

EA02-025

TEXAS INSTRUMENTS, INC.'S

9/10/03

REQUEST NO. 7

BOX 10

PART A – I

PART D

HIGHLIGHTS
Stephen B. Offler
Week Ending 92-46-19

Handwritten signature and date: 7/2/87



FORD MY V. ELECTRONIC SPEED CONTROL DEACTIVATE ES

7/1 SF3-3 and L11-3 VALIDATIONS: Stan Hornol and I have discovered that retesting of F3-3 creep-release "failures" (non-impulse) generally shows the devices to be good if tested at the ES maximum ramp rate of 10 psi/sec. However, some will show erratic behavior if subject to low-level shock (hitting them on a table). Stan suspects these may have an issue with spacer breakdown and/or wear particles hindering disc motion. We are rather confident that the bulk of the F3-3 issue is basically ramp-rate dependency, (ignoring the erratic ones) however, in my opinion the L11-3 still has pertinent problems. For example, we know that we had one cracked disc out of 33 devices undergoing the impulse retest, and several more confirmed creepers and/or shock-sensitive erratic parts, and the pin windows are very narrow and shrinking over life.

This information (gliding the L11-3 issue somewhat) was presented to Tom Dann during his visit on Thursday, 6/18, and was well-received. He has asked that we present these findings in writing, including initial char, final slow-ramp char, and final fast-ramp char. He will include these documents, supplementing ISR test reports, with a request for deviation. Additionally, the outstanding areas of the L11-3 ES were discussed. He has also requested that we present this information in writing, along with an action plan for resolution with Ford.

We are making good progress on the F3-3 action items generated by our call to Gary Berlino and Jim Jensen at Ford. The four impulse parts with creep-release between 10-30 msec were overnighted to Norm Freda, for hand-delivery early this week. We have completed production-cycling 20 devices from the original lot, looking for this test to produce creepers to prove correlation of production testing with lab testing. Characterizations by Gail and Jeff should be complete Monday 6/22. Stan has shipped most of the devices purposely built as creepers, which Ford has committed to testing in their system to determine detrimental effects if any.

Norm is working to set up the meetings and conference calls required to complete the ES negotiations with Kaippel and Straus. I have summarized our position in a lengthy memo to Norm, who is now well-prepared for face-to-face discussions - of course, I will stay closely involved in the negotiations.

AUSTRALIA: An issue has arisen with Ford of Australia, regarding the vacuum spec. They are asking us to go more than an order of magnitude lower than Ford USA. Our equipment can barely attain this level, and we have not had time yet to actually run devices. Field Sales in Australia is indicating a high priority is desired on this, as well as the delinquent prints.

F-SERIES: We are hosting John Pelkey and Nehru (sp?) Modi this Tuesday 6/23. Unfortunately, we are having problems with their 600 hour thermal-ramp impulse test. We have had two ruptured diaphragms, one at 230 hr (=192K cycles) and one at 294 hr (=245K cycles). Also, the infrared heater is located above the vertically-mounted devices, and the controlling thermocouple is mounted high, quite close to the heater than temperatures of the devices below the thermocouple are quite a bit cooler. It has been proposed that we revamp the setup to mount devices at 45 degrees to vertical to expose more of their length to the infrared rays. It is not clear if we'll be able to accomplish this by Tuesday. Finally, we are getting into a cyclical conflict, because we also need to begin thermal cycles and impulse testing on the EN53 and SHO quiet device validation. On a positive note, Pelkey has asked that the ISW needed ASAP include only a dimension check and reference to EN53/SO fluid resistance tests. Based on this, it looks like we should abort the 600 hour test for now.



T-NHTSA 015482

HIGHLIGHTS

Stephen B. Offler
Week Ending 92-05-08

87PS VALIDATION ISSUES:

During validation of 87PSL2-2, L8-1, and L11-3, we have discovered an issue with wear of the movable contact. This is mechanical wear not related to electrical erosion. The effect is to increase the base calibration by 3.5 mils (on average, for L2-2, others not analyzed yet). This causes a shift towards creep-actuation after impulse cycling. We are presently working at "A" priority level to correct the issue. Parallel efforts include:

Rebuild and test of switches which are purposely pinned towards creep release

Use of the 50418-5 (high current 55/56/58/61PS contact), which should be a drop-in replacement

Use of a contact similar to 50418-5, but with much less silver, which should provide a more robust mechanical interface with the stationary contact

Look into a harder version of the present contact, i.e. harder copper or possible use of brass base material instead

We will have all of the above items underway by mid-next week; with results by Mon. 5/18.

OTHER VALIDATION ISSUES

We will be delivering Fluid Resistance parts to the Chem Lab on Monday 5/11 for 77PSL5-2 and L3-1 combined validation. This represents a two-week slip from the original schedule; pushing completion from 7/2 to 7/16.

Problems which surfaced during the final characterizations of 57PSF3-3 and 57PSL11-3 need to be dealt with, which is preventing completion of these ISR packages originally due 4/15.

PRODUCTION ISSUES

We are analyzing samples from the 40% fallout that is occurring on 77PSL3-1. Dale has noted the "bad" devices make noise, and correlate poorly between production and lab readings; whereas "good" devices are just the opposite. It is hoped that Jeff and I will be able to shed light on these observations and help reduce the unacceptably high fallout.

MISCELLANEOUS

The team is working diligently to produce updated D and F FMEA's for the 87PS. Twice-weekly meetings are progressing.

Jeff is working on an extensive test for Dale to characterize the hydraulic disturbance equated to noise versus disc, and device differential. This uses many different test lots of devices. The highest priority item, due 5/13, is an R&R between production snap devices and quiet devices. The rest of the testing will lead to a noise test in the ES, as well as control plans, etc.

HIGHLIGHTS

Stephen B. Offler
Week Ending 92-05-22

ELECTRONIC SPEED CONTROL DEACTIVATE PS

CONTACT WEAR (87PS VALIDATION ISSUE):

The test of contact wear using 50418-5, 74079, standard 74408 with pin target skewed high, and a control lot will finish cycling today. A total of 48 devices are running, 12 per lot in four test lots. We will characterize the devices, looking for the wear problem to manifest itself as creep-actuators. Next, we will disassemble the devices and individually measure base dimensions to get a positive indication of the amount of pin-length change due to wear. The test should point out the best short- and/or long-term correction to this problem, and allow a reaction plan to be formulated for the failed 87PS validations.

HIGH-TEMPERATURE IMPULSE TESTING FOR LIGHT TRUCK:

We have completed a first-pass impulse test running devices at 170 C (ambient and fluid temp) with dismal results. All 12 devices failed between 222K and 262K cycles, with a median of 26.4 (1) and then at 246K. Upon opening the devices, we discovered the Kapton was disintegrating, while leaving the thin Teflon skins basically intact. This is shedding light on the old diaphragm life issue, with chemical attack now a primary suspect. We are finishing up a "control" test, using devices from the exact same build lot as the above, run at the normal impulse temperature parameters.

Light Truck brake engineering, without knowledge of the above failure, has asked us to run a complex 600 hour test with the "skin" temperature of the devices controlled on a ramp they are dictating. We will have a conference call with them to hammer out details, most important being the brake fluid temperature and how we'll control the skin temp. independently and at a higher level than the fluid temp. This will probably require heat lamps, various heat shields, and possibly some means of cooling the fluid. The heat lamps must be controlled by a programmable controller to-be-determined. The T1315 cannot handle thermocouple inputs.

57PSL11-3 VALIDATION FAILURE UPDATE:

Six of 24 devices failed during the impulse test (not to be confused with the large percentage of impulse failures in the 87PS tests, which are due to contact wear). One device is inoperative, with X-rays suggesting the disc is presnapped, although it worked normally in initial char. Two devices are gross creep on actuation, with one showing a misplaced environmental seal leading to sensor / switch misalignment causing a clipped (thus shortened) transfer pin; the other shows no apparent cause for CA. Three devices are gross creep release; no cause assigned. Also, two of 12 devices failed during the Terminal Strength test. One is a creep actuation at 39 msec, the other is creep release at 72 msec. I need to look into the ES to determine if any relief on the creep spec. is allowed post-test.

57PSF3-3 VALIDATION FAILURE UPDATE:

Many of the impulse parts have been highlighted as failures, due to a reduced actuation and release characteristics post-impulse. However, we need to scrutinize those values again, since we have learned that the ES allows some relief after impulse (drift downward of 12 psi on actuation spec's).

HIGHLIGHTS - Page 2 - 920522

PRODUCTION DRIFT ISSUE:

We are working on developing effective area curves, which initially are showing a significant difference between lab-crimped and production-crimped sensors. Fixing for the PSM pressure-deflection setup is being created to allow P-d curves, which combined with R-d curves from Pete Sampson's setup will give Area versus deflection.

NOISE / HYDRAULIC DISTURBANCE TESTING:

Jeff has completed initial characterization of a total of 50 parts, representing 10 different disc lots of 5 each, both truck and car. At this point, no snubber effects are being included. The R&R of 10 silent and 10 snap discs was completed and results forwarded to Ford by Dale.

AUSTRALIA SAMPLES:

The 24 parts for Capri, using the 3/8-24 thread p/h 36917 hexport, were shipped on 5/20. We are expediting the 10 parts for Falcon, which use an M10x1.0 custom hexport. These should ship on or about 5/27.

HIGHLIGHTS

Stephen B. Offler
Week Ending 92-04-10

[Handwritten signature]
2/2/92



FORD MY '92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

SHO TAURUS: The last test lot we were able to ship to Florida before the evaluation ended used old ultra-low-diff truck discs with snubbers. Warren Pierce rated these as 8-9's, very acceptable. This is what Ford thinks they'll be getting in volume for SHO. Per Ted Ballard, we don't know how to build these discs in production, however. We are assuming that the "Lot F" Pass Car discs (which we do know how to build) will suffice.

EN53 (CROWN VIC & GRAND MARQUIS): We are moving ahead very rapidly to meet the extreme schedule Ford is requiring. Production switches, with "Lot F" discs and Noryl bases, will ship on Saturday to Dana-Weatherhead. In parallel, we are throwing together a Partial ISR package, primarily using similarity to 77PSL2-1. For ES testing, we are doing only Impulse and Terminal Strength. This package will be ready Monday for review by Bruce Macroff (Supv. Brake Eng.) during his visit here. Our plan for full ISR will consolidate the SHO switch and the EN53 switch into one test procedure and report. This has been mistakenly promised to Ford for May-22, which is physically impossible to meet due to the Fluid Resistance test. Mid-June is more likely: we need to close with Ford on this.

THERMAL SHIFT: At this point, Noryl parts have been characterized only; no therm shift testing has been accomplished yet. We are expediting the completion of this test now, because the cycler will also be needed ASAP for Impulse on EN53 parts. As soon as we complete an initial pass at thermal shift, we will immediately put Impulse parts in, and adjust the cycle rate to ensure they are complete by Monday.

VALIDATION: Final characterization of the two highest-priority lots (57PSF3-3 and 57PSL11-3) is in progress now. We need burst, current leak, and final actrel on all devices, about 120. Lots will be continuing to work on this today and into tomorrow as needed. The report writeups, which are due to Ford on 4/15, have not begun as yet. These will need to be accomplished in a compressed timeframe over the weekend.

FIRST CYCLE SYNDROME: Nothing to report.

