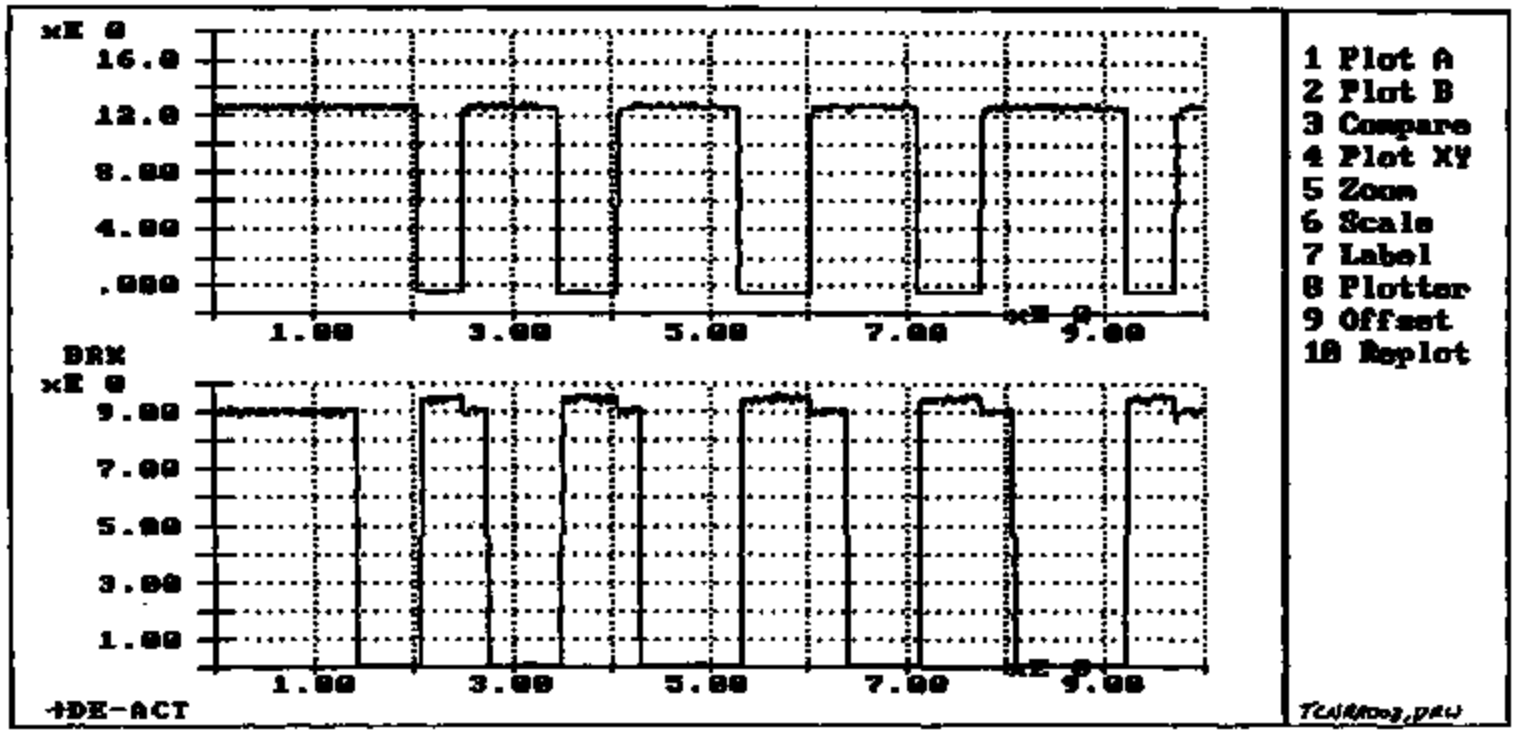
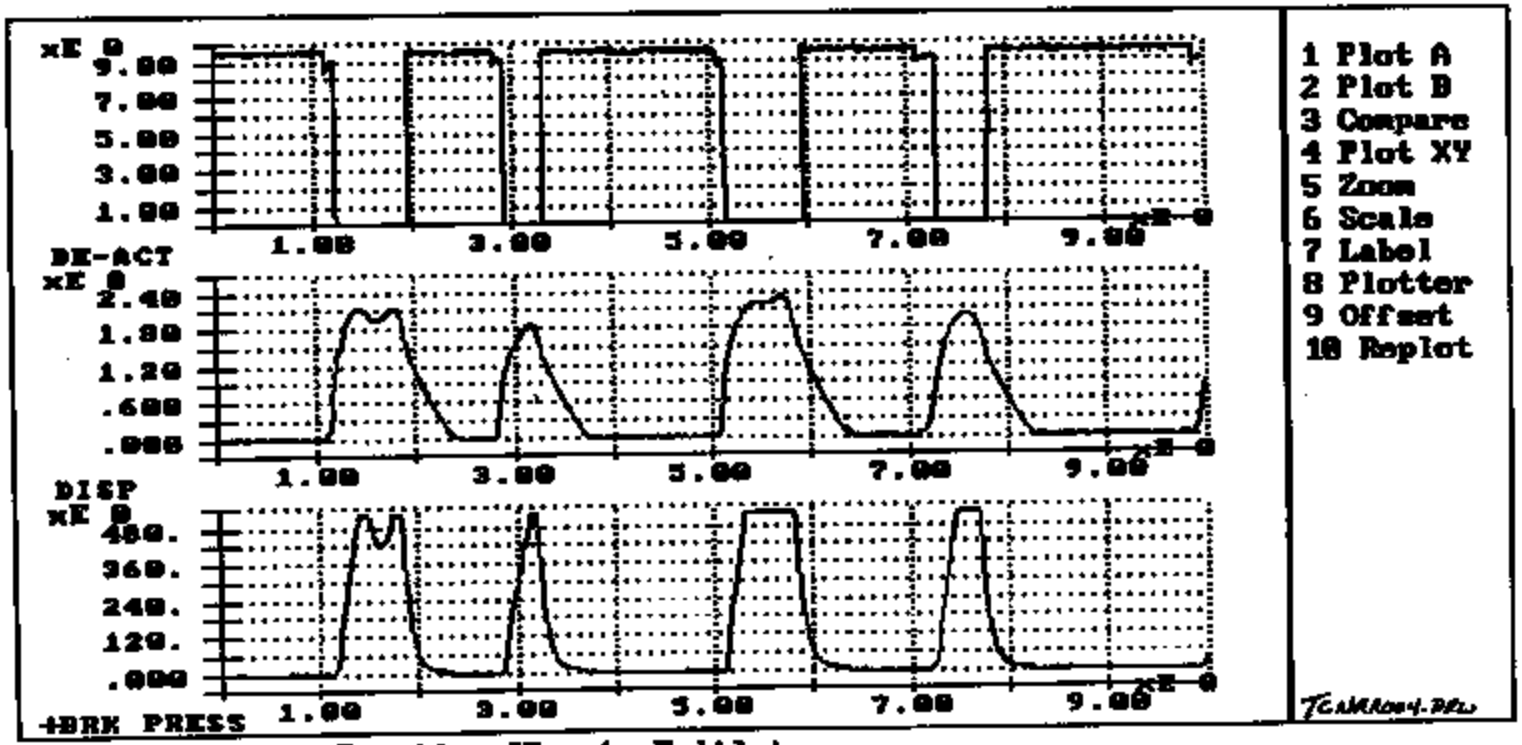
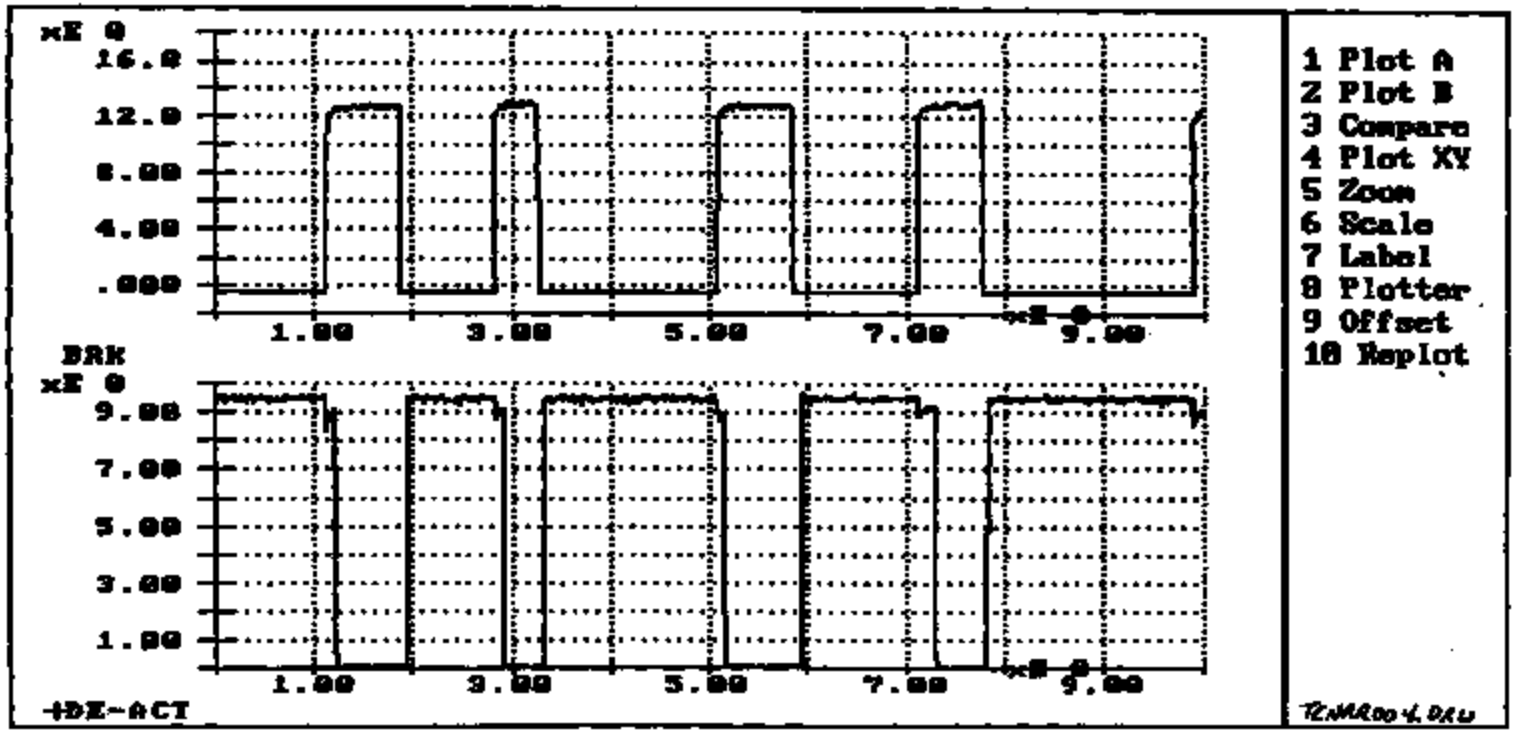


Select Graphics Function [Esc to Exit] :



Select Graphics Function [Esc to Exit] :



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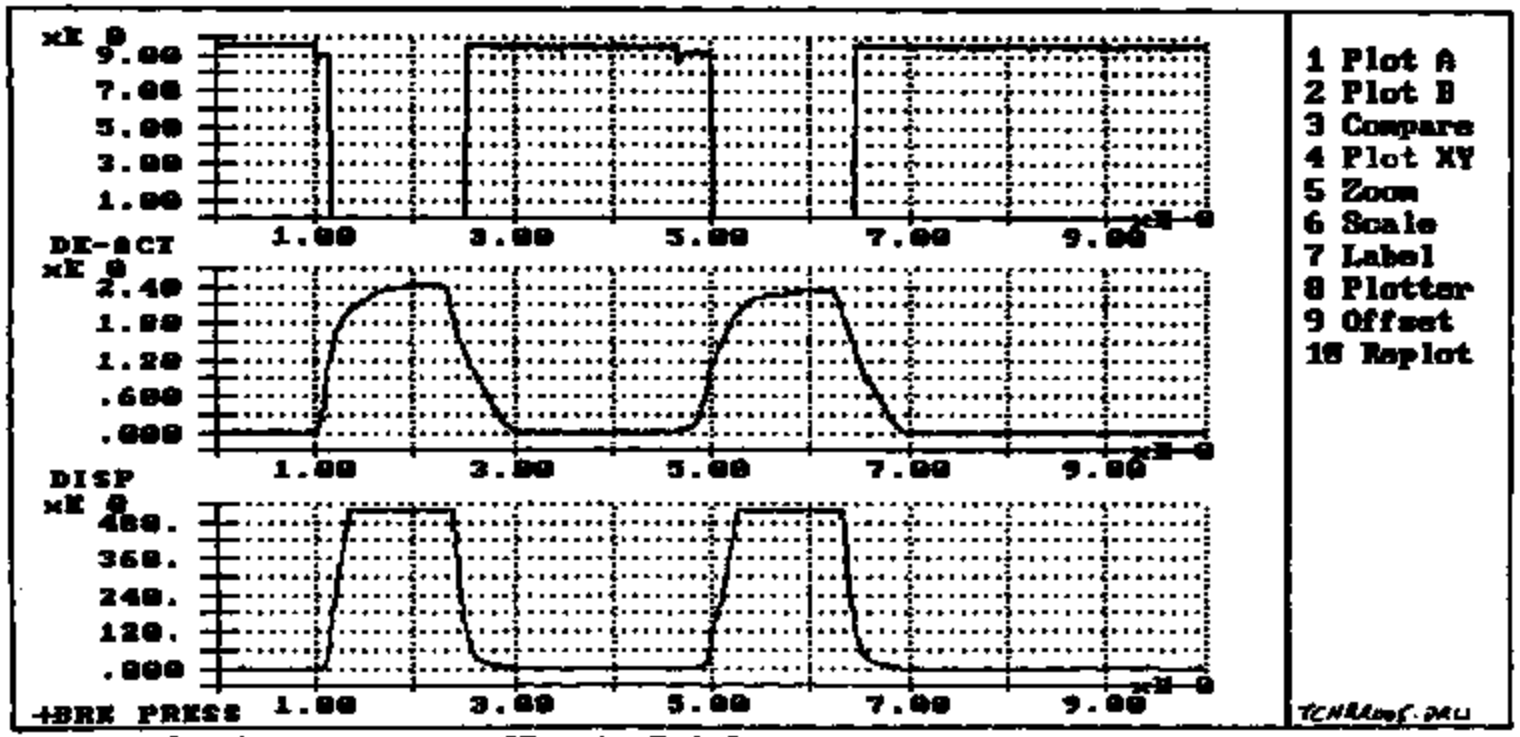

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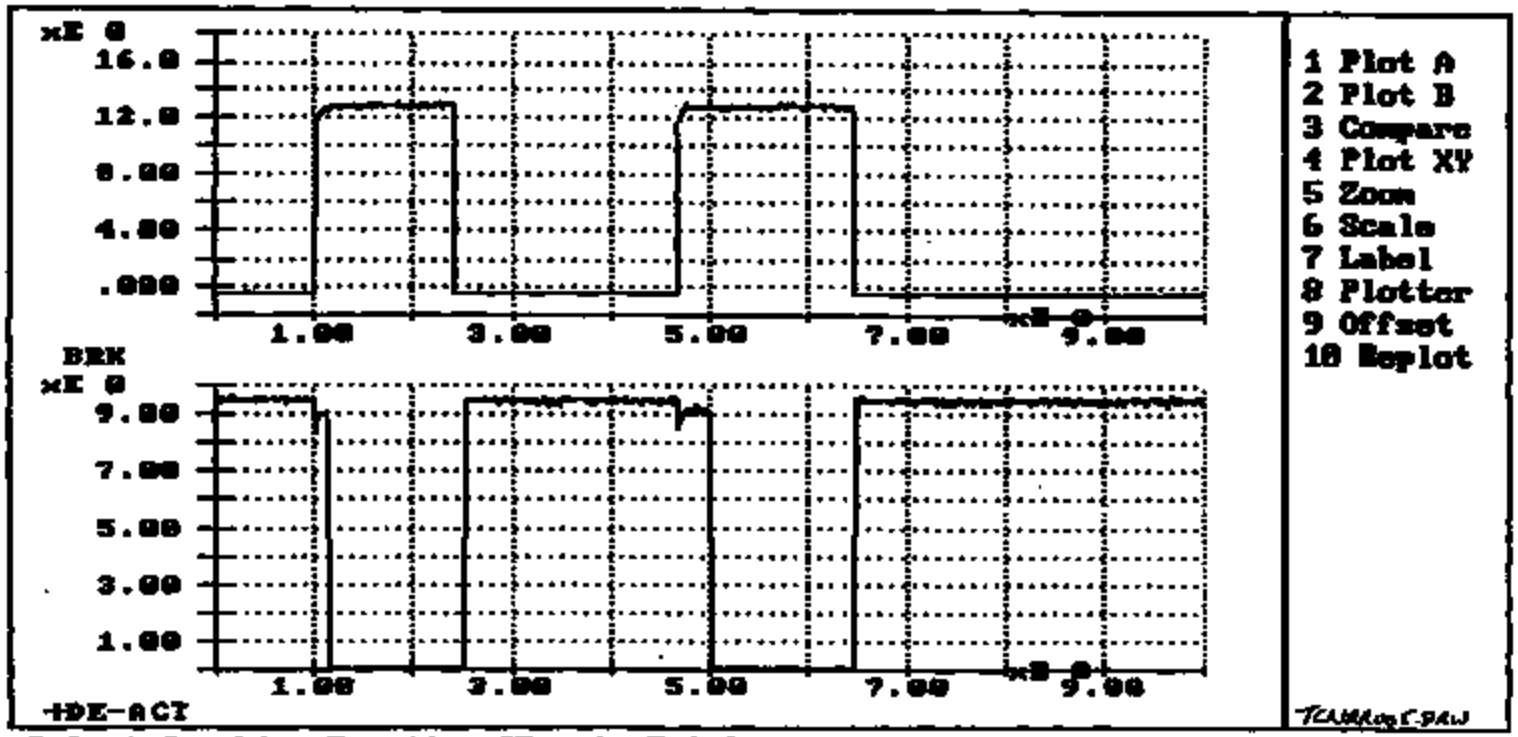


Select Graphics Function [Esc to Exit] :

Brake Pressure Switch Test

Attn. Steve Offiler

Jeffrey A. Anderson
Driver Controls
Ford Motor Company

Vehicle: Econoline 5.0L/E4OD (Newest Pressure Switch)
Date: 8/3/89 Design

Applied Pedal Force (lbs)	Master Cylinder Pressure (lbs)	Pedal Displacement (in)
1	0	0
2	0	0
3	0	0
4	0	.18
5	56	.67
6	82	.78
7	102	.89
8	116	.92
9	128	.95

Brake Light On At: 9 lbs. Pedal Pressure and 0.68" Pedal Displacement

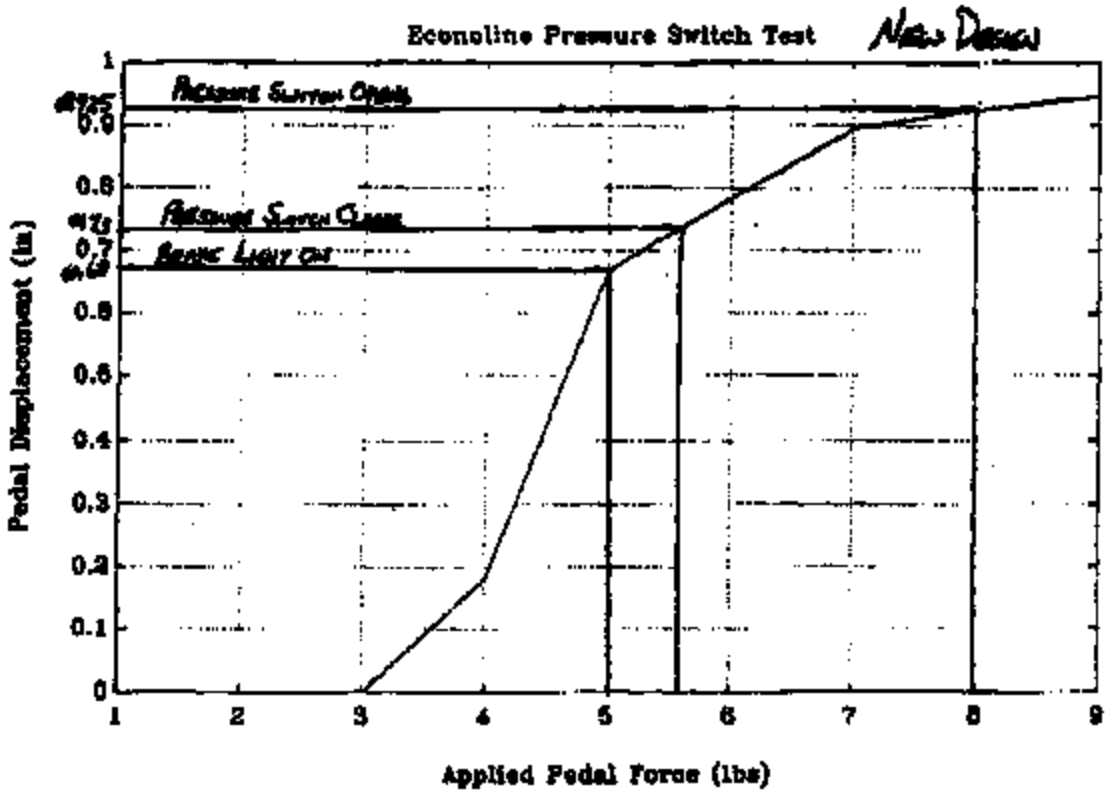
Pressure Switch Opens At: 8 lbs. Pedal Pressure, 0.93" Pedal Displacement and 122 psi Lbs. Master Cylinder Pressure

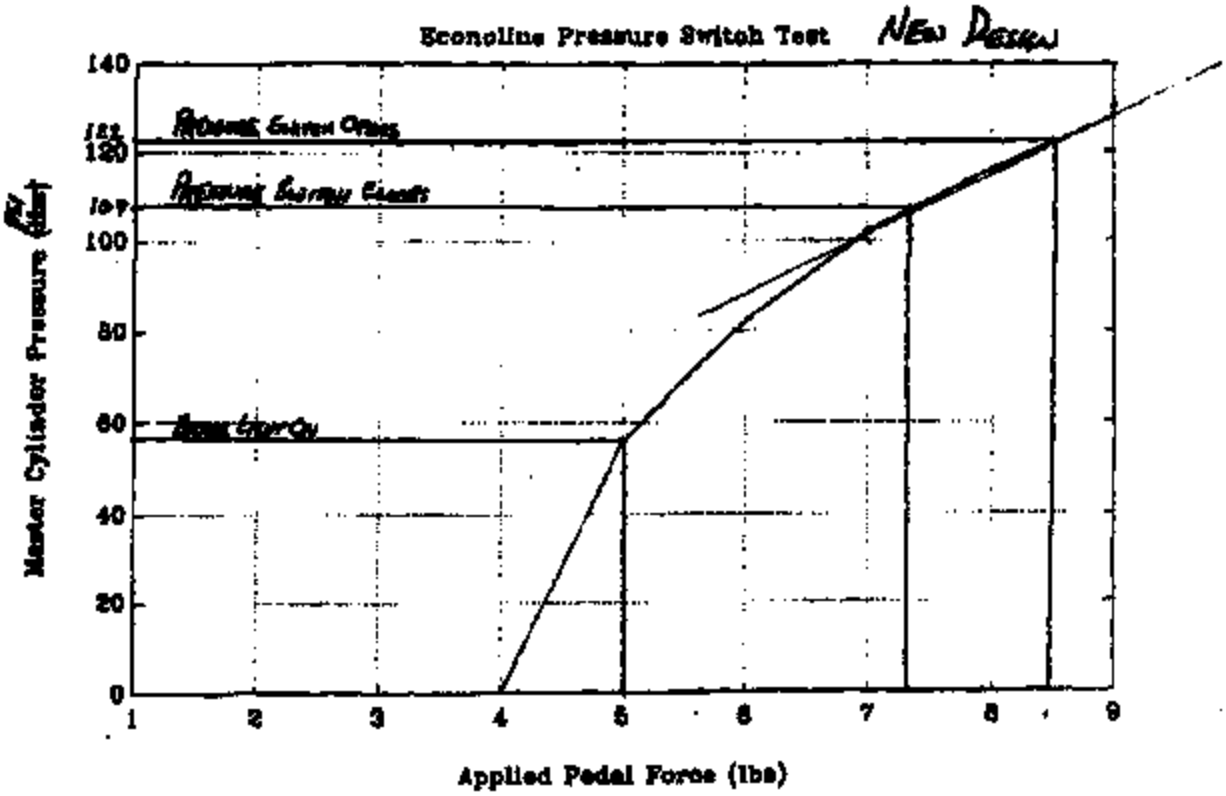
Pressure Switch Re-Closes At: 0.73" Pedal Displacement and 109 psi Lbs. Master Cylinder Pressure

Prepared By:

Driver Control
Next Generation Speed Control

Rupert Andrews
Jeffrey Anderson

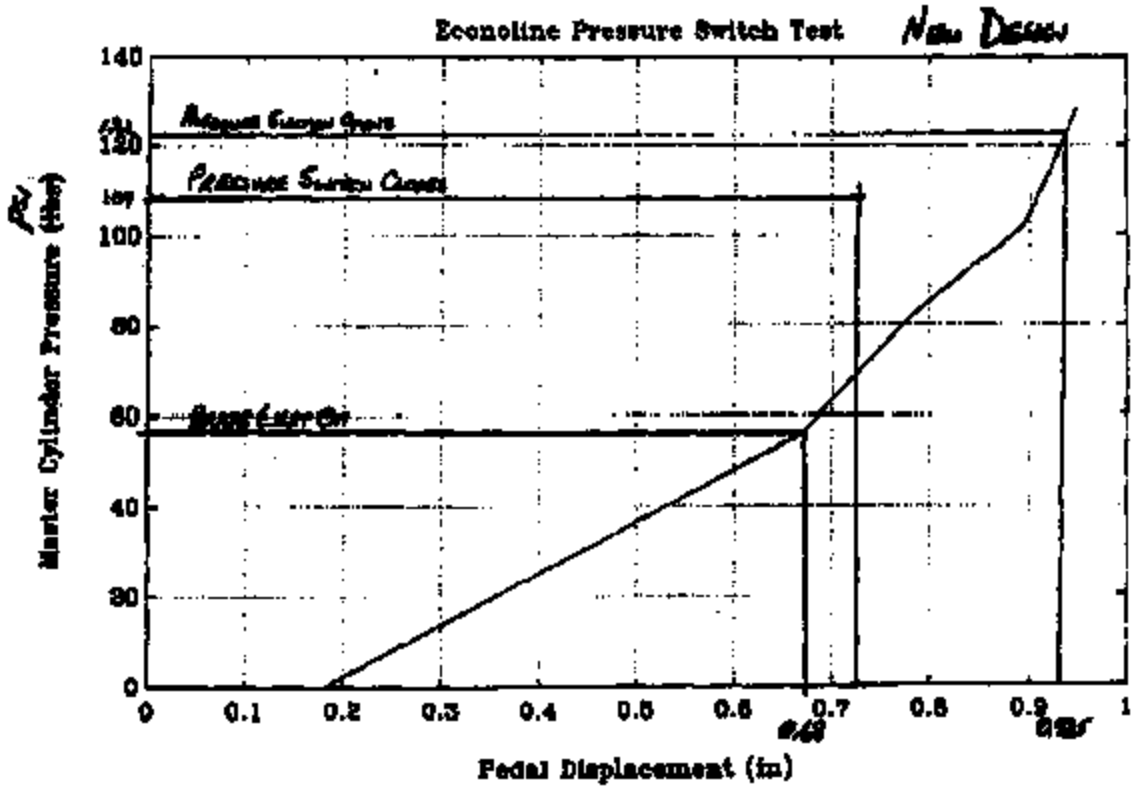

Econoline Pressure Switch Test
Pedal Displacement (in.)
Applied Pedal Force (lbs)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.8
1
2
3
4
5
6
7
8
9



7/66, 102 psi 13 psi/lb

9/66, 128 psi

= 32.5 psi


Econoline Pressure Switch Test
New Design
140
120
100
80
60
40
20
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Master Cylinder Pressure (psi)
Pedal Displacement (in)

Vehicle: Lincoln Town Car (Test a) Orig Design
Date: 8/3/89

Applied Pedal Force (lbs)	Master Cylinder Pressure (psi)	Pedal Displacement (in)
1	0	0
2	0	.045
3	0	.068
4	0	.10
5	0	.13
6	13	.51
7	77	.84
8	114	.92
9	134	.97
10	160	1.01
11	186	1.05
12	212	1.10
13	238	1.13

140 — 1.0

Brake Light On At: 4 lbs. Pedal Force and 0.1" Pedal Displacement

Pressure Switch Opens At: 1" Pedal Displacement and 140 psi Master Cylinder Pressure

Pressure Switch Re-Closes At: 0.82" Pedal Displacement and 93 psi Master Cylinder Pressure

Prepared By:

Driver Controls
Next Generation Speed Control

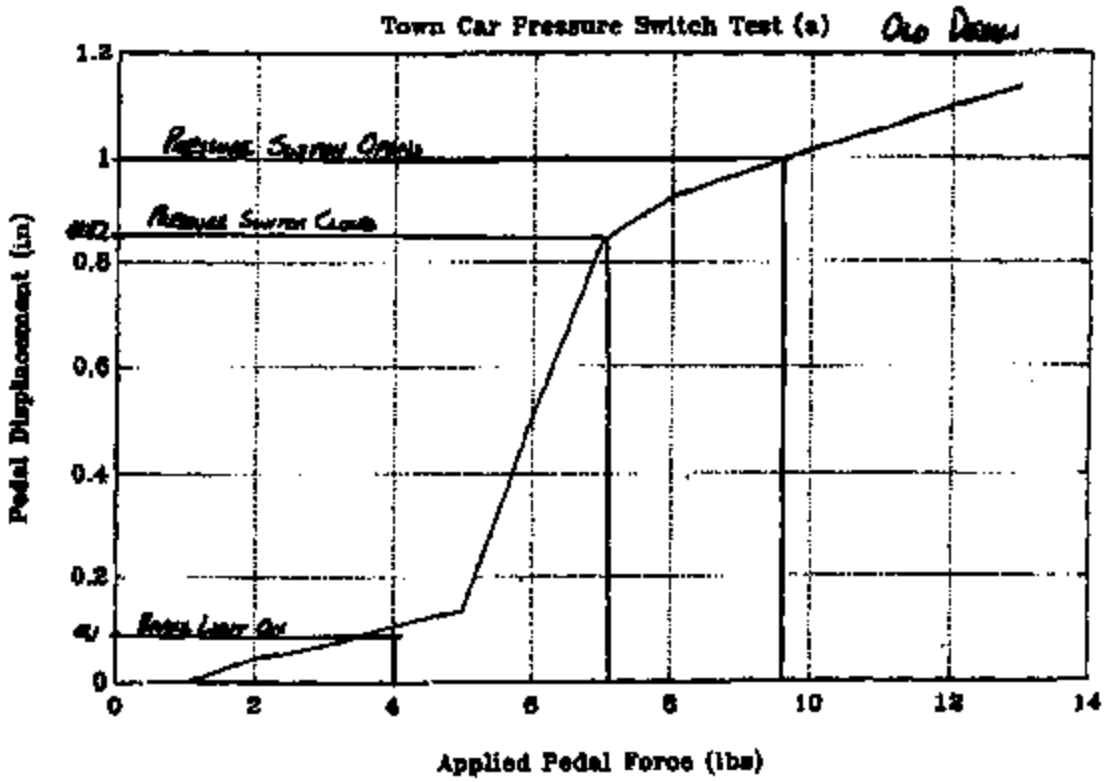
Rupert Andrews
Jeffrey Anderson

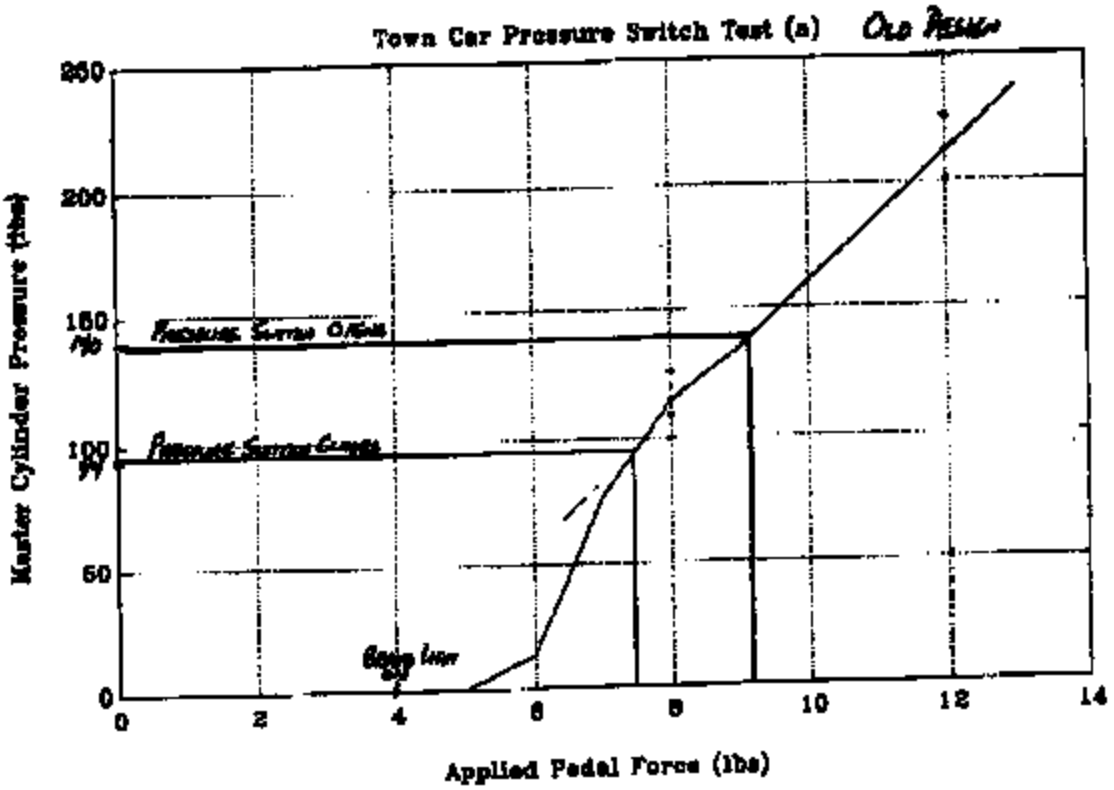
$\frac{x-9}{10-9}$ (9, x, 10) (134, 140, 160) $\frac{6}{\frac{140-134}{160-134}}$ 26