HIGHLIGHTS
Stephen B. Offler
Week Ending 92-04-10

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2/20/92
[Handwritten initials]

FORD MY '92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

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HIGHLIGHTS
Stephen B. Offiler
Week Ending 92-04-03

John M. [unclear]



FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

SILENT DEVICE: We have shipped several attempts at quiet switches, which are being evaluated on SHO Taurus at a Ford test facility in Florida. These include:

- Ultra-Low-Diff (1.4 psi) truck discs in pass-car sensors
- Low-Diff (3.0 psi) car discs with model-shop snubber hexports
- (supposedly) Ultra-Low-Diff (~ 5 psi) creep car discs with normal hexport

Warren Pierce, our contact Florida, informs us that all of these devices could be heard. It is unclear to us how loud the first lot was, but the second lot performed fairly well at first then degraded, and the third lot was not very good at all. Many questions come to mind, such as: is the SHO brake system in some way different from the Sable we tested? (performance car versus family car); have they tried a matrix of different switches along with different M/C's and boosters?; what level of noise will ultimately be considered acceptable?; have they tried any frequency or NVH analysis?; will Ford even consider the feasibility of moving the switch away from the M/C on this platform? (if indeed the problems are unique to SHO). Ford has requested 20 devices to ship today for a 2PP build in Atlanta, which we have prepared from the third lot above. Since these devices are not silent, there is no point in shipping them. We need to discuss this with Ford, specifically Tim Andresen and Bruce Macroff.

Ideally, we need a car to carry on our own testing, since our lab test methods detect no noise whatsoever from any of these devices. It was originally thought that the next-best way to proceed was to work closely with Warren, having him evaluate various options for us. However, it appears that this methodology will not work, because next week the Florida evaluation will end, with the personnel returning to Dearborn, and the plans for the cars unknown at present. I feel strongly that we need a car to maximize expediency in solving this problem.

We produced an "8D" for Bruce Macroff, Supervisor of PAC Brake Eng. This is written primarily for the SHO, but includes significant information pertaining to the EN53 issue at St Thomas as well. This document explains in general terms the snubber option and the low-energy option, and states that significant development is needed. It also tries to tactfully highlight the fact that our devices meet all Ford written specifications and requirements, hence the problem is not at all the result of errors on the part of TL.

THERMAL SHIFT: We are investigating options for a base material change. The production fluxes in place at present appear adequate for devices with normal pin windows, (including upcoming 87PS) but the silent devices will have a reduced window and therefore will require a more stable base. Initial evaluations of Fortron, Noryl, and Utem have shown all three to be more stable. Fortron is very difficult to crimp without cracking, and Utem is expensive, leaving Noryl as the primary choice. We are conducting various tests of Noryl with 4300 as a control, including thermal dimensional evaluation and thermal shift characterization using devices at a range of offsets. We plan to have the CCPS cycler available for this testing as soon as the Thermal Cycle validation test is complete, approx. next Wednesday. To help understand the causes, we also plan to investigate dimensional shifts related to final crimp, and thermal effects on the hatchet curve.

HIGHLIGHTS - Page 2 - 920403

VALIDATION: A sustained high level of effort is being expended to remain on schedule. We are still on track to complete the two highest priority ("group 1") ISR's by 920415, and we have not experienced any unexpected difficulties to date. Batteries of characterizations are required, including the final char's of group I, and completion of initial char's of groups II and III, and later the final char's of these groups. Dick Garlepy was approached to obtain an individual to help us with this effort, and I will be co-ordinating with him today. *- Dick Garlepy*

FIRST CYCLE SYNDROME: I spoke earlier this week with Bruce Pease regarding the first cycle syndrome testing we developed on 920320. He had a couple of minor comments regarding the types of measurements he'd like to see Dana-Weatherhead performing. I have begun to rough out a test plan, and will complete this and co-ordinate with Jim Watt who has been handling the customer interface at Dana.

March 27, 1992

To: Tom Charbonneau
Fr: Steve Offiler for Stan Homol for Dave Czarn
Re: Pressure Switch Group Weekly Highlights
Week ending March 27, 1992

Handwritten signature and date 3/27/92

VOLVO

Base mold modifications were completed by AFCC, and FAI passed. Terminals soaked on production line with no apparent problems. Samples being prepared for seal integrity testing using the modified base and M5-13 preform. Multi-Seals indicates that the M5-13 preform costs the same as the DC-004.

Complete evaluation of alternate pre-forms	Amore	3/25
Release base mold modifications for improved flow	Spooner	comp.
Evaluate epoxy fill w/modified bases	Amore	3/27
Identify C/A to film deposits on terminals	Amore/Spooner	t-b-d

78PS - FORD F3LB HPCO

The meeting held at Ford last Friday to determine program direction resulted in a decision to use the HPCO switch solely on the VN58 (Econoline) platform for MY94. It appears that HPCO usage on this platform will be a trial run for further Light Truck usage in MY95. Sample orders will be continuing. Norm Freda is working to clarify Pass Car usage in MY95.

ZUA Pump-mounted P/S switch

It appears that Zua has replicated the Unisia failure mode. They are eager to improved samples, with new thermoset base material and modified gasket. The heating test shows the device falls out of calibration when brought to 600F and 22 lb. load applied.

NISSAN P/S

PBT was used to build the 3/13 samples; an alternative material (Fortron, Noryl, Ultem) should be evaluated for future samples, if needed. Evaluation of these materials is ongoing for the CCPS.

FORD CCPS/78PS MY92

Daily meetings addressing the high temperature issue continue. Follow up testing has confirmed that our interim corrective action of a modified plating target is acceptable. Testing has also verified the major cause of the thermal shift to be base movement. We have received bases molded in Fortron, Noryl, and Ultem. Thermal shift characterizations are ongoing. While cracking was an issue with Fortron, it was molded cold. After heating the prototype mold for Ultem, some Fortron was rerun. We are presently working to characterize the thermal performance of these materials, using the base direct measurement techniques in addition to build of test lots of devices pinned at .45 to .65 mil offsets for thermal shift characterization. Cost estimates are due by 920330.

Regarding the noise issue on EN53, management at the St Thomas Assembly Plant has issued a Concern into Ford's system. They are requiring a Job 1 '93 permanent corrective action. Bruce Macroff, manager of Pass Car Brake Eng. Insisted an "8D" be forwarded to him today.

TI-NHTSA 015490

HIGHLIGHTS - 03/27/92 - Page 2

which Norm Freda will hand-carry. We have requests for 30 silent devices for STAP, and 20 for the SHO Taurus (Atlanta 7), all suitable-for-sale. We're presently making model-shop snubbers which will be built with regular low-diff discs for the SHO; actions TBD for STAP. We wish to avoid the ultra-low discs at this time due to their drastically reduced pin window, which aggravates the thermal shift concern.

Define Ultra-low diff disc processing	Ballard/ Sogge	04/10
Characterize discs, sensors	Sogge	03/30
Define device processing	Sogge/ Sellers	04/24

57PS and 87PS validation testing has been impacted by the thermal shift problem. We will do what's necessary to maintain the 4/15 completion of the two critical test programs, with completion of all testing by late May. A concern is that we have no time to recover from any additional problems. Daily meetings are being held to review actions required to meet the aggressive schedules and to allocate resources. Overtime for Jeff, Louis, and to some extent Sean and Rich will continue into May. (Watch out, Ron.)

DOWNSIZED 77PS

Program direction needs to be defined.

Determine needs for each platform	Sogge/ Freda	4/03
Set-up mtg to define program direction	Carm	3/27

SATURN VISIT

We were informed that they will change to R134A for MY94. They'd like a gasket material compatible with both R12 and R134A for MY93 devices. Ongoing testing of HNBR with R12/mineral oil will show if it is suitable for both refrigerants.

Jeffrey DiDomenico
Weekly Highlights for Steve Ofliter
03/28/82

FORD MY82 ELECTRONIC SPEED CONTROL DEACTIVATE P3-

57PS AND 87PS VALIDATIONS:

Validation testing has been significantly impacted by the thermal shift issue. Validation of the six devices in parallel is no longer feasible. Therefore, validation of the 87PS test groups and the 57PSF9-1 are being pushed out in favor of 57PSL11-3 and F3-3 promised to Ford by 4/15. Pushed-out validations will be delayed by approximately three weeks.

CUSTOMER SAMPLES:

Three urgent sample orders for silent Pass-Car devices (77PSL3-2, WIN68) are scheduled to ship today. These will go out on time, however, one of the sample orders requires PIST/PIPC evaluation. Quality will not have sufficient time to complete this on time. Also, since we have no silent discs within Pass-Car calibrations, these devices are being built with prototype Light Truck disc and will produce devices with actuations in the 170 range (spec. 90 - 160). Charlie Douglas has informed the customers of this fact and have agreed to accept the parts.

Sample orders for 57/87PSL11-2's have been delayed due to miscellaneous AMI and 52PS line problems. Sensors are expected today. Loris Pimentel will be working Saturday in order to keep us on schedule. — rec'd 1982!

Sample orders are being received for devices with new customer P/N's. Some of these P/N's contain unique characters which we do not have for our coder. To date we have been coding these parts by hand for small orders. This technique will be inadequate for larger sample orders or orders requiring PIST/PIPC. We should make an effort to predict future P/N requirements and get these letters ordered (or order the whole alphabet).

THERMAL SHIFT ISSUE:

We plan to piggy-back impulse of .045 - .054 offset parts with the 57PS validation impulse test. Following this the CCPS cycle will have very limited availability for thermal shift test due to 57PS validation.

We will continue to utilize Rich Turner for thermal shift testing whenever he is available. Report of T-shift test results here would be superfluous.

HILITE

Steve Off
W/E 920313

VALIDATION: Problems w/ printing both missing early '85 57F3-3
& 57L11-3. We experienced a large failure for creep, both act
and rel. The consensus is that the bars we received from production
were gaged very poorly/inconsistently. Two other ramifications are that
the designer has been down, and production has been extremely busy. Jim
has made it difficult to quickly rebuild/repair the Callast parts. Loss
in meeting progress now, and with O.T. tomorrow, should complete the
build and initial characterizations of these two lots. Assuming we
begin the '85 testing on these two lots by next Monday, we'll be
roughly 2 days behind the published schedule (see D). Reasoning
to meet 414 is not out of the question. Additionally, we're late in
delivering 6 dimensional parts / lot and prints to Quality.

SAMPLES: Val. build problems above are also impacting customer sample
builds. We're late on C092-2, due 920311; C092-TH/009 due today,
and we'll likely miss C092-TH/003 due Monday. We have
F of A samples on 120229, but the difficulty here is that
they want 100 pr. act, silent devices. We were able to ship the
25 highest-potential parts of 100 due on C092-TH/015, but the
remainder of 75 which is still due ASAP have been held up by
production problems with AM1.02.

MINORAL STAFF: (Too much effort to other company ...)

OTHER: No further action (yet) with First Cycle Syndrome of
both for Bruce Press. Trying to place priority on this issue.

Steve Off
920313

FORD CCPS - 77PS - MY92

Daily meetings addressing the high temperature issue have resulted in a workable interim c/a with a pinning target modification. High and low temperature testing is complete with acceptable results, and vibration will be completed early next week. Since the movement of the plastic base is known to be a contributor, we are evaluating potential mold parameter changes or minor design changes that may be quickly implemented to decrease movement. Alternative materials with better temperature stability will also be considered.