$x-9 = \frac{6}{26}$

$+9 \quad +9$

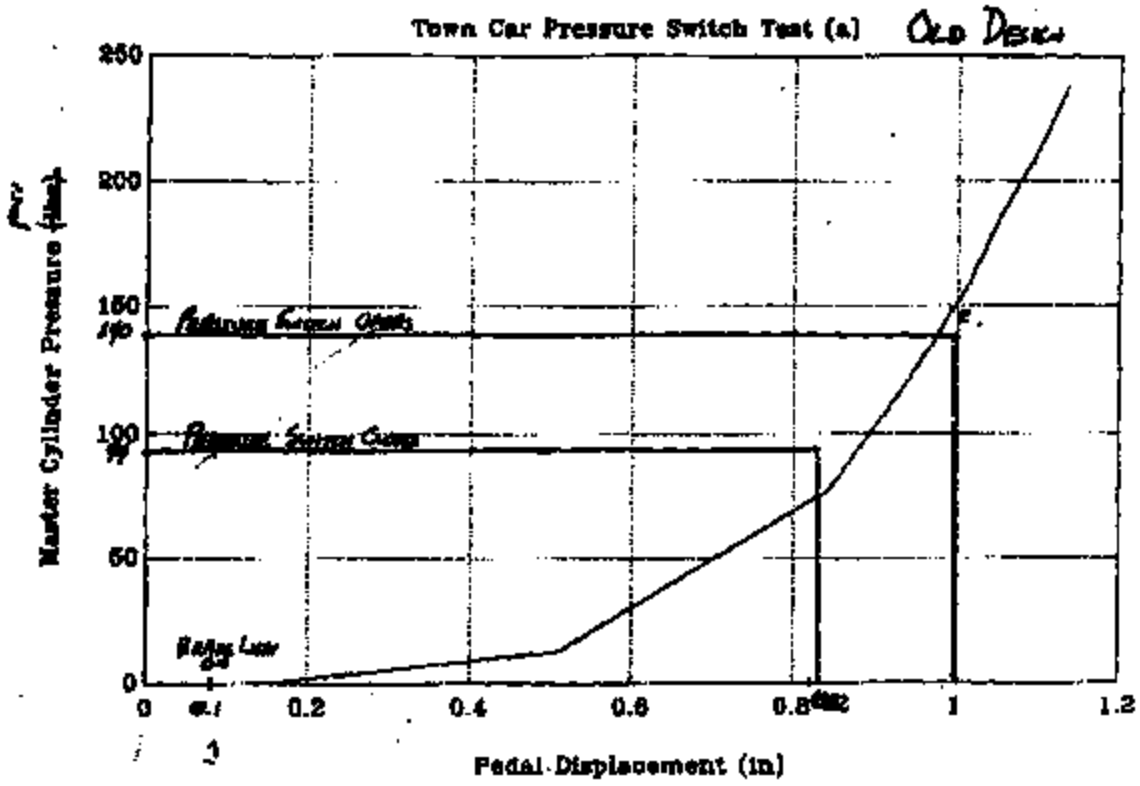
$x = 9.23$


Town Car Pressure Switch Test (a)
Old Design
1.2
1
0.8
0.6
0.4
0.2
0
Pedal Displacement (in)
0
2
4
6
8
10
12
14
Applied Pedal Force (lbs)



8 lbs 110 psi 25 psi/lb
12 lbs 210 psi

± 2.5 LBS GIVES ± 62.5 psi


Town Car Pressure Switch Test (a)
Old Design
Master Cylinder Pressure (psi)
250
200
150
100
50
0
0
0.2
0.4
0.6
0.8
1
1.2
Pedal Displacement (in)

Vehicle: Lincoln Town Car (Test b) Old Pedal
Date: 8/3/89

Applied Pedal Force (lbs)	Master Cylinder Pressure (psi)	Pedal Displacement (in)
1	0	0
2	0	0
3	0	0
4	0	.075
5	0	.10
6	4	.32
7	74	.77
8	104	.85
9	140	.92
10	162	.96

Brake Light On At: 4 lbs. Pedal Force and 0.075" Pedal Displacement

Pressure Switch Opens At: 8.5 lbs. Pedal Force

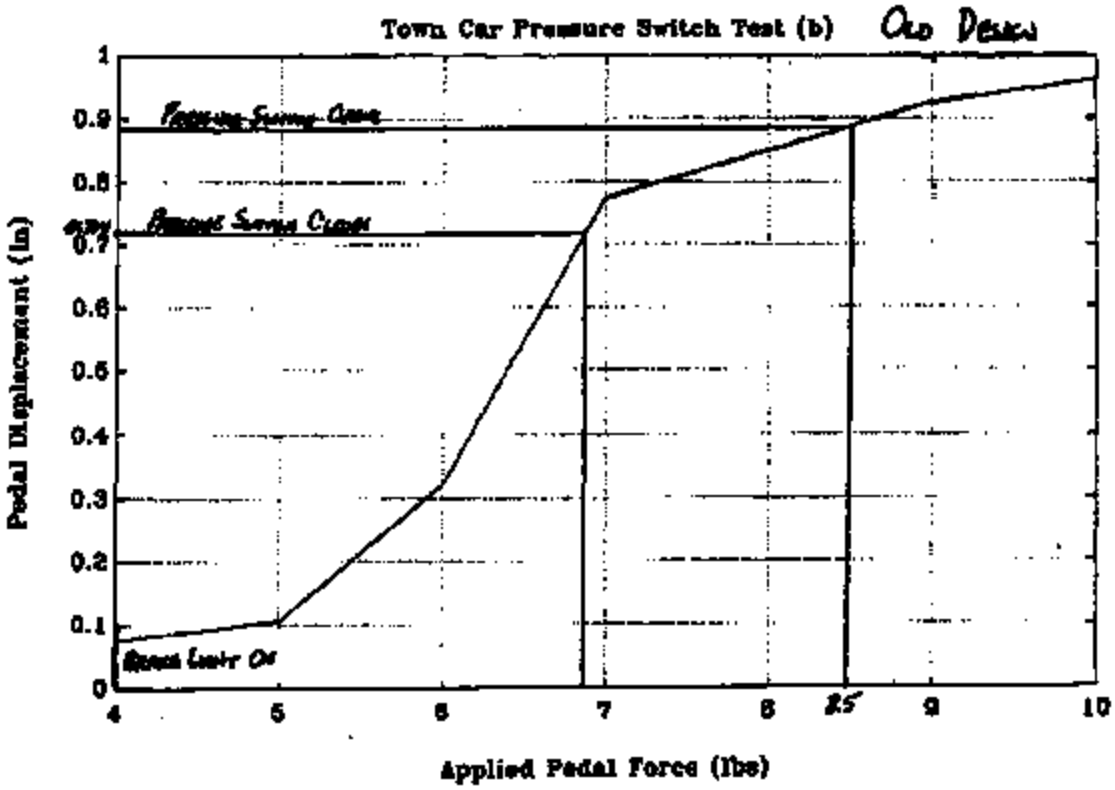
Pressure Switch Re-Closes At: 0.71" Pedal Displacement and 92 psi

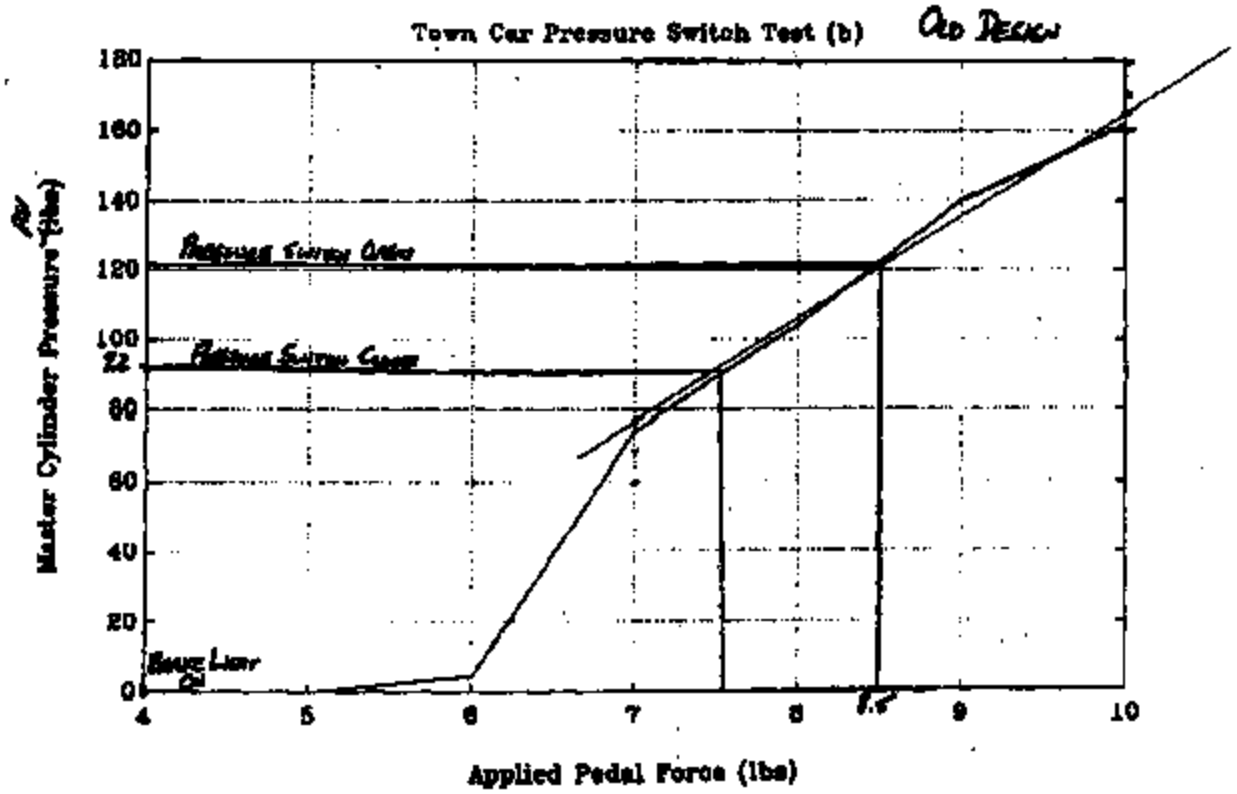
Master Cylinder Pressure

Prepared By:

Driver Controls
Next Generation Speed Control

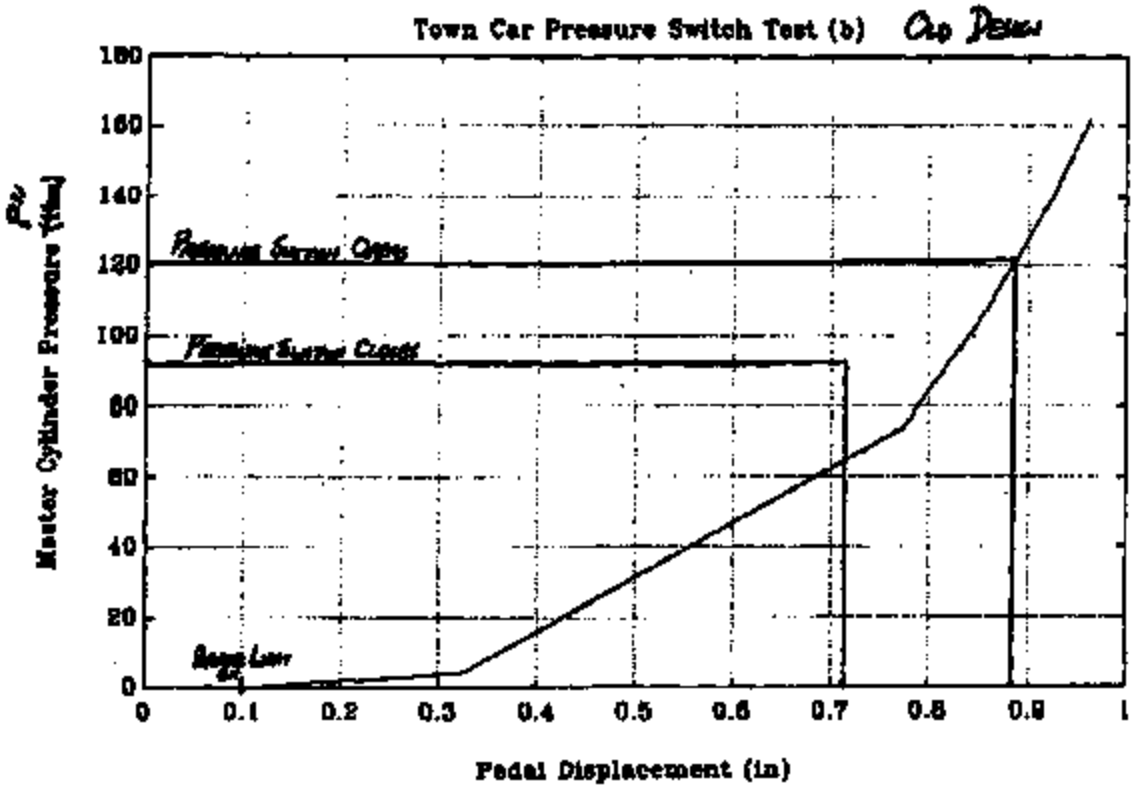
Rupert Andrews
Jeffrey Anderson


Town Car Pressure Switch Test (b) Old Design
Pedal Displacement (in)
Applied Pedal Force (lbs)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
4
5
6
7
8
9
10
25



716 77 psi 29 psi/lb
1816 165 psi

± 2.5 LBS GIVES ± 72.5 psi


Town Car Pressure Switch Test (b)
Master Cylinder Pressure (psi)
Pedal Displacement (in)
0
20
40
60
80
100
120
140
160
180
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9

Vehicle: Taurus Old Design
Date: 8/3/89

Applied Pedal Force (lbs)	Master Cylinder Pressure (psi)	Pedal Displacement (in)
1	0	0
2	0	0
3	0	.037
4	0	.19
5	0	.21
6	0	.33
7	24	.88
8	65	1.38
9	102	1.58
10	149	1.72
11	188	1.82
12	225	1.89

Brake Light On At: 3 lbs. Pedal Force and 0.1" Pedal Displacement

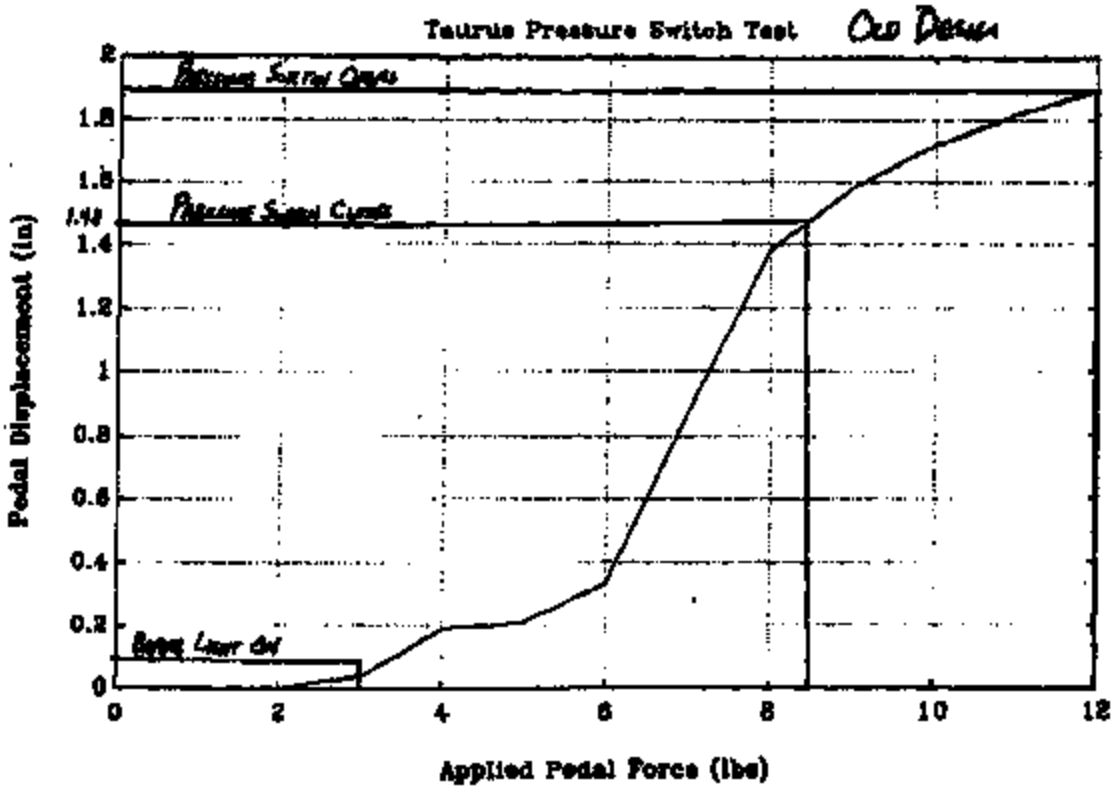
Pressure Switch Opens At: 12 lbs. Pedal Force and 185 psi. Master Cylinder Pressure

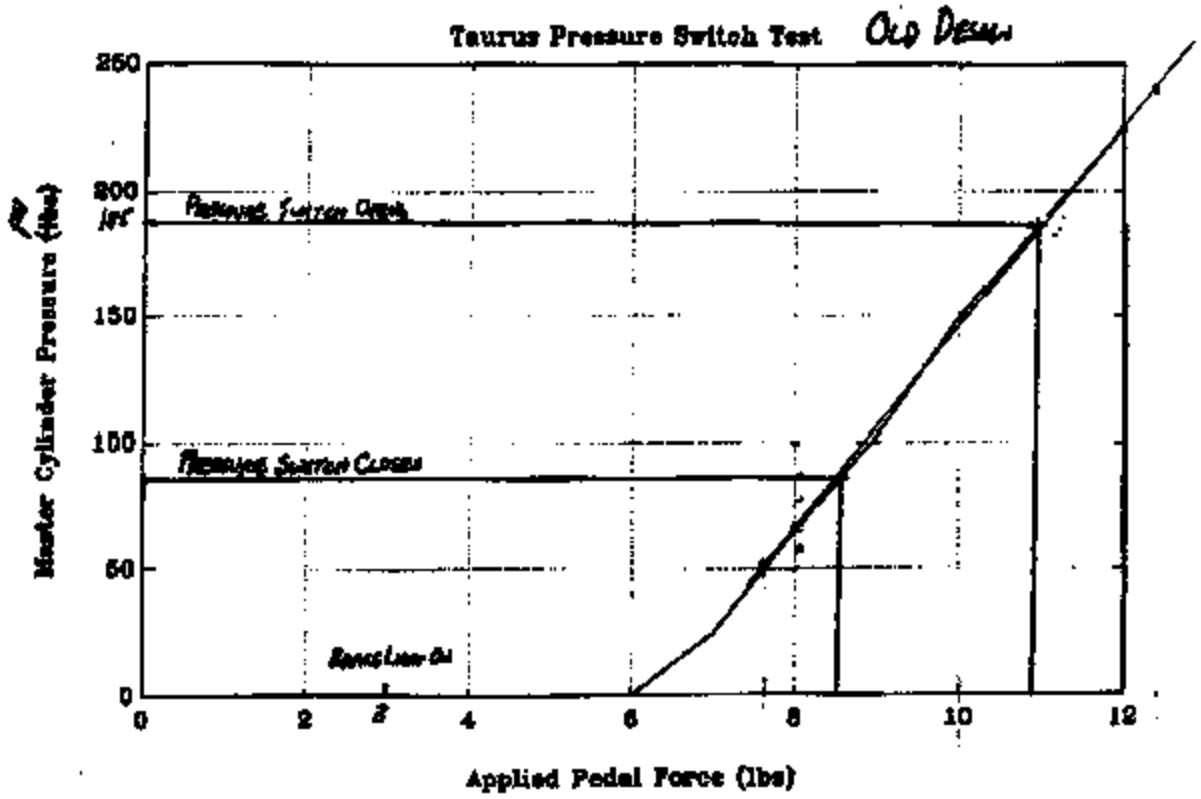
Pressure Switch Re-Closes At: 1.43" Pedal Displacement and 80 psi. Master Cylinder Pressure

Prepared By:

Driver Controls
Next Generation Speed Control

Rupert Andrews
Jeffrey Anderson

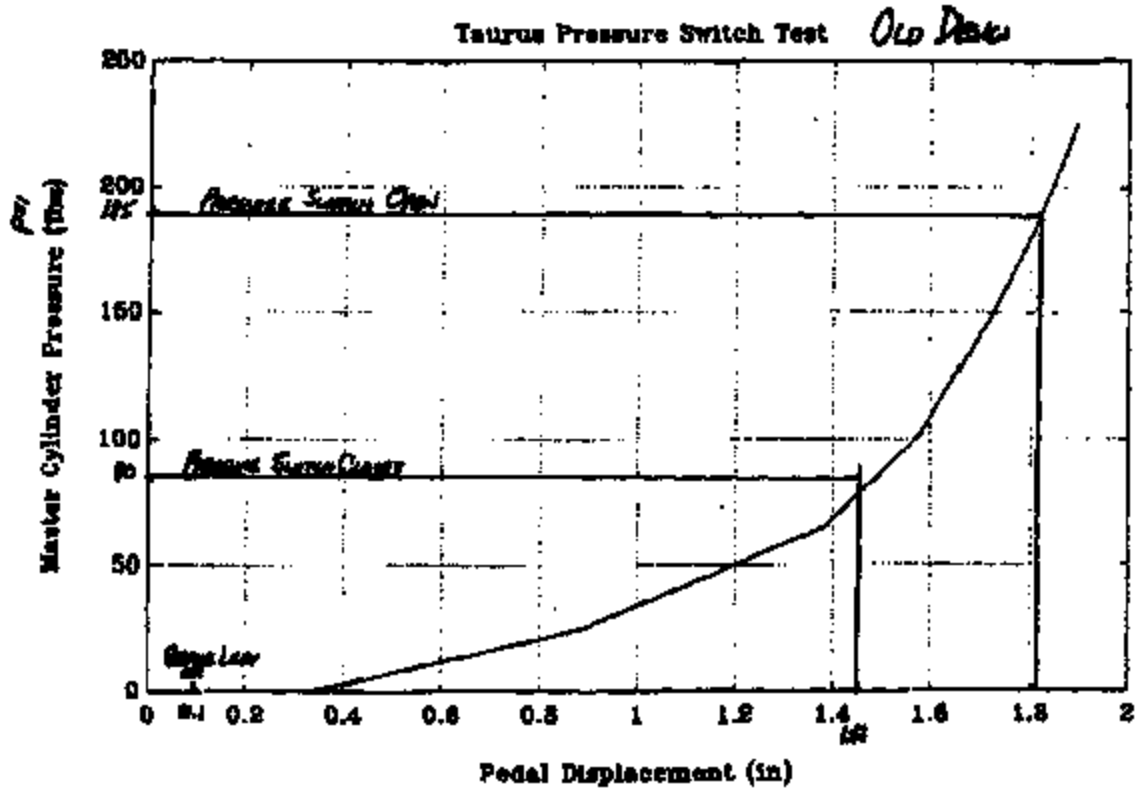

Taurus Pressure Switch Test
Old Design
Pressure Switch Opens
Pressure Switch Closes
1.44
Apply Lever Off
Pedal Displacement (in)
Applied Pedal Force (lbs)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0
2
4
6
8
10
12



8 lbs 70 psi

12 lbs 225 39 psi/lb

± 2.5 LBS = ± 100 psi


Taurus Pressure Switch Test
Old Data
Master Cylinder Pressure (psi)
200
150
100
50
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Pedal Displacement (in)

Vehicle: F-150 4X4 4.9L/E4OD (Engine On) New Design
Date: 8/3/89

SW DES?
SYS DES?

Applied Pedal Force (lbs)	Master Cylinder Pressure (psi)	Pedal Displacement (in)
1	0	0
2	0	0
3	0	.009
4	13	.36
5	43	.56
6	64	.62
7	87	.68
8	112	.77
9	132	.82
10	147	.86
11	165	.92
12	184	.99
13	204	1.11

Brake Light On At: 4 lbs Pedal Force and 0.49" Pedal Displacement

Pressure Switch Opens At: 0.85" Pedal Displacement and 184 psi. Master Cylinder Pressure

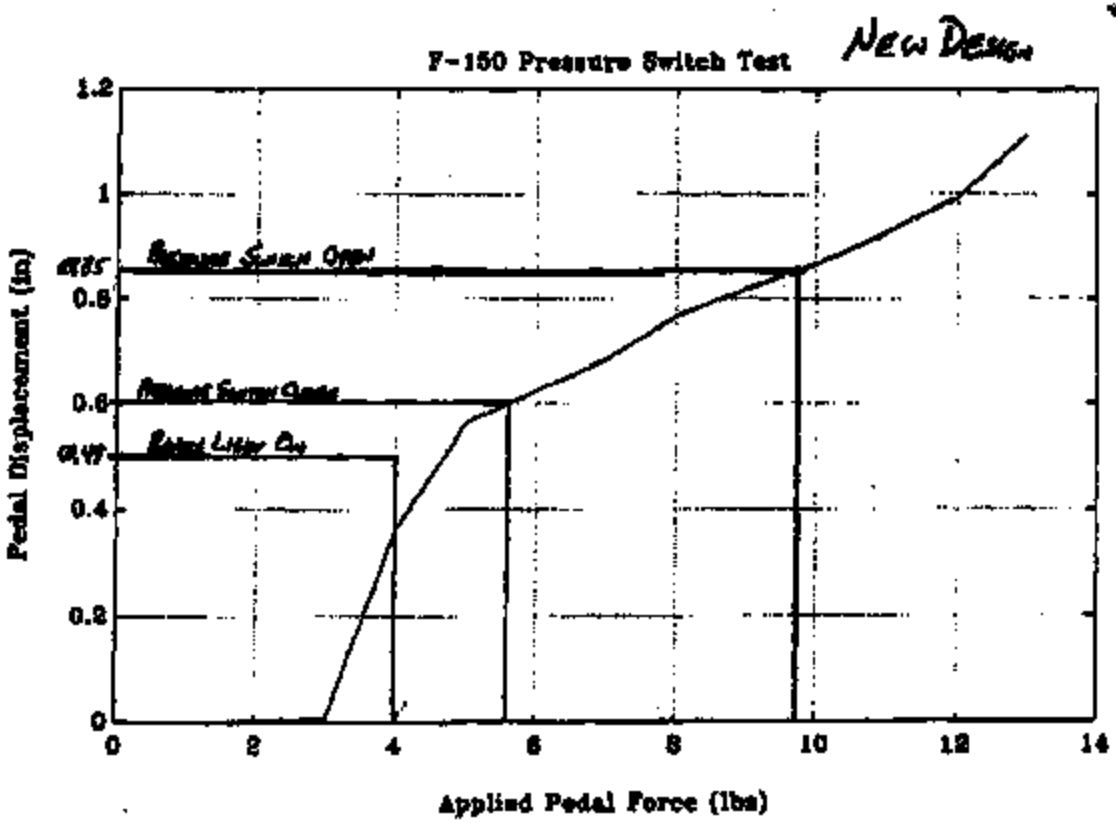
1347?

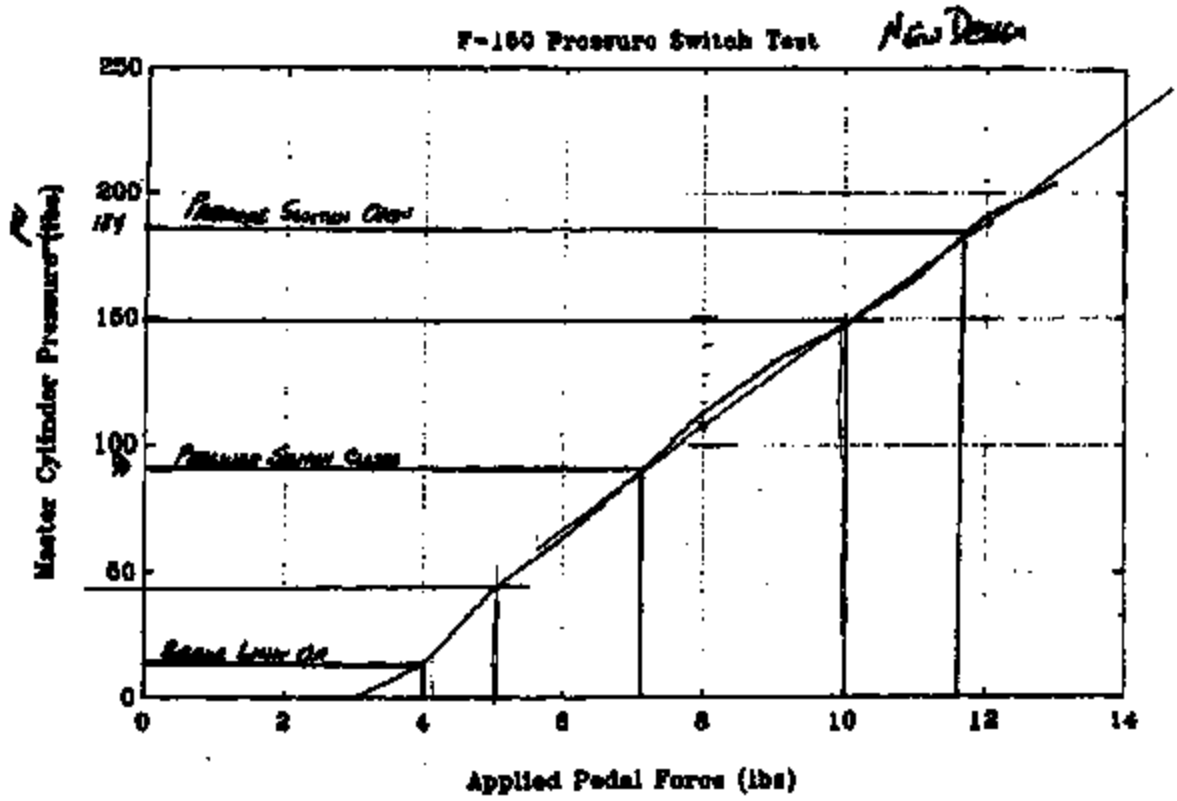
Pressure Switch Re-Closes At: 0.6" Pedal Displacement and 90 psi. Master Cylinder Pressure

Prepared By:

Driver Controls
Next Generation Speed Control

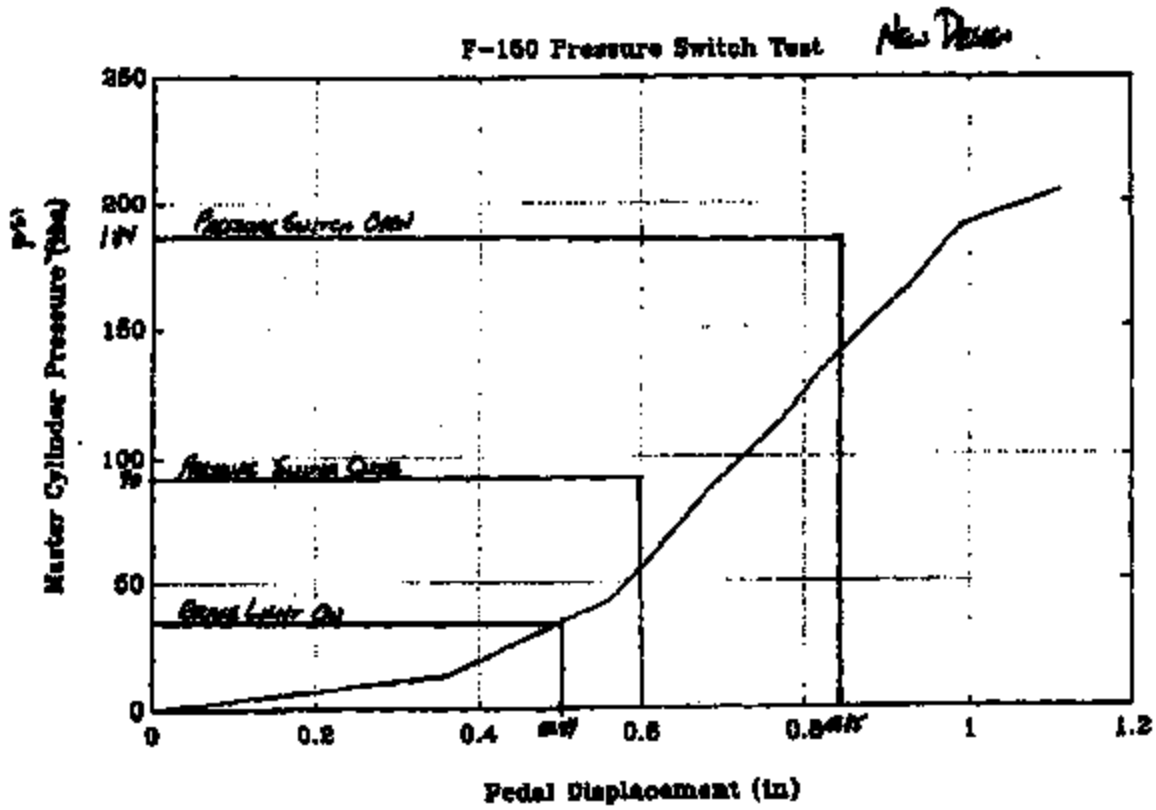
Rupert Andrews
Jeffrey Anderson


F-150 Pressure Switch Test
New Design
Pedal Displacement (in)
Applied Pedal Force (lbs)
1.2
1
0.8
0.6
0.4
0.2
0
0
2
4
6
8
10
12
14



8 lbs 110 psi
12 lbs 150 psi
20 psi/lb

± 2.5 LBS = ± 40 psi


F-150 Pressure Switch Test
Master Cylinder Pressure (psi)
250
200
150
100
50
0
0
0.2
0.4
0.6
1
1.2
Pedal Displacement (in)

Vehicle: F-150 4X4 4.9L/E4OD (Engine Off) New Design
Date: 8/3/89

Applied Pedal Force (lbs)	Master Cylinder Pressure (PSI)	Pedal Displacement (in)
1	0	0
2	0	0
3	0	0
4	1	.23
5	42	.58
6	64	.65
7	88	.71
8	115	.79
9	132	.84
10	182	.89
11	175	.95
12	190	1.01

Brake Light On At: 4 lbs. Pedal Force and 0.48" Pedal Displacement

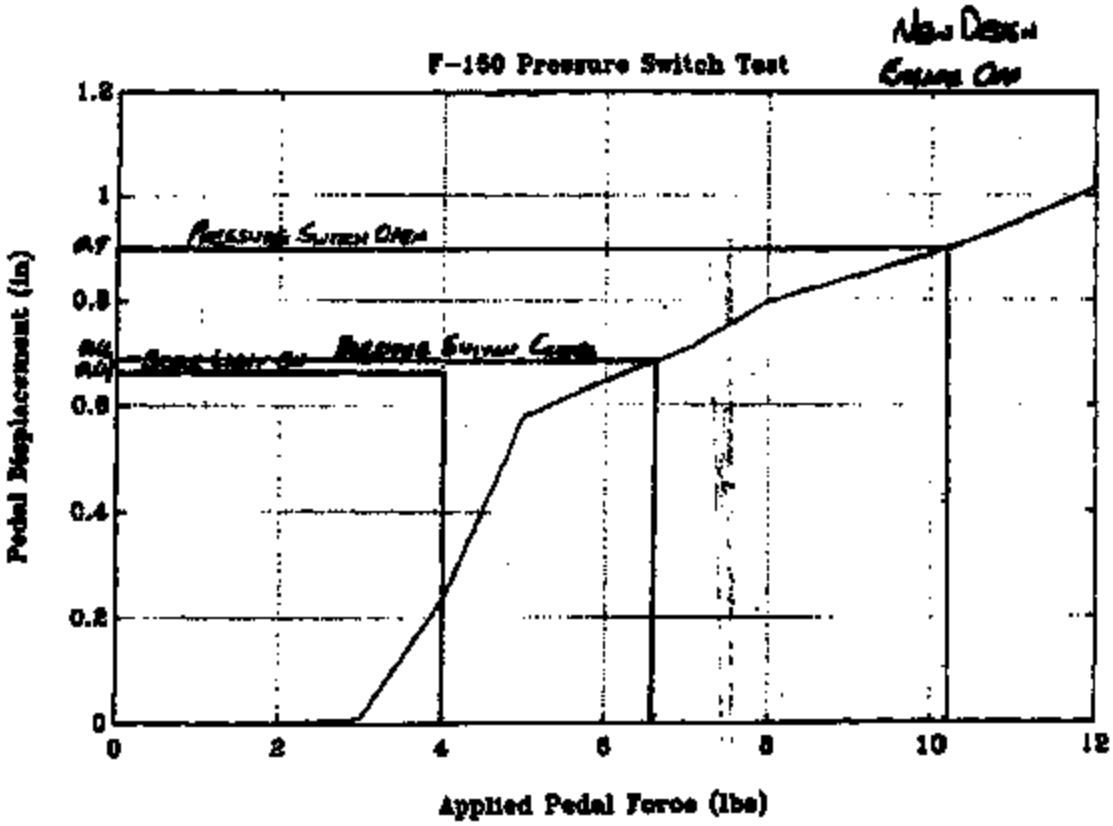
Pressure Switch Opens At: 0.9" Pedal Displacement and 182 PSI Master Cylinder Pressure