Silent switch development needs to be accelerated, and unfortunately may amplify the temperature shift problem. Dale Sogge is championing the effort, as it ties into the needs of a M/C mounted switch. Sensor curves will be taken today or Monday to evaluate pin window.

We're now faced with a significant challenge and potential problem regarding the silent switch. Ford notified field sales today that noise/brake feel has been identified as a problem at the St. Thomas (Canada) plant, as they've started to build MY92.5 Crown Vic/Grand Marquis. An alert is being issued, and Ford has requested that we hand carry silent switches to a joint meeting at St. Thomas, tentatively scheduled for next Friday, 3/20. Ford will certainly be requesting an almost immediate start-up of silent switch production, if they feel this is a potentially significant customer issue. We will be putting a plan in place today to address this issue, but at this point, someone from Auleboro will likely be visiting Ford next week.

DOWNSIZED 77PS

Program direction needs to be established.

HIGHLIGHTS

Stephen B. Offiler
Week Ending 92-03-06

FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

57PS and 87PS VALIDATIONS: We are progressing on the established timeline. The ^{three} lots of 87PS's are already built, although there is a snag: no customer part numbers. Those will have to be obtained and then hand-coded later. We expect the four lots of 57PS to be completed by production today, barring any unforeseen circumstances. The devices from each lot for the QC dimensional study will be delivered as soon as they are built, and Jeff will begin the battery of characterizations tomorrow.

The environmental chamber for the new power steering cyclor has been returned to our group from the PSM people. Jeff is working to do the final setup to this cyclor, which includes some plumbing of the new manifolds (48 stations), and some programming of the T1315 which controls the entire machine. We'll be needed this resource early next week for impulse testing, and soon thereafter for Thermal Cycle testing.

DESIGN & PRODUCTION ISSUES: The test of the ultrasonic welded movable terminals combined with the 10B21 hexports, undergoing the hybrid Impulse/Thermal Cycle test, has turned up three leakers to date, at 306K, 370K, and 382K. We rebuild these devices and return them to test. During rebuild it was discovered that one of the devices had a partially fractured spring arm, severed completely on one side of the rivet hole. All three showed varying degrees of the spring arm peeling away from the terminal.

We have aborted the test of the production devices with the calibration shifted to .087". As previously reported, three of these devices had erratic action at high temperature, which was sometimes intermittent.

We have obtained devices from production that were built for a pin window study. Our intention is to use samples of these, especially the creepers at either end, to study the thermal shifts. However, Jeff's readings did not correlate well with the production tester. According to production, a cal. range from .085" thru .092" encompassed the window. Jeff found that all of the .092's were gross creepers, the .091's were generally creepers, and a couple of the .090's were marginal; however, from here down through .085 the devices acted normally. It is possible that the production tester is providing erroneous readings, which is tending to skew the pin window results, and may in fact be helping to cause the erratic action at high temp that we're chasing. We are presently planning to run samples from the .089 thru .092 lots up to high temperature for the purpose of observing any shifts that occur, to provide more information on the temperature shift phenomenon. An informal meeting is planned for later today or early next week to discuss these results.

SAMPLES: Loris Pimental is assisting us with the stack of Ford-Europe (and other) sample requests. She's doing an excellent job. We are keying on CD92-TTH/01's which are the UTA-England samples urgently needed because they are holding up car builds. 25 of these devices will go out today, barring any unforeseen circumstance, with the remainder of 75 to follow soon thereafter.

HIGHLIGHTS

Stephen B. Offiler
Week Ending 92-02-28

FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

57PS and 87PS VALIDATIONS: The timing chart to complete the six parallel validations has been completed. We're working to complete the background details (equipment preparation, co-ordination with TSL, etc) prior to receipt of 46412 and 46515 bases which will allow switch builds to commence. Jeff is co-ordinating the builds, and thus far we've got all the sensors taken care of. We're getting excellent support and co-operation from production.

SILENT DEVICE: Ted Ballard is beginning to work on the BEO for discs with "lowest attainable differential." These will be constructed like the previous prototype lots, using a pre-heat-treat snap sound. Mechanization is presently constructing a pressure/deflection (noncontact) system for the Disc Department, and they're looking into whatever modifications would be required in order to make this equipment suitable for ultra-low-diff discs. I've asked Ted to return the bag of ULD prototypes he borrowed a couple of weeks ago, so we may do some of our own F/d, P/d, and numerical pin-window techniques. The priority on these efforts is obviously impacted by the validation efforts.

PRODUCTION ISSUES: Disturbing news to report on the suspected high-temp pin shift issue. Matt delivered to us 12 devices which had been calibrated to a new target, .087" vs. the previous .089". This was intended to move the calibration to the high side of the window to counteract temperature shifts. When we characterized the devices, we found nine normal ones, two creep releases (which were expected) and one creep actuation (not expected). At high temperature, all three creepers exhibited the loss of continuity phenomenon. We have no hypothesis at present which would explain this behaviour. Keep in mind that these devices are representative of regular production, meaning that some statistical percentage of parts are shipping with this problem. It may not manifest itself in the field, but if it does, we can expect RMR's to begin in the southern states as the warm months approach. Incidentally, one of the twelve parts built with ultrasonic weld springs is also exhibiting this problem at high temp. As soon as we can, we plan to take a look at the contact transfer using a 'scope, since all the above is based on the erratic flashing action of a simple diode which is conducting a trace current through each device.

CUSTOMER ISSUES: We've got an urgent sample request from UTA in Britain. They need a total of 100 (25 ASAP) 57PSL11-2's for a Phase II VP build of CDW27. Apparently the power steering systems have already been shipped to the customer without switches installed, hence the urgency. We've got the correct-color 46412 bases, and all other required components to complete this build.

HIGHLIGHTS
Stephen B. Offler
Week Ending 92-02-21

FORD MY92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

57 AND 87 VALIDATIONS: The decision has been made to significantly elevate the priority on these programs. All six are planned to progress more or less in parallel, but rearrangements can and will be made in order to finish 57PSL11-3 and 57PSF3-3 to avoid jeopardizing the 920415 date promised to Ford. The internal motivation for completing the other four ASAP is to expedite the changeover of 57Lx-x business to 87Lx-x, which improves company profits. We are presently working on the detailed timing, and in parallel Jeff has begun to co-ordinate device builds and equipment requirements. Additional resources required will be determined by the timing charts. The elevated priority of these six programs tends to place everything else on the back burner.

SILENT DEVICE: Initial meetings have been held with Mechanization to begin to explore production techniques for piloting/pinning (calibration) silent devices. Pending test results on the first lots of silent ultra-low-differential discs from the disc dept., we'll begin looking at force- and pressure-deflection curves to determine characteristics that would be correlatable to pinning technique, such as inflection points in the hatcher curves and determination of slope changes that define these points, etc. etc. Additionally, we'll be doing more work with the numerical approach originally proposed, where the ratio's of device differential vs. act. sigma across a range of calibrator settings produce a local peak at the center of the pinning window. Mechanization has taken a first-~~plus~~ look at an automatic machine to collect hatcher-curve data on sensors to find the center of the pin window. The cost is very roughly \$88K.

DIAPHRAGM LIFE / MISC TESTING: Progress on the current lots of diaphragm-life experiments has been halted by the validations. Some progress has been made: we have discovered that features which stretch the Kapton during crimp leave asymmetric strain patterns in the diaphragm (not teardrops, but actually worse); the lots using small round diaphragms constrained by the gasket (rather than clamped by the hex flange/washer) look quite good, and we plan to eventually cycle a lot of these; and, the two-vs-three full round Kaptons running to determine drift performance has produced a leaker in the two-pc lot.

San Homel has provided a bagful of miscellaneous 52PS and 57PS devices built in 1986. We plan to choose a few 52's from the bag (bulk on AMI) and open them up to look for teardrops.

Devices using ultrasonic-welded movable terminal assemblies and 10B21 hexports have been built to undergo a hybrid Impulse and Thermal Cycle test. This is designed to provide data on the life of these components at temperature, pressure, and cycling extremes. The hybrid test was originally conceived to expedite individual Impulse and TC tests and distribute the temperature cycling throughout life cycling. ~~This test is not held.~~

While cycling production devices recently (looking for spring arm cracks at the bump) we had one PC device that went open-circuit at high temperature. It actually displayed continuity very briefly during release, which we attributed to bounce. The switching action seems to suggest the device was pinned very short. We opened the device, and discovered the base was calibrated to .092" (outside the .089" +/- .002 machine settings) and the T-pin was .142". Our calculations show this is at least .003" too short. We need to understand if thermal expansion is causing a pin-shift at high temp, and/or if temperature causes characteristic changes to the hatcher curve. This may lead to revised room-temp pinning to compensate, shooting for the high end of the window instead of the center.

HIGHLIGHTS

Stephen B. Offler
Week Ending 92-02-14

FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

SWITCH NOISE ISSUE: We've begun to work with the disc department to arrive upon a production-viable method to produce ultra-low-differential discs. We've returned the original Disc Dept. prototype lot of 1.3 psi diff. to Ted for further analysis, including Force-Deflection work. The goal is to develop a means of producing and checking these discs in production. Additionally, Ted has provided a bit of disturbing news: the disc used in the actual device which caused the customer noise complaint has a differential of 2.5 psi (all quoted measurements using Disc Dept equipment) while our experimentation showed a 3 psi device to be undetectable. Does this mean that diff. is not necessarily correlatable to sound? Mfg. Eng. and Mechanization are becoming involved at this point. A meeting will be held next Monday to discuss how to pilot, build, and test a device which is silent.

HI-STAT DEVICE: We've completed a competitive evaluation of this device. This includes X-rays, characterizations, cycle testing to failure, and disassembly. We discovered quite a bit of drift in characterization, with initial readings of 289/144, 10K readings of 279/129, and 50K readings of 265/134. The mV drop looked okay. The device was a release-crimp. The device developed a leak at about 100K cycles. Upon opening, we discovered the internal seal (composed of a round-section O-ring, colored purple) had extruded. Design features include an insert-molded base, with very beefy sections to support the crimp operation which must withstand the entire burst pressure. No transfer pin is used, rather the discs (2 stacked) act directly on the spring arm with a Kapton insulator. Overall the device appears very prototype in nature, with no plating of any kind on any steel internal components. Additionally, the device is quite poor in terms of Design For Assembly, with the diaphragm, the pressure/force converter pin, and the discs poorly located and easy to misplace.

DIAPHRAGM LIFE: We've received test parts from the model shop, and evaluations have begun. Configurations include:

- stepped hexports to accommodate small-diameter round diaphragms which are constrained primarily by the gasket rather than clamped between hex flange and washer
- hexports and washers with features to stretch the diaphragm during assembly
- two vs. three pieces of full-round Kapton to explore drift and life
- concave features cut into washer and hex flange to mimic the "bent" geometry which occurs during crimp

HEXPORT: As a result of the Elco meeting, we are planning to do a combined Impulse and Thermal Cycle test of the 10B21 hexports in order to have this information available if the customers request it when we inform them of the material change. This is likely to be combined with the evaluation of the Staple ultrasonic welded movable terminals, and one of the higher pressure disc lots for 87PS conversion.