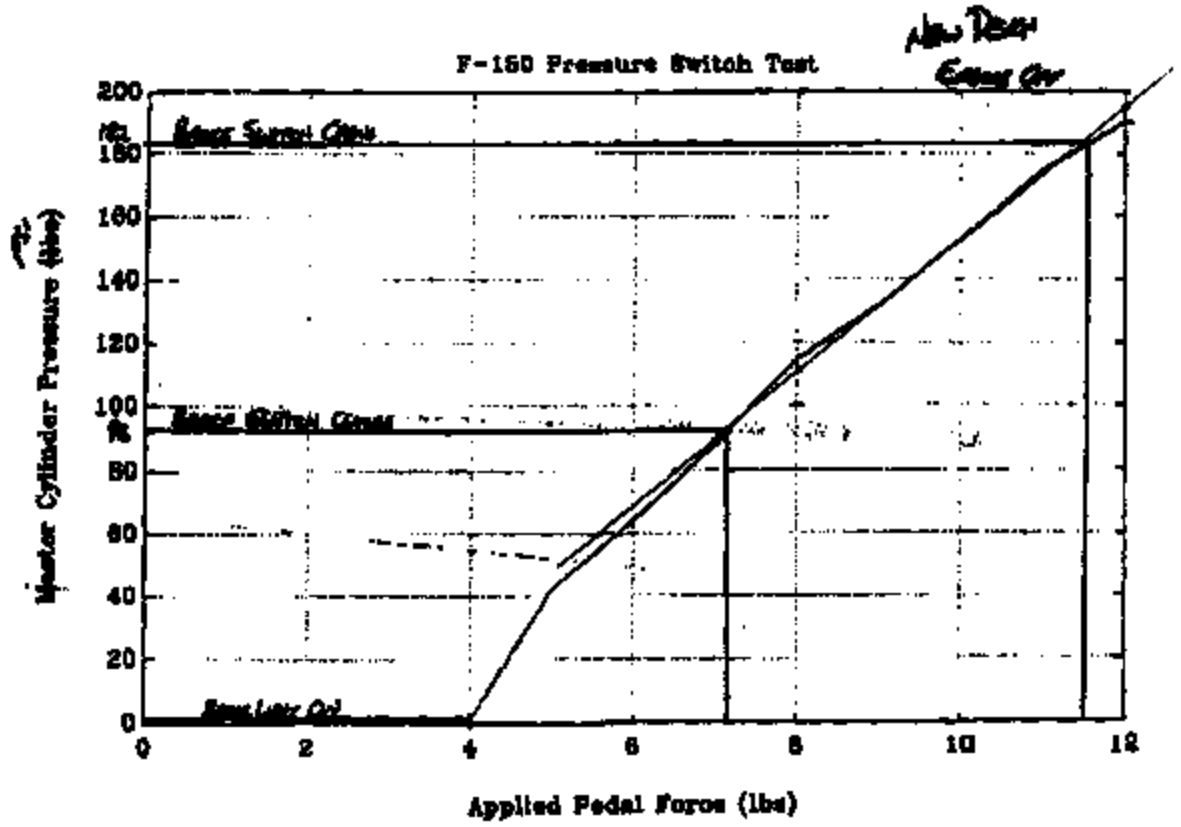
Pressure Switch Re-Closes At: 0.66" Pedal Displacement and 92 PSI Master Cylinder Pressure

Prepared By:

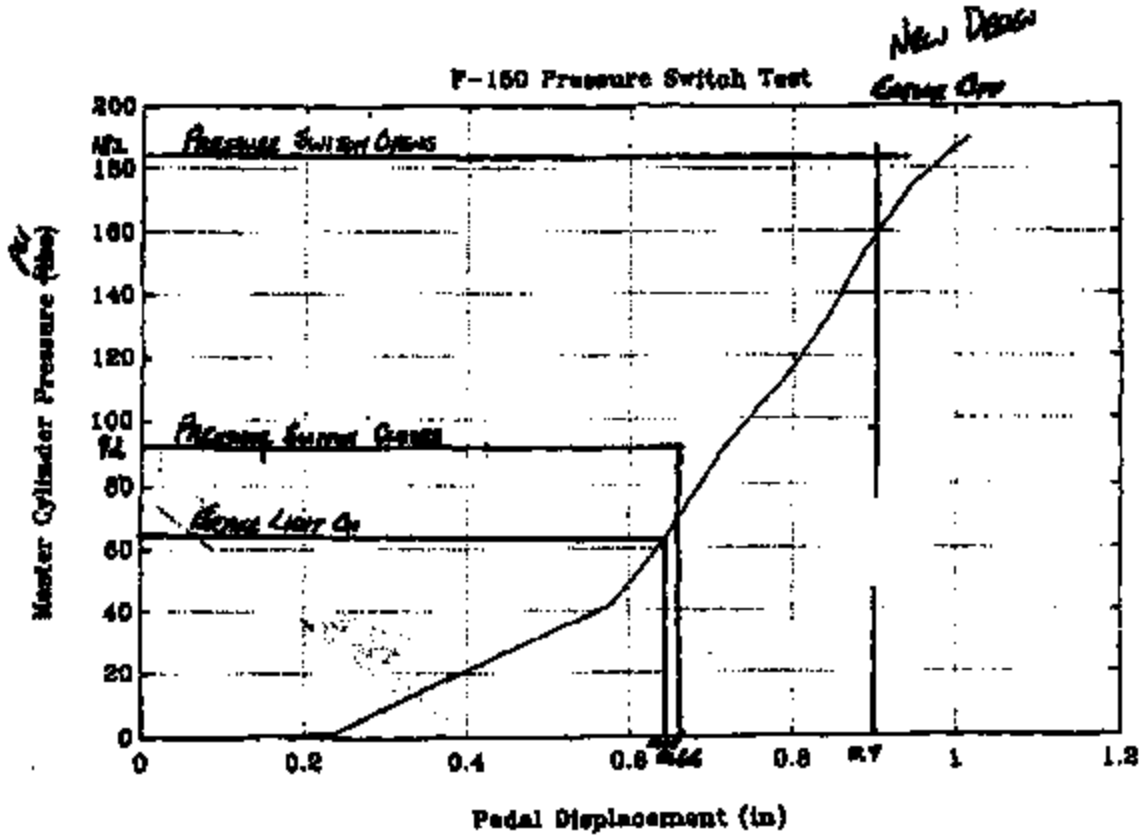
Driver Controls
Next Generation Speed Control

Rupert Andrews
Jeffrey Anderson


F-150 Pressure Switch Test
Pedal Displacement (in)
Applied Pedal Force (lbs)
0
0.2
0.4
0.6
0.8
1
1.2
0
2
4
6
8
10
12



9 lbs 112 psi
12 lbs 195 psi 21 psi/lb


F-150 Pressure Switch Test
New Design
Master Cylinder Pressure (psi)
200
150
100
60
0
0.2
0.4
0.8
1
1.2
Pedal Displacement (in)

DIGITAL TRANSMITTAL
ELECTRONICS DIVISION
VEHICLE CONTROLS GROUP
DRIVER CONTROLS DEPT.

Delay ? .2 sec
get back to him

To: Steve OFFilec Fax No. 508-699-1598 Page 1 of 12

Location & No.: _____ Date: _____

cc: _____ _____ _____ _____

From: Gary Klingler Tel No. (313) 845-1493

Fax Tel No. (313) 398-7143

Subject: _____

Reference: _____

Steve,

Attached is in vehicle data (Econoline) of speed control On-engagements. Any ? Pls Call

SEP 1 '89 11:48 FROM DRIVER CONTROLS PAGE.001

SEP 1 '98 11:49 FROM DRIVER CONTROLS

6

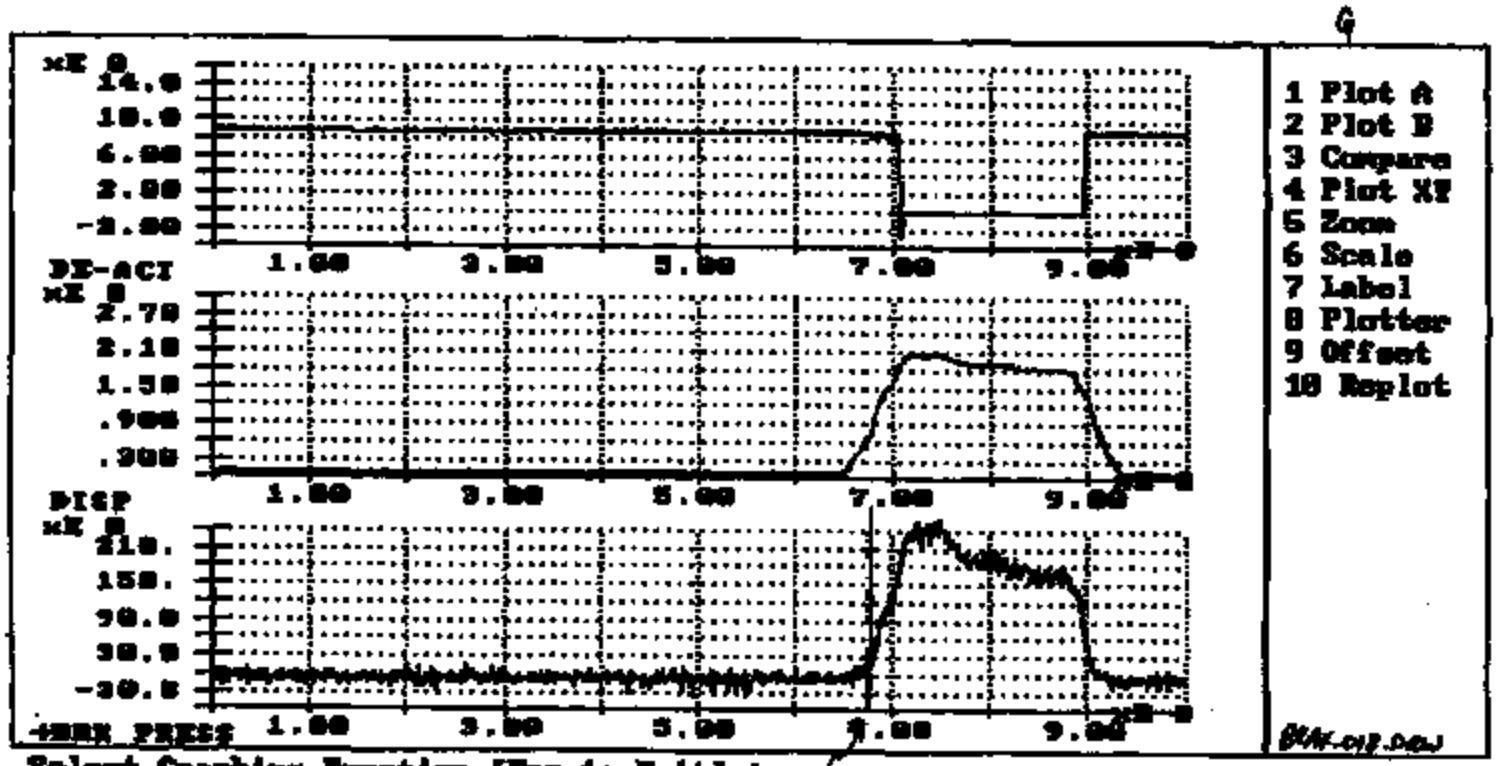
Why the delay

I

SEP 1 '89 11:51 FROM DRIVER CONTROLS

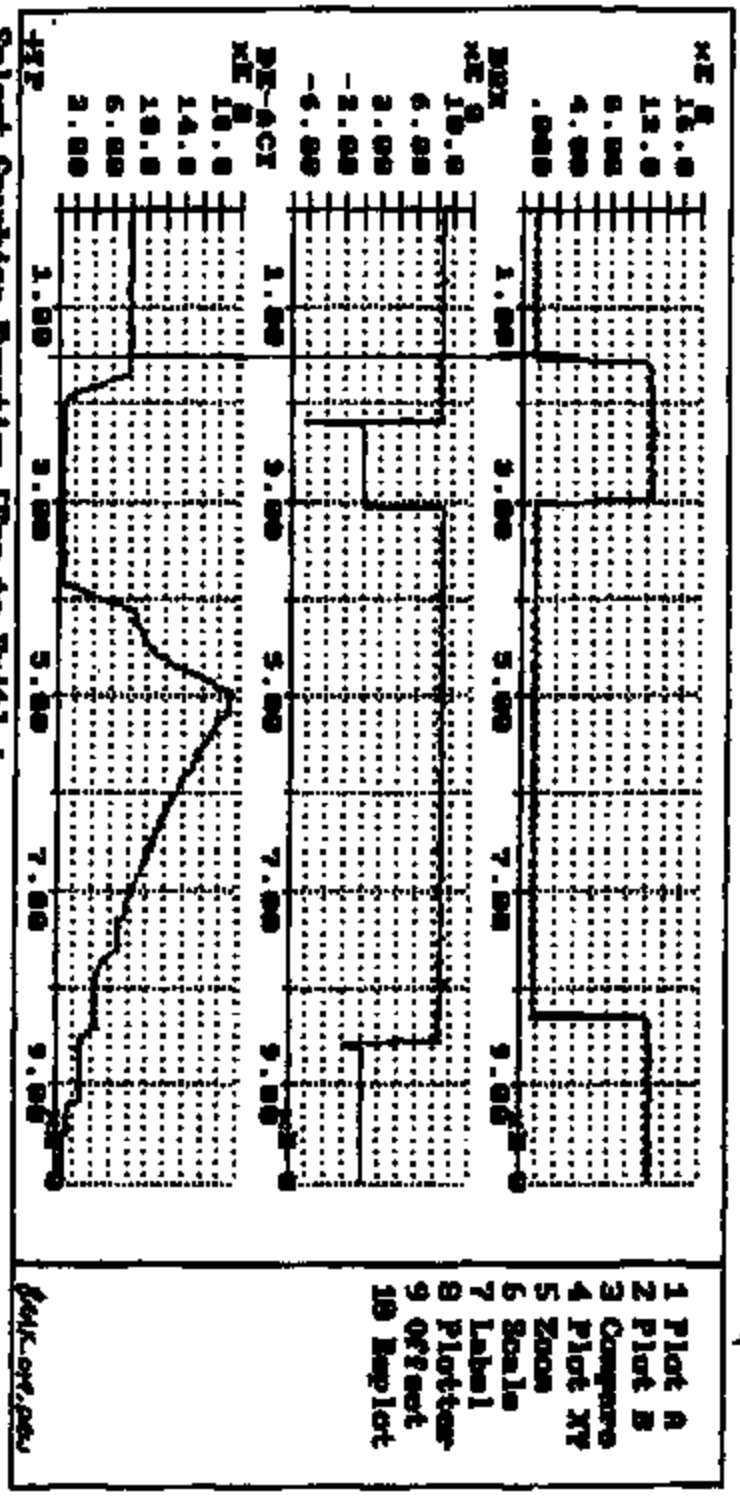
Why the delay

Dis-engagement During a Resure



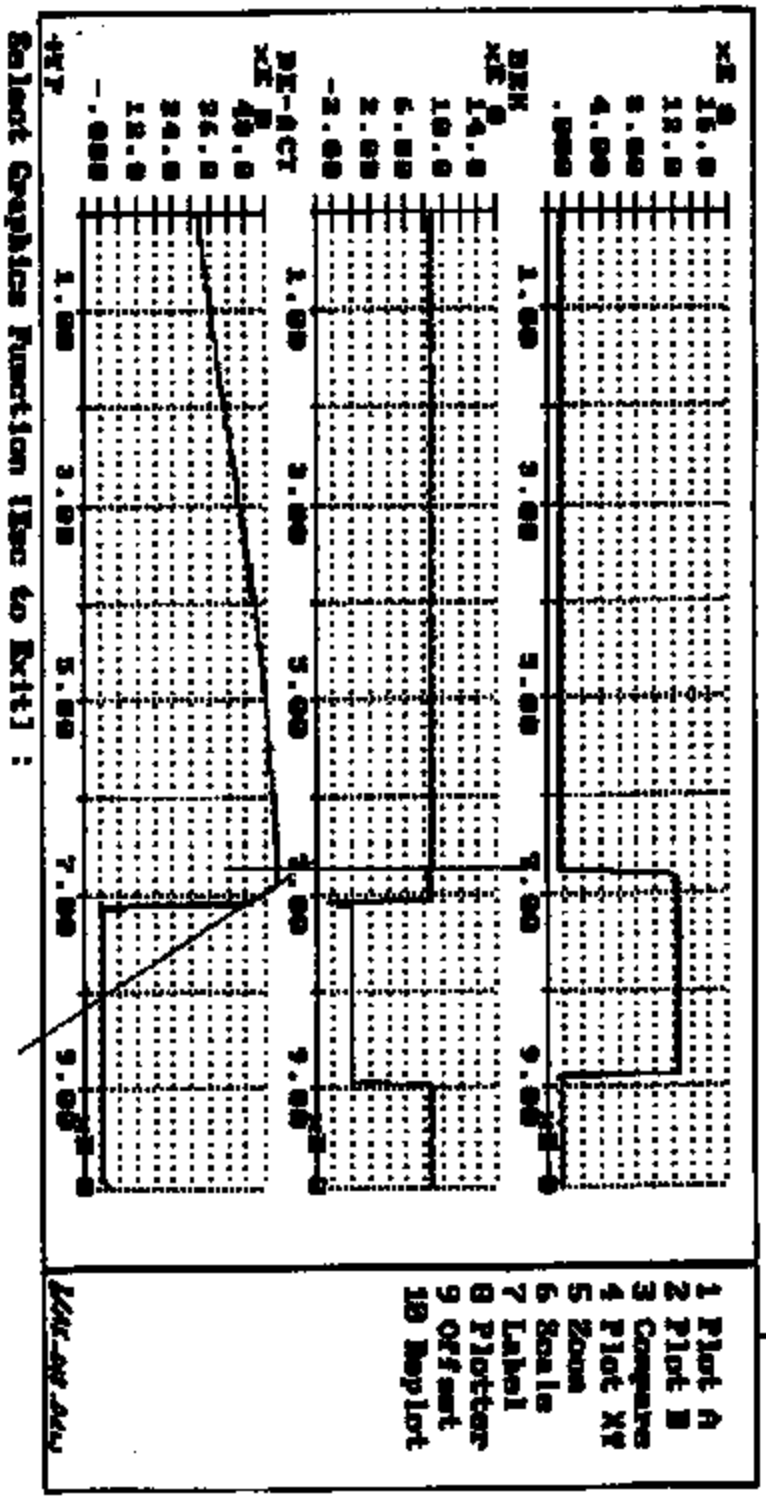
9

Brake Light "ON"



SEP 1 '89 11:55 FROM DRIVER CONTROLS

9
1 Plot A
2 Plot B
3 Compare
4 Plot XY
5 Zoom
6 Scale
7 Label
8 Plotter
9 Offset
10 Replot
DE-ACT
DISP
1.00
3.00
5.00
7.00
9.00
Select Graphics Function [Esc to Exit] :

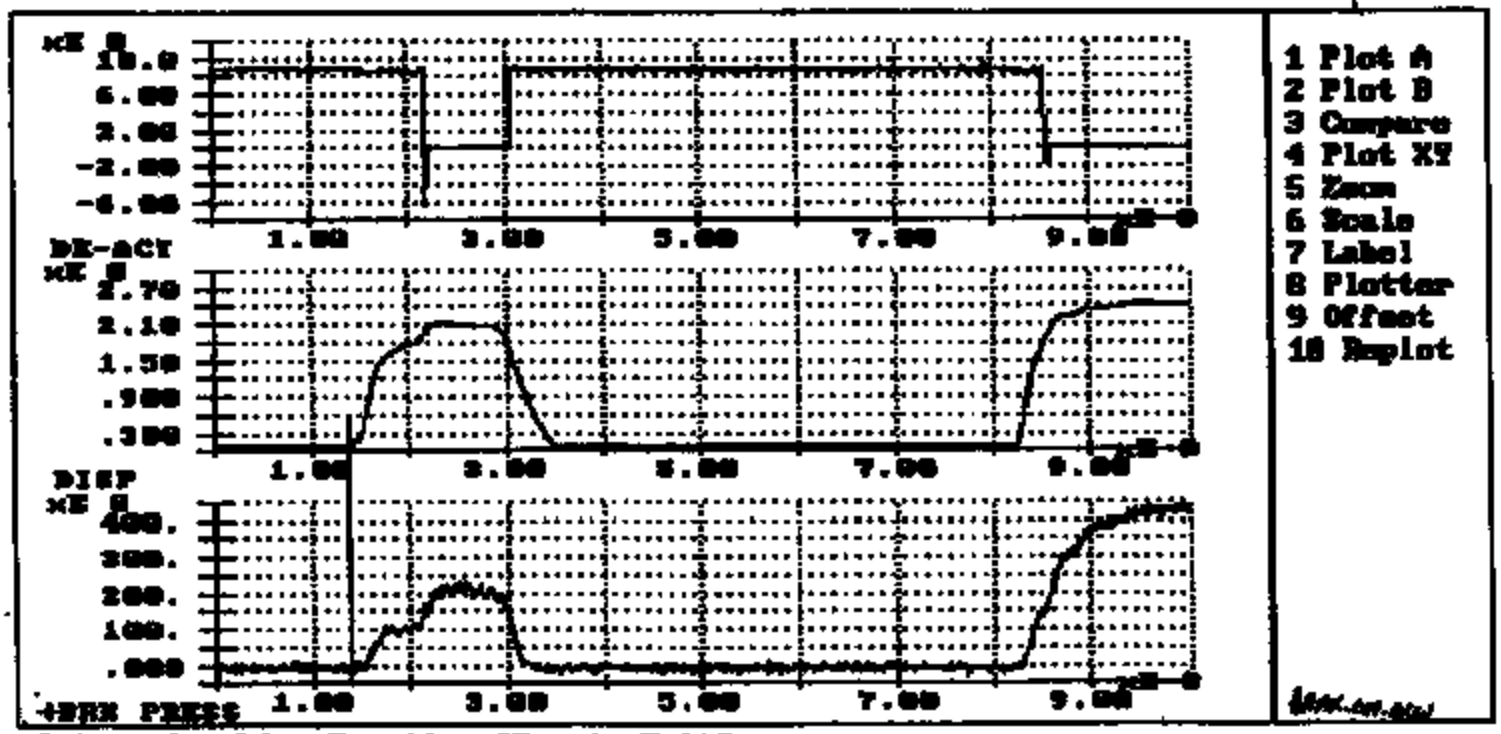

XE
15.0
12.0
8.00
4.00
.000
1.00
3.00
5.00
7.00
9.00
DEK XE
14.0
10.0
6.00
2.00
-2.00
1.00
3.00
5.00
7.00
9.00
DE-ACT XE
40.0
30.0
20.0
10.0
-.000
1.00
3.00
5.00
7.00
9.00
1 Plot A
2 Plot B
3 Compare
4 Plot XY
5 Zoom
6 Scale
7 Label
8 Plotter
9 Offset
10 Replot
Select Graphics Function [Esc to Exit] :

Rear RC

3

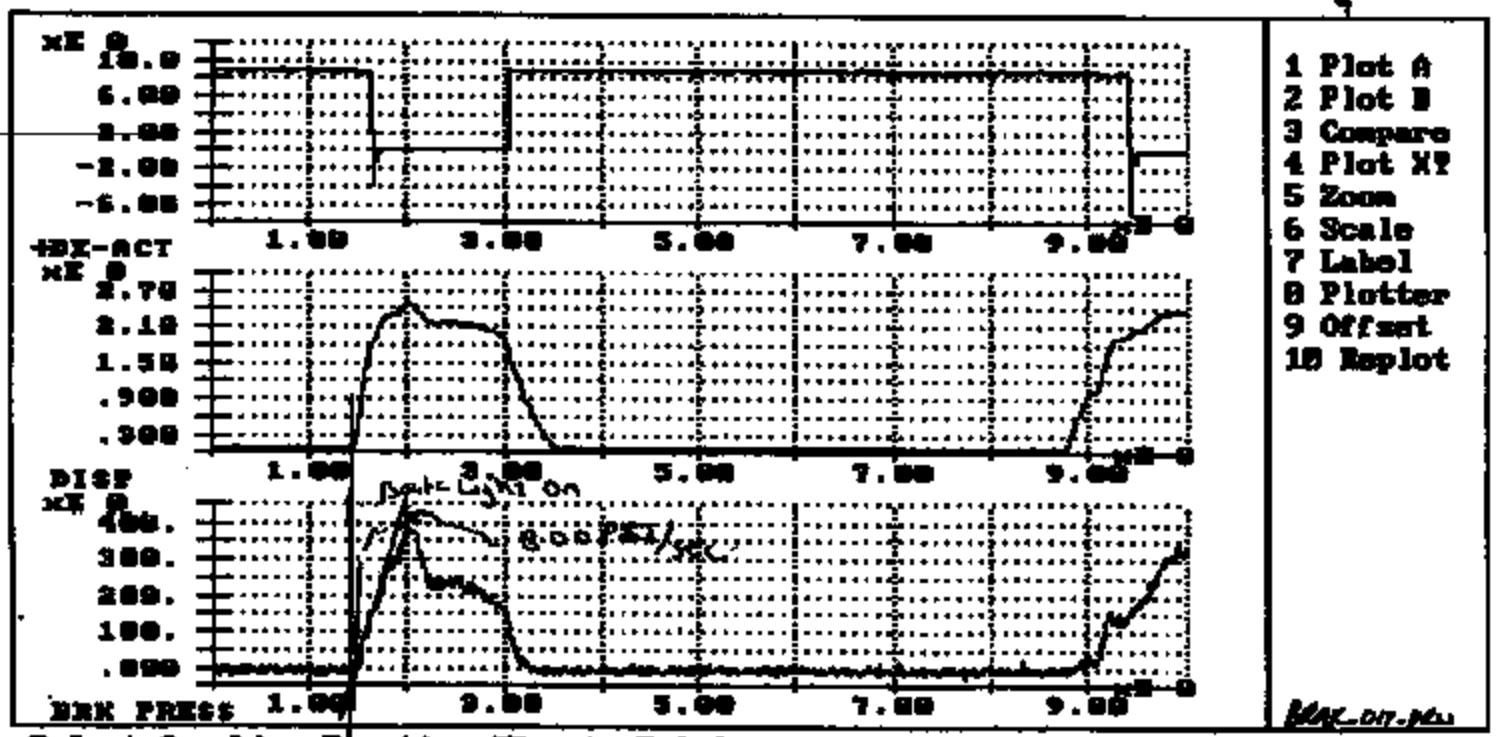
SEP 1 '89 11:54 FROM DRIVER CONTROLS

Dis-engegement



Select Graphics Function [Esc to Exit] :

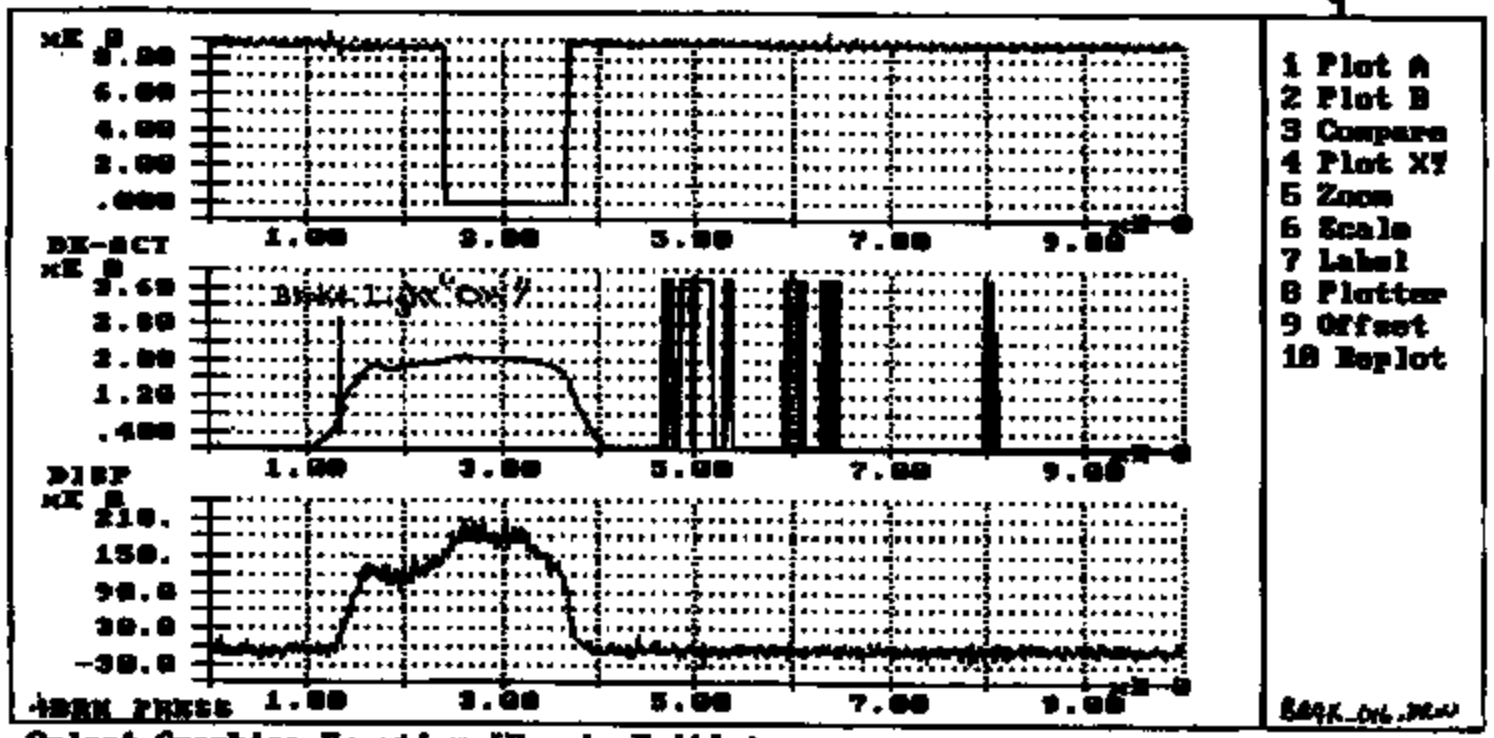
Quick Dis-engagement



Drop

Easy Dis-engagement

9



1

PRESSURE SWITCH DATA FORM 21605 **TEST NO.** 29-01-15

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
EX 2423	9/14/99	SBO	

PERFORMED BY	DATE STARTED	DATE COMPLETED	APPROVED BY
RAB	9/?/99	9/17/99	

PROJECT TITLE: Cruise Control Pressure Switch

CUSTOMER: Pitts

PURPOSE OF TEST: Furnish 15 samples

PROCEDURE: These sample will have 70 Duro Gaskets and [illegible] Kapton washers

Device #	Spring Offset	Force Grams	Travel Dimens	Proof	Act	Rel	Diff
29-01-01	.006	250	213	Pass	126	121	2.9
02	.006	220	213		129	125	4.4
03	.006	250	216		130	122	13.5
04	.005	215	218		128	121	6.5
05	.005	200	218		126	122	4.0
06	.005	190	214		128	123	5.2
07	.006	200	214		132	127	2.2
08	.004	200	215		127	132	2.0
09	.006	225	212		128	129	4.7
10	.005	270	214		143	134	6.1
11	.005	200	213		135	132	6.7
12	.006	235	216		133	129	4.3
13	.005	225	212		136	130	4.9
14	.005	190	213		130	129	4.4
15	.005	215	211		135	130	1.9

HIGHLIGHTS

Stephen B. Offiler

Week Ending 09/15/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EX3423

SPECIFICATIONS: We have completed shipment of the special test-set of 57PS's. A total of 22 devices were shipped, with actuations ranging from 156 psi to 299 psi in 5-10 psi increments.

I have discussed the use of this test-set with Gary Klingler, and learned some new facts. The harsh speed-control cancellation that he is trying to avoid by raising the actuation pressure is presently a problem with Light Truck but Gary expects the same issue to arise with PassCar also, maybe to a lesser extent. In testing, depending on the manner in which the brake pedal is applied, he sometimes gets high-pressure spikes to 500 psi and beyond... even when system cancellation, NOT stopping, is the objective. So in order to avoid the harsh throttle-pedal motion that occurs when our switch opens too soon, it is beginning to look like we need to either: 1) set actuation above the expected spike pressure or 2) filter out or at least soften the spike hydraulically with an orifice.

Gary continues to do testing to understand the spikes. He is presently quite set upon the idea of an orifice. I have written a computer program which allows us to model the pressure drop vs. time characteristics of orifices of various sizes. Pending further work by Gary, it presently looks like the orifice used on the 57PS is much too large. The idea of using a porous-metal insert in the hexport has been proposed. I've obtained samples of this material (commonly used for filters) and we plan to build and test some prototypes. The customer is well aware of the cost implications of such a device. I'm in touch with Gary regularly to monitor this situation.

DESIGN ISSUES: Rather than travel to visit Eloo on the hexport, it was decided that a telephone conversation plus fax'ed sketches would suffice. I spoke at length with Ken Carlson, Eloo's VP of Engineering and technical guru. He has given me recommendations for design changes to make the part more cost-effective to produce, and is sending a marked-up print. He indicates that various design features, such as the SAE J512 flats, the O-ring groove at the thread, the O-ring/gasket gland at the pressure cavity, etc. do not contribute significantly to the cost because both sides of the part must undergo secondary operations anyway.

We're looking into use of multiple stacked discs for this application (if actuation pressures increase significantly) and to possibly meet other applications. I have a Nippondenso device with multiple discs which have some kind of lubricant. I plan to have Al Hopkins analyze this material. Also, I plan to talk to Hank Boulanger about the 20PS, which I'm told uses a surface-treatment on the discs to prevent wear between them. A third proposed idea uses a graphite-impregnated mylar film.

Jack Kearns has been asked to contact Norwalk to obtain machinable slugs of powdered metal for testing purposes. They've also been asked to pursue alternate P/M houses and to obtain prototype crimp rings. Regarding terminals, Purchasing & Mfg. Eng. wish to give both terminals to the same supplier. A.J. Knott is generally the low quote on non-production-type terminal designs; we will approach them to determine if they have sufficient capacity to produce both terminals, then seek design assistance from them to arrive at the most cost-effective terminal design.

PRESSURE SWITCH DATA Form 21605 **TEST NO.** 27-01-09

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
EX 3413	9/11/97	SBO	

PERFORMED BY	DATE STARTED	DATE COMPLETED	APPROVED BY
JAP	9/11/97	9/19/97	

PROJECT TITLE: Cruise Control Pressure Switch

CUSTOMER: Ford

PURPOSE OF TEST: To test valve-like, cone-shaped sealing mechanism.

PROCEDURE: Build devices w/cone-shaped seals. Thermal cycle and intake test.

Device #	Snap Disc Deflect	Force	Trans Pins	Proof	Act	Rel	MV Drop	
27-01-01	.005	210	212		Failed - Leaker			
02	.006	200	209		132	128	8.3	
03	.005	230	213		Failed - leaks wlair			
04	.006	180	213		Failed - leaker wlair			
	Scrap	Test						

TI-NHTSA 000537

PRESSURE SWITCH DATA Form 21605 **TEST NO.** 29-15-03

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
Ex 3423	9/15/99	SBO	
PERFORMED BY	**DATE STARTED**	**DATE COMPLETED**	**APPROVED BY**
JAD	9/20/99	10/1/99	

PROJECT TITLE: Cruise Control Pressure Switch

CUSTOMER: Ford

PURPOSE OF TEST: To see if these plugs in our hexport will produce an acceptable delay of actuation when pressure

PROCEDURE: On Next Page

Device	Spring Deflect	Force Grams	Trans Pin + 3	Act	Ref	Restriction Factor
Red	.085	220	213	138	121	50
Green	.084	170	213	140	122	100
Blue	.095	110	213	140	120	25

Temp	Psi/Sec		Green	Red	Blue
121	1500		13.4 mS	10.6 mS	7.95 mS
121	500		31.9 mS	19.5 mS	13.05 mS
121	300		231 mS	176 mS	70.6 mS
-40	1500		5.18	2.75	1.25
-40	500		22.2	13.15	5.25
-40	300		188.05	73.95	24.15

TI-NHTSA 000536

ϕ .1861	ϕ .1865	ϕ .1864
T .0645	T .0645	T .0640
20	50	100

ϕ thru ~ .135 A = .014 in²

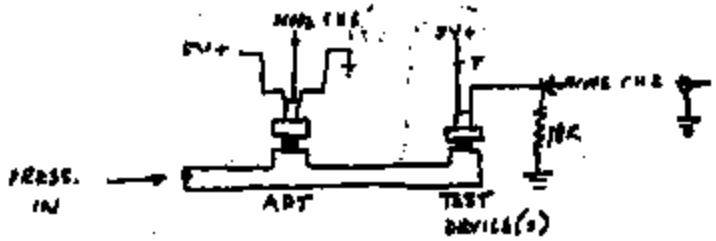
Brass pellet

ϕ = .185

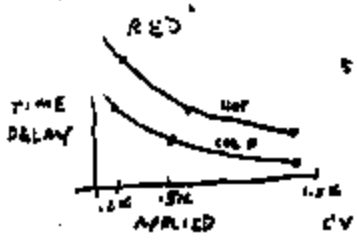
- Characteristic slowly w/ air → this will slow time pressure for contacts to open

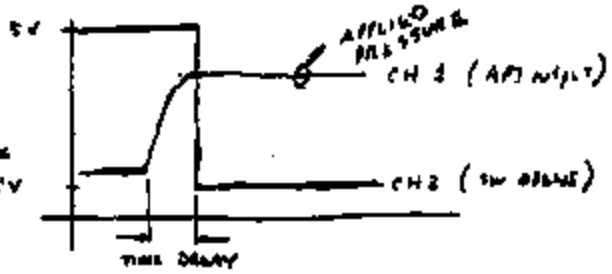
- Force trying to press pellet at : F = PA = (100)(.014) = 1.4 lbs

- Run a cycler w/ ADT in ckt (turn cycler down to ~ psi)



BL — 20
RD — 50
GRN — 100





PRESSURE SWITCH DATA Form 21605 **TEST NO.** 30-15-03

DEVICE	DATE REQUESTED 9/22/89	REQUESTED BY C. E. Sanford	REQUESTED COMPL. DATE
PERFORMED BY JAD	DATE STARTED 9/25/89	DATE COMPLETED 9/29/89	APPROVED BY

PROJECT TITLE:

CUSTOMER: TRW

PURPOSE OF TEST: To see how well stacked discs maintain their characteristics over life.

PROCEDURE: Assemble devices w/2 discs and impulse test.

Measurements

Discs only snap after. Can only check creep open.

Open and rebuild w/ .005 disc stop

Device #	M_1	M_2	M_3	$M_3 - M_1$	$M_2 - M_1$ (PIN @ +.003)	Spring Ø Flat	Force Gauge	Trans Pin +S	
30-15-01	.169	.170	.206	.036	.003	.006	235	195	
02	.169	.170	.207	.037	.003	.004	170	196	
03	.169	.170	.206	.036	.003	.004	180	195	

Device #	Disc 1	Disc 2	1st Cycle Act	1st Cycle Rel	1st Cycle Creep	4th Cycle Act	4th Cycle Rel	4th Cycle Creep
30-15-01	177/175	178/184	346	318	Mixed	379	318	12.5 Ch
02	179/178	179/180	381	324	12.5	371	326	12.1
03	178/189	175/186	384	319	19.9	376	321	19.6

Device #	10th Cycle Act	10th Cycle Rel	10th Cycle Creep
30-15-01	379	327	32.8
-02	368	326	12.5
-03	371	322	11.6

Rebuild

Device #	1st Cycle Act	1st Cycle Creep	1st Cycle Rel	1st Cycle Creep	4th Cycle Act	4th Cycle Creep	4th Cycle Rel	4th Cycle Creep
30-15-01	428	1.9	377	1.2	404	1.9	391	1.1
02	451		399	1.9	406	2.1	394	1.3
03	410	2.3	388	1.2	403	2.1	391	1.2

Device #	10th Cycle Act	10th Cycle Creep	10th Cycle Rel	10th Cycle Creep
30-15-01	404	1.9	390	.68
02	403	2.7	397	1.3
03	399	2.9	390	.63

Rebuild

355.5

ACTUATION 327 – 384 PSIG

RELEASE 241 – 327 PSIG

43 PSI MINIMUM DIFFERENTIAL

Disc Sum	Final	
353	404	353 + 353X = 404 → X = 14.4% increase
356	403	→ X = 13.2%
351	399	→ X = 13.7%

AVG 13.6%

~~X + .136X = 327~~

~~1.136X = 327~~

~~X = 287.85~~

X + .136X = 355.5

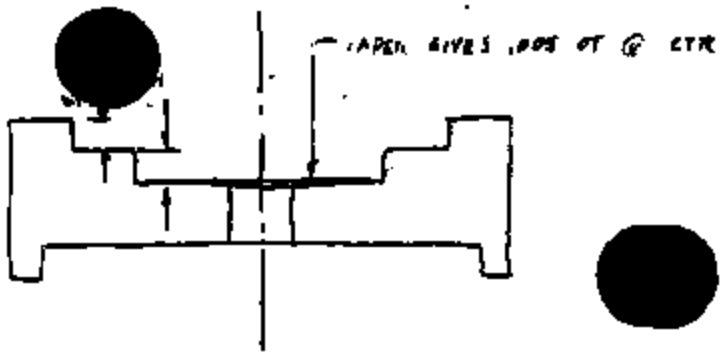
1.136X = 355.5

X = 312.94

Build device w/ 154/143 and 154/141

Parts from #1

- BUILD DOUBLE DEVICES
- MSC STABILITY FLOW CYCLING
- NO X-Y PLOTS YET
- OT .005
- DIA .000



H: 2 Axes .013 (?) + graphic = .018"

"H" step height = $(H_1 + H_2)/2$

= .042" + .005 (more for & down steps) , < .037"

HIGHLIGHTS

Stephen B. Offiler
Week Ending 09/22/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EX3423

SAMPLES: 15 more devices were shipped to Pitts this week. At present we do not have any good estimate of Pitts' future sample requirements; sample requests keep coming in intermittently. We owe Ford Light Truck a total of 56 devices; 20 will be shipped next week. We are running low on inventory of a couple parts, notably disc seats and discs. We will update the inventory as soon as possible.

SPECIFICATIONS: At Ford, Gary Klingler continues his efforts to arrive at a spec. I speak to him regularly, and I'm fairly convinced that he's doing everything in his power to resolve this issue quickly. He's beginning to veer on his idea of use of some kind of orifice, based on my computer analysis which shows drastic changes in delay characteristics over temperature (as fluid viscosity changes). He continues to do testing with the special set of 57PS's sent last week.

DESIGN ISSUES: We've built devices using porous metal plugs of various sizes in the hexport to give orifice-like characteristics. We will test these devices for delay over temperature and attempt to correlate the results with the computer analysis.

We're in the process of building a small lot of devices using two discs, with graphite/mylar lubrication between them. The information will be useful to gain knowledge for the TRW application, where tight tolerance makes one of the 57PS questionable, and for CCPS application if the specification were to be raised significantly from 150 psi. I've spoken with Hank Boulanger to learn how they use multiple discs in the 20PS, and I've got Hank Griffin doing analysis of lubricant found between discs on a Nippondenso dual-function device.

The initial O-ring sealing system test ended in failure. Of four devices built, one O-ring failed very early in the test, possibly defective; one device had delaminated teflon from the Kapton; one had cut Kapton resulting from interaction to the disc seat edges; the last began to leak slightly and was removed before total failure occured. This idea has not died, however. We plan to rebuild devices with the proper, 70-duro O-rings; with bare Kapton to prevent delamination; and with better smoothing of sharp edges.

PURCHASING ISSUES: We have received a response from Elco on the lowest-possible-cost hexport. They have made design recommendations that will help lower the cost. The bottom line is about $0.22 each.

We are waiting for Jack Kearns to address a number of issues: pursuit of machinable Powder Metal rings for disc seat proto's; crimp ring proto's built by a high-volume supplier (as opposed to R.W. Jacques); international purchasing involvement on the hexport; and initiation of dialogue with A.J.Knott on the terminal design.

9/22/89

P R O P O S A L
==========

26 SEPTEMBER 1989

TO:	KEITH ROBERTS	12-37
CC:	JIM ARMSTRONG	20-25
	STAN STELIGA	20-01
	JOHN KOURTESIS	20-25
	JOHN GORMLEY	20-25
	LOU ROCHA	20-25
	DAVE KEYES	20-25
	CARL SANFORD	12-29
	BOB HITT	12-35
	CHARLIE DOUGLAS	12-33
FROM:	STEVE MCCOOEY	20-25
	ED KAOISEVSKIS	20-25
SUBJECT:	CCPS ASSEMBLY TOOLING PROPOSAL (PROJ. #2530600941)	

Direct Disc Design

TER SEVERAL MEETINGS WITH THE PRODUCT DESIGNERS AND SEVERAL WITHIN MeCHANIZATION WE HAVE DEVELOPED THE METHOD IN WHICH WE WOULD ASSEMBLE AND TEST YOUR CRUISE CONTROL PRESSURE WITCH. ATTACHED IS A SKETCH SHOWING THE PROCESS FLOW FROM ONE MACHINE TO THE NEXT AND THE ASSOCIATED STATIONS LISTED FOR EACH MACHINE.

THE LINE CONSISTS OF FOUR MACHINES:

MACH I - OFF LINE ASSEMBLY OF THE BeCu ARM TO THE TERMINAL.

MACH II - 24 STATION AMI. LOAD RING, BASE 2 TERMINALS. DISC SEAT. PIN AND CALIBRATE.

MACH III- 24 STATION AMI. LOAD ONTO BASE ASSEMBLY. DISC. 2 KAPTON. GASKET. KAPTON W/HOLE. HEXPORT. ORING AND SLEEVE.

MACH IV - DUAL NESTS INDEXER BASED ROTARY CRIMP AND TEST MACHINE. THE DUAL NESTS WILL ALLOW 7.2 SEC INDEX ON THIS MACHINE. THE REST OF THE LINE WILL RUN ON A 3.6 SEC CYCLE 1000 PCS/HR.

[illegible] - CONVEYORS BETWEEN 2/3, 3/4 ARE INCLUDED WITH 15K ALLOWED EA.

THE COST FOR THE DESIGN AND BUILD IS AS FOLLOWS:

EXPENSE:

MECH DESIGN	158.8
ELEC DESIGN	145.9
TOTAL	304.7K

CAPITAL:

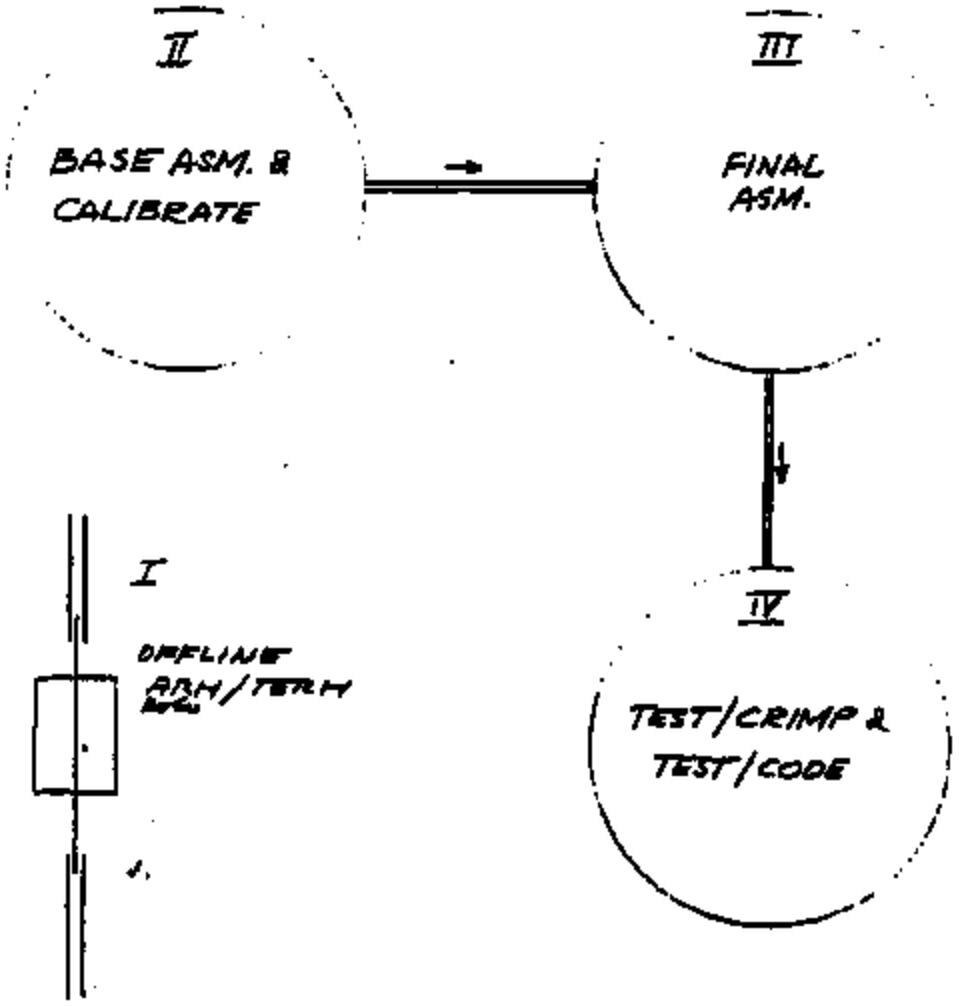
MECH DEBUG (750 @ $44/HR)	33.0K
ELEC DEBUG (734 @ $44/HR)	32.3K
MECH PURCH	478.0K
ELEC PURCH	124.5K
MECH BUILD (6755 HRS @ $41/HR)	271.4K
ELEC BUILD (4284 HRS @ $31/HR)	132.8K
TOTAL	1,072.0K

APPROVALS:

JOHN KOURTESIS _____ 9/26/89

LOU ROCHA _____ 9/26/89

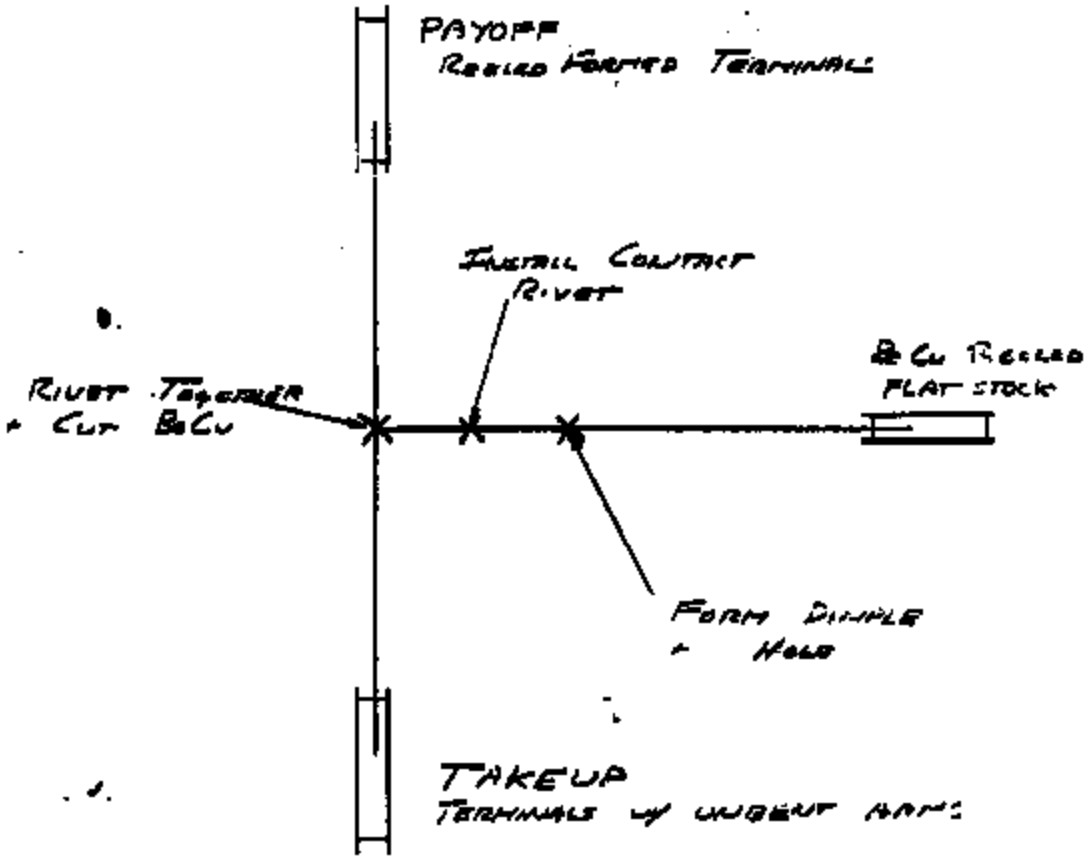
STAN STELIGA _____ 9/26/89



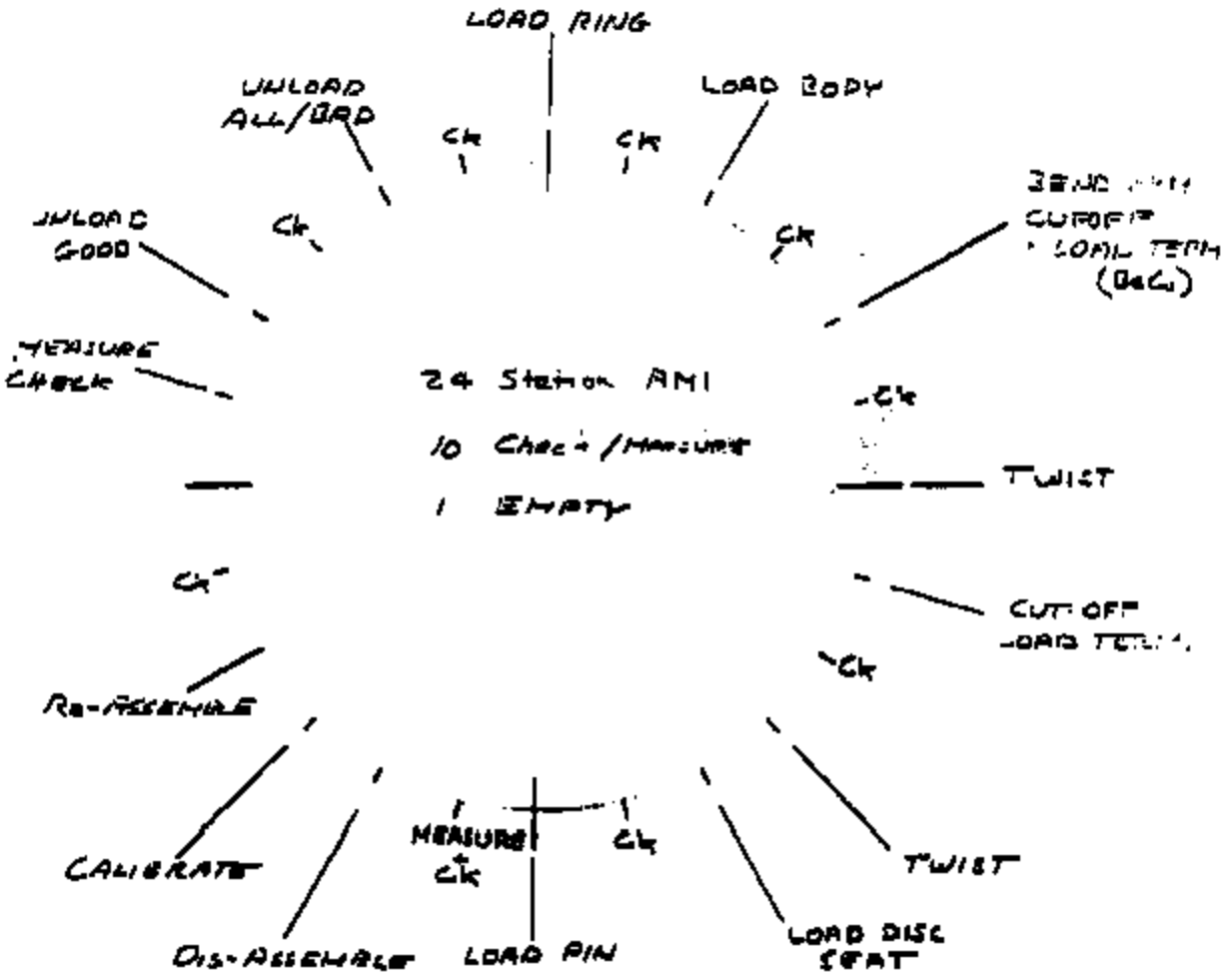
CCPS MACHINE LAYOUT

I

SPRING ARM / STRIP



II

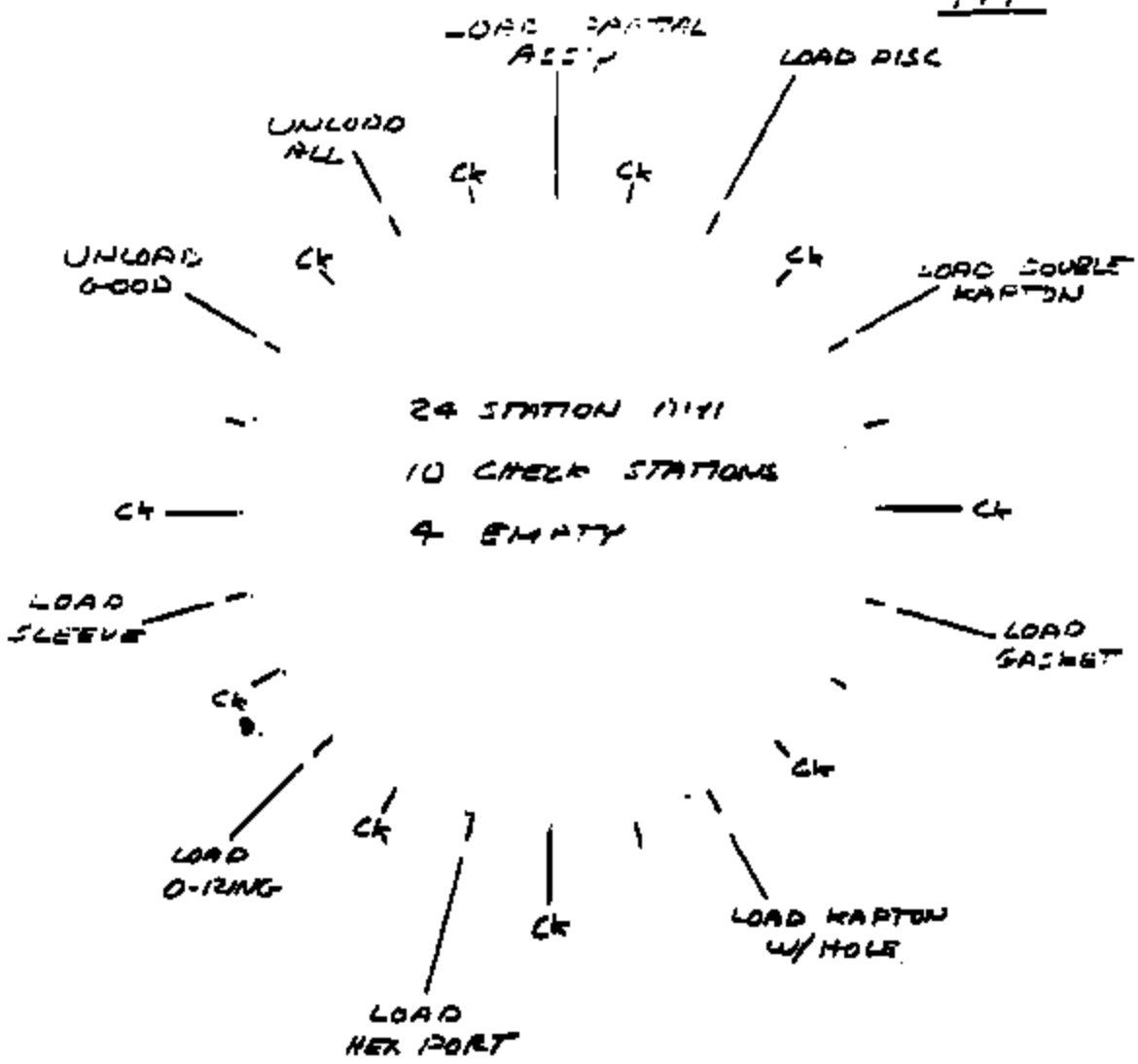


* LOAD RING = FEEDER
* " BODY = " "
* LOAD TERM I = REELED STRIP
* " " II = " "
* LOAD DISC SEAT = FEEDER
* " PIN = " "

* UNLOAD GOOD - TO CONVEYOR THAT CONNECTS TO MACHINE III. LENGTH TO BE DETERMINED, HOWEVER OPERATOR SHOULD BE ABLE TO MANUALLY LOAD/UNLOAD IN THE MIDDLE OF THE CONVEYOR.

* UNLOAD ALL/BAD - BUCKET

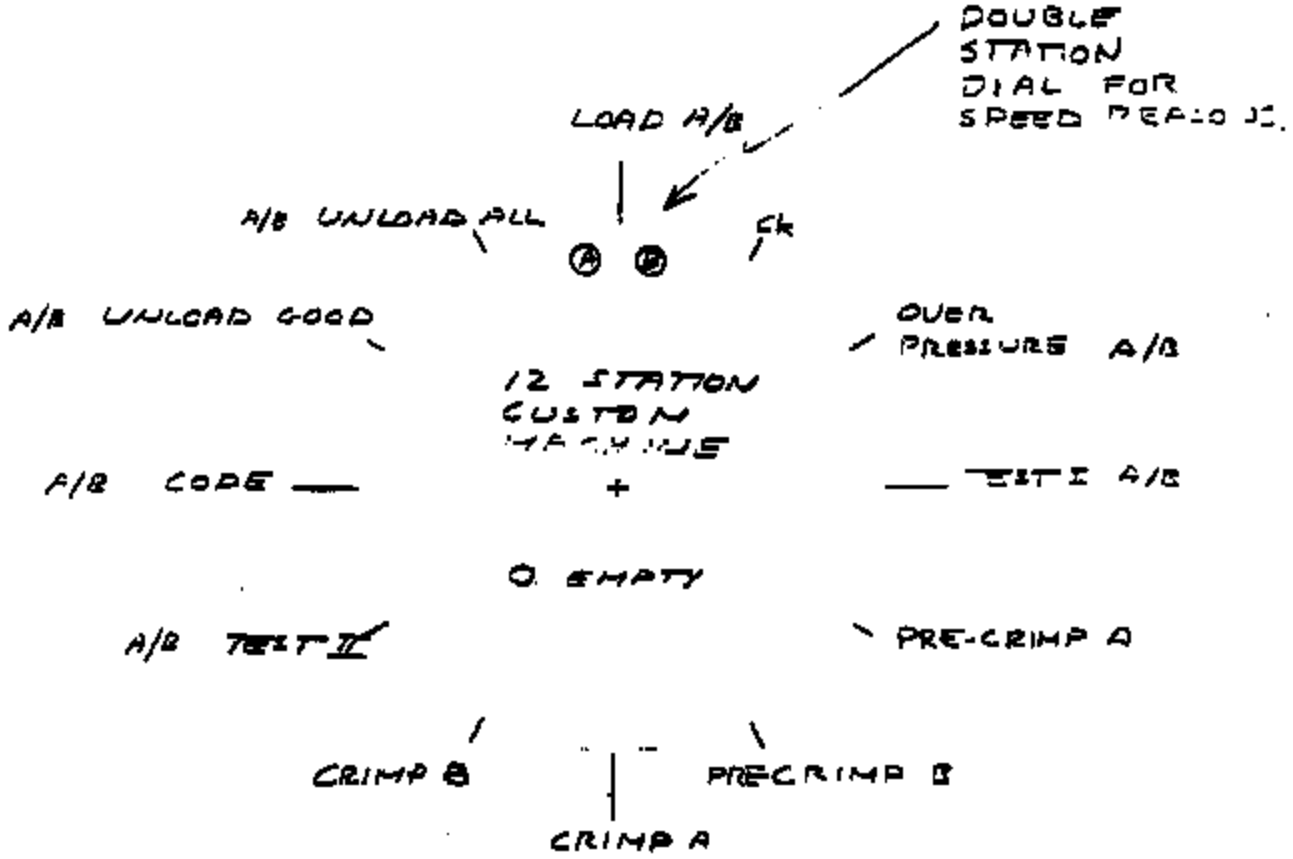
III



FROM CONVEYOR

* LOAD PARTIAL ASS'Y - SLEEVE, BASE, DISC SEAT, PIN
* LOAD DISC - FEEDER
* LOAD DOUBLE KAPTON - PUNCH + DIE THROUGH TWO LAYERS.
* LOAD GASKET - FEEDER
* LOAD KAPTON W/ HOLE - 2 STAGE PUNCH + DIE
* LOAD HEXPORT - FEEDER
* LOAD O-RING - FEEDER
* LOAD SLEEVE - FEEDER
* UNLOAD GOOD - TO SAME/SIMILAR CONVEYOR SYSTEM BETWEEN MACH II/III
* UNLOAD ALL - BUCKET

V



* LOAD - UNCRIMPED DEVICE FROM CONVEYOR
* OVER PRESS - 5000 PSI UNCRIMPED DEVICE
* TEST I
* PRECRIMP A/B (SEPERATE STATIONS DUE
* CRIMP A/B (TO ROOM CONSTRAINTS)
* TEST II
* CODE - CODE ON RING, METAL STAMP
* UNLOAD GOOD - TOTE
* UNLOAD BAD - BUCKET

HIGHLIGHTS
Stephen B. Offiler
Week Ending 09/29/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EX3423

SAMPLES: We shipped 20 more parts to Ford Light Truck this week. They have enough now to complete their fleet build, the balance of 36 are spares.

Our inventory of prototype components is beginning to dip dangerously low. I have plans to place orders with APCC Screw-Machine for disc seats; with R.W. Jacques for crimp rings; and to have Dave Brown create some more discs (and train Jeff to use the disc press). Please note these parts are *not* production-representative; their purpose is to enable us to continue to provide Ford with samples and to continue with our various tests.

SPECIFICATIONS: When I last spoke with Gary Klingler, he told me he was preparing a test Econoline van with capability for two pressure switches and a selector switch to allow A/B comparison. The "A" switch is the CCPS that gives harsh system cancellation, and the "B" switch will be one of the test-set of 57PS's shipped earlier this month. I do not have any results of this test; however Gary has been regularly sending me quantities of data as he collects it.

DESIGN ISSUES: Work progresses on the multiple-disc concept for CCPS and TRW. The first devices with .002 overtravel (concave, no step) had no release snap. Increasing to .005 overtravel (flat, w/ step) gave snap, but the device actuation increased significantly above the sum of the two individual free-disc actuations. New devices were built with discs with lower actuations. This worked initially; however after 1K cycles the actuation seems to be sliding downward towards the simple sum of the individual free-disc actuations. We are rebuilding the original devices using a grease to lubricate the discs; we plan to continue testing of the multiple-disc concept with both test-lots.

Testing of the sealing system is ongoing. The devices with lathe-cut gaskets and Kapton to block extrusion have passes 1.5KK cycles without failure; initial O-ring devices did not make 500K. Since the O-ring concept is more manufacturable, we still plan to rebuild these devices with better attention to detail (no sharp edges to cut Kapton; no Teflon on the Kapton; careful characterization of the gland dimensions) however my request to Parker for standard O-ring samples has gone unanswered. I plan to recontact Parker as well as Acushnet and Minnesota Rubber (favored by APT people); the test will resume with the first O-rings to arrive.

The APCC Disc Dept. is working on discs for us. They have made snap discs to about 90 psi act, 10 psi diff. using .0105" 301 SS. We are now looking into .012" 455 SS which Jeff Melton thinks will easily make 100 psi act, 70 psi rel.

PURCHASING ISSUES: We are *still* waiting for Jack Kearns to address a number of issues: pursuit of machinable Powder Metal slugs for disc seat proto's; crimp ring proto's built by a high-volume supplier (as opposed to R.W. Jacques); international purchasing involvement on the hexport; and initiation of dialogue with A.J.Knott on the terminal design. Joe Schuck has gotten the name of a screw-machine house which is favored by Ford, Curtis Screw Machine. We have requested that Jack add them to his list of potential hexport suppliers. They claim to be competitive with Elco.

9/26/89

MANUFACTURING ENGINEERING PRECISION CONTROLS
CCP8 MANUFACTURING REVIEW
SEPTEMBER 29, 1989

AGENDA

DEVICE FUNCTION OVERVIEW

PRODUCT EVOLUTION

PROGRAM OVERVIEW

COST STATUS

ASSEMBLY PLANS

SCHEDULE

SUMMARY

III. TEST PROCEDURES AND REQUIREMENTS (cont'd)

C. Current Leakage

1. Test Requirements

a. Current leakage is to be checked with 500 volts, 60 Hz alternating current.

b. Current leakage is to be checked:

(1) Between the switch leads with the contacts open.
(2) Between the lead and the switch housing with contacts closed.
(3) Between either lead and switch housing with the contacts open.

2. Acceptance Requirements

a. Nonconformance is defined as any leakage current in excess of one hundred (100) microampere.

D. Proof Test

1. Test Requirements

a. Subject sample switches to Section A to establish their initial switching pressures.

b. Proof test is to be conducted using brake fluid or equivalent as the pressure medium. Test pressure shall be as specified on the part drawing. Test pressure shall be isolated from pressure source and held for not less than 30 seconds.

c. Recheck the switches to Section A.

2. Acceptance Requirements

a. No evidence of fluid leakage, seepage, or drop in test pressure greater than 430 KPa.(62 PSI) is permitted.

b. A change in cut-in and cut-out pressures greater than ± 5% from the initial value is not permitted.

c. The test samples must be destroyed after testing.

III. TEST PROCEDURES AND REQUIREMENTS (cont'd)

E. Impulse

1 Test Requirements

a. Test the switch for a total of 500,000 cycles. Cycle pressure between (low) 0-276 KPa (0-40 psi) and (high) 10,000 ± 345 KPa (1450 ± 50 psi).

1) 0 - 475,00 cycles: 13 ± 1 volts, trace current to monitor function.

2) 475,001 - 500,000 cycles: 13 ± 1 volts D.C., 750 ± 50 ma., per figure 4.

b. Brake fluid temperature to be 135 ± 14°C and ambient temperature to be 107°C min.

c. Cycle rate is to be 110-130 cycles per minute.

d. Switch must open and close each cycle.

2. Acceptance Requirements

a. After impulse test check to sections A, B, C, & D using the procedure established in each section.

b. Nonconformance is defined as any switch not meeting the criteria in sections A, B, C, & D.

c. Samples used for this test must be destroyed after all testing is completed.

F. Burst

1. Test Requirement

a. Burst strength is to be checked using brake fluid or equivalent as the pressure medium.

b. Pressurize the switch to 48.3 MPa (7000 PSI) minimum and held for 30 seconds minimum.

2. Acceptance Requirements

a. Nonconformance is defined as any evidence of fluid leakage or seepage from the switch or threads. Samples used for this test must be destroyed after testing is completed.

G. Humidity

1. Test Requirements

a. Mount the switch in the test port in a humidity chamber. Currently released mating electrical connector must be installed before start of test.

b. Subject the switch to ten (10) continuous humidity cycles as follows:

(1) Raise temperature to 65 +10/-2 °C over 2.5 hours; at 90-98% relative humidity.

(2) Hold 3 hours at 65 +10/-2 °C at 90-98% relative humidity.

(3) Lower temperature to 25 +10/-2 °C over 2.5 hours; at 80-98% relative humidity.

2. Acceptance Requirements

a. Within 15 minutes after completion of the tenth humidity cycle check the switch to sections A, B, C, D, using the procedure established in each section.

b. Nonconformance is defined as any switch not meeting the criteria in sections A, B, C, or D.

H. Salt Spray

1. Test Requirements

a. Mount the switch in the test port in a salt spray chamber. The currently released mating electrical connector and wiring must be installed prior to start of test.

b. Expose the switch assembly to 72 hours of salt-spray per ASTM B-117.