HIGHLIGHTS

Stephen B. Offler
Week Ending 92-02-07

Handwritten signature and date 9/20/92



FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

SWITCH NOISE ISSUE: We have completed testing on the borrowed '92 Sable w/ Teves ABS, and the car has been restored to original equipment condition and returned on schedule to Tusca Lincoln Mercury. We had the opportunity to explore a number of different switch configurations, including: discs at various differentials; snubbers vs. standard J512 ports; remote mounting with rubber hose; and the HI-Stat device. We confirmed the noise issue reported by Ford, as well as a tactile feel, although the so-named "low-differential" (4 psi) device implicated by Ford was not considered significantly obtrusive. Subsequent testing showed absolutely no noise or feel using discs with "ultra-low differential" up to 2.6 psi, while a 3.6 psi device was marginal. It is generally felt that 3.0 psi max differential would be sufficient to completely eliminate this customer concern. We'll need to explore the disc-processing ramifications of such a spec. Experimentation conducted with snubber hexports showed 4.0 psi diff. was undetectable, while 5.6 psi was marginal, suggesting a spec of about 5.0 max. However, concerns with the snubber include the fact that snubber plus J512 will be quite expensive, standard o-ring snubber may be sellable to Pass Car but won't help this issue when it arises at Light Truck, and finally air entrainment. We found no difference in noise and feel when the switches were remotely mounted with about 12" of 1/4" LD. hydraulic hose. Finally, running the HI-Stat switch for information showed that even with its snubber it has significant noise and feel, to a somewhat greater extent than our low-diff device and somewhat less than one of our production snap devices.

PRODUCTION ISSUES: Production Impulse testing turned up spring arms cracking at the bump. Analysis by Mfg. Eng. and Mech. showed that the bump was not being formed correctly, with a fairly sharp crease in one area where the bump comes out of the plane of the spring. This corresponded with the location of the crack. The tool was dismantled and it was learned that the die was formed asymmetrically, causing this sharp crease. Since this feature has not been touched since day 1, there is some cause for concern that all product shipped has this potential to crack. However, the production cycle is known to be unrealistically severe. We have had no problems to date with any spring arms run in our cycle. We are presently running a sampling of recent production devices in our cycle to ensure that there truly isn't any cause for concern. The feature in the die which caused this condition was expertly re-worked by hand, and the bumps now look exemplary.

CUSTOMER ISSUES: We were forced to rush to get a print-out to WINSE, and as such did not have the opportunity to reduce the number of dimensions as we intend to do on all future envelope prints. This print was turned around by drafting in one day. Our "lateness" perceived by Ford is a black eye for TI, although the real reason the print was "late" is that we don't seem to have a good ability to anticipate the requirements of Ford's system, thus we're caught unprepared and forced to rush which causes negative feelings and greatly increases the chances for error.

HIGHLIGHTS

Stephen B. Offler
Week Ending 92-01-31

12/24/91



FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

87PS: We've received information from John Kalppel (LT Steering) which shows the requirement for the hoses used in PS assemblies is 400K cycles at 150 C fluid / 135 C ambient to 1600 psi. John has asked us to increase our requirement (for Validation only) to this, with the exception that he hasn't asked for any change in our present test temperature, which is 135 C fluid / 107 C ambient. We are generally in agreement that we can meet the higher number of cycles and higher pressure without any problem, and furthermore it appears to be a large negotiation concession on our part. We now owe John a marked-up spec. for finalization, and concurrence with other PS engineers (Pass Car, Europa, etc.).

SHO TAURUS NOISE ISSUE: We have obtained a brand-new '92 Mercury Sable as a test vehicle from Tusca Lincoln-Mercury in Seekonk, MA. Their co-operation in this matter has been exemplary. The car is to be returned the morning of Feb. 6. We have installed the master cylinder that was sent to us by Tim Andresen, along with the prototype "silent" 77PS device which they found to make noise on a '93 SHO Taurus evaluation prototype. We have installed this M/C, and discovered a very minor noise in the system, and tactile feel in the pedal. With engine off or on, the noise is not as noticeable as the sound made by the brake light switch. Subjectively, the noise/feel are generally not considered annoying in any way by several individuals who have experienced it. We have noted at least three points in the pedal travel which produce some noise and/or tactile feel: the BLS, our switch, and the third is suspected to be the ABS pedal-travel sensor. The Ford memo from Tim Andresen which accompanied the M/C states: "Based on the number of cars we have built with the switch, I don't think this is a 100% problem. However, some of the switches make significant noise which may be intermittent." This seems to suggest that the noise we are experiencing is not necessarily as acute as it might be under different conditions. We plan to continue evaluations, including: installation of a normal snap device for comparison sake; isolation of the "silent" switch with rubber hose; a custom device with rubber diaphragm; and we are considering the logistics required in order to use the prototype snubber devices we've prepared with silent and snap discs.

DIAPHRAGM LIFE: The most recent test of square vs. round Kapton has been completed. The round Kapton from the sample sheet fared best, with rel. at 300K = 99.71%; next is square Kapton from the same sample sheet at 99.53%; then production square Kapton at 95.76%; finally the Japanese polyimide at 83.29%. (all values at 50% confidence).

HIGHLIGHTS

Stephen B. Offler
Week Ending 92-01-24

FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

87PS: Planning for the various validations and all attendant documentation continues. We are presently working with Tom Strauss (PC Steering) and John Kaippel (LT Steering) to consolidate the two separate ES's (E53C for most applications, and E57A for LT). We've been able to steer LT away from the temperature characterizations required during their Thermal Cycle test. The impulse test, previously 225K to 1450 psi and 775K to 600 psi was tentatively changed to 250K at 1450 psi, but John dug up a hose assembly ES which calls out 400K to 1600 psi. Before we settle on anything, I've requested that John forward a copy of that spec. It is possible that other parameters (such as temperature) are also different. Regardless, any changes apply to Validation testing, not to In-Process testing which will remain the same.

CUSTOMER ISSUES: Marketing has come up with a plan to borrow a car from Tasca Lincoln-Mercury in order to install the Teves M/C and conduct experiments on switch noise. We will visit Tasca today to finalize details. I have roughed out a test plan which will be presented to Tasca management. We have five switches that we'd like to experiment with: 1) the low-differential "silent" switch returned with the M/C; 2) a snubber device with snap disc; 3) a snubber device with low-diff disc; 4) a device using a custom diaphragm composed of layers of Kapton and EPDM rubber; 5) the Hi-Stat switch. We hope to be able to determine where the noise is coming from, and under what conditions, so that we may recommend possible solutions to Ford.

We've learned that our delay in producing an envelope drawing for WIN88 has upset a certain individual on that program, who has now threatened to go ahead with Hi-Stat. In order to placate this individual, we will place high priority on producing this print, although his reaction is somewhat childish and underscores a seemingly fundamental problem with the T/Ford working relationship.

DIAPHRAGM LIFE: The present test of round vs. square diaphragms is nearing completion. The round test parts are again showing the best life, with only 3 of 6 dead and no Weibull stat's calculated yet. The square test parts (same sample-sheet material as round) have 3 of 6 dead, with a rel. at 500K = 99.91%. The controls (production material) have all 6 dead, with rel. at 500K = 95.76%. Finally, the Japanese polyimide material shows the worst life with all 6 dead and a rel. at 500K = 83.29%.

We have an outline, but still need to finalize plans to continue with diaphragm life experiments as discussed at last week's meeting. This is complicated somewhat by the need for cycler resources to conduct the battery of validation tests for 87PS and 87PS.

PRODUCTION ISSUES: Mfg. Eng. is interested in redefining the 77PS switch calibration scheme, by running the calibrator/check station at a fixed value and selecting pins as appropriate for different sensor lots. A meeting will need to be organized in the near future to explore ramifications of this.

HIGHLIGHTS

Stephen B. Officer
Week Ending 92-01-17

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FORD MY92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

87PS: Charlie Douglas has begun to hold startup meetings, and we are proceeding with required planning to co-ordinate internal design validation plus customer production validation of 87PSL2-2, L2-1, and L11-3. Also included are revalidation of 57PSF3-3, and 57PSF9-1 which are running in parallel with 87PS testing. Certain devices already have LSR dates promised to Ford (92-04-15), which will serve to direct priorities. We are working on several items to streamline this process, including approval from Ford to consolidate specifications.

Since a fairly large number of devices will ultimately need to undergo impulse and Thermal Cycle (using similarity as much as possible for all other tests) we are beginning to plan for cycler capacity. Jeff has devised a scheme to set up the new cycler to run the complex TC test unattended. He will place an order for an Omega dual-setpoint temperature controller needed to accomplish this, as well as a spare brake-fluid-compatible hydraulic cylinder.

SILENT DEVICE FOR MY93 SHO TAURUS: Benchmark testing of the M/C with our silent 77 installed showed extremely little audible noise, requiring amplification to hear at all. This suggests that the noise problem is emanating from elsewhere in the system, but of course it could still be stimulated by our switch. Ford has requested we perform an evaluation and respond with a formal test report. This will require that we obtain an ABS-equipped vehicle in order to isolate the source of noise. Any ABS Taurus, or any Continental (ABS standard) will fit this Taurus M/C. We prefer a Taurus if possible, since Ford reports the problem manifests itself here, but we are having significant trouble locating a rental ABS Taurus. We may have to try the Continental, which is based on the Taurus platform but probably includes more sound-deadening materials which will make the audible noise situation different.

DIAPHRAGM LIFE: The ongoing square vs. round Kapton test has begun to produce interesting results. (Recall that round Kapton from a previous test, from an 8.5 x 11 sample sheet, produced exemplary results.) This test compares round and square cut from the same sample sheet. The test also includes a Japanese polyimide film from Ube, square, and a control lot. As the test nears 1KK cycles, 3 of 6 Ube parts are dead beginning at 414K; 4 of 6 controls are dead beginning at 343K; and NO failures from either square or round lot from sample sheet material. It seems obvious that the sample material has much greater resistance to rupture, and it remains to be seen whether round vs. square makes a significant difference in these parts. Upon completion of this test, we should involve DuPont to explain the material differences (production vs. sample sheet) and possibly upgrade the production material.

A synopsis of developments in diaphragm life testing was presented this week. As a result, several good ideas were generated. The general attitude is that a more robust design is required, which is not sensitive to production line variables such as crimp tool geometries, crimp forces, etc. We will proceed with testing and development work, including the following experimentation: reduce/eliminate Kapton clamping by machining a step on the outer portion of the hexport flange to provide metal-to-metal contact to washer and using a small-diameter round diaphragm; try full-round diaphragms with only 2 layers; try Kapton without Teklon; addition of a "bump" male feature on the hexport with corresponding female in the washer in order to latch the Kapton during assembly; and use of pre-bent, concave hexports (salvage parts, for example) to see if this eliminates the tendency of the diaphragm to move radially inward which is thought to happen as the hexport and washer bond at crimp.

TEKCO: Info coming from Charlie in Dearborn via Dave indicates we've laid our hands on a Tekco M/C with Hy-Sat switch installed. Apparently the switch mounts at an angle in order to clear the reservoir. We plan to completely characterize the switch, take photos and X-rays, then cross-section it.

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HIGHLIGHTS
Stephen B. Offler
Week Ending 92-01-10

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FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

57-to-77 CONVERSION: I have officially reserved the number 87PS (project #3472) for the new devices. For the sake of continuity and mfg simplicity, we plan to retain the same suffix, for example 57PSL11-2 becomes 87PSL11-2. It is important that we agree upon a strategy soon, since we are beginning to fall behind the aggressive schedule drafted in December and there remains some question whether we work exclusively on L2-2 or simultaneously work on all candidates, i.e. L2-2, L2-1, L11-2, and L11-3 as well as 57PS devices which need validation of AI crimp ring and line-move.

SILENT DEVICE FOR MY93 SHO TAURUS: We have received a M/C, with our silent 77PS switch installed, from Tim Andresen at Ford. They claim that the supposedly silent switch makes audible noise in the passenger compartment, and request an evaluation and test report. We plan to fixture the M/C on benchtop, confirm that the switch is the culprit, and next obtain an ABS Taurus to install this M/C and quantify the audible noise. Other experimentation, such as use of a snubber, can be executed at the same time.

→ etc. SILENT SWITCH; SILENT SILENT; RVDOR-01A?

DIAPHRAGM LIFE: We are presently running a test which is comparing square and round Kapton which is taken from the exact same material lot. This is because the exemplary life performance of the round Kapton witnessed previously was compared to production square Kapton from a different lot and different mfg. process. We've included a control group using standard production parts, and another test group using Ube polyimide material obtained from Gary Baker.

We have completed all testing designed to expose the formation process of the teardrop. Results will be presented and discussed at a meeting with Mfg. Eng. early next week.

DFMEA: Significant efforts are being expended in order to remain on track for completion in early February. While this is requiring more time commitment than originally planned, the team is very pleased thus far with the results. This should become a benchmark document for future DFMEA's.

HIGHLIGHTS
Stephen B. Offiler
Week Ending 91-12-20

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FORD MY '92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

DIAPHRAGM LIFE:

All devices from the round Kapton test have finally failed (except one, expected to go any second now). Results are as follows:

Control lot, square Kapton	Beta=5.3	Theta=1369K Rel @ 500K=99.52%
All round Kapton lots	Beta=9.2	Theta=2350K Rel @ 500K=99.9999%

The only questionable aspect of the above test is that the round Kapton came from a different lot of material, possibly produced in a lab process, and therefore it possibly has greater mechanical properties which help account for the increased life. We plan a test using square versus round Kapton from the same material lot.

We plan to consolidate all recent knowledge gained from various design and process testing, and hold a meeting in early January.

VALIDATION:

The Pass Car revalidation has been completed successfully, and the addendum to the original test report has been written, bound in TI test report format, and delivered to QRA for submission to Ford. The 90-day alert expires on 91-12-31. We run two test lots in parallel: crimped on Hand Line, and crimped on AMI using HL tools. All of these devices passed 500K cycles with flying colors. The writeup includes both test lots, such that we will be approved for both processes using HL crimp dies.

57 TO 77 CONVERSION:

The lifetest of 10 devices (L8-1 sensors, 77 switches) has been aborted at 6KK cycles, with 2 devices remaining. A rough draft development schedule has been assembled, which shows that we can begin shipping new devices as early as Q3/92 if all goes well, and high priority is placed on completion of all internal and customer validation testing. This also assumes red-tape (customer envelope prints into Ford's system, TI parts lists, all ISR paperwork, etc. etc.) is handled efficiently.

DFMEA:

Work is progressing fairly smoothly. Since we recently began the serious attempt at completing this task, we've experienced only minor scheduling snags. Additional meetings have been scheduled in order to continue on a path to intercept mid-February completion. At this point, this effort is occupying significantly more than the 8-10 hours/week I previously estimated, and this is likely to continue.

HIGHLIGHTS

Stephen B. Offler
Week Ending 91-12-13

FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

VALIDATION: The two lots of PC revulidation parts (AMI built and HL built) have completed the Fluid Resistance test, and are presently undergoing the Impulse test. This test will be completed by Tuesday morning, with final characterization to commence immediately, and final test report writeup to take place Wednesday in order to prepare the ISR package addendum by Friday. The plan is to report results from both lots, hopefully to gain approval from Ford for both processes.

DIAPHRAGM LIFE: The test of round diaphragms is nearing completion. Approx. nine survivors from the various test lots are presently at 2250K cycles, running in parallel with the above reval test. The control lot, with all standard components, is complete with Beta=5.3, Theta=1369, and Rel at 500K=99.52%. The lot with round Kapton and all other components standard has only 3 failures (beginning at 1933K) and no stat's calculated yet. The lot with round Kapton and .003" step in the hexport to control Kapton clamp has 5/6 dead, Beta=10.2, Theta=2090, and Rel at 500K=99.9999%. The other two experimental lots, with various size steps in the hexport, also do not have enough failures to allow stat's. These results certainly suggest that the round Kapton has much better life expectancy relative to square, but other significant problems exist, specifically device calibration drift and manufacturing concerns.

The test to determine the mechanism of teardrop formation is partially complete, and some initial conclusions can be made. Standard parts, parts without gaskets, and parts modified to produce zero-height converter buttons are being crimped to various stages of completion, in order to track the progress of teardrop formation. We've seen parts with the familiar teardrop after final crimp and air blast having a twin-apex teardrop (Mickey Mouse) pre-air blast, and a somewhat fuzzy suggestion of the Mickey shape pre-final crimp (post 45° crimp). The next significant milestones in this experiment is to check the condition of the diaphragm pre-45° crimp (post precrimp). The only way to do this is to use 2-piece hexports, which allow normal precrimp assembly action and also allow inspection of the diaphragm without needing to take-out the hexport. The model shop is presently working on these. The parts without gaskets are also very interesting. Pre-air blast (post final crimp) there is significant excess material which has been moved radially inward, although there is no suggestion of a teardrop shape. At the previous process step, pre-final crimp (post 45° crimp) the same sort of condition is apparent, but less material has been moved inward at this point. The 2-piece hexports will be used to complete this sequence as well. At this point, we are definitely seeing a progressive action taking place, which is tending to move material radially inward as the crimps are made. Without gaskets, much more material seems to be allowed to move.

57 TO 77 CONVERSION: Using 77PS switches calibrated to .089" and 57PSL8-1 sensors placed high, we have seen 7/10 devices fail on the production cycle due to fractured springs. All are breaking in the expected location, at the top of the rivet head where the spring is effectively constrained and the bending stresses are concentrated per cantilever beam theory. Weibull analysis shows Beta=2.1 and Theta=3230 with Rel @ 225K=99.63% and Rel @ 1000K=91.83%.

Charlie Douglas hand-carried 6 samples of the 57PSL2-2 conversion to Tom Strauss at Ford Power Steering. These were well-received. Charlie discussed revalidation requirements, and also found out that they're planning to switch to the more robust UTA mating connector.

HIGHLIGHTS

Stephen B. Offler
Week Ending 91-12-06

FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

DIAPHRAGM LIFE:

The test of round diaphragms continues. Five of six controls (standard, square Kapton) have failed with a beta of 7.5 and theta of 1245, which is quite good. However, only two of the twenty test devices (round Kapton with various hexport steps) have failed, beginning at nearly 1700K. We are presently working on a new set of controls, which use square Kapton cut from the exact same material as the round parts. A "standard" control lot will again be included.

We have expanded the plans for the determination of the mechanism of teardrop formation. We are now looking at process and design contributors. Test lots are being built using all standard parts, as well as lots without gaskets, and lots with modified converters to produce a zero-height bump. These will be crimped to various stages of completion, including removal prior to air-blast, prior to final (stage II) crimp, and prior to stage I crimp. In order to examine the diaphragm in the pre-crimp condition (prior to stage I), we plan to have the model shop modify hexports to make them into 2-piece units which match a standard hexport when assembled but allow easy removal of the hex portion from the flange.

The test of possible asymmetry in the crimp procedure has been partially completed. We have observed no real correlation between the location of the teardrop and the orientation of the device relative to the nest. Based on this, we've decided to abort the rest of this test in order to place emphasis on the above test of teardrop mechanism.

57 TO 77 CONVERSION:

To date, using 77 switches calibrated to .089" and 57PSL8-1 sensors, pinned high, we have had one spring break (in the expected location, at the top of the rivet head) at 900K cycles. The remaining 9 have passed 1250K cycles, and the test continues.

We are formulating a game plan to begin a detailed test, based on tentatively positive results from the above. This will include a study at tolerance extremes, using high- and low-calibrated switches, planned at each extreme of the pin window. The test will use the actual sensor assembly in question rather than the worst-case as above. Cycling will be done on the CCPS cycler rather than the production equipment, at the ES specified temperatures and pressures.

Co-ordination with Marketing is planned, to ensure that our testing program is aimed at the high-volume 57PSL product(s), and to decide on the correct approach for customer approval and validation of the new product. At some point a decision will be reached on a TI part number designation for these; it is inappropriate to call them 57's, and it may be risky to call them 77's due to the price difference between these and cruise control 77's. It has been suggested to use the next available series number, probably 78PS.

DFMEA:

We plan to get work underway again on the Design FMEA. Given the number of parts and an estimate of the time required to complete each part based on recent hexport work, it looks like the completion date will be mid-February if all goes well.

HIGHLIGHTS

Stephen B. Offler
Week Ending 91-11-27

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FORD MY '92 ELECTRONIC SPEED CONTROL DEACTIVATE PS DIAPHRAGM LIFE:

All of the Pass Car Revalidation parts have been cycled to failure. The AMI-cripped parts (hand-line crimp tools) exhibited by far the best diaphragm performance to date, with a Beta of 15.3 and a Theta of 1579; versus the hand-line crimped parts with 7.2 and 1207 respectively. We have held aside several sensors from each lot for analysis of this large difference, including virgins, 500K cycles, and long-life parts which hadn't failed at 1350K cycles.

We are now cycling the experimental lots with full-round Kapton, built with stepped hexports in order to concentrate the clamping force at the outer circumference. Control lots with round Kapton/no step, and normal square Kapton are also included. Initial characterization showed the full-round lots actuated and released at higher values than the square control lot, which was expected because the Kapton is not wetted very well hence a smaller effective area and larger pressures needed to develop equivalent disc force. A quick interim characterization of a few of the parts at 450K cycles shows that the pressures have dropped, again as expected, since cycling has completed the wetting. The only failures have been in the lots with the largest step (.007" nom.) and based on the very slow progression of the leakage I expect we'll find extruded gaskets, not diaphragm problems.

We have completed the build of all test parts for the analysis of the asymmetric-clamp study, to help determine if crimp tool "C" frame flexing contributes to teardrop formation. We're checking two parts from each nest with Fuji pressure-sensitive paper, to look for nest-to-nest variations, as well as analyzing crimp height and diameter and teardrop formation relative to the nest and the direction of the "C" frame flex. This test is delayed slightly by the fact that the decrimper is down for repairs, as well as lack of tech support while Jeff is attending Hydraulic Training.

57PS TO 77PS CONVERSION:

The initial phase of this testing program has gotten underway. 57PS sensors with the highest actuation and the widest release (LS-1) were chosen as representative of the largest pin travel and the highest snap energy. Sensors were pre-characterized and the pin window analyzed, then built onto 77PS switches using a pin length skewed long (towards creep-release) to obtain the largest spring deflections. Devices were given an initial characterization and returned to Matt to be cycled on production cycling equipment. They will be checked for continuity every 50K cycles, and failures will be opened for analysis as they occur. Wetbulb techniques will be employed as well after all have failed.