2. Acceptance Requirements

a. After exposure, check the switch to sections A, B, C, D, using the procedure established in each section.

b. Nonconformance is defined as any switch not meeting the criteria in sections A, B, C, or D. Samples used for this test must be destroyed after all testing is completed.

III. TEST PROCEDURES AND REQUIREMENTS (cont'd)

I. Vibration

1. Test Requirements

a. Mount the switch in the test part and attach the currently released mating electrical connector before start of test.

b. Switches are to be vibrated in all 3 planes with electrical continuity being monitored during the entire test. See Figure 1 for switch orientation in the 3 planes. Vibration tests are to be conducted at room temperature using brake fluid, ambient air, or equivalent as the pressure medium.

c. Internal pressure shall be maintained at 0 KPa G. when the switch is in the closed position and 1.1 times max actuation pressure shown on print when the switch is in the open position.

d. Vibrate the switch at 1.5 mm displacement (peak-to-peak) while varying the frequency uniformly from 5 to 50 to 5 Hz over a 5 minute period.

e. Vibrate the switch in alternate one-hour periods in the open and closed positions for a total of 8 hours in each plane. (Total test time is 24 hours).

2. Acceptance Requirements

a. After the entire vibration sequence check the switches to sections A, B, C, or D using the procedure established in each section.

b. Nonconformance is defined as any evidence of leakage or any change in electrical continuity/discontinuity during the vibration cycles, or any switch not meeting the criteria in sections A, B, C, or D. Samples used for this test must be destroyed after all testing is completed.

III. TEST REQUIREMENTS AND CONDITIONS (cont'd)

J. Terminal Strength

1. Test Requirements

a. Mount the switch in the test port.

(1) Apply a 89 ± 9 N axial force to each terminal.

(2) With a pendulum apply a 45 ± 5 N impact force to the switch housing at the connector end, perpendicular to the centerline axis of the switch. See Figure 2 for force application point and direction.

2. Acceptance Requirements

a. Check the switch to sections A, B, C, and D using the procedures established in each section.

b. Nonconformance is defined as any terminal or housing fracture, or any switch not meeting the criteria in sections A, B, C, or D.

K. Vacuum

1. Test Requirements

a. Mount the switch in the test port. Vacuum tests are to be conducted at room temperature using ambient air as the pressure medium.

b. Subject the switch to 5 cycles of vacuum from atmospheric pressure (760 mm Hg) to an absolute pressure of 3-6 mm Hg. Maintain the vacuum for a minimum of 60 seconds.

2. Acceptance Requirements

a. Check the switch to sections A, B, C, and D using the procedure established in each section.

b. Nonconformance is defined as any switch not meeting the criteria in sections A, B, C, and D.

III. TEST PROCEDURES AND REQUIREMENTS (cont'd)

L. Temperature Cycle

1. Test Requirements

a. Mount switches in test ports; test to be run using currently released brake fluid.

b. Repeat the following procedure 25 times.

(1) Lower the switch and fluid temperature to at least -40°C.

(2) Cycle the switches ten times at 10 seconds/cycles. One cycle consists of a pressure variation from 0 - 276 KPa.G (0-40 psi) to 10,000 ± 345 KPa.G (1450 ± 50 PSI).
Note: Switch must open and close each cycle.

(3) Raise switch and fluid temperature to 38°C minimum.

(4) Repeat Step 2.

c. At completion of Step b, check switches per sections A, B, C, and D.

2. Acceptance Requirements

a. Nonconformance is defined as any evidence of switch fluid leakage, seepage, or not meeting the criteria of sections A, B, C, and D.

M. Fluid Resistance

1. Test Requirements

a. Mount the switch in the test port and orient as installed in the vehicle.

b. Install the currently released mating electrical connector (with wire leads) to the switch.

c. Sequentially, immerse the switch into each of the specified fluids, at a temperature of 23 ± 2 °C, for 5 ± 1 second. Remove the switch and drain and store the switch for the specified time at room temperature, prior to immersing into the next fluid.

III. TEST PROCEDURES AND REQUIREMENTS (cont'd)

Fluid	Drain Time	Storage Time
Reference Fuel C ASTM D471	60 ± 5 min.	none
10W40 Engine Oil	24 ± 1 hour	14 days
Ethylene Glycol/ Water 50/50 by Volume	24 ± 1 hour	24 ± 1 hour
Brake Fluid DOT 3	24 ± 1 hour	48 ± 1 hour
Automatic Transmission/ Power Steering Fluid (same) ESP-M2C138-CJ	24 ± 1 hour	14 days
Isopropyl Alcohol/ Water 50/50 by Volume	24 ± 1 hour	none
Reference Fuel C, ASTM D471 with Methyl Alcohol 85/15 by Volume	24 ± 1 hour	none

d. Per the Flow Chart, subject the prescribed number of immersed switches to the post immersion tests specified below:

III. G. Impulse
III. O. Humidity
III. N. Salt Spray
III. J. Terminal Strength

Acceptance Requirements

a. Switches must fully meet the requirements of the specified post immersion test.

b. Nonconformance is defined as any switch not meeting the criteria in sections A, B, C, or D. Samples used for this test must be destroyed after all testing is completed.

IV. STATISTICAL ANALYSIS METHODS

A. For FV, IP-1 and IP-2 tests, all samples tested must pass. Having all the required sample size pass will provide data to support the conclusion that the switch has a minimum reliability R, at a given confidence of C. The notation Pc-R is interpreted as minimum reliability equal to R, at a confidence C; thus P90-.80 means a minimum reliability of 80% at 90% confidence.

B. All samples must pass is the statistical test acceptance criteria stated for tests with 100% frequency; or samples from lots, which could have a variable size.

V. REVALIDATION REQUIREMENTS

A. No change in design, material, process or component supplier shall be made without prior approval from the releasing Product Engineering Office. As part of approving a change, the releasing Product Engineering Office will establish the portion of the Product Validation tests required to be run to revalidate the switch.. The following table is to be used as a guide in determining the type of tests required for revalidation requirements.

RUNNING CHANGE REVALIDATION

Component	Process or Material Change or Non Supplier
1. Terminals, Contacts, or Connector	III, B, C, E, G, H,I, J, L, M.
2. Case or Housing	All Tests
3. Disc or Diaphragm	III, A,D,E,F,I,K,L.
4. Fitting or Fluid Connection	III, D, E, F, H, I, M.

B. Annual revalidation is not required on carryover switches.

VI. LOT DEFINITION

A lot is defined as no more than eight (8) hours of production up to 4,000 pieces. If shifts extend beyond eight (8) hours, or more than 4,000 pieces are produced in a shift, the product must be separated into at least two lots.

VII. RECORD RETENTION

A. Recording and record retention shall conform with Ford Q-101.

B. Production Validation test results and analysis are to be forwarded to the releasing Product Engineering Office before approval for shipment of production parts can be granted.

C. In-Process test results shall be available at the supplier's manufacturing facility for the releasing Product Engineering Office and Ford SQA or its representatives to review on request.

VIII. INSTRUCTIONS AND NOTES

All switches are to be identified with the Ford part number, supplier identification, and a date code indicating final assembly.

All test equipment and test procedures for testing to this specification must be approved by the releasing Product Engineering Office and no change in equipment or procedure may be made without their written concurrence.

Test port configuration is shown in Figure 3.

O-rings, if used in the design, shall be free from cuts, nicks, abrasions or any other damage which would result in a fluid leak.

All switches must have a shipping cap installed over the port threads to prevent contamination. All shipping caps must be approved by the releasing Product Engineering Office prior to production incorporation.

All switches that do not pass the calibration test are to either be readjusted and rechecked, or scrapped. (Salvage of component parts permitted with 100% reinspection).

If product nonconformance occurs for test Sections III. B, C, D, E, F, and J, production shall be stopped and the problems corrected. All production lots shall be sorted 100% prior to shipment. Suspected nonconformance of any shipped parts shall be reported immediately to the releasing Product Engineering Office.

If nonconformance of the statistical acceptance criteria occurs for test Sections III. G, H, I, K, L and M, a cause to recall the subject weeks production and to stop production may result.

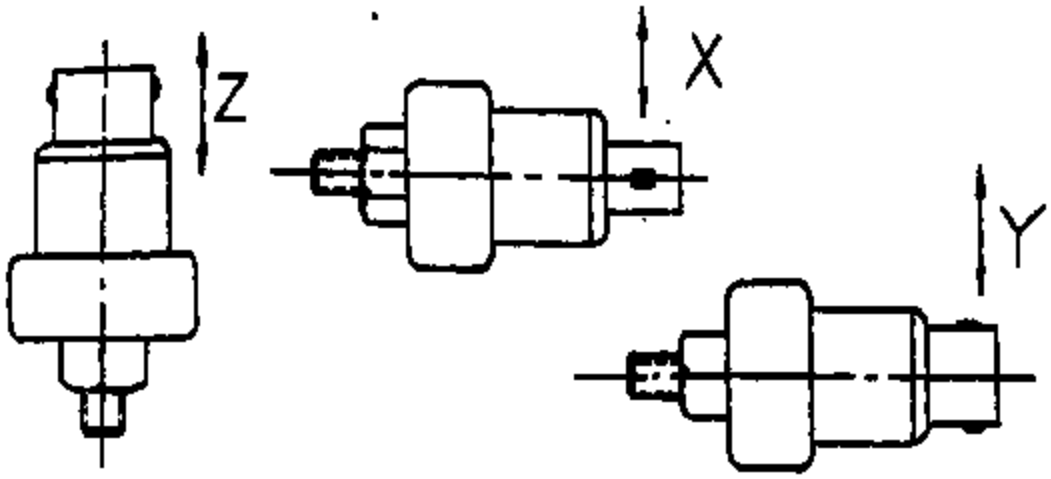
IX. COMPILATION OF REFERENCE DOCUMENTS

ASTM B-117, Salt Spray Testing

Ford Q-101, Quality System Standard - 1983 Edition

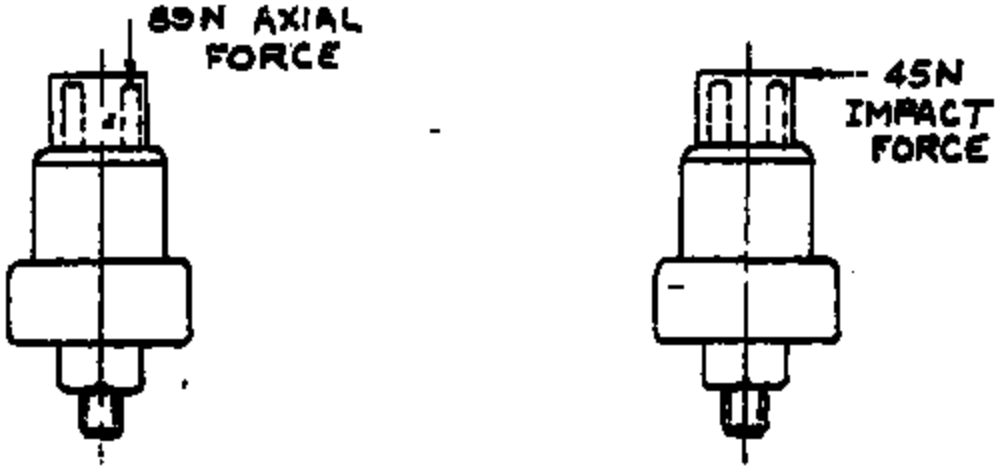
ES-FDEB-14A464-AA, Specification - SLV Assy - Wire Connector

ES-F2VF-9C735-AA, Specification - Servo Assembly Speed Control



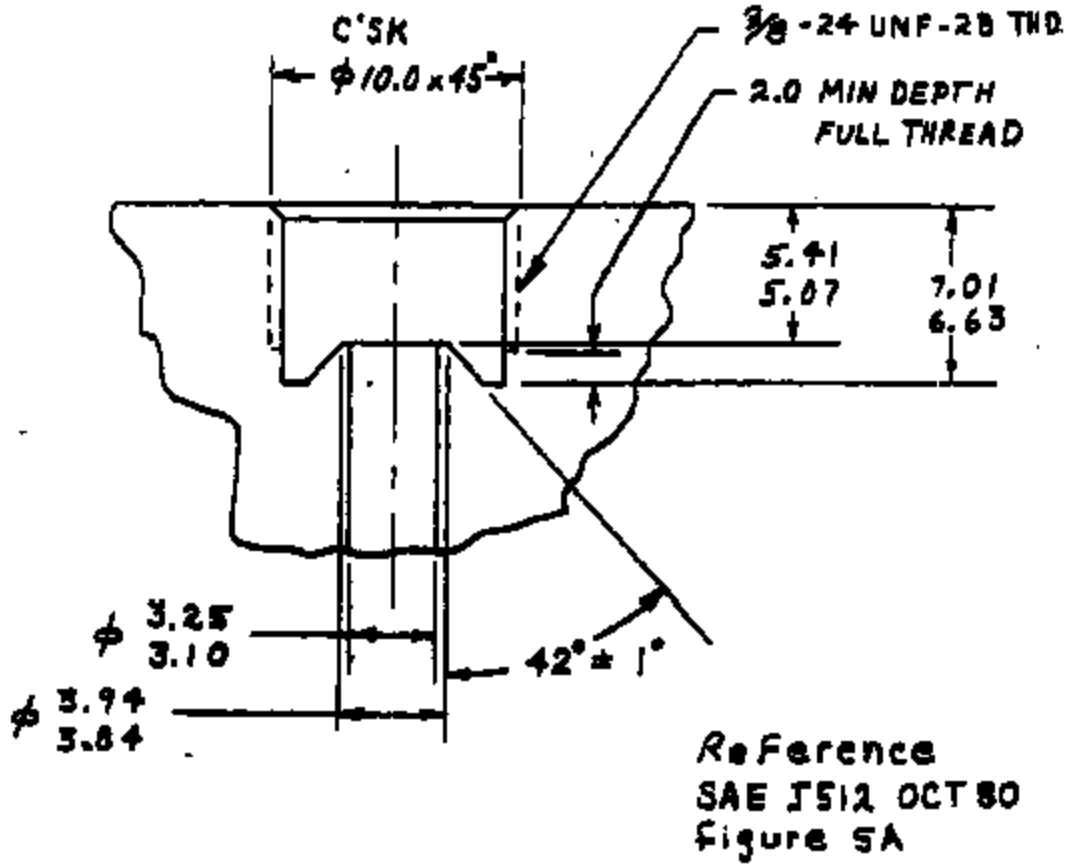
VIBRATION TEST - SWITCH ORIENTATION

FIGURE 1.



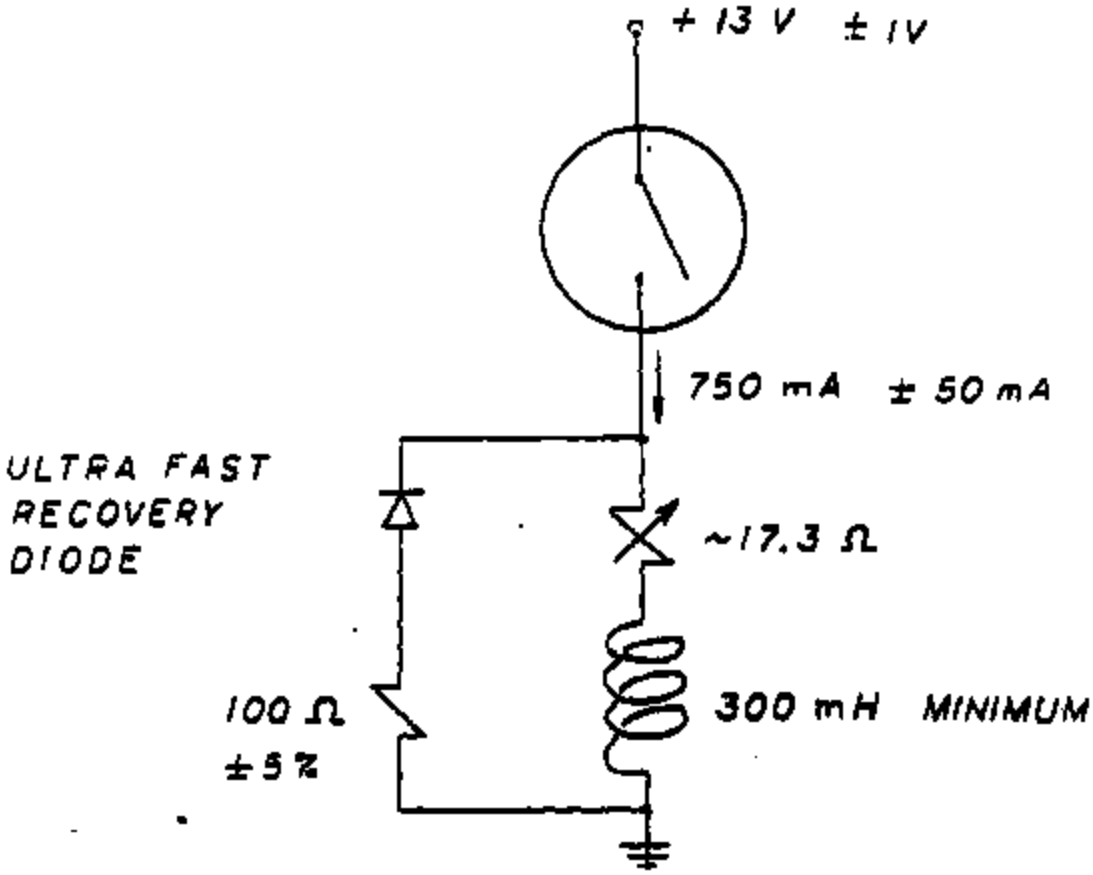
TERMINAL STRENGTH - LOAD ORIENTATION

FIGURE 2.



TEST FIXTURE PORT CONFIGURATION

FIGURE 3



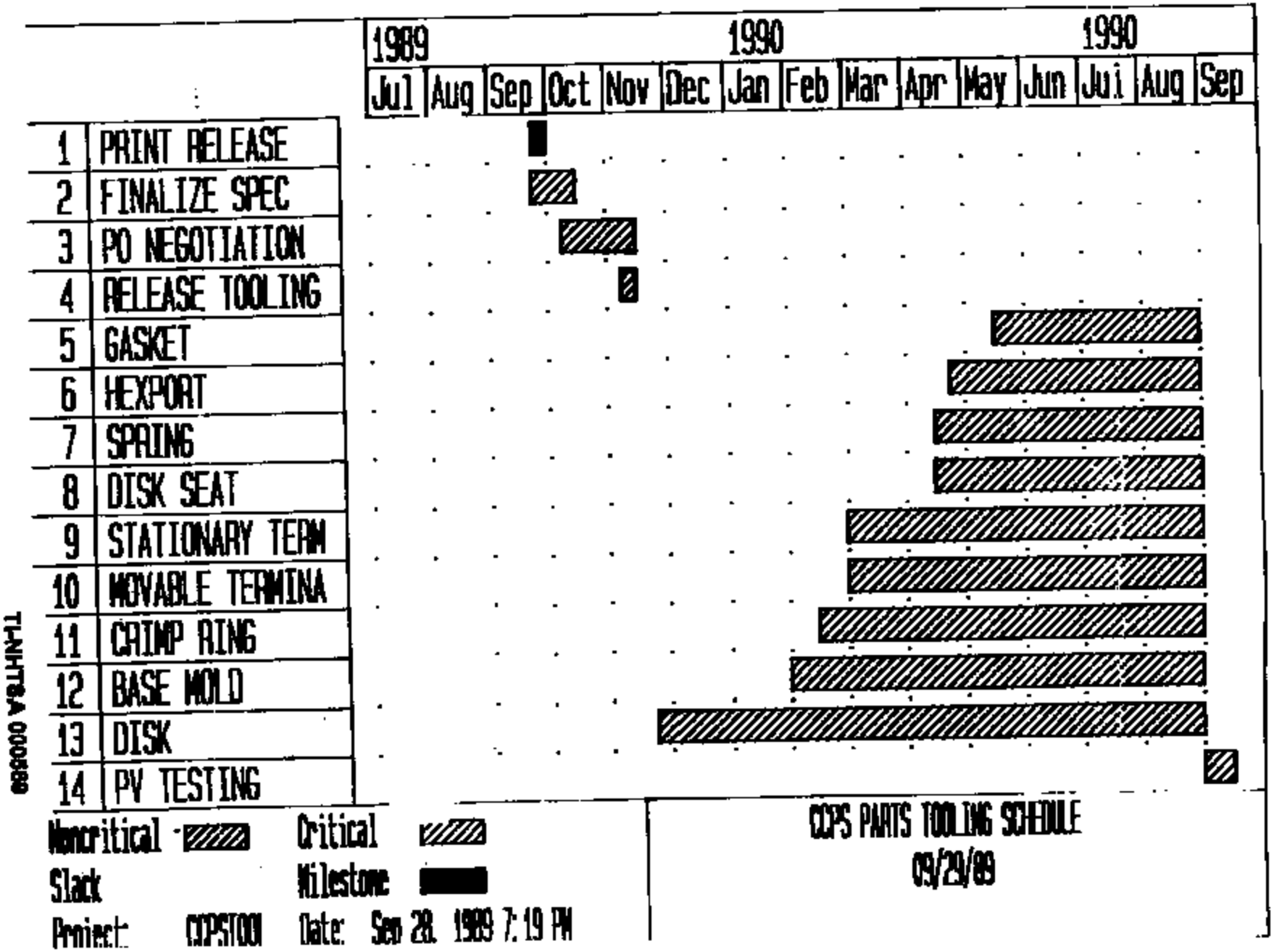
DEACTIVATE SWITCH
TEST SET UP

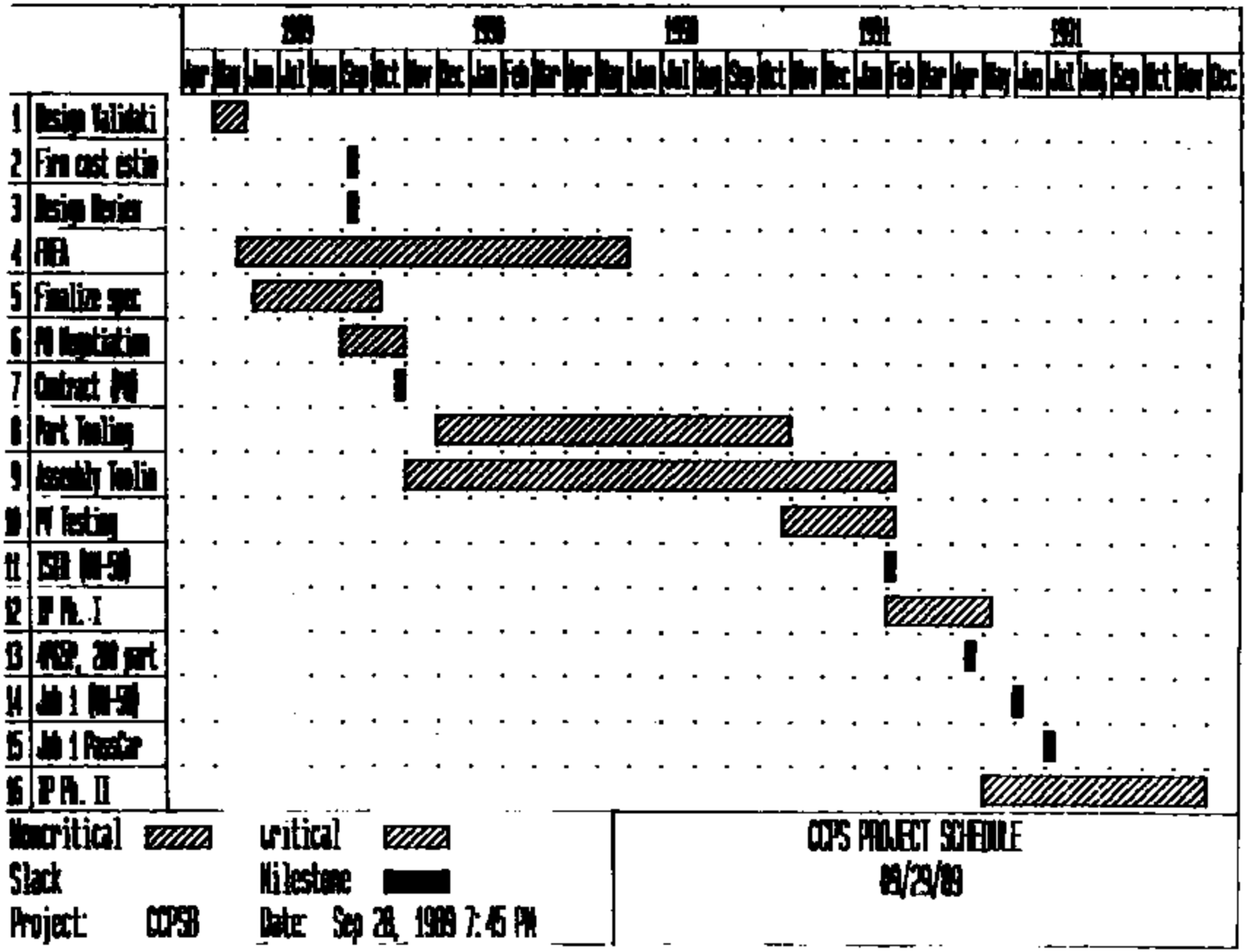
FIGURE 4

MANUFACTURING ENGINEERING PRECISION CONTROLS
CCPS MANUFACTURING REVIEW
SEPTEMBER 29, 1999

TOOLING OVER RUN SUMMARY

		WAS	IS	DELTA
*	CURRENT AUTOMATED ASSEMBLY EQUIPMENT QUOTES ARE HIGHER THAN BEST GUESS ESTIMATE USED FOR CUSTOMER WINDOW.	1KK-1.25KK	1.377KK	154.1
*	COMPONENT TOOLING INCREASES			
	- POWDERED METAL DISC SEAT	0.65K	33.0K	32.4K
	- MOLDED BASE	50.0K	63.0K	13.0K
	- CRIMP RING	11.8K	37.3K	25.5K
	- MOVE TERM	15.8K	28.4K	12.6K
	- DISC	0.0K	50.0K	50.0K
*	CONTINGENCY (10%).	0.0K	160.0K	160.0K
			TOTAL	447.8K





TI-NHTSA 000570

MANUFACTURING ENGINEERING PRECISION CONTROLS
CCPS MANUFACTURING REVIEW
SEPTEMBER 29, 1989

SUMMARY

- DESIGN IS NOT COMPLETE. THE GATING ITEM FOR DESIGN COMPLETION IS BEING DELAYED BY CUSTOMER SPECIFICATION DELAYS.

- THE DROP DEAD DATE FOR CUSTOMER PURCHASE ORDER FOR THE RELEASE OF DISC AND ASSEMBLY TOOLING IS OCTOBER 27, 1989.

- THE SELLING PRICE OF THE DEVICE IS IN LINE WITH CUSTOMER EXPECTATIONS AT 1.97 WITH 40.0% GPM. (57PS SELLING PRICE IS $2.68 WITH 38.8% GPM.)

- TOOLING COST IS NOW PROJECTED AT 447K OVER THE ORIGINAL ESTIMATE. THIS OVE.1 [redacted] IS SPREAD THROUGHOUT THE TOOLING. THE TOOLING IS STILL BEING FINALIZED. THE CURRENT PLAN DOES NOT INCLUDE PILOT LINE.

- OUR ANALYSIS SHOWS THAT THE LOST OF CCPS FULLY AUTOMATED HAS A $0.44 GAP TO THE 57PS COST.

- TOOLING A BASE ASSEMBLY ON AN AMI, BASED ON THE TOTAL COSTS OF AN AMI, WILL SAVE US 133.43$/ K.

TI-NHTSA 000671

29 SEPT 89 KRR/dmn 050-0134

MANUFACTURING ENGINEERING PRECISION CONTROLS
CCPS MANUFACTURING REVIEW
SEPTEMBER 29, 1989

A G E N D A

DEVICE FUNCTION OVERVIEW

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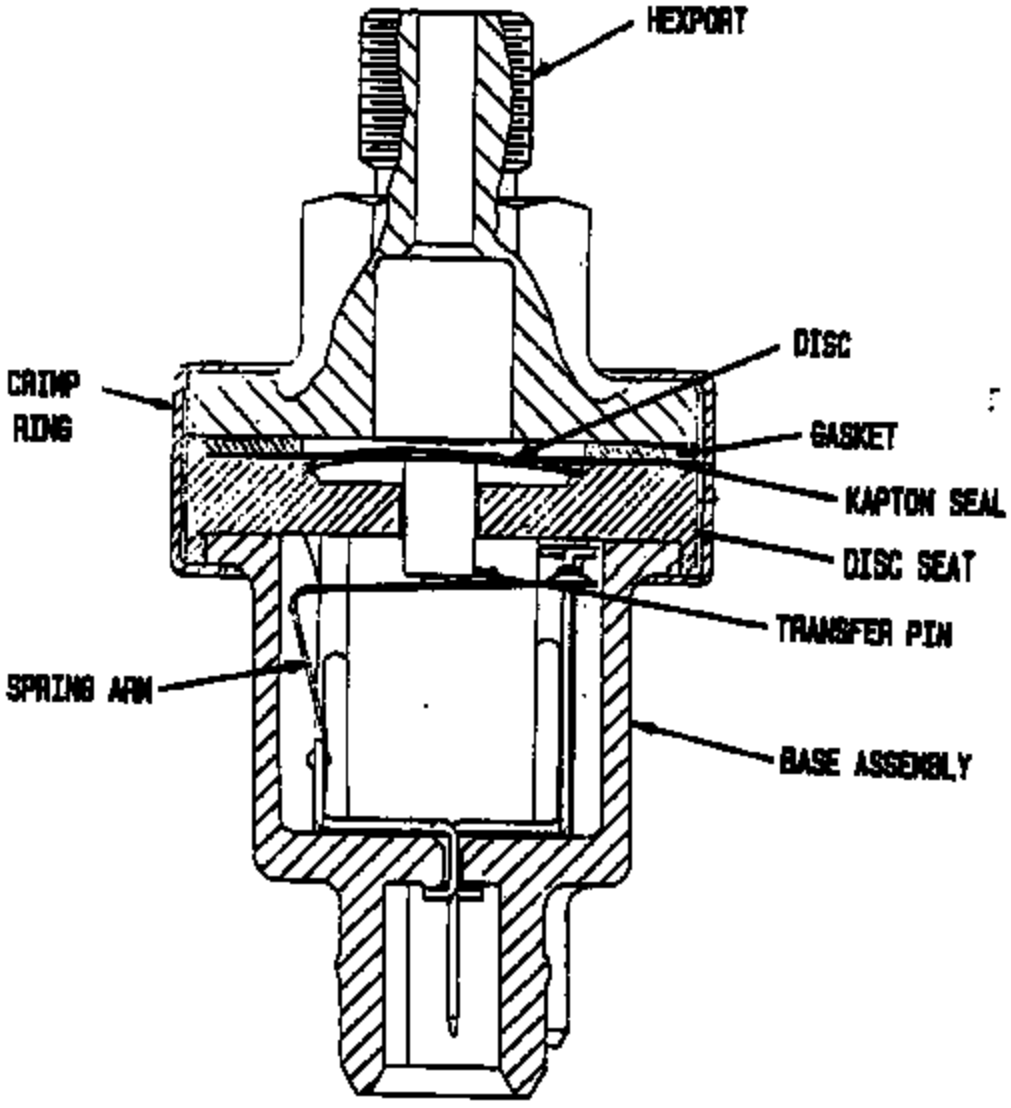
SUMMARY


HEXPORT
DISC
CRIMP RING
GASKET
KAPTON SEAL
DISC SEAT
TRANSFER PIN
SPRING ARM
BASE ASSEMBLY

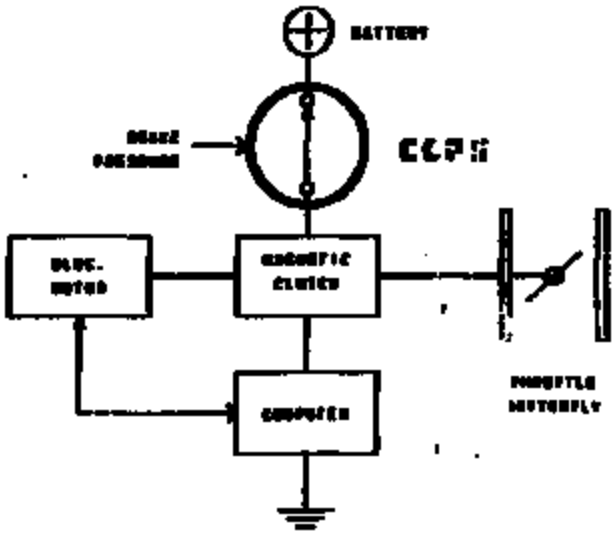
PRECISION CONTROLS DESIGN ENGINEERING
DESIGN REVIEW - 18 MAY 1989
MY92 CRUISE CONTROL PRESSURE SWITCH

OVERVIEW

THE CCPS IS A REDUNDANT SAFETY DEVICE IN A NEW, VACUUM-LESS ELECTRONIC CRUISE CONTROL DESIGNED BY FORD.

FUNCTIONALLY, IT REPLACES THE PRESENT VACUUM DUMP VALVE BY DE-ENERGIZING A CLUTCH WHICH CONNECTS THE THROTTLE TO AN ELECTRIC ACTUATOR.

IT IS PLUMBED INTO THE BRAKE LINE. WHEN THE DRIVER APPLIES PRESSURE TO THE BRAKE PEDAL, THE NORMALLY-CLOSED SWITCH OPENS, DISCONNECTING THE ACTUATOR FROM THE THROTTLE BUTTERFLY.



SPECIFICATIONS:

ACTUATION:	150 PSI +/- 50
RELEASE:	100 PSI MIN.
BURST:	7000 PSI
CYCLES:	500K, 0 - 1450 PSI, 2 Hz
VOLTAGE:	BATTERY
CURRENT:	0.75 AMP

TI-HHT&A 000674

[redacted]

[redacted]

[redacted]

[redacted]

DEVICE PRICE - $1.75 - $1.90
TOOLING - $700K - $800K

[redacted]

- USE OF CURRENT PRODUCTION BASE ASSEMBLY WITH METRI-PACK CONNECTOR
- ACTUATION PRESSURE IN 150PSI RANGE, TOLERANCE UNDEFINED
- NORMALLY CLOSED LOGIC
- NO CREEP REQUIREMENT
- NO THREAD CAP OR O-RING ON MEMPORT
- PROOF PRESSURE 2K PSI
- BURST PRESSURE 6K PSI
- NORMALLY CLOSED LOGIC
- NO PIN GAUGING NECESSARY

TI-NHTSA 000875

[redacted] 655-6134

[redacted]

[redacted]

[redacted]

[redacted]	-	$1.91 - $2.06
[redacted]	-	$1670K - $1320K

[redacted]

- [redacted]
- [redacted]
- [redacted]
- [redacted]

[redacted]

MANUFACTURING ENGINEERING PRECISION CONTROLS
CCPS MANUFACTURING REVIEW
SEPTEMBER 29, 1999

STATUS / CONCERNS / ASSUMPTIONS

(1) PROGRAM COST IS NOT IN LINE WITH CUSTOMER EXPECTATIONS. PIECE PRICE IS ACCEPTABLE. TOOLING MONEY IS ABOVE THE LAST ESTIMATE.