MISCELLANEOUS:

TI-NHTSA 015507

We have received word from Ford SQA Mark Scholler that the revamped partial DPMEA has been corrected consistent with Ford philosophy. We must now continue to revamp the rest of the document in the same fashion.

It has come to my attention that the on-line 57PS inspection equipment for current leakage has not been upgraded yet to comprehend the 77PS. They are therefore relying on us to supply lab equipment for this test, which is unacceptable for several reasons: equipment availability; setup time; and especially safety concerns, since our 500VAC sources are not protected and guarded appropriately for use by non-technically-astute production personnel.

HIGHLIGHTS

Stephen B. Offler
Week Ending 91-11-22



FORD MY '92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

PASS-CAR REVALIDATION:

Eight of ten parts crimped on the hand line, cycling to failure for information, have died between 853K and 1336K. The remaining two have been removed from test for diaphragm analysis. In contrast, only one of the eight parts crimped on AMI (using HL crimp dies) has failed thus far, at 1361K cycles. Two of these have also been removed for analysis. The remaining five will continue to run to failure. This lot is of particular interest, because this is the first time since we began diaphragm life testing in August that the AMI has produced parts superior to the hand line.

DIAPHRAGM LIFE:

The planned analysis of the four long-life parts from the above validation consists of F/d characterization, to observe if differences in converter travel (pre-deflection caused by crimp differences?) account for the drastic life differences, plus opening for observation of diaphragm condition/teardrop. F/d curves have been obtained on virgin sensors from this test to explore the observed differences in release pressures between AMI crimp and HL crimp. It was learned that the effective area on actuation is comparable for all, whereas the effective area on release is much larger for the HL crimp parts, which accounts for their much lower release values. No good hypothesis has been generated to explain this large shift, however.

The model shop has built a set of test hexports which have a step to clamp the Kapton at the outer circumference. This was tried previously, however this time we're using three different step heights, and full-round Kapton. We're using this to explore teardrop formation/wetting, to understand whether the Kapton primarily stretches (deforms plastically) to wet, or whether it primarily pulls out from under the clamped area. We've opened two samples from each of the test lots for diaphragm observation. The control lot (square Kapton, no step) has one textbook teardrop, and one which is wetted ideally. The round Kapton test lots show generally poor wetting with no actual teardrop but some looseness and upward bulging. The fact that we're observing poor wetting in the test lots seems to suggest that the square Kapton promotes some pulling out from the clamp area in order to wet, and the teardrops form if the Kapton pulls out asymmetrically. We are also characterizing samples from these lots, which should show the differences in wetting as smaller effective area hence higher actuation and release values relative to the control group. Finally, these parts will be cycled to failure.

Another extensive test of the theory of teardrop formation is getting underway now. We're marking all caps, so that orientation in the nest during crimp can be controlled. Thus, if the flexing of the "C" frames of the crimp tools (radially outward) is a factor, there should be some correlation between teardrop and position. Some parts are being run with Fuji pressure-sensitive paper, while others are "normal" construction. We'll be performing extensive measurements of the crimp height/diameter of these parts (relative to position), as well as opening them for observation of teardrop. A few will be removed from the table before the air-blast station, to help determine if the teardrop forms before or during wetting.

MECHANIZATION/MANUFACTURING:

A problem with staking the stationary terminal on the base asm machine has been observed. Various efforts to correct this, including comparison with staking on the 57PS-style stakers, has led to the conclusion that a small amount of lubrication is required in order to fold the stake tab correctly. In fact, simply touching the stake tool with a finger has been shown to produce good stakes for several parts. A short-term lubrication procedure, swabbing the tool with Vanishing Oil, has been implemented. Longer term, Mechanization is working on staking tools with various surface treatments (chrome, nitriding) which do not require lubrication. It is generally assumed that the movable terminal does not exhibit this problem due to trace amounts of lubricant picked up from the exhaust of the air cylinders in the movable terminal assembly machine, and the 57PS does not exhibit this problem because all terminals are handled by operators during assembly.

A meeting was held with Stapla, a manufacturer of ultrasonic welding equipment, to explore the possibility of replacing the troublesome spring arm rivet with a weld. They showed extensive literature and examples of ultrasonic welds of copper to brass, as well as many other material combinations. They claim to have excellent acceptance with the US automotive companies and their electrical suppliers. Mechanization has contracted them to produce prototypes for us, which we will initially evaluate with various cycling and pull/peel tests.

HIGHLIGHTS

Stephen B. Offler
Week Ending 91-11-15

FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

PASS-CAR REVALIDATION:

Twelve parts from each lot (AMI crimp and HL crimp) successfully passed the impulse test. Twelve more of each will undergo this test when they complete the Fluid Resistance test in December. They have been characterized post-test, and are now running to failure for information. They are at 950K cycles with no significant number of failures to report yet. As previously reported, the pre-test characterization showed significant differences in release pressure between the two lots. This difference disappeared during cycling; it is possible that it is attributable to a Kapton-wetting phenomenon. We're looking into linking this with observed differences in the crimp techniques which are suspected to lead to diaphragm life problems. Also, Jeff has noticed crimp dimension differences between the two lots, even though the same crimp dies were used for both. We're looking into this with Mfg. Eng. help.

HEXPORT:

We have completed an initial evaluation of the mechanical strength of the 10B21 hexports. Two tests were used: burst, and torque-to-breakage. Results of both tests indicate that the 10B21 hexports have better strength. The average burst strength of 10B21 was 7983 psi versus 7650 psi for 10L10. The average torque of 10B21 was 51.8 ft-lb versus 41.3 for 10L10. Also, we previously cross-sectioned samples of each material and measured the hardness in the thread area. Results of 8 measurements at the crests of the threads show the 10B21 averaging 244 DPH (200 gram Diamond Pyramid Hardness), with the 10L10 averaging 194 DPH. If no cost differences exist (as Elco has led us to believe) then we should seriously consider a move to 10B21 material. Final decision on this is pending environmental analysis of the reduced plating thickness (to reduce thread damage in plating barrel) as well as final decision on the ANSI-specified gaging technique, using 2A LO and 3A GO gages. I'm confident that the combination of the above will finally eliminate the chronic thread problems we've been experiencing on this and all other Elco hexports.

SAMPLES / CUSTOMER ISSUES:

We've begun to receive sample requests for silent devices from Ford for WIN88 (Truck style centered connector with Pass Car style pressure) and from Bendix for Truck. We're establishing new part numbers, envelope drawings, and parts lists for these products. Samples are due in early December, which doesn't seem to be a problem since we already have small quantities of silent discs. Base colors have not been firmly established, hence for samples we'll use standard black for truck and brown for car.

The Ford Australia samples with metric M10 x 1.0 o-ring hexports shipped last week. We received a fax from Brent Franks, the P of A engineer on this program, which indicates he's experiencing audible noise difficulties. I have responded to this, indicating that this is an established concern and we are working to minimize it. Brent also alluded to a possible change in pressure spec's, downward. I am trying to steer him away from this, since the Pass Car disc already has reduced throw (relative to Truck and other 57PS's) and making it silent will only worsen this; compounded with even lower pressure spec's may reduce throw to an unacceptable level.

TI-NHTSA 015510

HIGHLIGHTS
Stephen B. Offiler
Week Ending 91-11-08

Handwritten: 5/11/88



FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

PASS-CAR REVALIDATION:

Two lots of parts were constructed to undergo the combined Fluid Resistance and Impulse testing, which was compromised in the original validation attempt. One lot uses the desired production technique (AMI) whereas the other uses the technique we were forced into as a fallback during the original validation (STPS Hand Line). Based on results of failure testing over the last several weeks, the best-performing crimp dies and washers were used. Half of each lot was precharacterized and delivered to the Chem Lab on time to begin the Fluid Resistance test on schedule Tuesday. The other half, which undergo only Impulse, started cycling on Wednesday. These will complete their 475K mechanical cycles early Saturday, and Jeff will come in to set up and run the 25K powered cycles. Post-characterizations will be done early next week, then all parts will be run to failure in order for the sake of information. An interesting observation was made regarding act/re pressures. Parts crimped on the hand-line were lower on average than the AMI parts, by about 3 psi on act and 1 psi on release. We plan to take a closer look at this phenomenon to see if it provides any clues to the diaphragm life issue.

KAPTON DIAPHRAGM LIFE:

We're continuing to work on the teardrop shape in the Kapton surface as a contributor to early life failures. We've seen the perforation in the diaphragm to generally coincide with the apex of the teardrop if present; if absent the diaphragm wear is well distributed around the perimeter. We're looking into the possible mechanisms that promote teardrop formation, including pre-crimp, gasket friction, and asymmetric clamping. We're also looking into whether teardrop formation is an issue with Light Truck parts.

CUSTOMER ISSUES, SAMPLES:

For the Ford of Australia samples, the M10 x 1.0 hexports were completed by an outside house, plated in B11, and have been built into devices. We planned to test these on the production tester, but apparently it would not seal properly. We're making an adapter so we can manually test these on our Life Test check station. They will ship today, on-time per the revised schedule. They were originally promised for 91-09-17 until confusion over thread spec's arose.

Charlie Douglas met with Bruce Pease earlier this week to discuss the Kapton Life / revalidation issue. Charlie reports that the meeting went well, and Bruce is convinced we're making good progress on the solution to this problem. It looks like an extension to the 90-day alert is possible, if required. On another subject, Charlie hand-delivered the SREA for the change to blue-colored environmental seals for PC devices.

MECHANIZATION:

John Kourtesis and crew are presently working on eliminating the rivet from the Eastern Automation movable-terminal assembly machine. The two options being considered are ultrasonic welding and resistance welding. I'm working on a quick sketch of the terminal/spring redesign for presentation at a meeting John will hold early next week. Of course, this change will require revalidation. I propose that we use our P & DFMEA's to drive the justification for this change, possibly rethinking the PRN's associated with the rivet and riveting process relative to a welding process.

HIGHLIGHTS

Steve Officer

W/E 91-11-01

DIAPHRAGM LIFES

Results of washer test (using 0.125 Zn plate; 2.00 Zn plate; and 0.125 Ni plate) all crimped in Area C "normal" pressure:

	LOT	β	Φ	
a)	0.125 Ni	2.4	1680	(First Fail @ 603K)
b)	2.00 Zn	2.4	1472	(First Fail @ 607K)
c)	0.125 Zn	3.3	960	(First Fail @ 426K)

Mixed failure modes were apparent from the vertical graphs; the first failures seemed to be at a different curve than the latter ones. The above β and Φ therefore actually represent averages of the mixed modes combined.

Results of crimp test swap:

	LOT	β	Φ	
a)	Hand-lie tests on Area	10.4	709	LOT OPEN
b)	Hand-lie tests on HL	5.3	670	
c)	First tests on Area	6.6	668	
d)	Area tests on HL	7.9	540	

Control, a washer test, mixed modes did not appear to be a factor. It seems that the hand-lie tests produce a higher Φ , while the Area produces a higher β . All above used 0.125 Zn washers based on results of washer test. However, LOT C of washer test should be identical to LOT C of crimp test swap.

Based on a combination of the above, it would appear that hand-lie tests on the Area dies with 2.00 Zn washers will produce our best shot at good devices. Of course, we still have no concrete idea why.