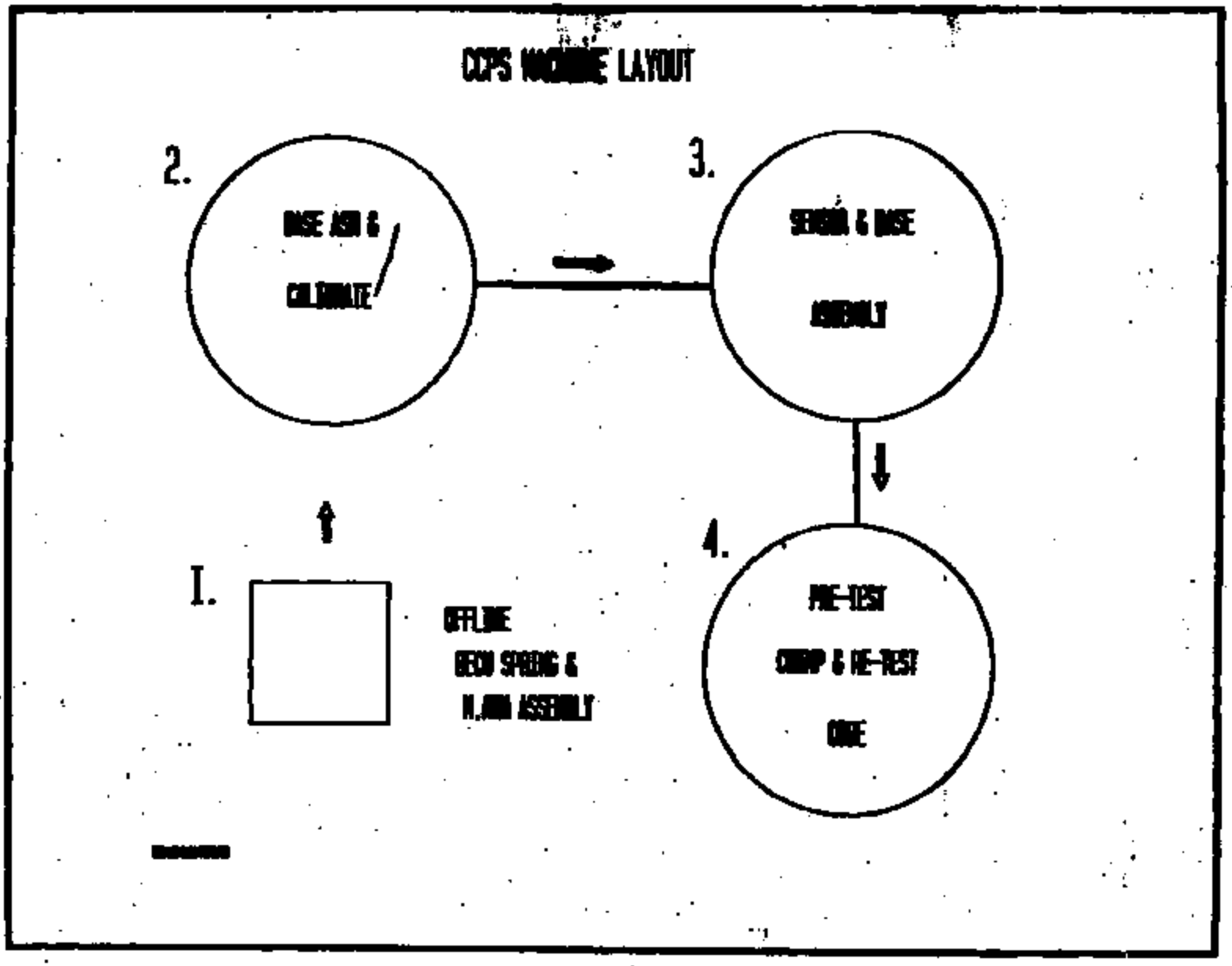
(2) CUSTOMER SPECIFICATION IS NOT SOLID.

(3) THE FINAL DESIGN IS NOT RELEASED.

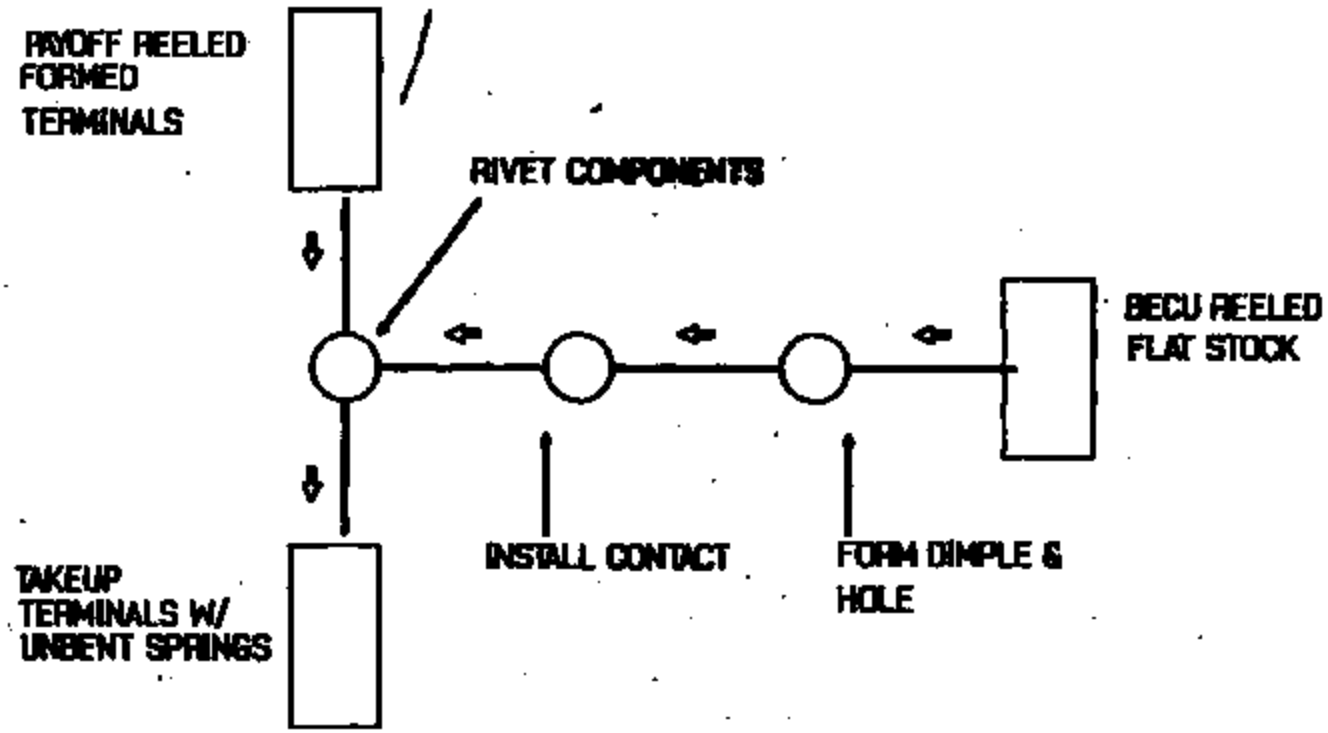
- a. DISC SPEC
- b. BASE GEOMETRY
- c. SENSOR SEALING SYSTEM
- d. PRODUCTION PROTOTYPES OF NEW TECHNOLOGY
- e. CALIBRATION METHOD NOT PROTOTYPED

(4) SCHEDULE IS ON TARGET, BUT AT RISK.

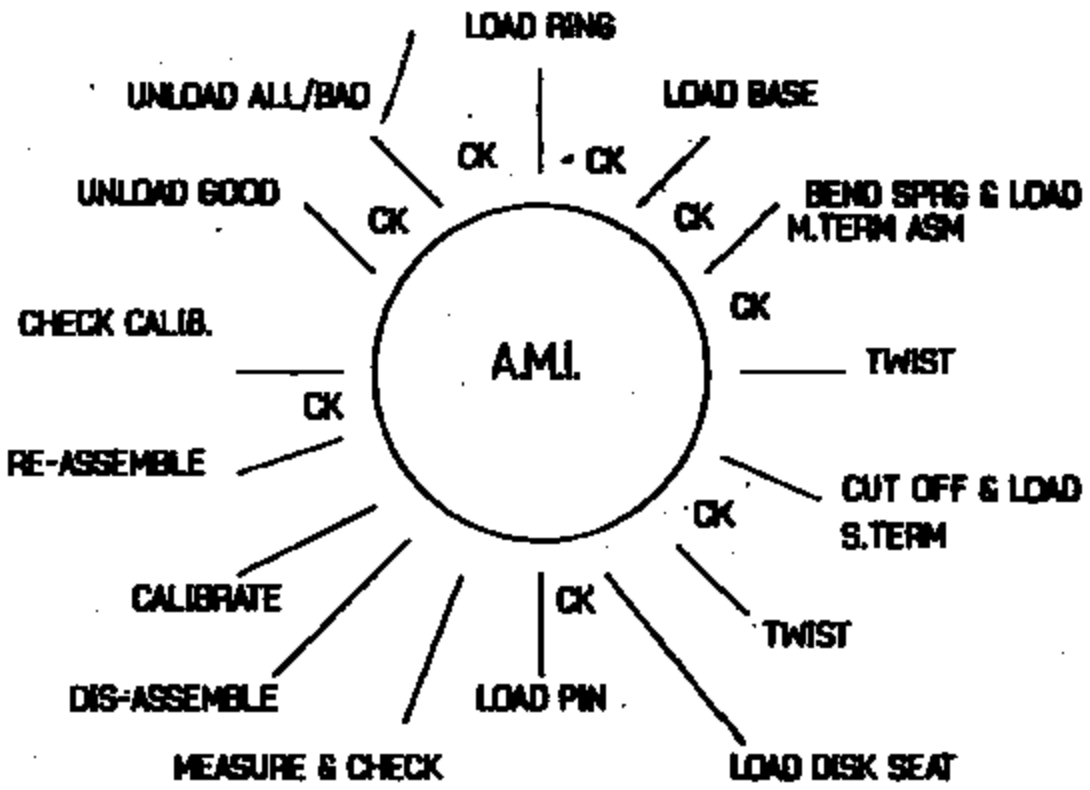
(5) TOOLING ASSUMPTION DOES NOT INCLUDE SOFT TOOLING OR PILOT LINE COSTS.



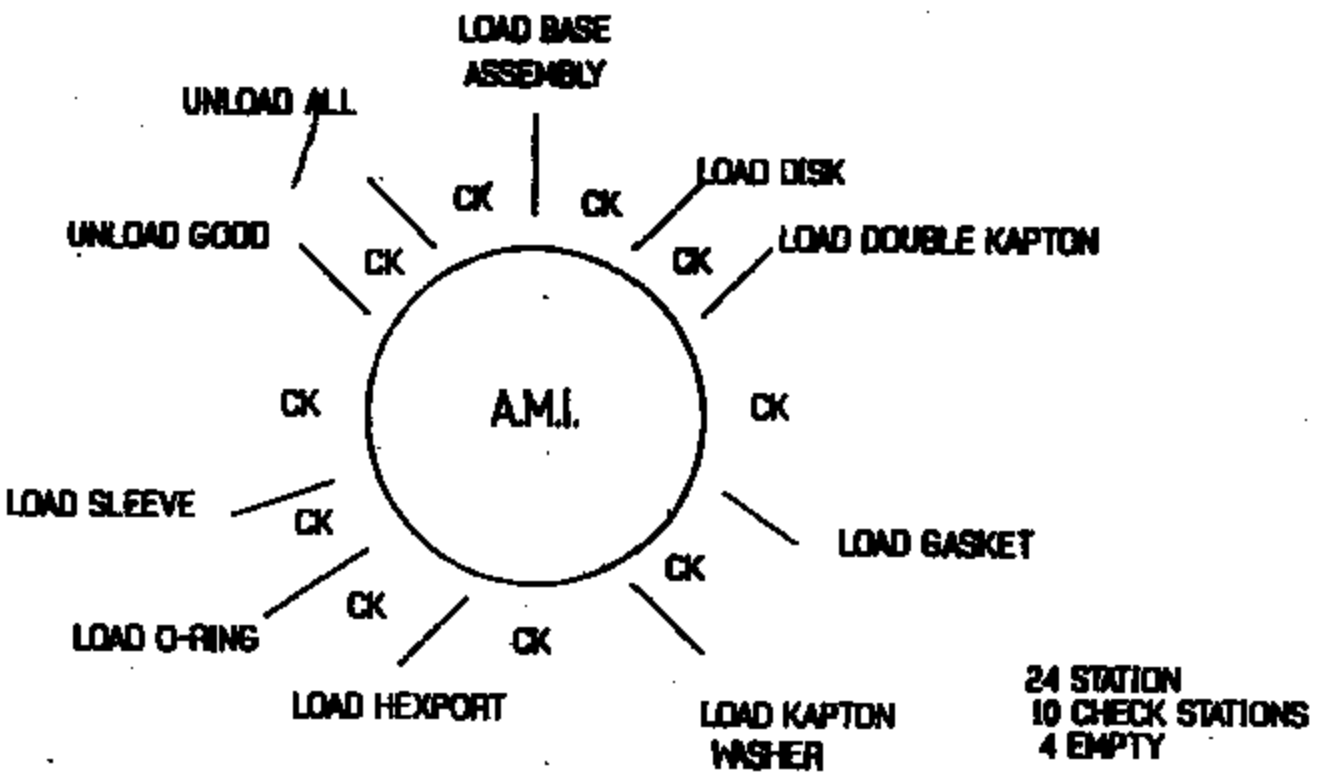
MACHINE 1. SPRING ARM TO TERMINAL



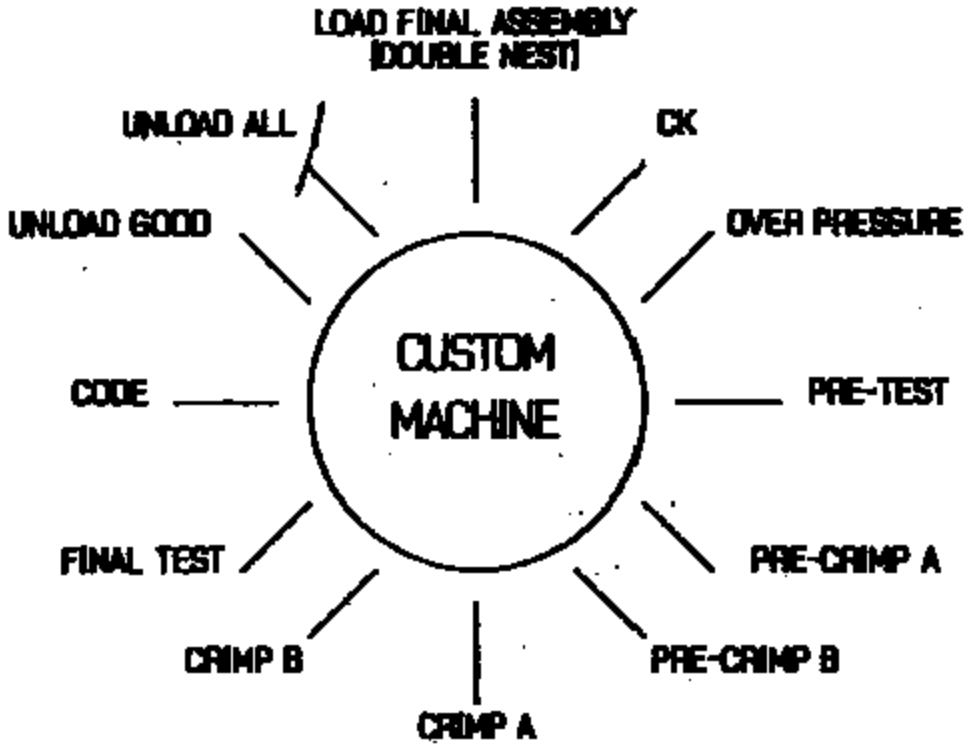
MACHINE 2. BASE ASM & CALIBRATE



MACHINE 3. FINAL ASSEMBLY



MACHINE 4. P.TEST, CRIMP, & CODE



TI-NHT8A 0005B2

AMI VS MANUAL LABOR,OH,OOH COST COMPARISON SUMMARY

	PER K
57 MANUAL BASE ASSEMBLY COST.....	$217.78
TOTAL A.M.I. COST.....	$84.35
SAVINGS	$133.43

A.M.I. $1 COST (MONTH OF AUG,89)

TOOLMAKER DOWNTIME & MAINT. 174HRS @ 27 $/HR.....	$4,698.00
SPARE AND REPLACEMENT PARTS.....	$4,913.50
MOST EXPENSIVE DEPRN (1 MONTH OF 1ST YEAR).....	$7,704.00
TOTAL	$17,315.50

PROJECTED CCPS MONTHLY LINELOAD 250K

TOTAL DEVICE COST FOR AMI..... 69.26 $/K

A.M.I. OPERATOR COST

A.M.I. $2 RATE .80 HRS/K $7.33 $/HR.....	$5.86
OVERHEAD 13%.....	$0.76
OH 114%.....	$7.55
OOH 12%.....	$0.91
TOTAL AMI LABOR	$15.09
AMI DEVICE COST	$69.26
TOTAL AMI COST....	$84.35

5726 V8 CCPS
COST ESTIMATE SUMMARY

MY89

OPERATION DESCRIPTION	5726	CCPS 87LAB	CCPS SENSOR AUTO	CCPS TOTAL AUTO
LABOR ($ 7.1 /HR)	$239.84	$239.84	$176.01	$79.37
LABOR OVERAGE (@ 13.00%)	$31.18	$31.18	$22.88	$10.32
LABOR SUB-TOTAL	$271.02	$271.02	$198.89	$89.68
OVERHEAD	$308.96	$308.96	$226.73	$102.24
DEPRECIATION	--	--	--	0.08
LABOR TOTAL	$579.98	$579.98	$425.62	$192.00
MATERIAL	$832.28	$741.01	$741.01	$741.01
MATERIAL YIELD ($95.47%)	$37.74	$33.60	$37.05	$37.05
MATERIAL SUB-TOTAL	$870.02	$774.61	$778.06	$778.06
LABOR & MATERIAL SUB-TOTAL	$1,450.00	$1,354.59	$1,203.69	$970.06
OTHER OVERHEAD	$174.00	$162.55	$144.44	$116.41
AUTOMATED R & M	--	--	$38.40	$96.12
TOTAL DEVICE COST PER K	$1,624.00	$1,517.14	$1,386.53	$1,182.59
TOTAL DEVICE COST	$1.62	$1.52	$1.39	$1.18

* A.M.I. LABOR RATE IS ESTIMATED AT 8.25 $/HR
* ONE MONTH R&M COST FOR ONE A.M.I. IS 9611 $ OVER 250K PCS/MONTH
* ALL ESTIMATES IN TODAYS DOLLARS

5725 vs CCPS
MATERIAL COST MATRIX

	BASE ASSEMBLY		5725	CCPS	DELTA
*	46412-1	BASE	$65.80	$65.80	$0.00
	74405-1	MOVABLE ARM	$7.03	-----	-----
	74405-1	PLATING	$2.01	-----	-----
*	36779-1	SPRING	$29.90	$13.27	$16.63
	74080-2	MOVABLE CONTACT	$8.74	$8.74	$0.00
	74171-1	RIVET	$4.21	$4.21	$0.00
*	36689-1	MOVABLE TERMINAL	$17.89	$16.96	$0.93
*	36686-1	STATIONARY TERMINAL	$42.66	$42.80	($0.14)
		BASE TOTAL	$178.24	$151.78	$26.46

	SENSOR ASSEMBLY				
*	27290-2	HEXPORT	$218.81	$222.30	($3.49)
*	74074-1	GASKET	$20.10	$15.60	$4.50
	27288-1	CUP	$83.67	-----	-----
	27288-1	PLATING	$16.38	-----	-----
*	27725-1	SEAL(3 PIECES)	$30.26	$45.50	($15.24)
	74073-6	WASHER	$51.24	-----	-----
	74073-6	PLATING	$22.31	-----	-----
	27406-1	CONVERTER	$37.59	-----	-----
	27406-1	PLATING	$4.80	-----	-----
	73958-1	SPACER	$5.80	-----	-----
*	36656-7	FORGED DISC	$46.21	$46.21	$0.00
*	74076-5	CRIMP RING	$28.00	$75.80	($47.80)
	74076-5	PLATING	$58.32	$58.32	$0.00
	74078	TRANSFER PIN	$20.60	$20.60	$0.00
	74179-2	THREAD CAP	$3.80	$3.80	$0.00
	74247-2	ENVIRONMENTAL SEAL	$10.65	-----	-----
*	HX3423-12	DISK SEAT	-----	$75.60	($75.60)
	74681-1	O-RING	$25.50	$25.50	$0.00
		TOTAL SENSOR	$654.04	$589.23	$64.81
		MATERIAL MY89	$832.28	$741.01	$91.27

* DESIGN/PRICING NOT FIXED

5728 VS CCF8
LABOR COST

OPERATION DESCRIPTION	5728 MANUAL	CCF8 SENSOR AUTO	CCF8 TOTAL AUTO
		SEC/K	
GROUP LEADER	1.00	1.00	1.00
PILOT MAKER	1.00	1.00	1.00
SORT CONVERTER	1.17	-----	-----
ASSEMBLE GASKET TO EBK.	1.80	-----	-----
ASSEMBLE 2 SEALS TO WASHER	1.80	-----	-----
ASSEMBLE SPACER AND DISC TO CONV.	1.80	-----	-----
ASSEMBLE CUP TO HEXPORT	1.80	-----	-----
ASSEMBLE CRIMP RING AND SENSOR	1.62	-----	-----
ASSEMBLE PIN AND O-RING	1.62	1.62	-----
CRIMP DEVICE	1.62	1.62	-----
RIVET SPRING TO ARM	2.91	2.91	-----
RIVET ARM ASSEMBLY TO TERMINAL	2.78	2.78	-----
ARM TERMINAL TO BASE AND STAKE ("L" TYPE)	4.72	4.72	-----
PIN GAUGE BASE	1.80	1.80	-----
CODE CRIMP RING	0.30	0.30	-----
AUTO PRESSURE TEST	1.89	1.89	-----
ASSEMBLE THREAD CAP & PACK	2.15	2.15	-----
INSPECTION	1.00	1.00	1.00
MATERIAL HANDLER	1.00	1.00	1.00
BASE ASSEMBLY MACHINE	-----	-----	1.54
SENSOR MACHINE	-----	-----	1.54
F.TEST MACHINE	-----	-----	1.54
SET-UP PERSON	-----	1.00	1.00
TOTAL MH89	33.78	24.79	9.62

OCPS
TOOLING COST MATRIX

COMPONENT TOOLING

PART #	DESCRIPTION	SUPPLIER	K DOLLARS
*3423-10	BASE	AFCC	$63.00
3423-20	SPRING	N.AMERICAN	$3.50
*3423-32	CRIMP RING	VALENTINE	$37.30
3423-33	GASKET	PARKER	$0.00
74080-2	MOVABLE CONTACT	BIGELOW	$0.00
74171-1	RIVET	MILFORD	$0.00
*3423-22	STATIONARY TERMINAL	K.F.BASSLER	$14.90
*3423-23	MOVABLE TERMINAL	A.J.KNOTT	$28.40
3423-5	HEXPORT	ELCO	$0.00
*3423-12	DISK SEAT	AMER FNDR MTL	$33.00
*3423-28	FORMED DISC	F.C.	$50.00
27725-1	KAPTON	DUPONT	$0.00
74078	TRANSFER PIN	DU CO	$0.00
74179-2	TERED CAP	SINCLAIR	$0.00
74681-1	O-RING	WINN'S-PRECISION	$0.00
		TOTAL COMPONENT TOOLS	$230.10

ASSEMBLY TOOLING

FOUR MACHINES

1. ASSEMBLY OF EECU ASM TO TERMINAL
2. 24 STATION AMI BASE ASSEMBLY AND CALIBRATION
3. 24 STATION AMI SENSOR ASSEMBLY TO BASE
4. PRESSURE TEST

TOTAL ASSEMBLY TOOLING $1,376.70

TOTAL TOOLING FOR OCPS $1,606.80

CONTINGENCY $160.68

TOOLING FROM CUSTOMER $1,767.48

TOP OF CUSTOMER EXPECTATION WINDOW..... $1,320.00

DELTA..... ($447.48)

NOTE: ALL ESTIMATES IN TODAYS DOLLARS

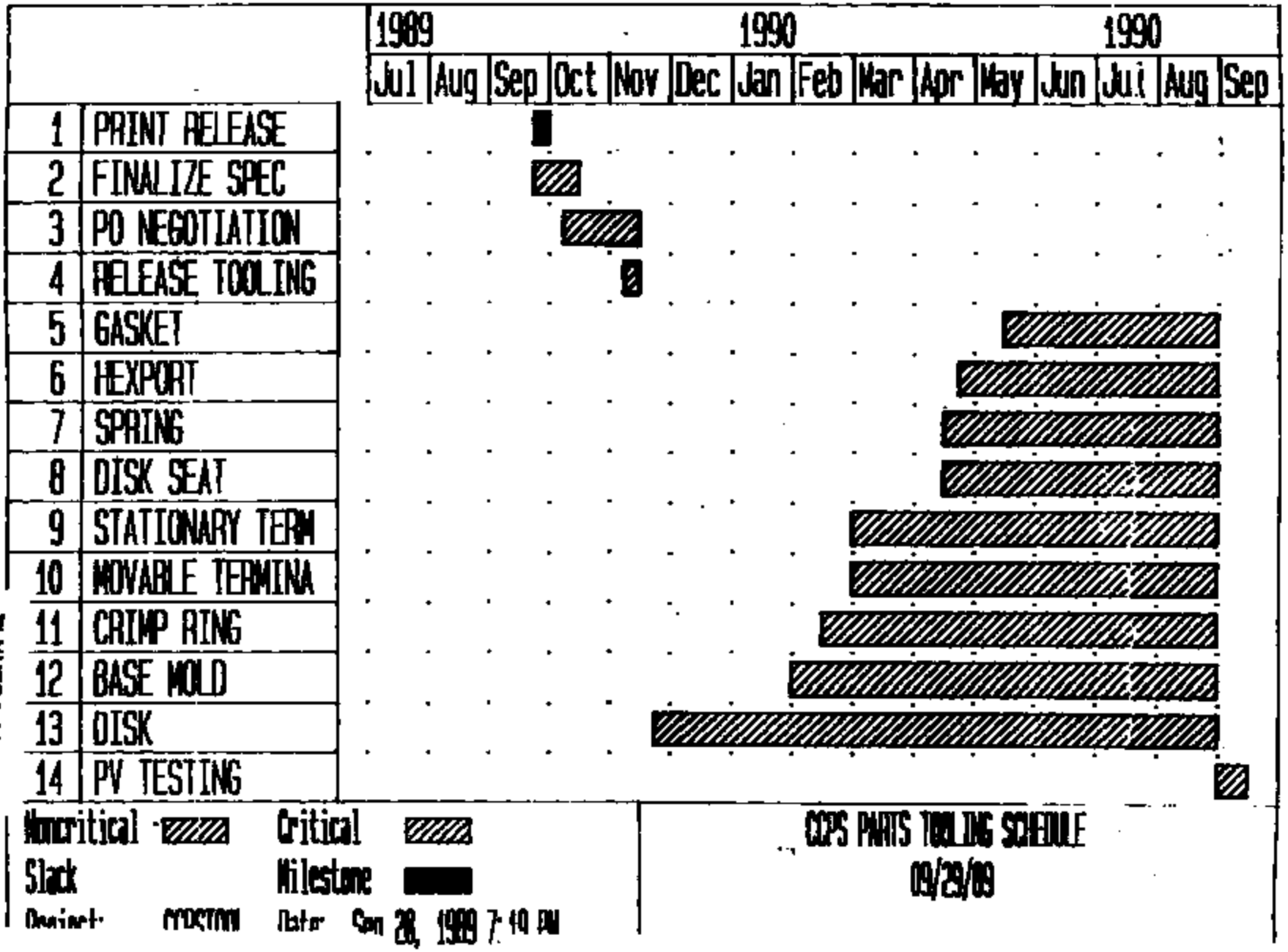
MANUFACTURING ENGINEERING PRECISION CONTROLS
CCPS MANUFACTURING REVIEW
SEPTEMBER 29, 1989

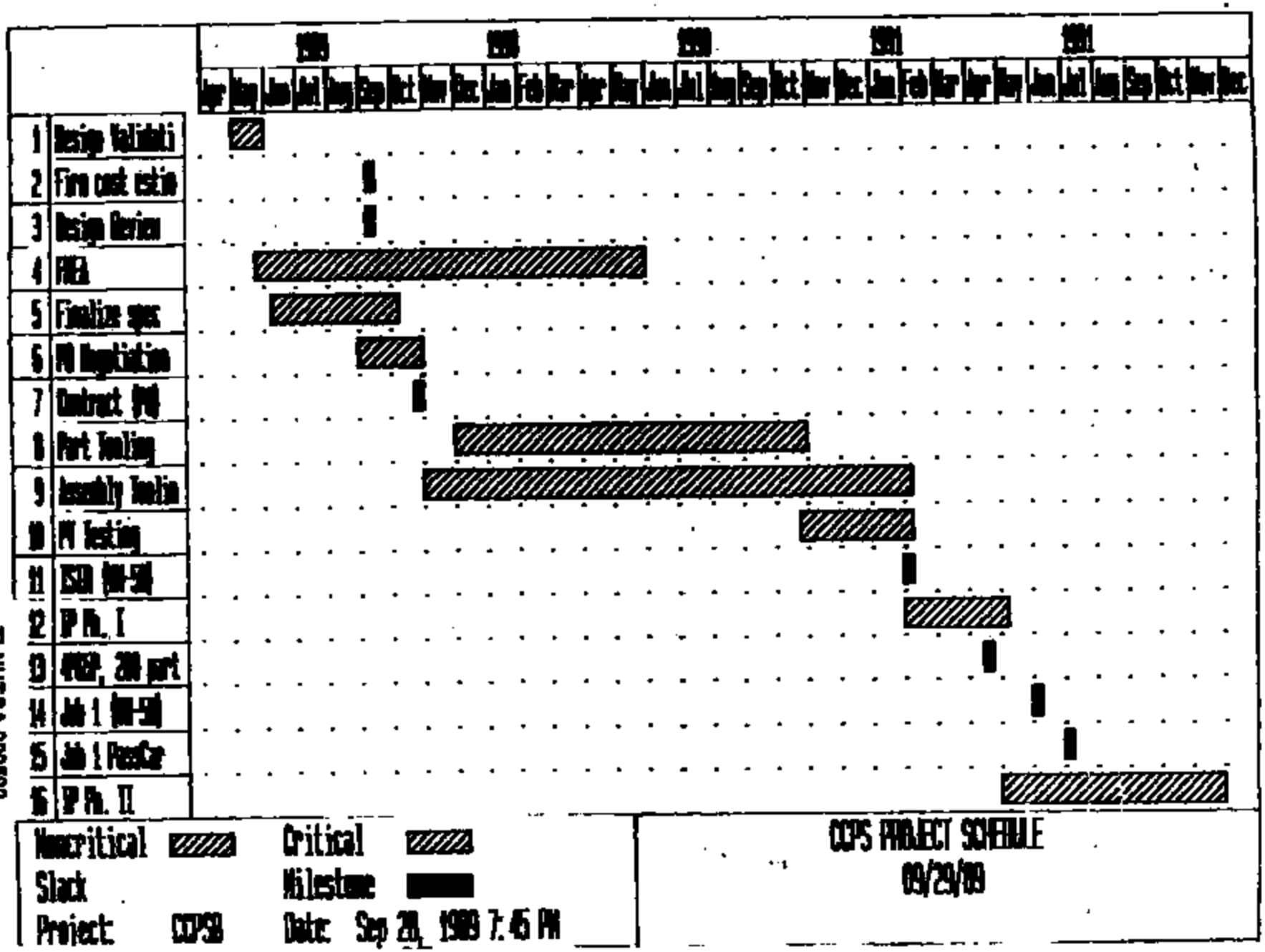
TOOLING OVER RUN SUMMARY

		WAS	IS	DELTA
*	CURRENT AUTOMATED ASSEMBLY EQUIPMENT QUOTES ARE HIGHER THAN BEST GUESS ESTIMATE USED FOR CUSTOMER WINDOW.	1KK-1.25KK	1.377KK	154.1
*	COMPONENT TOOLING INCREASES			
	- POWDERED METAL DISC SEAT	0.65K	33.0K	32.4K
	- MOLDED BASE	50.0K	63.0K	13.0K
	- CRIMP RING	11.8K	37.3K	25.5K
	- MOVE TERM	15.8K	28.4K	12.6K
	- DISC	0.0K	50.0K	50.0K
*	CONTINGENCY (10%).	0.0K	160.0K	160.0K
			TOTAL	447.8K

TI-HHTSA 000698

29 SEPT 89 KRR/dmm 668-0134





MANUFACTURING ENGINEERING PRECISION CONTROLS
CCPS MANUFACTURING REVIEW
SEPTEMBER 29, 1989

SUMMARY

- DESIGN IS NOT COMPLETE. THE GATING ITEM FOR DESIGN COMPLETION IS BEING DELAYED BY CUSTOMER SPECIFICATION DELAYS.

- THE DROP DEAD DATE FOR CUSTOMER PURCHASE ORDER FOR THE RELEASE OF DISC AND ASSEMBLY TOOLING IS OCTOBER 27, 1989.

- THE SELLING PRICE OF THE DEVICE IS IN LINE WITH CUSTOMER EXPECTATIONS AT 1.97 WITH 40.0% GPM. (57PS SELLING PRICE IS $2.66 WITH 38.8% GPM.)

- TOOLING COST IS NOW PROJECTED AT 447K OVER THE ORIGINAL ESTIMATE. THIS OVE[illegible] IS SPREAD THROUGHOUT THE TOOLING. THE TOOLING IS STILL BEING FINALIZED. THE CURRENT PLAN DOES NOT INCLUDE PILOT LINE.

- OUR ANALYSIS SHOWS THAT THE LOST OF CCPS FULLY AUTOMATED HAS A $0.44 GAP TO THE 57PS COST.

- TOOLING A BASE ASSEMBLY ON AN AMI, BASED ON THE TOTAL COSTS OF AN AMI, WILL SAVE US 133.43¢/K.

TI-NHTSA 000091

29 SEPT 89 KRWdmm 869-6134

HIGHLIGHTS

Stephen B. Offiler

Week Ending 10/06/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EC3423

SAMPLES: As soon as possible, I will be updating our inventory to allow build of customer samples and development parts. The disc seat print will be updated, and AFCC Screw Machine will build the parts. R.W. Jacques will build old-style crimp rings. These are the two most critical items. Others include Kapton washers, stamped by the model shop, and discs created in the lab.

DESIGN ISSUES: I have obtained the names of the proper persons to contact at Norwalk Powdered Metals and American Powdered Metals Co. I will be speaking to them to obtain machinable slugs of P/M. I plan to investigate use of various materials per the recommendation of the P/M experts and as economics dictate.

I will be speaking to Bob Jacques regarding prototyping the new, more complex crimp ring design. Valentine is the lowest production quote, however Jacques is more expedient to prototype the production-intent design.

A sample quantity of 70-duro O-rings arrived from Parker, allowing testing to resume on the O-ring/dovetail gland seal concept. One device failed immediately on its first cold-temp cycle. Disassembly and inspection showed the Kapton seal somewhat misplaced, although this doesn't seem to explain the gross leak. We will rebuild and return the device to test. As soon as possible, I plan to prototype the revised lathe-cut gasket w/ Kapton washer design as well. This uses a larger gasket in a deeper gland to minimize the chances of gasket misplacement in production.

Testing on the multiple-disc concept (knowledge for CCPS and for TRW application) was aborted at 40K cycles due to fractured discs. Disassembly showed radial cracks propagating from the vestige. I'm awaiting word on how to proceed.

Tests were run on devices built with porous plugs using three different pore sizes. The tests were run at 200, 500, and 1500 psi and at -40C and +121C. Empirical results generally seemed to follow the computer model, but the change in delay time over temperature was much greater than predicted: almost three orders of magnitude. The smallest pore size yielded 231 milliseconds delay at +121C, and 103 seconds (!) at -40C. I will relay this information to Gary Klingler early next week. This should effectively kill the idea of hydraulic time delay.

PURCHASING/MFG ISSUES: We will be holding a meeting with AFCC molding next week to review the base print. They are the lowest quote by far. I will make updates to the print which reflect the new twist concept.

Jack Kearns has determined that both Bassler and A.J. Knox have sufficient capacity to handle both terminals. It has been left to Purchasing to choose a supplier, and I've asked Jack to set up a technical meeting with the preferred supplier next week. Also, he's taken action on Curtis Screw and has contacted the international purchasing department in Dallas on the hexport.