Jeff Williams has designed a very good hypothesis which explains bonding formation. It suggests that the washer & support bonding is quite visibly asymmetric, leading to greater clamp - some areas and less in others. Those areas clamped less would allow the Kapton to pull out, producing the "point" of the bondrup. We're experimenting with this hypothesis using stepped rebels in the largest combined w/ full-round Kapton.

HIGHLIGHTS

STEPHEN A. OFFICER
W/E 91-10-25

Jeff
9/10/85

KAPTON DIAPHRAGM LIFE:

As Jeff D. reported last week, the results of the crimp pressure showed absolutely no influence on diaphragm life. We are now in the middle of the washer test, using O-cut H plate, O-cut B plate, and Z-cut B plate. The O-cut Z is seems worse than the other two, which are about equal, preliminarily. Failures in the latter lots began around 200K, so the washer is merely a secondary variable.

Based on Carl Sanford's inputs, we tried lubricating gaskets (using silicone DOT-5 brake fluid) to see if this would have any effect on the "teardrop" shape observed in the Kapton surface when the tungsten is cut off a crimped device. Dry and heat parts were crimped on H-L and Am1. Teardrops were observed in most devices; one dry Am1 part and one heat H-L part had no teardrop. Since essentially no difference was observed in any of the lots, we have no confidence that the teardrop phenomenon has any influence on Kapton life. We plan to go back to previous failed devices and cut off tungsten to see if any further clues can be obtained using this analysis technique.

We have elevated the priority on the HL vs. Am1 die-crimp so we can get test parts cycling over the weekend. Jeff, Dave, Matt, and I will work together to get these test-lots built today. A full matrix will be built: Am1 tests on both crimpers, plus HL tests on both crimpers. Jeff is hand-setting parts, using O-cut B washers. We'll need to bring Jeff in a couple times over the weekend to keep the test running.

SAMPLES:

I think we're finally straight on the Ford Australia samples, after a flurry of correspondence between Charlie and John Butler @ TI Australia. We'll ship 12 TTPS's of mating connectors and 210x40 H&B for US\$25 each. Mike Mettys reports that... reports will be received Oct 29. Flaking should be complete by Nov 2, allowing build & ship Nov 4 if all goes well.

HIGHLIGHTS

STEPHEN G. OFFICER
W/E 91-10-25

*Jeff off
911025*

KAPTON DIAPHRAGM LIFE:

As Jeff O. reported last week, the results of the spring pressure showed absolutely no influence on diaphragm life. We are now in the middle of the master test, using O-out H1 plate, O-out B1 plate, and 2-out B1 plate. The O-out B1 seems worse than the other two, which are about equal preliminarily. Failure in the latter tests began around 200K, so the master is nearly a secondary variable.

Based on Carl Sanford's inputs, we tried lubricating gaskets (using silicone DOT-5 brake fluid) to see if this would have any effect on the "leakage" shape observed in the Kapton surface when the input is cut off a crimped device. Dry and lubed parts were crimped on H-L and Anst. Leakages were observed in most devices; on dry Anst part and on lubed H-L part had no leakage. Since, essentially, no difference was observed in any of the tests, we have no confidence that the leakage phenomenon has any influence on Kapton life. We plan to go back to previous lube devices and cut off inputs to see if any further clues can be obtained using this analysis technique.

We have elevated the priority on the H-L vs Anst die-crimp to "as soon as possible" testing over the weekend. Jeff, Dave, Matt, and I will work together to get these test-lots built today. A full matrix will be built: Anst and H-L on both crimpers, plus H-L tests on both crimpers. Jeff is hand-spraying parts, using O-out B1 mixture. We'll need to bring Jeff in a couple times over the weekend to keep the test running.

SAMPLES:

I think we're finally straight on the Ford Australia samples, after a flurry of correspondence between Charles and John Carter @ TI Australia. We'll ship 12 TTPS of mating connectors and M10x110 Hds for US&ES each. Mike Phillips reports that input will be received Oct 29. Flaking should be complete by Nov 2, allowing build of ship Nov 4 if all goes well.

Using the relatively new technique of cutting away the suspect to observe the top Kapton layer while the device is still fully crimped, we have opened up the worst and best devices from the three washer lots. This was done to attempt to understand the apparent differences in failure mode. Evidence of leadwire shape was fairly subtle, but nonetheless the three low-life parts had a fairly narrow area of perforation, apparently at the point of the leadwire (but this is questionable, since the leadwire could be a result of the perforation rather than the cause.) In contrast, the high-life parts showed the top layer to be failing uniformly all the way around.

It is unfortunate that we are at our drop-dead point to build ISR parts, because all indications seem to be pointing to the leadwire as the fundamental problem, and we are only just beginning to understand the cause and remedy to this phenomenon. With Joe Schuck's departure, it might be wise for Marketing to place a call to Bruce Paine to update him on our status and request an extension to our 90-day deadline.

Jeffrey DiDomenico
Weekly Highlights for Steve Offiler
10/16/91

FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

KAPTON DIAPHRAGM LIFE:

Impulse of test lots crimped at different pressures is nearly complete. Weibull analysis of the data has revealed a general downward trend in reliability at 500K as crimp pressure is increased, however, we have not seen the drastic differences of trend we expected.

<u>Crimp Pressure</u>	<u>Data</u>	<u>Theta</u>	<u>Reliability at 500K</u>
45/40	1.6	677	78%
50/44	5.4	672	81%
55/48	3.9	669	73%
60/50	2.8	764	74%
65/56	4.9	632	73%
70/60	3.6	643	67%

A new matrix of test lots are scheduled to go on impulse by the end of today. This matrix will target differences in washer as a cause of diaphragm failure. The matrix will include 0-cut washers (control lot) which have more of a chamfer on the inner edge than a radius, 2-cut washers which have the best radius we have seen, and the old-style nickel plated washers which are more slippery. A fourth group will be added to the matrix early next week which will be crimped on the AMI with the tools from the hand-line crimper substituted.

CUSTOMER ISSUES/SAMPLES:

It is still unclear which thread is required to fulfill the 12-piece sample order for Ford of Australia. Charlie Douglas hopes to have confirmation one way or the other by Monday. If the M10 x 1.25 thread is correct, we can ship samples next week. However, if the M10 x 1.0 is required, we will not be ready to ship until early November due to back log in the CNC lathe department and the necessity of plating.

CRUISE CONTROL AUTOMATION EQUIPMENT:

Manufacturing engineering and mechanization continue to iron out problems with the switch assembly AMI (SWAMI) and the Easton Automation machine. Production has an order of 3,576 parts to be shipped on Monday which has put this debug on emergency status. 100% of Dave Peripoli's time will be dedicated to this effort until resolved. This accounts for the delay in the above test lot being delayed until next week.

HIGHLIGHTS
Stephen B. Offler
Week Ending 9/10/11

John G. [unclear]



FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

INITIAL SAMPLE REPORT (ISR):

We have completed the detailed action plan for correction of outstanding ISR issues, and sent it via MSG (#163560) to Joe Schuck for relay to Bruce Pease. We have good confidence that the Kapton life can be improved via minor process upgrades/controls, since over the course of Kapton life testing we have seen numerous "control" lots which have demonstrated excellent life. The challenge remains to isolate the cause and eliminate/control it, and progress is being made.

KAPTON DIAPHRAGM LIFE:

Crimp pressures (i.e. the air pressure in each of the two crimp stages) remain the suspected primary cause of poor Kapton life. We are running a test of six lots of devices, built on AMI with known, consistent components, and crimped over a range of pressures from about 45/40 to 70/60. These will be cycled to failure beginning today and analyzed with Weibull techniques for comparison with previous test lots. This test should identify the correct crimp pressures to use.

We are also investigating secondary influences, specifically the washer. Of all internal components directly or indirectly affecting the Kapton, the washer is the only one which is built on several different tools and is therefore known to have the potential for geometric differences. Furthermore, we have learned from production operators that significant shifts in device characteristics can be obtained by changing washer lots. They sometimes use this fact to help control piloting. Parts hand-built by Jeff typically have no control over washer lot, so we plan to go back through our past experimental lots to check washers. Pending results of this investigation, we'll likely produce another set of test lots, varying only washer lot, with the inclusion of a NI-plated lot. These will be crimped at a pressure which produces poor life, in the interest of obtaining comparative results more quickly.

Given our experiences with cycler failures during the course of this investigation, we are looking into spare parts to allow rapid repair in the future. Jeff has discovered that the Enerpak hydraulic pump unit is around \$2300, and the Moog servovalve is around \$2500. The alternative to purchase of spare parts is to comprehend potential downtime delays. Failure of either causes a minimum delay of 4-5 days, potentially longer.

CUSTOMER ISSUES:

Tim Andresen (Pass Car Brake Eng.) has requested a couple of silent 77's. We happen to have a couple of spare switches of this configuration already built. These will be shipped N/C to Joe for hand delivery to Tim.

We had a brief meeting with Dave Poklar of GM Powertrain Eng. They were here on APT business, but during the course of the meeting Dave learned of our switch capabilities and realized he had a potential application. Cadillac (Northstar) is working on an engine torque management safety system (an offshoot of traction control) which will reduce engine power if sensors determine the driver is on the brake and gas simultaneously. They are unsure as to the pressure range, but Dave's gut feel is that a typical cruise-control-deactivate level is appropriate. During the informal 77PS line tour, he was particularly impressed by our base calibration technique requiring only one pin length.

HIGHLIGHTS
Stephen B. Offler
Week Ending 91-10-04

Long off
2/1/04



FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

INITIAL SAMPLE REPORT (ISR):

Conditional approval has been granted at Pass Car. Bruce Pease has written a 90-day "alert" which means we must complete full ISR in this timeframe. Basically this means correction of the problems which led to early Kapton failures, and a re-run of some (or all) of the ES tests. If the correction is simple and straightforward, then it is likely we'll only need to submit Fluid Resistance and Impulse; whereas if significant process or design changes are made, we'll need to do the whole thing. Timing, of course, is absolutely critical, since our 90-day period (911002 thru 911231) is effectively shortened because it encompasses both holidays. Bruce has asked for a detailed action plan ASAP, which is in the works. Before submittal to Bruce we will review this plan formally with Design, Mfg. Eng., Mfg. Quality, and Mkt. The rough outline shows that regardless of which tests we run, we must have the final parts built on Wed. 911030, three and a half weeks from today.

The Design FMEA was completed on a very high priority basis last weekend for review with Mark Scholler (SQA) during Dave's trip last Tuesday 911001. Apparently our DFMEA technique/approach on this program (and others) is not pure Design; we seem to have a tendency to mix too much process in with it. Mark is being very helpful on this. We need to revamp the DFMEA and resubmit. Weekly FMEA meetings will recommence.

We are now expediting arrival of new, blue-colored environmental seals for Pass Car to replace the current ones, which have only a hard-to-find stripe mark for differentiation. We plan to file an SREA for these, and if all goes well, we'll build the above revalidation parts with these.

KAPTON LIFE:

Diaphragm lifetesting of various experimental lots was suspended last Sat. 910928 due to hydraulic pump failure. The pump was removed from the cycler and hand-carried to an authorized service center in Warwick, RI. Repair was turned around in two days, and we are in the process of re-installing it in the cycler. Excellent job by Jeff D., Natalia in Purchasing, and Tri-Power Sales & Service. Since a failure of this nature can set critical testing back by a week minimum, we have decided it is wise to purchase a spare Enerpak unit which will be available for any of the cyclers (not just CCPS) in the event of failure.