11/6/89

Sign Off 10/13/89

HIGHLIGHTS

Stephen B. Oliffer
Week Ending 10/13/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EO3423

SPECIFICATIONS: A call was placed to Gary Klingler at Ford to determine the status of his testing to set the pressure specifications. He's done some work with the test-set of 57PS's, and is moving away from ideas like hydraulic time delay, etc. To combat the problem of the gas pedal slamming against its stop when our switch actuates, he's looking into setting the brake light switch to be more sensitive along with providing a cushion for the gas pedal. He will then complete testing with the 57PS's to arrive upon a minimum and maximum acceptible actuation pressure.

SAMPLES: I have placed the order with R.W. Jacques for 300 old-style crimp rings for use in sample build. These should arrive in about two weeks. I am presently updating the disc seat print, so APCC Screw Machine can build a quantity of about 250. Depending on their workload, this could be the gating item for our next sample commitment which is 11/15.

DESIGN ISSUES: R. W. Jacques is looking at the new-style crimp ring; he has committed to responding next Monday on capability, tooling, and piece price for sample quantities. Tom C. has suggested that I look into an integral hexport/crimp ring similar to the one used on the high-pressure APT. I will be speaking to Bob Bishop right away on this concept.

Regarding the O-Ring, the latest iteration using 70-duro rubber and Kapton without Teflon failed miserably after a very low number of cycles. I attribute the poor seal performance to the lack of Teflon. This idea was attempted because the previous iteration showed Teflon delamination.

Work is ongoing to prototype the idea of using a thicker gasket in a deeper gland for more reliable placement in production. I have spoken with JBL and got a bottom-line price of $300 for 1K parts.

A new seal idea was proposed by Jeff DiDomenico, integrating the Kapton seal and the gasket into a single, thick piece of rubber which serves both purposes. This is not an entirely original idea; this design concept was seen when we reverse-engineered a Volkswagen brake switch from a 15-year-old Beetle. I'm putting together sketches and I plan to contact JBL to build prototypes of the diaphragm from EPDM rubber.

We need to sit down to discuss prototyping the idea of using the automated CCPS switch assembly and spring design on the 57PS.

PURCHASING/MFG ISSUES: Jack Keene reports that he is in negotiation with Bassler and A.J. Knott for the terminal business; this is progressing very slowly in my opinion. We need to choose one and get on with the final terminal designs. Jack has sent hexport prints to a Mr. Appenfelder in Dallas; he handles international purchasing. He's also sent a hexport RFQ to Curtis Screw, a supplier with capabilities similar to Elco and preferred by Ford.

HIGHLIGHTS
Stephen B. Offiler
Week Ending 10/20/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EW3423

CUSTOMER SAMPLES: We presently owe Pins 47 devices, due 11/15, and Ford Light Truck 36 devices, due TBD. Our inventory of disc seats is presently too low to meet these needs. The disc seat print, with minor revisions such as elimination of the disc step, was sent to APCC Screw Machine with a toll order for 250. They informed me today that they can't find (!) the tools that were previously used to make this part, and that the revisions would have necessitated building a new tool anyway. Lead time is 4 weeks, and cost is over $1K. I've cancelled the toll order, and will pursue build of this part with an outside house such as KMS Machine Works.

DESIGN ISSUES: R.W. Jacques has responded to my request to prototype the new-style crimp ring. He will build the necessary drawing tools for $650, with a piece price on the order of $2.00. This production-intent crimp ring has an extra step feature in it to capture the switch assembly, eliminating the step from the disc seat.

J-B-L has created new gaskets for us in two sizes, 50% thicker and 100% thicker than the present design. These are to address the issue of manufacturability of the present design which is prone to gasket mis-placement. Their minimum quantity is 1K and the cost is $300 per lot. A small quantity of disc seats with deeper glands will be made in the model shop to prototype these gaskets.

Last week I reported very poor results on the latest iteration of the O-ring seal design which was blamed on use of Kapton without Teflon. Subsequently we discovered that the 70-durometer O-rings that were used exhibited fairly large swell in brake fluid, on the order of 10%, whereas the 80-duro parts used in a previous iteration exhibited negligible swell. There are no plans to proceed with the O-ring design concept at present pending work on other design approaches.

I've created sketches of a revamped design based on the high-pressure AFT hexport. This part has an integral crimp ring and costs about 30 cents from Elco, versus our 22 cent hexport plus a separate 10 cent crimp ring. Furthermore, the Kapton seal and EPDM rubber gasket have been combined into a single rubber part. I'm putting a plan in place now to prototype this design.

Stephen Offiler 10/20/89

HIGHLIGHTS

Stephen B. Offiler

Week Ending 10/27/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH #X3423

CUSTOMER SAMPLES: KMS Machine Works is building 250 old-style disc seats for use in sample build. These will be delivered on or around 11/15, at a cost of $3.24/ea, which is similar to APCC's cost in this low quantity. This pushes out sample delivery to Pitts by about a week. Charlie Douglas has contacted them with this information.

R. W. Jacques has delivered 300 old-style crimp rings on time. These have been transferred to plating.

DESIGN ISSUES: The model shop is presently working on parts to prototype the newest CCPS design using the high-pressure APT housing. This design was laid out to utilize the same ID's and OD as the APT so Elco may use the same extrusion tools. Secondary op's, of course, are different. These diameter constraints dictate that the lip of the molded base must be made smaller, from .925 nom to .855 nom. This does not effect the rest of the base dimensions. I have received a sheet of 70-duro EPDM rubber which the model shop will use to stamp diaphragms. A single diaphragm replaces the separate Kapton seal and EPDM gasket in this design.

Once the details of reducing the base lip diameter were worked out, it became clear that this base would allow the new-style stepped crimp ring (used on the non-APT design) to be made smaller, to match the O.D. of the old-style crimp ring. This change was communicated to R.W. Jacques, who is in the process of prototyping the new crimp ring. This changes his tooling completely, but was caught in time before he cut any steel. Additionally, the model shop is working on a crimp tool for this crimp ring.

PURCH./MFG. ISSUES: Regarding the terminals, several weeks ago Purchasing narrowed the field to either A.J. Knott or Bassler (based on non-production-representative prints). No further progress has been made, but recent inputs from Mfg. Eng. indicate that Knott is presently raising prices with existing business and Bassler on the other hand is hungry for business. Ray Tourangeau has clearly stated a preference for Bassler. It's time to drive the proverbial stake in the ground and embark on finalizing the design with Bassler's tooling experts.

57PS/CCPS AUTOMATION STRATEGY: Meetings are being held to evaluate various strategies of sharing CCPS automation tooling with 57PS switch assemblies, or sharing common switches, or common sensors, etc. Keith Roberts is championing this effort. Stan Hornal and I have worked out an adapter to allow CCPS switches to be added to 57PS sensors for prototype work. The model shop is working on this.

10/27/89

/20 10/31

STIS/CCPS SWCH ASS'Y STUDY

GOAL: We are building Kluge devices with STIS sensors and CCPS switches. The purpose i.e. the question we are trying to answer is: How does a CCPS spring affect act/rel performance of the STIS sensor?

We will build a total of 20 devices, 10 ST's as a control and 10 Kluges.

PROCEDURE:

A. Sensor Assemblies

Overpressure to 800 psi min. 3 times. Cycle 3 times, take 4th reading. Record both act & rel. Actuation on these devices is (ballpark) 500 psi for your information.

B. CCPS Switch Ass'y

Pin-gage "X" qty devices. Use a single, known thickness disc tool. Take the +000 reading, subtract disc tool thickness, add .056, and keep the ass'y for use only if the value is between .142 and .156. See me if you have problems. Continue until you get 10 parts. Measure the spring force on these 10.

C. STIS Sw Ass'y

Measure the spring force on all 10.

D. Final Ass'y

The model shop is building adapter rings to mate CCPS to STIS sensor. We must track which sw ass'y mates to which sensor ass'y. Sean Kenisten will put the devices together. Finally, you will characterize act/rel, collect data:

ACT	REL	SERIAL #	ACT	REL	ACT Torque	REL Torque
BEFORE			AFTER			

E. Pin window done by Sean Kenisten - sealed windows of .081" for devices w/STIS Bases and CCPS Bases

PRESSURE SWITCH DATA Form 21605 **TEST NO.** 33-15-20

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
EX 3417	10/31	SBO	

PERFORMED BY	DATE STARTED	DATE COMPLETED	APPROVED BY
JAH	10/31	4/4/94	

PROJECT TITLE: Cruise control Pressure switch

CUSTOMER: Ford

PURPOSE OF TEST: To see if a CCPS spring will effect disc snap of a 57PS

PROCEDURE: ON Next Page.

				Initial		Crimped	Devices		
Device #	Base	Force	Spring Offset	Act	Rel	Creep Open	Act	Rel	Creep closed
33-15-01	57PS	45 Grams	.001	346	193	9.4	337	196	1.5
02		50	.001	337	194	1.5	339	196	1.5
03		75	.001	342	193	1.6	337	193	1.7
04		55	.001	333	188	1.9	329	185	1.4
05		55	.001	350	198	1.4	342	195	1.5
06		60	.001	340	192	1.9	338	193	1.6
07		45	.001	337	195	1.7	328	196	1.5
08		54	.001	333	217	1.9	331	219	1.7
09		45	.001	345	203	1.8	346	204	1.5
10	57PS	48	.001	349	196	1.9	338	198	1.4
/									
11	CCPS	210	.005	351	199	1.7	325	188	1.0
12		210	.005	341	196	1.7	316	199	1.8
13		205	.005	358	204	1.7	323	205	2.0
14		190	.004	360	206	1.7	340	204	1.7
15		180	.005	342	199	1.7	333	197	2.0
16		245	.006	310	183	1.6	304	194	1.8
17		250	.006	338	191	1.5	316	193	1.8
18		225	.005	335	192	1.5	317	191	2.6
19		215	.005	317	200	1.9	308	187	1.9
20	CCPS	230	.006	344	188	1.5	327	188	2.0

PRESSURE SWITCH DATA Form 21605 **TEST NO.** 34-15-09

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
E x 3413	11/1/99	510	
PERFORMED BY	**DATE STARTED**	**DATE COMPLETED**	**APPROVED BY**
DAD	11/1/99	11/1/99	

PROJECT TITLE: Cruise control Pressure switch

CUSTOMER: Ford

PURPOSE OF TEST: 1) To test new sealing mechanism (diaphragm)
2) To study the KO cycle of devices with more than 1 disc

PROCEDURE: Thermal cycle linealee hybrid test

Device #	Diaphragm Bld	Sealing Mono	Temp P.in °C	Force Req	Spring Δ Elect	Diaphragm thickness	% compression	Lubrication	
34-15-01	.067	.011	214	225	.005	.072	25%	Annular	
02	.067	.011	217	220	.005	.072	33.2%	2 Graphite	
03	.067	.011	218	225	.005	.073	23.1%	[illegible]	
04	.067	.011	213	170	.004	.072	12.4%	Ger time	DEAD
05	.067	.011	216	225	.006	.074	29.5%	1 Graphite	DEAD
06	.066	.011	215	175	.004	.077	31.1%	[illegible]	
07	.066	.011	214	200	.005	.079	35.7%	1 Various	
08	.067	.012	216	225	.006	.077	31.3%	0 Graphite	
09	.068	.012	214	190	.004	.079	32.3%	[illegible]	DEAD

	INITIAL		1 [illegible] cycles		25K cycles		13K cycles	
	Act	Rel	Act	Rel	Act	Rel	Act	Rel
34-15-01	283	261	274	266	274	246	274	258
02	276	247	269	263	272	259	273	257
03	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
04	276	259	264	249	272	261	271	245
05	279	267	279	262	276	262	275	256
06	[illegible]	[illegible]	270	264	278	255	280	248
07	276	259	269	251	269	246	267	246
09	270	261	276	249	275	252	270	250

HIGHLIGHTS
Stephen B. Offiler
Week Ending 11/03/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EO3423

CUSTOMER ISSUES: I spoke with Gary Klingler late last week. His work which will lead up to determination of the actuation specification is ongoing. His best guess at this point is 250 psi +/- 50, necessitating use of multiple discs or a converter design.

DESIGN ISSUES: The model shop has completed all parts needed to build 10 prototype devices using the APT hexport. These parts will be built in a matrix of variants designed to get as much information as possible in a short time. Two separate issues are being tested with these parts: the seal system, and use of multiple discs.

Regarding the seal system, the devices are designed to use a rubber diaphragm rather than Kapton. The issue in question is the appropriate compression to obtain a seal. Devices are being built with three levels of compression: 24%, 30%, and 35%.

Regarding use of multiple discs, all devices are being built with two of our standard incipient-snap discs, using various lubricant alternatives. Of the first group of three, one device uses no lube as a control and the other two use graphite-impregnated mylar. The second group uses two anti-sieze paste products, one aluminum(?)-bearing and the other copper-bearing. The third group uses discs tumbled in graphite. Inputs from Mfg. Eng. indicate a slight preference for a fluid lubricant rather than a film such as the mylar, for handling reasons.

To test these devices, we will use our combination Impulse test/Thermal Cycle test. During the Impulse test, we stop periodically for characterization which will indicate disc cracking, galling, or other problems.

I've contacted Henry Adams at Norwalk Powder Metals to obtain prototype machinable slugs. We will use steel P/M, with a typical tensile strength of about 40 Kpsi. This is close to our present brass disc seat (approx 45 Kpsi tensile) which has been proven adequately strong to withstand proof and burst.

I've contacted Jeff Melton in the APCC Disc Dept. with revised specifications for the discs he's developing for us. Based on the new information from the customer, he'll work to develop 455 SS discs with 125 act and 90 rel. Two of these will meet the customer's 250 psi spec. Discs expected in a couple weeks.

MFG. / PURCH. ISSUES: As previously reported, Mfg. Eng. has a preference for Bataler over A.J. Knott for the terminals. They are presently doing a good job, working to lay the groundwork for co-development of the production-intent terminal design. Purchasing will need to be brought into this loop at some point; to date they've been non-committal and generally not useful.

57PS / CCPS AUTOMATION STRATEGY: Twenty test devices have been characterized and built. Ten use CCPS switches, and the other ten use 57PS "F" switches. Sensors were characterized for act/rel, and the switches characterized for spring force. We will finish by characterizing the finished devices, and comparing the change in act/rel caused by the stiffer CCPS spring design.

HIGHLIGHTS

Stephen B. Offiler

Week Ending 11/10/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EX3423

DESIGN ISSUES: Testing on the APT Hexport is ongoing. To date, we've had three failures of the nine devices, all at about 95 K cycles. The other 6 have passed 156K cycles. Failure mode is a puncture in the center of the rubber diaphragm where it is pressed against the inlet port in the hexport by the disc during release. We neglected to chamfer this edge, and the relief in the hexport is too shallow. The next iteration will take care of this. Additionally, we should look into a thinner diaphragm so it will conform to the surface of the disc better.

We received initial samples of the new-style stepped crimp ring from Bob Jacques. These were used to construct dummy devices, and burst-tested. We discovered that deformation of the flat-bottom disc seat caused early failure, at about 6K psi.

PURCH/MFG ISSUES: Mfg. Eng. has set up a meeting with Bassler for this Monday to begin critiquing the terminal designs and tweaking for lowest cost. This circumvents Jack Kearns entirely; Mfg. Eng. has gone straight to Ed O'Neill and gotten approval.

Sketches of the components of the APT Hexport design have been transferred to Mfg. Eng. in order to obtain quotes.

AUTOMATION STRATEGY: Results to-date in the testing of CCPS bases with 57PS sensors: the stiffer CCPS spring causes a drop in actuation pressure of approx. 6% compared with the sensor alone; the 57 spring causes a drop of approx. 1.5%. Sigma's (measured on lot size of 10) are very similar. Release values are essentially unchanged in both cases. Pin-window experiments are being done on 3 devices; the other 7 are undergoing impulse on the 57PS line. The results of these tests will help determine feasibility of using the CCPS spring design on the 52PS/57PS.

In considering the matrix of automation options available, it is important to separate the switch assembly from the sensor assembly. It makes sense for TI to own a piece of automatic equipment capable of building the switch ass'y for the 52PS, 57PS, and CCPS. Quick-change tooling will be required to handle the three distinct bases. Mechanization can begin on this machine ASAP; it should be debugged using the 57PS switch while production is still supported by manual assembly. The CCPS switch will be added later; debug should be minimal.

It is too soon to make a realistic decision on which sensor will be used on CCPS: a 57PS style from the AMI, a multiple-disc device in hexport T-B-D, or a single, thicker disc which the AFCC thinks is possible. Work is ongoing to make this decision clearer.

HIGHLIGHTS

Stephen B. Offiler
Week Ending 11/16/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EX3423

DESIGN ISSUES: Testing on the APT Hexport devices has been aborted temporarily. Three devices failed at 95K cycles, and two more began to show leakage at 240K. All nine have been dissected at this point. The failure mode in all cases was a puncture in the center of the rubber diaphragm. This was caused by insufficient clearance in the hexport which forced the diaphragm against the sharp edge of the inlet port.

This design has been iterated, and new sketches have been sent to the model shop. Thinner diaphragms (.060" new vs. .080" old) will be used, which will stretch more easily to conform to the disc better. J-B-L reports that they will send a sheet of .060" EPDM rubber by next Wednesday. The relief in the hexport has been deepened, and the inlet port chamfered. Additionally, the gland for the diaphragm has been redesigned per Mechanization to enhance manufacturability. The gland has been moved from the hexport to the disc seat, and the bump in the gland which controls compression has been moved radially inward.

The APT Hexport devices were also being used to test multiple discs. At 240K, six devices were still intact enough to characterize the discs. Results were inconclusive: upward *and* downward drifts were observed, but with no apparent pattern; none of the discs showed failure in terms of galling or cracking.

Work is progressing on the terminals and base, a priority item per the Program Review. A layout to-scale was created to define the shape and dimensions of each terminal and the three-dimensional relationship between the terminals, spring, and base. A meeting was held with the terminal supplier, K.F. Bansler, to flesh out stamping details and tolerances. Prints of the production terminal designs are forthcoming. A meeting is planned for next Tuesday with AFCC Molding to discuss the base design. As soon as possible, the twist concept will be prototyped with EDM terminals and actual bases (modified).

PURCHASING/MFG. ISSUES: Jack Kearns reports that the machinable powder metal slugs have been ordered from Norwalk. Per the Program Review, Norwalk's reputation with TI is not exemplary, and Jack has been asked to do a thorough analysis of the P/M houses in the U.S. which fit our needs. I provided him with a booklet from the Metal Powders Industries Federation which lists about 100 firms in this business.

Sketches of the three key parts of the new APT Hexport design (modified APT hexport, new disc seat, and rubber diaphragm) were transferred last week to Mfg. Eng. They have been relayed to Purchasing, and reportedly will go out today for quotes.

AUTOMATION STRATEGY: Initial testing of CCPS switches with 57PS sensors is complete. Initial characterization, impulse testing, and pin window tests were performed. The stiffer CCPS spring causes a 6% reduction in the actuation pressure (compared with the sensor alone) while the 57Ps spring causes a 1.5% reduction. Both look quite repeatable and predictable. 500K impulse cycles were run on the 57PS line, at room temp and 10 Hz. (Spec. is 121 C and 2 Hz). No failures occurred. Pin window tests, performed using our methodology (rather

than Mfg. Eng.'s) showed essentially the same pin window, .006", for both the CCPS switches and the 57PS switches run as a control.

MISCELLANEOUS: We should have no problem shipping 47 customer samples to Pitts by next Tuesday. We are picking up the required disc seats from KMS Machine Works today, and Jeff DiDomenico will work this Saturday to assembly the devices.

Joe Schuck is working to set up a meeting for me in Dearborn with the key Ford engineers. We hope to settle the specification issue at this meeting. This will not happen until after Thanksgiving.

I will be attending the Reliability Seminar conducted by Dr. Lamberson at Howard Johnson's tomorrow, and Friday Dec. 1.

PRESSURE SWITCH DATA Form 21605 **TEST NO.** 35-01-47

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
Ex343B	11/11/99	SBO	11/21/99

PERFORMED BY	DATE STARTED	DATE COMPLETED	APPROVED BY
JAB	11/17/99	11/20/99	

PROJECT TITLE: Cruise Control Pressure Switch

CUSTOMER: Pitts

PURPOSE OF TEST: Customer Samples

PROCEDURE: 1) Stepless DSC seat
2) 2 Piece 1-3-1 Kapton seal
3) 70 Duro O-Ring
4) 1 Piece 9-2-9 Kapton washer

Device #	Force Gauge	Spring Offset	Trans. Pit +5	Proof	Act	Rel	Hyst
35-01-01	215	.005	219	Fail			
02	245	.005	214	Pass	131	127	2.6
03	230	.005	218	|	129	124	6.9
04	210	.005	216	|	128	124	6.2
05	255	.004	219	|	142	136	5.9
06	225	.005	217	|	129	125	6.4
07	260	.006	217	|	141	138	2.6
08	205	.004	216	|	129	124	3.9
09	170	.004	216	|	135	130	2.5
10	155	.004	214	|	118	114	6.3
11	190	.005	215	|	135	141	6.9
12	175	.004	215	|	129	124	5.6
13	220	.005	218	|	146	142	2.6
14	100	.004	216	|	141	137	3.8
15	175	.004	216	|	119	114	3.3
16	220	.005	213	|	125	121	3.9
17	205	.005	215	|	136	132	4.5
18	235	.005	215	|	131	127	2.7
19	225	.005	216	|	119	114	2.2
20	215	.005	218	|	137	133	2.4
21	210	.005	216	|	118	114	5.6
22	195	.004	216	|	130	126	2.0
23	220	.005	216	|	129	125	3.9
24	165	.004	217	|	128	124	6.3
25	200	.005	215	|	134	129	6.8
26	160	.004	214	|	130	126	2.6
27	160	.004	216	↓	129	125	2.9
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TI-NHTSA 000606

Device #	Force Grams	Spring Offset	Trans Deg F	Pass	Act	Rel	Mv Avg
79-11-28	230	.006	216	Pass	115	119	20.4
30	240	.006	215		135	131	7.3
31	220	.008	215		120	116	9.2
32	180	.004	215		126	122	9.2
33	210	.005	215		123	119	6.7
34	225	.005	215		121	117	7.8
35	193	.005	216		134	130	19.5
36	270	.006	217		125	120	9.1
37	240	.006	215		124	120	6.5
39	210	.005	215		127	121	9.3
38	195	.004	214		138	133	6.9
40	175	.004	215		125	121	9.9
41	240	.005	215		133	129	5.4
42	200	.004	215		122	119	6.8
43	215	.005	217		121	117	6.3
44	185	.004	215		122	119	5.9
45	240	.006	215		123	119	5.3
46	190	.005	215		128	124	5.7
47	195	.004	219		138	134	5.0
49	230	.006	217	Pass	130	126	7.1

PRESSURE SWITCH DATA Form 21605 **TEST NO.** 37-15-10

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
Ex 3423	11/11/99	SBO	

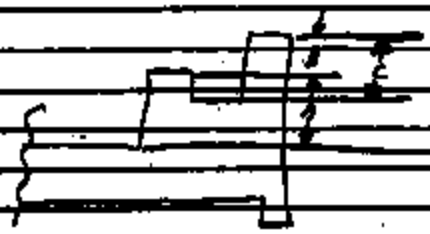
PERFORMED BY	DATE STARTED	DATE COMPLETED	APPROVED BY
ABD	11/18/99	11/19/99	

PROJECT TITLE: Cruise Control Pressure Switch

CUSTOMER:

PURPOSE OF TEST: 1) Test sealing mechanism
2) Test multiple disc life.

PROCEDURE: Hybrid cycle test - Same as 34-15-09

Disc Seat

Device #	Dimensions A	B	C	Force grams	Spring Flat	Trans Pins	Lube	GASKET
37-15-01	.045	.032	.039	190	.004	217	NONE	.047
02	.047	.030	.039	218	.005	215	Teflon	.046
03	.045	.032	.039	215	.005	217	Arctic	.047
04	.046	.033	.040	205	.005	216	Paraplex	.046
05	.046	.032	.040	175	.004	217	Graphite	.046
06	.048	.046	.057	245	.006	219	NONE	.064
07	.047	.046	.057	218	.005	217	Teflon	.065
08	.048	.046	.056	210	.005	217	Arctic	.066
09	.047	.046	.057	220	.005	217	Paraplex	.066
10	.049	.046	.056	200	.004	216	Graphite	.066

All device leaked

TI-NHTSA 000607

HIGHLIGHTS

Stephen B. Offiler

Week Ending 11/30/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EX3423

PROGRAM ISSUES: Significant controversy has developed over the present design direction. With Ford raising the pressure specification into a range normally served by a converter design, use of a 57PS sensor has been proposed. This has serious and complex ramifications revolving around cost, selling price, schedule, and risk associated with an as-yet unproven CCPS design. A visit to Ford has been arranged for 12/07 to attempt to finalize the specification and take care of miscellaneous business. After this meeting, it will be necessary to hold a meeting with our management to solidify the design direction.

CUSTOMER SAMPLES: 47 devices were shipped to Pitts on 11/20; 36 will go out to Ford Light Truck tomorrow. This completes all outstanding orders at present.

DESIGN ISSUES: The second iteration of the APT hexport design was constructed, using two different diaphragm thicknesses: .065" and .046". Miscellaneous detail changes were made to correct the problems with the first iteration which led to failure around 240K cycles. However, the seal mechanism on the second-iteration devices proved inadequate. Analysis pointed to a combination of factors, including inadequate compression on the new, thinner diaphragms, aggravated by a poor crimp arising from an attempt to tighten the switch in the assembly. The third iteration is now underway. Comparing notes with Bob Bishop, we discovered that the geometries of the Bendix APT and the CCPS are almost identical in the area of the crimp, so his dimensions are being used. Significantly higher diaphragm compression will be used as well.

A meeting was held with Norm Roy and Steve Walters to discuss required changes to the molded base. We are working on making minor changes to the present soft tool to rotate the terminal slots which will allow us to prototype the terminal twist concept. Terminals will be wire-EDM'ed. Other changes to the base are ultimately required, including moving the polarity tabs (to differentiate from the 57PS), customer-mandated changes to the locking tabs, reduction in major diameter in order to fit into the APT hexport ID, etc. Some of these other changes will not be implemented in the present soft tool to avoid the need to start the mold from scratch.

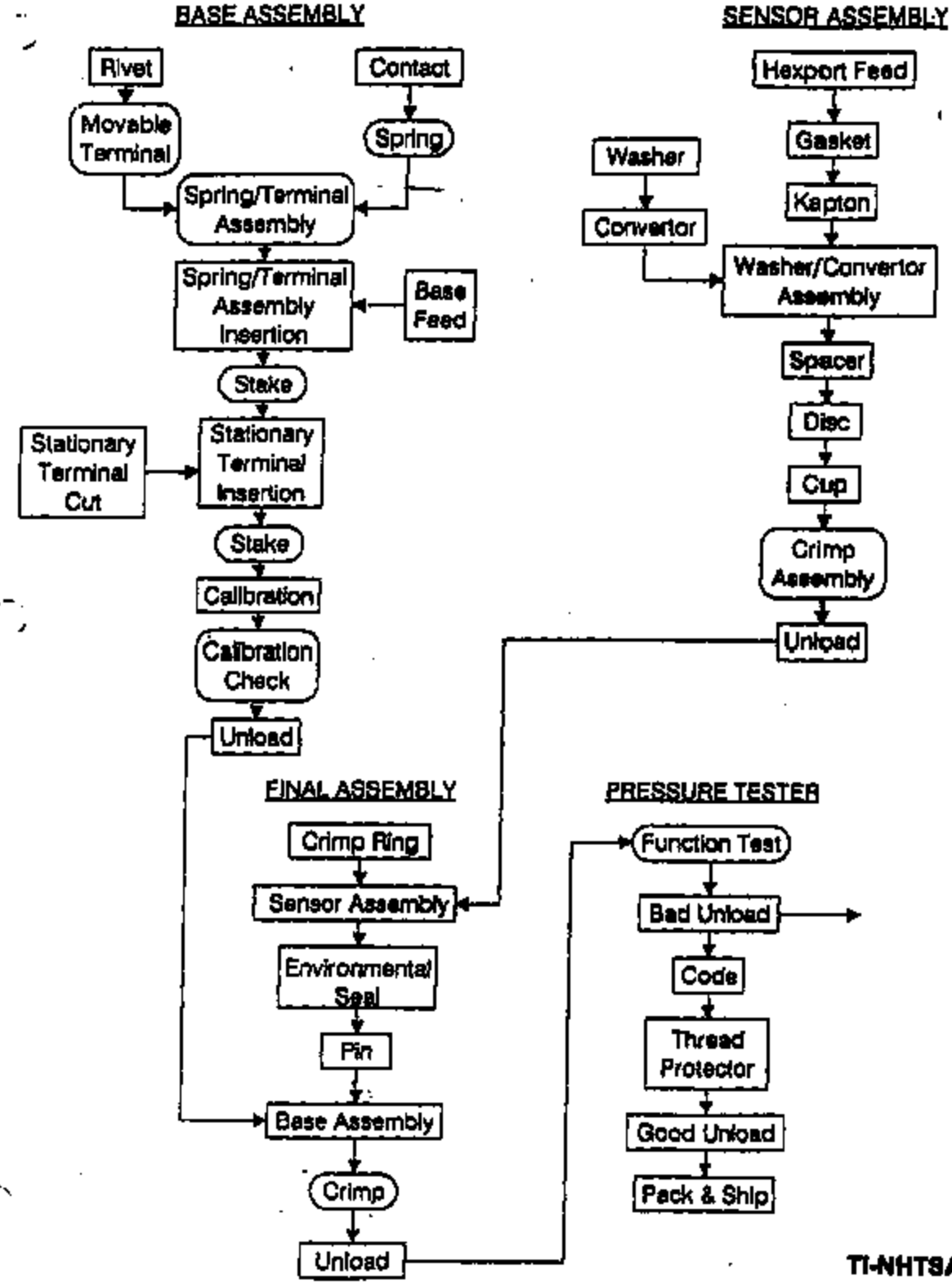
A meeting was held with the AFCC Disc Dept. It was decided to pursue a single-disc approach, using the thickest material feasible (.013", 301SS). We hand-delivered several pounds of material slit to .750" and ready to make 5/8" blanks. Development work will progress in parallel between the disc department and Dave Brown. We are working towards Ford's best-guess 250 psi actuation. This could prove a significant challenge, and as such the idea of using multiple discs will NOT be abandoned.

I spoke with Norwalk Powder Metals to check the status of the prototype machinable slugs (for use in prototyping disc seats). I was informed that the parts will be complete very soon, but that the purchase order had not been received. I have asked Jack Kearns to address the issue immediately.

Steve B. Offiler 11/30/89

FORD NEXT GENERATION SPEED CONTROL

PROCESS FLOW CHART 77PSL2-1/2-3



TI-NHTSA 000609

FORD NEXT GENERATION SPEED CONTROL (77PS)
MANUFACTURING CONTROL PLAN

PROCESS STEP DESCRIPTION	PRODUCT CHARACTERISTICS	EVALUATION METHOD	CONTROL METHOD	FREQUENCY OF TEST	REACTION PLAN
BASE ASSEMBLY (AMI AUTOMATION)	TERMINAL HEIGHT	DIAL INDICATOR	X/R	5pc/Hr.	SORT SINCE LAST CHECK
	TERMINAL PUSHOUT	FORCE GAGE/ DIAL INDICATOR	X/R	5pc/Hr.	SORT SINCE LAST CHECK
	TERMINAL SEPERATION/ ALIGNMENT	PLUG GAGE	X/R	5pc/Hr.	SORT SINCE LAST CHECK
	SPRING CONTACT WIDTH	CALIPERS	X/R	5pc/Hr.	SORT SINCE LAST CHECK
	SPRING TORQUE	FORCE GAGE	X/R	5pc/Hr.	SORT SINCE LAST CHECK
	SPRING BUMP HEIGHT	DIAL INDICATOR	X/R	5pc/Hr.	SORT SINCE LAST CHECK
	RIVET HEIGHT	DIAL INDICATOR	X/R	5Pc/Hr.	SORT SINCE LAST CHECK
	CALIBRATION DEFORMATION	CUSTOM CONTINUITY SYSTEM	X/R	5pc/Hr.	SORT SINCE LAST CHECK
	VISUAL QUALITY	VISUAL	X/R	5pc/Hr.	SORT SINCE LAST CHECK
SENSOR ASSEMBLY	CRIMP DIAMETER	CALIPERS	X/R	5pc/Hr.	SORT SINCE LAST CHECK
	CRIMP HEIGHT	CALIPERS	X/R	5pc/Hr.	SORT SINCE LAST CHECK
	VISUAL QUALITY	VISUAL	P	5pc/Hr.	SORT SINCE LAST CHECK

FORD NEXT GENERATION SPEED CONTROL (77PS)
MANUFACTURING CONTROL PLAN

PROCESS STEP DESCRIPTION	PRODUCT CHARACTERISTICS	EVALUATION METHOD	CONTROL METHOD	FREQUENCY OF TEST	REACTION PLAN
FINAL ASSEMBLY (AMI AUTOMATION)	CRIMP DIAMETER	CALIPER	X/R	5pc/Hr.	SORT SINCE LAST CHECK
	CRIMP HEIGHT	CALIPER	X/R	5pc/Hr.	SORT SINCE LAST CHECK
	BASE TORQUE	TORQUE GAGE	X/R	5pc/Hr.	SORT SINCE LAST CHECK
FUNCTION TESTER (CUSTOM)	ACTUATION/ RELEASE POINTS	MASTERS	X/R	EACH SHIFT	TOOL ROOM/ ENGINEERING EVALUATIONS
	ACTUATION/ RELEASE POINTS	RAMP THROUGH PRESSURE RANGE	X/R	100%	YIELD TRACKING/ SCRAP CONTROL
Q.C. AUDITS	FUNCTION TESTING DURABILITY TESTING ELEVATED TEMP TESTING ENVELOP DIMENSIONAL CHECKS				

TI-NHTSA 000614

24 September 1991 MJS/cnr 058-0134

PRESSURE SWITCH DATA Form 21605 **TEST NO.** 3845-38

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
EX3423	12/7/97	[illegible]	
PERFORMED BY	**DATE STARTED**	**DATE COMPLETED**	**APPROVED BY**
MD	12/7/97	1/15/98	

PROJECT TITLE: Cruise control Pressure Switch

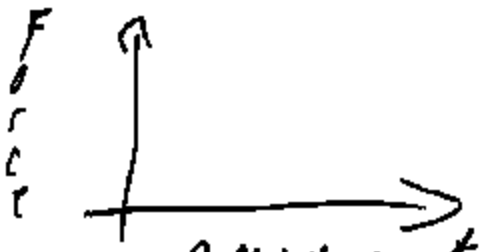
CUSTOMER: Ford

PURPOSE OF TEST: To build a normally closed device using a 57PS sensor and modified CCPS base.

PROCEDURE: 1) Bend the stationary terminal so that it sits lower in the [illegible]
2) Remove [illegible]

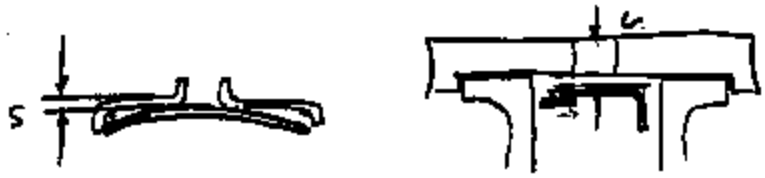
Device #	Standard Act	Standard Rel	Swing	Trans. Pt.	Act	Rel			
97-15-01	356	239	.010	136					
02	358	230	.009	177					
03	347	227							
04	360	225	.010	136					
05	367	203							
06	369	223	.005	145					
[illegible] 07	367	222							
08	358	215							
[illegible] 09	365	227							
10	377	220							
11	406	201							
12	358	218	.006	150					
13	360	232	.010	150					
14	338	212							
15	350	220							
16	346	228							
17	339	222							
18	347	224	.008	141					
19	345	231							
20	398	196							
21	368	214							
22	344	227							
23	344	232							
24	351	225	.008	142					
25	343	246							
26	351	215	.011	143					
27	370	248	.009	136					
[illegible]	[illegible]	[illegible]							

TI-NHTSA 000612



Offset	.006"	.009"	.010"	
-.009	93	109	63	
-.006	92	124	95	
-.003	100	145	125	
0	112	172	167	Continuity
.003	205	293	307	
.006	297	407	461	

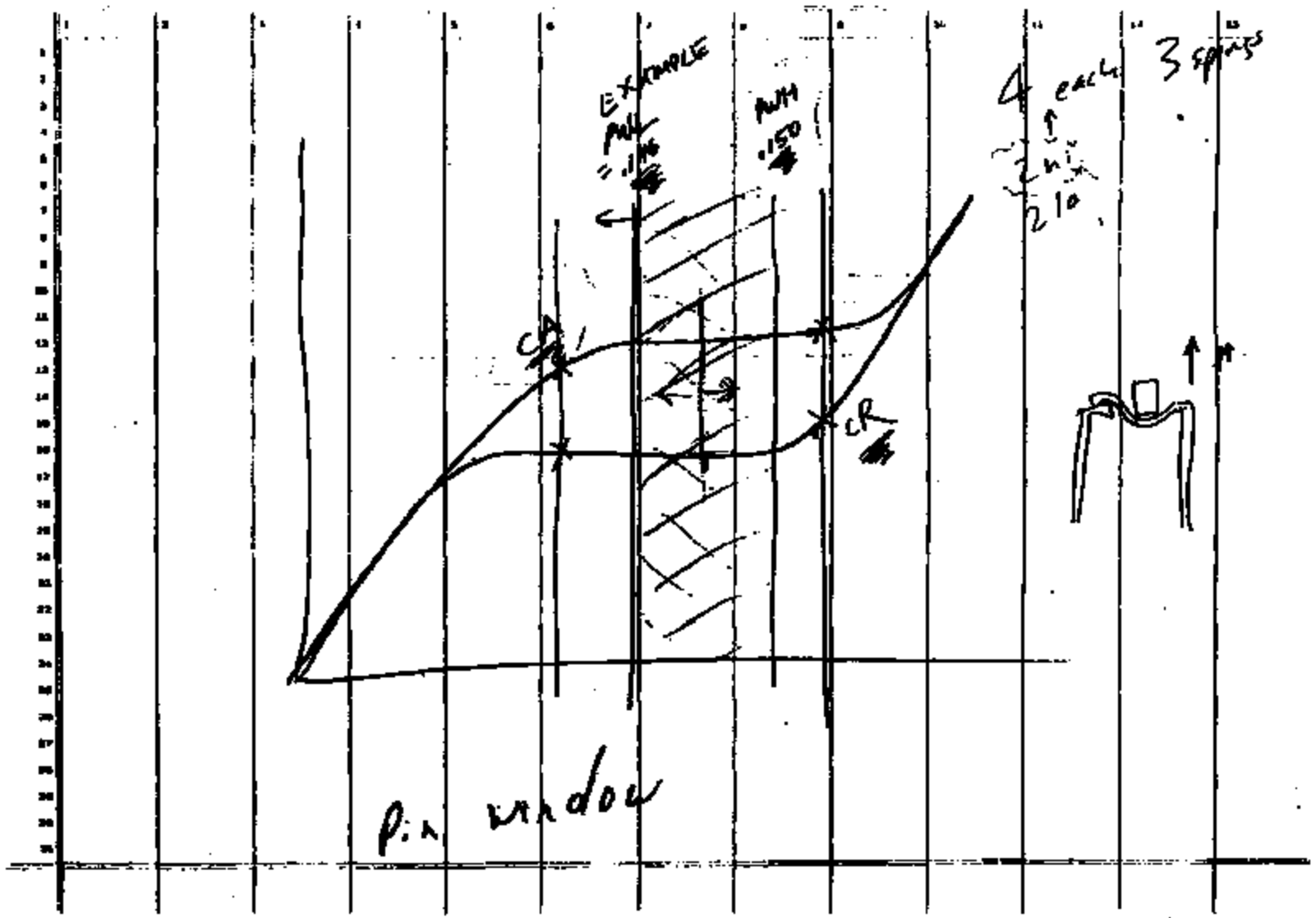
ALIGNING 67'S FOR MAX BE STRESS + MIN CONTACT AREA



$L_{INT} = [C - .006 + .019 - B.S.] + S$

$B.S. = .119$

$L_{pin} = C + S - .106$


EXAMPLE
AUTH
.150
4 each
3 steps
2 in
CA
CR
pin window

PRESSURE SWITCH DATA Form 21605 **TEST NO.** 3[illegible]15-30

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
EX 3423	12/1/89	SAD	

PERFORMED BY	DATE STARTED	DATE COMPLETED	APPROVED BY
SAD	12/2/89		

PROJECT TITLE:

CUSTOMER:

PURPOSE OF TEST:

PROCEDURE: Rebuild and cycle to failure on 5705 Line. devices already had 500K low stress and 500 K high stress cycles. The figures on this sheet are in addition to this ?ways.

Sensor #	Base	Failed at	Spring	Stress	Comments				
5	15		500	High	Spring broke in front of ramp				
7	27								
8	26								
9	6	631K							
10	27								
11	1								
14	29								
15	12								
16	30								
17	13								

The remaining 9 devices ran 2.3KK cycles on the 5705 line cycler. (2.8KK total cycles) They were then disassembled for inspection.

Base	Force
1	174
12	124
13	[illegible]
15	77
24	125
26	109
27	172
29	[illegible]
30	155

EXHIBIT NO. 56

HIGHLIGHTS

Stephen B. Offiler
Week Ending 12/08/89

12/11/89

FORD MY92 CRUISE CONTROL PRESSURE SWITCH EX3423

PROGRAM ISSUES: Ford is very close to officially confirming the actuation specification of 250 +/- 50 psi. Release is inconsequential. This applies to the lead platform which is Econoline van; further work will be done ASAP at Ford to determine the actuation on passenger car. It is fair to assume the tolerance will be the same on pass-car.

Both truck and car brake engineers at Ford are looking into the proof specification. Our goal is to back off the 5000 psi spec, down to about 3500 psi. We should have some input on this from Ford soon.

Work is also ongoing at Ford to finalize the written specification. We have given Ford our rough draft based on a marked-up 57PS T'bird suspension-control specification, which will form the basis for discussion and negotiation of the final spec.

Changes to the envelope prints (different for truck and car) have been completed. This includes changes to the locking tabs, moving the polarity tab off-center to differentiate from the 57PS, and increasing the overall length slightly dictated by the APT hexport dimensions. Joe Schuck will be working to approve the polarity tab change with Ford and with their mating-connector supplier. If we end up using the 57PS sensor, further increases in overall length and width will have to be approved by Ford.

DESIGN ISSUES: We are presently working to get prototypes on test, using 57PS sensors with actuation around 350 psi, and CCPS switches with hand-modified terminals to provide the correct Normally-Closed logic. The model shop has provided spring arms using .006" and .008" BeCu mill-hard, and we're also running standard .010" springs as well. The devices were pinned to provide 100 grams contact force. A 500K Impulse test will be run, with 25K electrical cycles, at 2.25 Hz in order to complete the test by first thing Monday morning. The purpose is to determine spring life and any adverse effects on the disc.

Modifications to the base mold will be designed on a high priority basis in order to prototype the twist concept. Terminals will be wire-EDM'ed.

The model shop is working on the third (and hopefully final) iteration of the APT hexport design. Various tweaks have been made to the second iteration to improve the hydraulic seal. These devices will be tested using two of our standard 150 psi incipient discs with various lubricants. Dave Brown has developed a single disc with 250 psi actuation, using .014" 301SS, which will be life-tested independently. We have disc blanks made in the model shop (perfectly round) and blanks made by APCC (vestige).

We have received our powder-metal slugs. These will be machined by the model shop into disc seats which are compatible with the old CCPS design (because it is generally a known quantity) and life tested. For comparison sake, we can also run zinc parts representative of die castings.

We've received crimp rings from Jacques, which are the newer, stepped design. These parts burst at above 8200 psi.

PRESSURE SWITCH DATA Form 21605 **TEST NO.** 39-15-10

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
Ex-3423	12/1/99	SBB	
PERFORMED BY	**DATE STARTED**	**DATE COMPLETED**	**APPROVED BY**
JAG	12/4/99	12/13/99	

PROJECT TITLE: Cruise Control Pressure Switch

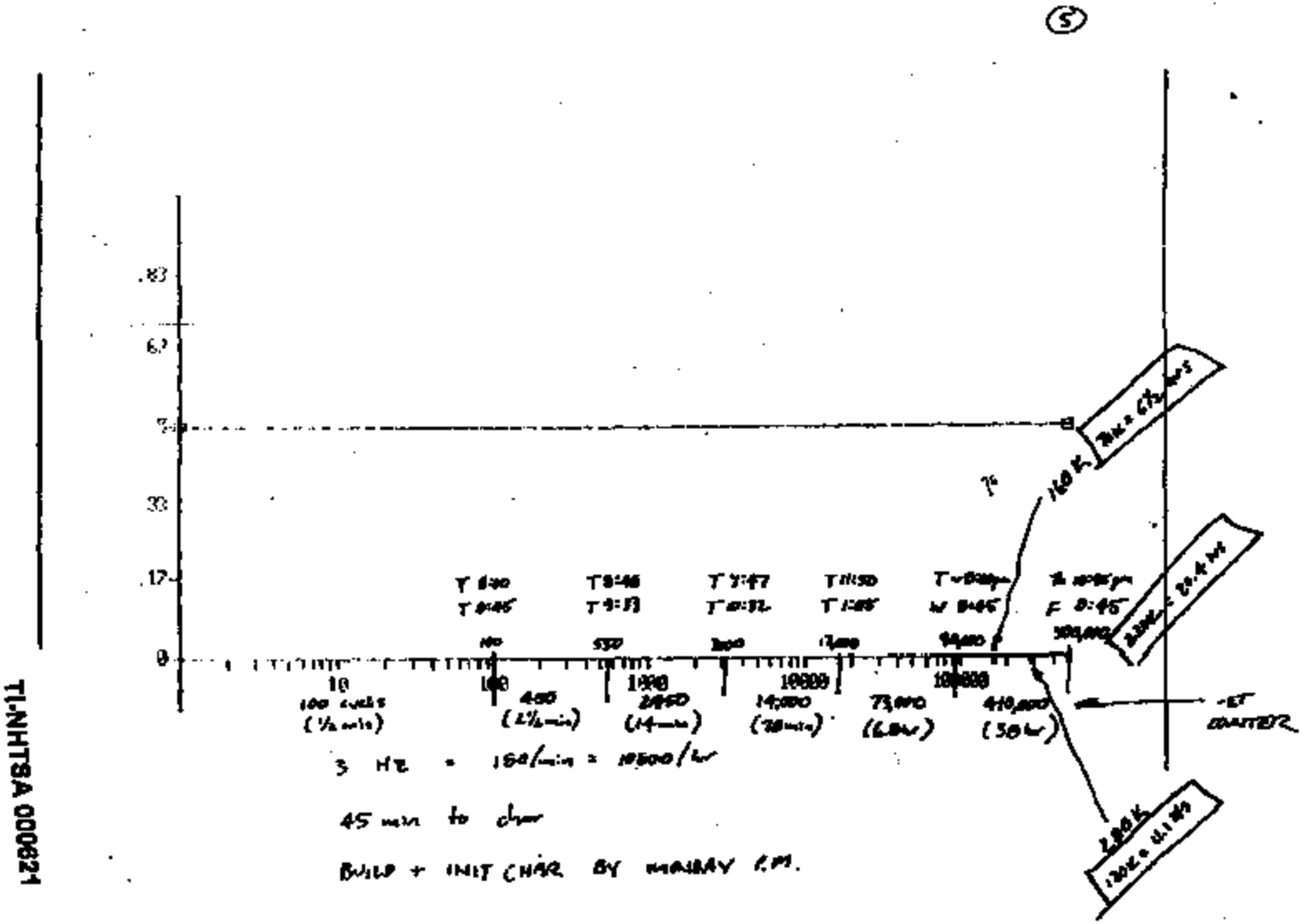
CUSTOMER: Ford

PURPOSE OF TEST: Test 250 psi discs for life

PROCEDURE: Assemble as per usual
characterize periodically

Device #	Force (grams)	Spring Affect?	Travel Height?	Disc?	Disc Act	Disc Rel	Lmed?	Initial Act	Initial Rel
39-15-01	200	.009	216	[illegible]	260	241	yes	261	254
02	230	.005	213	[illegible]	273	240	yes	241	254
03	195	.004	216	[illegible]	271	249	yes	279	230
04	200	.004	217	[illegible]	261	237	no	275	250
05	200	.006	216	[illegible]	265	237	no	274	247
06	200	.004	215	[illegible]	260	219	no	262	246
07	125	.004	214	Over	292	260	–	290	274
08	270	.005	216	Over	279	–	–	270	262
09	185	.004	213	Over	277	267	–	277	271
10	165	.004	213	Over	276	259	–	272	265

	After 100 cycles		After 500 cycles		After 3K cycles		After 12K	
Device #	Act	Rel	Act	Rel	Act	Rel	Act	Rel
39-15-01	263	250	261	254	269	246	265	254
02	293	254	294	252	296	248	296	250
03	280	264	282	270	281	259	281	263
04	276	244	276	243	277	240	276	240
05	272	247	278	245	290	242	279	243
06	264	235	264	234	266	232	265	234
07	272	256	272	251	272	250	266	253
08	266	259	267	256	270	258	270	255
09	263	257	273	262	272	249	272	256
10	266	252	266	253	264	249	277	256



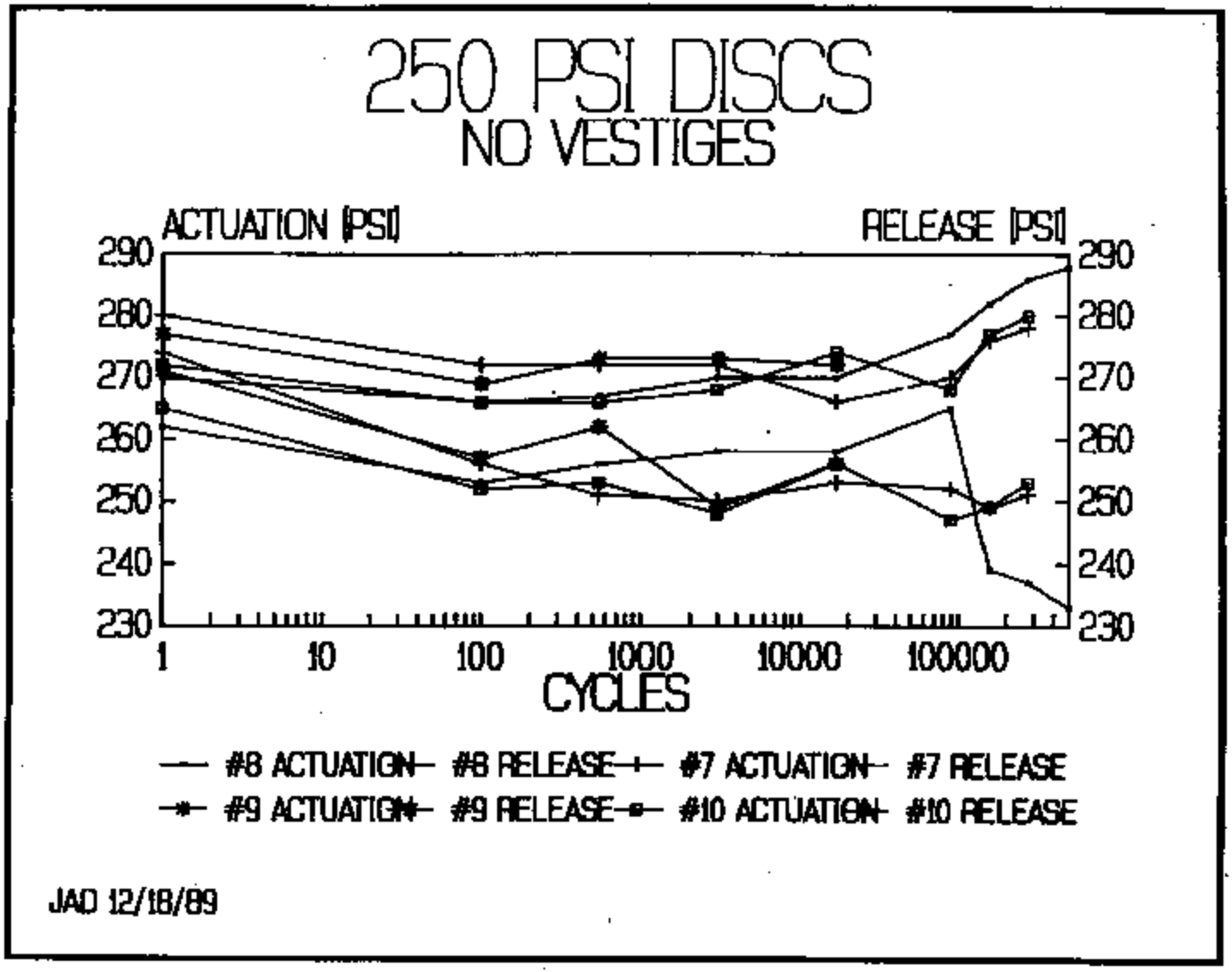
250 PSI DISCS

	0 CYCLES		100 CYC		550 CYC		3K CYC		17K CYC		90K CYC	
DEVICE #	ACT	REL	ACT	REL	ACT	REL	ACT	REL	ACT	REL	ACT	REL
39-15-01	261	254	263	252	261	254	268	246	265	254	CRACKED	
39-15-02	281	254	282	254	284	252	286	248	286	250	CRACKED	
39-15-03	278	270	280	254	282	270	283	259	281	263	CRACKED	
39-15-04	275	250	276	244	276	243	279	240	276	240	CRACKED	
39-15-05	274	247	277	247	278	245	280	242	279	243	CRACKED	
39-15-06	263	246	264	235	264	234	266	232	265	234	CRACKED	
39-15-07	280	274	272	256	272	251	272	250	266	253	270	252
39-15-08	270	262	266	253	267	256	270	258	270	258	277	265
39-15-09	277	271	269	257	273	262	273	249	272	256	226	219
39-15-10	272	265	266	252	266	253	268	248	274	256	268	247
AVG.	273	259	271	250	272	252	274	247	273	250	260	245
STD.	6.4	9.8	6.5	6.3	7.3	9.4	6.6	7.6	6.8	8.5	20	17

	160K CYC		280K CYC		500K CYC	
DEVICE #	ACT	REL	ACT	REL	ACT	REL
39-15-07	276	249	278	251	CRACKED	
39-15-08	282	239	286	237	288	233
39-15-09	CRACKED					
39-15-10	277	249	280	253	CRACKED	
AVG.	278	245	281	247		
STD.	2.6	4.7	3.5	7.1		

250 PSI DISCS

DEVICE #	FORCE GRAMS	SPRING DFLECT	TRANS PIN+5	DISC	HONED	BARE DISC ACT	REL
39-15-01	200	0.004	216	AFCC	YES	260	241
39-15-02	230	0.005	213	AFCC	YES	273	240
39-15-03	195	0.004	216	AFCC	YES	271	248
39-15-04	200	0.004	212	AFCC	NO	266	237
39-15-05	300	0.006	216	AFCC	NO	265	232
39-15-06	200	0.004	213	AFCC	NO	260	238
39-15-07	175	0.004	214	DAVE	-	282	260
39-15-08	230	0.005	216	DAVE	-	278	
39-15-09	185	0.004	213	DAVE	-	277	269
39-15-10	165	0.004	213	DAVE	-	276	258
AVG.	208	0.004	214			270	247
STD.	36.4	0.000	1.53			7.3	12



HIGHLIGHTS

Stephen B. Offiler

Week Ending 12/14/89

FORD MY91.875 CRUISE CONTROL PRESSURE SWITCH EX3423

CCPS/CONVERTER DESIGN: We've outlined the steps needed to develop the design of the "hybrid" switch assembly. This is the switch that will be fully automated and compatible with 57PS "L", 57PS "F", CCPS w/ converter, and CCPS w/ APT hexport. Mechanization & Mfg. Eng. have helped identify those areas which must be geometrically identical on all switch variations to allow use of a single assembly machine w/ mechanical calibration rather than pin gaging. Priority #1 is to determine changes to be made to the present CCPS prototype mold in order to accept the new terminal design and orientation, and to complete the design of the terminals (one movable, two stationary to provide N/C and N/O). This effort is underway and targeted for completion before the end of next week.

A 500K cycle test was run on hand-modified (to provide N/C-logic) CCPS switch assemblies with 57PS sensors. The purpose was to prove feasibility and test life of the CCPS spring design with a converter-type sensor. Three groups were run, using .006", .008", and the standard .010" springs. However, these devices were accidentally pinned too low, reducing the stress on the spring. Not surprisingly, all devices passed 500K. We are now taking the time to do it correctly. Using the same switches and new sensors, we have run pin windows on each device individually. Half of the devices will be pinned at the low side of the window, the other half at the high side. They will undergo another 500K test over this weekend.

It will be necessary to build a third variation of the present 52/57PS hexport. The two present production hexports are:

1) short (.297nom) 3/8-24 thread w/ .136nom hole; and
2) long (.375nom) 3/8-24 thread w/ snubber hole.

For Light Truck application, we need a hexport with long thread, .136 hole, and an SAE J512 inverted flare. For Pass-Car, we'd probably use the snubber hexport. Volumes on these parts will be small, assuming that we move to the APT-hexport-based design as soon as it is completely designed and validated.

Based on inputs from Mfg. Eng., the standard 9:1 converter is able to meet +/- 50 psi with high yields. Assuming disc sigma's comparable to present production discs, there is no need to move to the 6:1 (TRW) converter which is presently under development.

CCPS/APT DESIGN: Dave Brown's first pass at a single 250 psi disc using .014" material is undergoing cycle test (in parallel with spring arm life test above). Of ten devices, six use discs blanked perfectly round and four use APCC vestige discs. All four APCC discs have failed, somewhere between 17K and 90K cycles. All six vestigeless discs have passed 90K successfully. The test devices were built with zero-overtravel disc seats from our inventory and pinned at plus-five.

The model shop has completed some of the parts needed to build the next iteration of the APT hexport design. These will test three different rubber diaphragm thicknesses at

different levels of compression. The primary effort here is to complete the design of the hydraulic seal. These devices will be running two, 150 psi incipient discs with various lubricants in order to accumulate knowledge. They will be tested after completion of the two tests now running in the cycler; using a combination Impulse and Thermal Cycle test.

OLD CCPS DESIGN: A quantity of 200 dual-step crimp rings have been received from R.W. Jacques, and are now being plated. These use the flat-bottom disc seats which are recognized to be more cost-effective to produce by screw-machine or by powdered metal. The first iteration burst at around 6K psi; this iteration burst around 8.5K. We continue with this idea on a low priority because it will be useful to test prototypes of powdered metal and die-cast disc seats, which are now being made in the model shop. These devices will be tested sometime in January as time permits, using Impulse and Burst tests to determine fatigue strength and ultimate strength respectively.

12/14/89

PRESSURE SWITCH DATA Form 21605 **TEST NO.** 40-15-09

DEVICE	DATE REQUESTED	REQUESTED BY	REQUESTED COMPL. DATE
Ex 3413	12/14/99	RBB	
PERFORMED BY	**DATE STARTED**	**DATE COMPLETED**	**APPROVED BY**
JAD	12/15/99	1/13/00	

PROJECT TITLE: Cruise Control Pressure Switch

CUSTOMER: Ford

PURPOSE OF TEST: Iteration of test 34-15-09

PROCEDURE: ON Following pages

Device #	Force grams	Spring Offset	Disc seat	[illegible] at [illegible]	Dim [illegible] on seat	Dim [illegible] at [illegible]	Diaphragm	[illegible] pin 15	Lube
40-15-01	240	.006	C	.049	.039	.051	.059	229 → 232	Graphite
02	200	.009	D	.048	.039	.051	.059	229 → 232	Teflon
03	175	.004	E	.049	.039	.051	.059	229 → 232	Neverseize
04	150	.004	I	.049	.033	.015	.047	240	Graphite
05	205	.005	K	.049	.033	.025	.047	237	Teflon
06	195	.005	L	.049	.033	.015	.047	238	Neverseize
07	170	.004	M	.049	.043	.010	.039	216	Graphite
08	110	.004	N	.049	.043	.010	.039	213	Teflon
09	225	.005	O	.050	.043	.010	.041	212	Neverseize

Device #	Load	Ambient Act	Ambient Rel	180 Cube Act	180 Cube Rel	25 K Cycles Act	25 K Cycles Rel	125 K Cycles Act	125 K Cycles Rel
40-15-01	Reset	214	185	210	210	237	175	171	157
02	Reset	234	213	243	232	249	221	242	216
03	Reset	187	156	130	183	181	107	No Act	
04	Reset	271	253	284	246	238	252	278	250
05	Reset	261	245	231	216	262	241	269	246
06	Reset	260	243	263	244	270	249	272	249
07	Reset	232	212	248	215	248	219	238	218
08	Reset	240	223	254	213	249	227	252	227
09	Reset	259	239	261	233	269	237	235	188

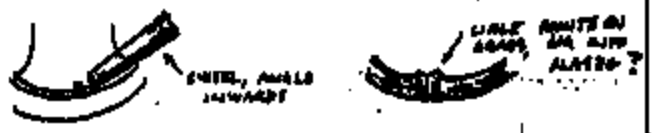
So 12/14

CCPS/APT BUILD INSTRUCTIONS

1) CHECK ALL DIMENSIONS & COMPARE W/ PRINT. ON HERMETIC, THIS IS BECAUSE QUALITY MIGHT BE QUESTIONABLE; ON DISC SEATS THIS IS BECAUSE WE'VE HAT THESE SIZES TO WORK WITH AND MUST INSURE CORRECT DISC SEATS MATCHED W/ CORRECT GASKETS

2) INSURE ALL SHARP EDGES IN VICINITY OF RUBBER HAVE BEEN BROKEN

3) (TRY THIS FIRST ON JUNK PARTS) AFTER PIN-REAMING, ASSEMBLE DISC SEAT TO WITCH + STAKE W/ SMALL CHISEL AT BRASS/PLASTIC INTERFACE, 3 OR 4 TIMES. THIS HOPEFULLY PROVIDES ANTI-ROTATION

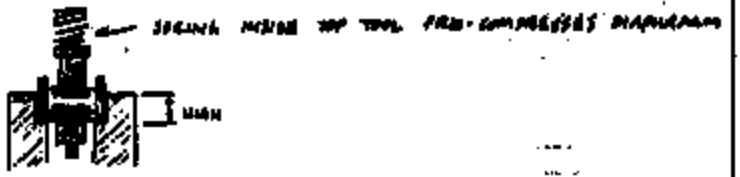


4) NOTE: -3 DISC SEAT IS FOR .068" DIAPHRAGM (50%)
-4 " " " " .046" " "
-5 " " " " .025" " (40%)

FOR -5, USE AVERAGE OF .079 AND .082 GAGE
DURING BUILD, MEASURE + RECORD ACTUAL CUPPED THICKNESS

5) WE'LL BUILD A TOTAL OF 9 DEVICES IN A MATRIX ...
3 DIAPHRAGM THICKNESSES, 3 TYPES OF LUBE ON DISCS
LUBE: 3 W/ MOLYBDENUM DISULPHIDE, 3 W/ TEFLON SPRAY, 3 W/ NICKEL-PASTE

6) AVENUE CRIMP, INSPECT AS HIGH AS POSSIBLE + USE "SPRING" TO REBOUND IF POSSIBLE

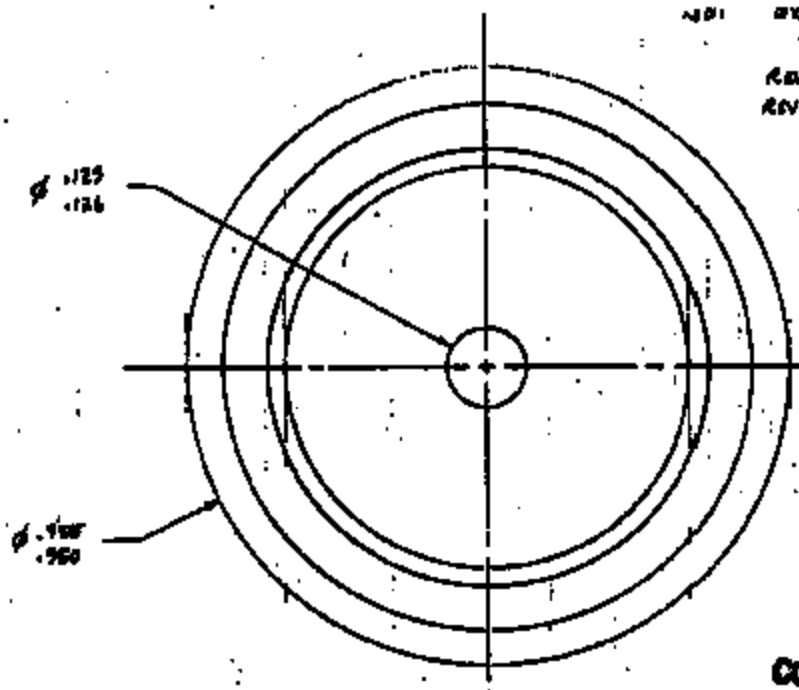


7) THESE PARTS TESTED ON 121°C IMPULSE COMBINED W/ THERMAL CYCLE COMBINED W/ PERIODIC CHARACTERIZATION, AS SOON AS CYCLER IS AVAILABLE. PROBABLY WANT TO REMOVE SPECIAL MANIFOLD BEFORE IT'S "THERMAL MASS" WILL SLOW DOWN TEMP CHANGES DURING T.C. TEST

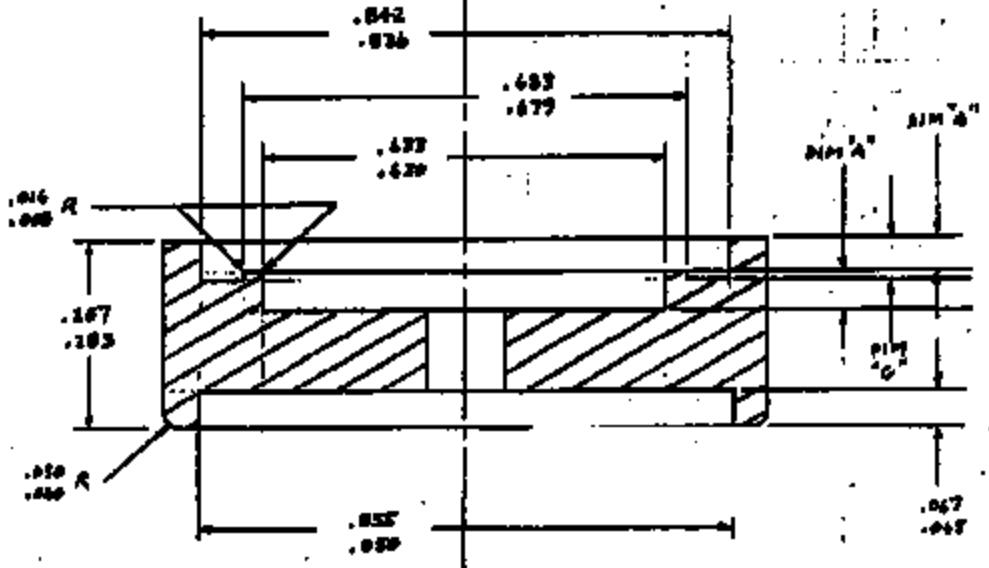
8) USE YOUR JUDGEMENT WITH ALL OF THE ABOVE - DON'T LET ANYTHING SLOW US DOWN EXCESSIVELY! ESPECIALLY IN ITEMS 3, 6, 7

TITLE: MSC SEAT III
BY: S. OPPELOR
DT: 11-10-89
NO: 8X3423-37

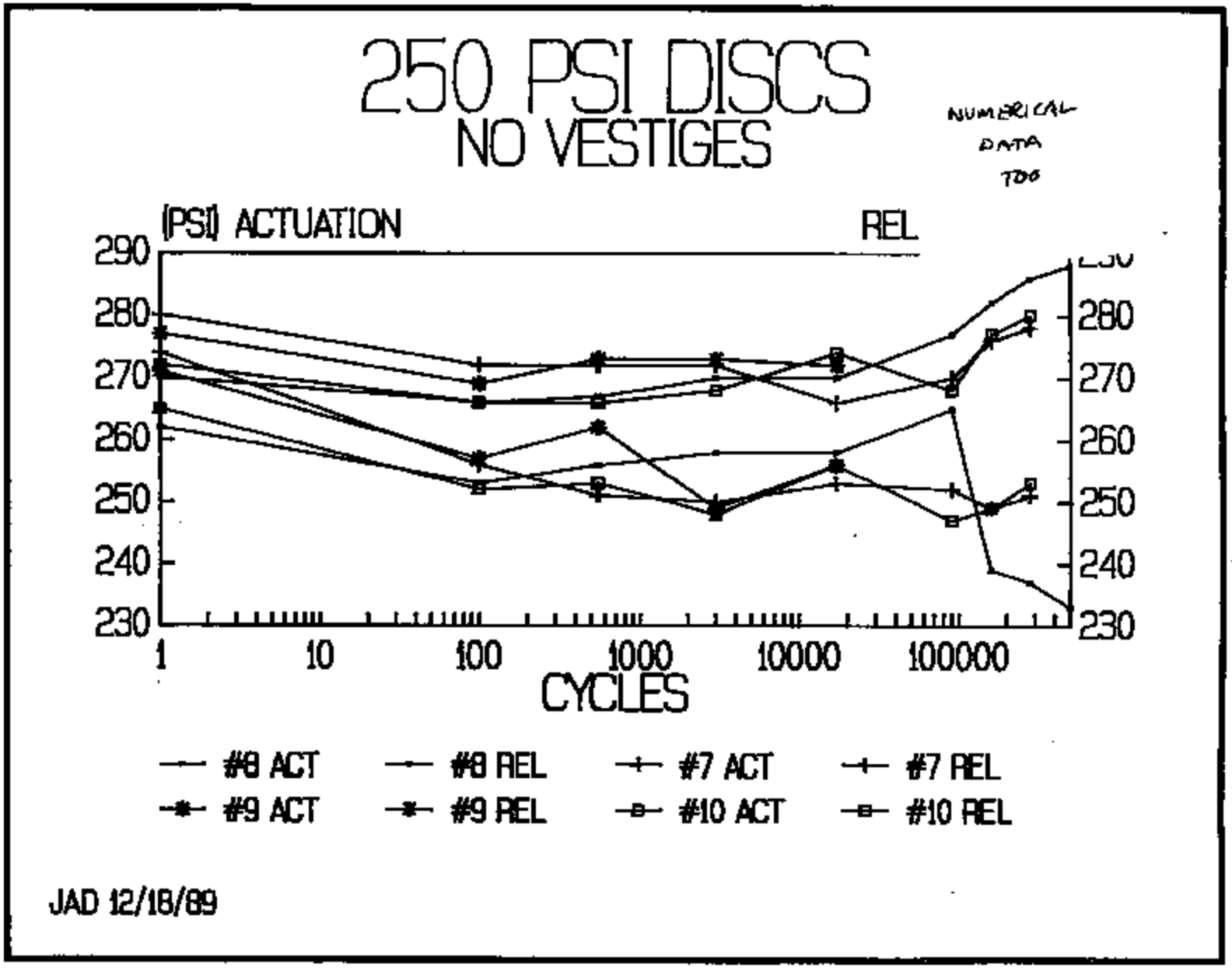
REV B 11-14-89
REV C 11-20-89



CONFIDENTIAL



PART NO.	8X3423-37-1	-2	-3	-4	-5
DIM. "A":	.019/.015	.051/.047	.051/.047	.051/.047	.051/.047
DIM. "B":	.078/.074	.046/.040	.035/.033	.026/.024	.058/.047
DIM. "C":	.067/.063	.053/.049	.033/.030	.036/.034	.017/.013



TI-NHTSA 000631