We plan to run an experiment to test the hypothesis that air pressure in the AMI crimp heads was insufficient during the original (failed) validation build. We've taken a sample of pre-crimp-only devices directly off the AMI during a production run. The pressures will be turned down to the lower level discovered recently to crimp one test lot; they will be turned up to match the land-line to crimp the other lot. These will be cycled to failure and analyzed with Weibull techniques for comparison with other test-lots.

HEXPORT:

Thread rejections continue to waste everyone's time. Most are written in-process, and end up being a gaging-technique issue rather than a true rejection. We are attempting to streamline the process by instituting a reaction plan whenever a potential rejection is discovered. Use of the 4.5 in-lb gage torque is the arbitrator if rejected on the GO gage.

HIGHLIGHTS - 911004 - Page 2

We are creating an evaluation plan for the 10B21 hexport samples. These have the potential to solve the thread problem because the thread is significantly harder (per actual DPH measurements) than current 10L10, hence damage during plating should theoretically be lessened. We will look at undergoing tests of strength (burst, stripping torque) and environmental resistance. We'll need to approach Ford with an SREA if all evaluations are positive. Also, we are expecting soon the full-plating-lot of reduced zinc parts (.00015 vs current .0003 min) which have olive-drab chromate to help regain some lost corrosion resistance. These spend significantly less time in the plating bath, and hence they theoretically are damaged less.

At some point, it is conceivable that we'll combine all of our thread efforts to produce a higher quality part. This includes the above 10B21 harder material, with thinner plating and olive-drab chromate, using the ANSI B1.1 gaging technique which allows 3A GO / 2A NOGO on plated parts.

SAMPLES:

Due to the move of the Mechanization equipment, we are presently unable to produce any parts. Efforts have been prioritized by Mfg. Eng. to correct issues with the Eastern Automation movable terminal equipment, then get the base asm. machine up, then last-but-not-least the final asm. This is likely to take about another week, including interim evaluations of the EA progress, cycled on the severe production cycle. This will put us behind schedule in shipping the 300-pc run for Pitts.

I've discovered that the paperwork for the Ford Australia metric hexport samples was lost somewhere between the Model Shop and the CNC Lathe in Bld. 20. We are still a couple of weeks from shipping these samples.

HIGHLIGHTS

Stephen B. Offler
Week Ending 91-09-27

Handwritten: JMS 9/27/91



FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

VALIDATION, PASS CAR:

Test reports were finalized late last Friday, and fax'ed to Joe Schuck in preparation for a call first-thing Monday morning to Bruce Pease to solicit his support for a conditional ISR. Because he was about to leave on business for several days, he asked us to approach his supervisor, Bruce Macroff, with a concise explanation of the situation. Apparently Mr. Pease did not prepare Mr. Macroff, because the deviation from procedure, using hand-line built parts without Fluid Resistance testing to pass Impulse, has caused quite a commotion. Joe is very critical of our reluctance to approach Ford up-front when the problems began. At this point, SQA Mark Scholler has asked for Bruce P. to write an "alert" at which point Mark will enter a 90-day extension. We'd like to understand Ford's position relative to holding us to only 90 days, because this simply might not be enough time to get the Kapton rupture issues cleaned up to Ford's liking, which includes at least a re-run of Fluid Resistance and Impulse. A complete explanation of the Kapton issue has been forwarded to Joe, to arm him with more facts for use in dealing with Ford.

VALIDATION, LIGHT TRUCK:

A different set of problems to deal with at Light Truck. Here, salt-spray failures occurred which were attributed to the mating connector. Our validation was run with EPC connectors, which are an older design and not very robust. This has raised questions such as which connector LT actually plans to use, which we do not know. They may in fact choose (or have chosen) the UTAG connector, which we used successfully on Pass Car. We have tried to claim similarity in the ISR writeup, which at this point has not been well received. There has been talk of re-running the whole thing with UTAG connectors, which is ridiculous.

KAPTON LIFE:

Cycling of the various test lots continues. At this point, we have, generally, 4 or more failures of 6 in each lot, enabling decent Weibulls to be calculated. For the modified-converter-travel lots, we have learned that there is no difference between the control lot, the lot with .006" reduced washers to raise the converter bump, and the lot with .005" stepped washer to pre-deflect the disc and limit travel. All three have Beta's between 4.4 and 5.1, and Theta's between 1073 and 1148. Note that these AMI-built parts actually performed typically well in terms of characteristic life (Theta), although Beta's are typical. For the lot with the stepped hexport to move the Kapton clamp diameter outward, we found the test lot significantly worse than the control lot. The Beta & Theta for the control lot was 4.0 & 711, versus 2.8 & 579 for the test lot. Maybe we actually need to bring the clamp diameter inward, as Stan Hentzel has suggested. We're also analyzing the hand-line built Pass Car validation parts, and have found a Beta of 7.2 and Theta of 1080, very typical numbers for hand-line product (compared with 6.0 and 1133 previously).

Presently, we have 6 to test the AMI-built validation attempt which was run in Jan's cycle at reduced pressure (different parts from same lot), and two lots of parts being run to support production. These two lots are part of a 1500-pc Pass Car lot accidentally built on the AMI, and we are now cycling them to determine if they are, by chance, actually good. We have six straight off the AMI, and another 6 which were crimped on AMI then crimped again on the hand-line, which may expose a potential salvage technique.

HIGHLIGHTS - 910927 - Page 2

Mfg. Eng. has exposed a key piece of information in the crimp puzzle. Actual pressure-transducer measurements of the crimp cylinder pressures has shown that the AMI was running significantly lower in pressure on both stages of crimp. This data was collected before some maintenance (cleaning filters, etc) was done on AMI, so the plan is to repeat the measurements to obtain the present status. Furthermore, a test is planned by Mfg. Eng. with our support where devices will be built with pressures on AMI at lower values, and at values matching the hand-line. Controls will be built on the hand-line as well. These will be cycled to failure in our cycler for direct comparison with all previous data, as soon as manifold positions begin to open up early next week. We also plan to build a couple from each lot with Fuji pressure-sensitive film.

MECHANIZATION:

Mfg. Eng. and Mechanization have spent significant efforts to correct the problems noted with the EA and the AMI. This includes the spring-bending tool, which was leaving score marks, bending to an insufficient angle, and the bottom die was found to be chipped. On AMI, the cutoff stations for both terminals have been upgraded to ensure that asymmetric cutoff cannot occur, which combined with a new, lower calibrator target should help avoid broken stationary terminals. We plan to begin testing with devices calibrated .005 lower and using the corresponding pin (.146 -.005 = .141).

The Final Asm Machine and the pressure tester have been moved from B20 to B12, and are presently being set-up and connected to utilities. The Base Asm Machine and the EA machine are in the process of being moved. It will be several days before we can even power-up the machines, at which point several more days will be needed to get them back to their status before the move.

SAMPLES:

The schedule for the .300-pc lot of 77PS's requested by PHS for ISR work has been successfully moved forward by Marketing, pending the correction to the base mold, which also co-incides with the completion of the machine move. They are expecting parts around 911007.

For the Ford Australia samples, I have updated the metric hexport dwg EX3423-61 to include the correct thread, M10 x 1.0 - 6g. I have also reviewed the ISO tolerancing technique and calculated the correct pre-plate major and pitch diameters for the thread, which have been placed on the print. The specified 6H (internal) and 6g (external) thread tolerances correspond with our 2B and 2A respectively; while the metric standard actually provides about 13% more tolerance. The EX has been forwarded to Mike McHugh for creation on the CNC lath.

HIGHLIGHTS

Stephen B. Offler
Week Ending 91-09-20

FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE ES

VALIDATION:

Rough drafts of both the Pass Car and Light Truck ISR reports are complete; final reports are being slightly delayed by the Humidity test. This should have completed yesterday (Thurs.), however, the chamber in ETL was hit by an electrical disturbance during a thunderstorm Tuesday night and shut down. We had completed three full cycles at this point, so another seven were required after re-start. This will complete this afternoon at 4:30pm. Jeff has been scheduled to work until 6:30 tonight to finish final characterization on these devices so the reports can be finalized.

Unfortunately, problems occurred in both the Car and Truck devices during the testing; the ES states "all devices must pass." Car is worse, due to the significant difficulties encountered with Kapton life, and the reaction plan which finally led to running 24 manual-built devices on an emergency test without any initial characterizations and without subjecting 12 to Fluid Resistance. It is likely that Pass Car will grant conditional approval at best, or no approval at all, until we straighten out the Kapton problems and re-run the test "by the book". Problems encountered with Truck are much less severe, and hopefully will not prevent approval. The difficulty we had was salt spray failures, where 4 of 6 devices filled with salt solution which caused extremely high current leakage. However, careful scrutiny of those devices showed the leak path was via the mating connector, and we have blamed the design of this connector in the writeup.

We plan to fax the final versions of the reports to Joe Schuck so he may prepare for telcon's with Bruce Pease and John Polkey on Monday morning. The actual finished product will be bound in T1 Test Report standard format for inclusion with the rest of the ISR package, and shipped early next week.

KAPTON LIFE:

Now that the CCPS cycler has been freed up by completion of validation, we plan to continue with the various test-lots for Kapton failures. Testing includes devices with limited converter travel (via modified washers); devices with modified hexports to control Kapton clamping and move it outward; and devices with switches versus without switches, which the data strongly suggests as a variable.

SPRING AND STATIONARY TERMINAL BREAKAGE:

When Q.C. ran their QAS pilot test procedure on LT 77's off of the effectivity runs, spring breakage was noted on parts cycled at 640/min on the production cycler. This had never previously been an issue, although until this time all parts have typically been run only in the CCPS cycler at under 130/min. A comparison test was started, using parts picked at random from the effectivity runs, running on the production cycler and the CCPS cycler in parallel. This time, the production cycler turned up not only broken springs, but also broken stationary terminals. Parts on the CCPS cycler have not been completely analyzed, but we do not suspect any problems with these parts. We've cut windows in a couple of devices and took high-speed video of the spring action on both cyclers. This footage will be analyzed as soon as possible to attempt to determine the differences between the cyclers. As far as stationary

terminal breakage, we've discovered that they were not cut off strip symmetrically on the AMI, and the calibrator was deforming them improperly. Both these issues are being addressed. A toolmaker is presently working to modify the spring bending station on the BA equipment to bring it closer to the spec, which should help minimize bending stresses and breakage.

SAMPLES:

We had an order for 12 parts for Ford Australia which was due to ship on 910917. However, correspondence via fax with the brake engineer, Brent Franks, made it clear that an M10 x 1.0 thread is required. Previous samples used M10 x 1.25, and we have no hexports with the correct thread. I sent a lengthy memo to Brent, copying TI Australia Field Sales and Engineering, explaining the confusion over the thread spec and the schedule slip it has caused. At this point, we need to have hexports made on CNC lathe in order to complete the order.

We have received an urgent request from Hillite Industries / Pitts' head of purchasing for 300 Pass-Car 77's for their validation. They want these devices next Friday. We should be able to meet this need if we crimp sensors on the manual line and correct the problems with the springs and stationary terminals.

HIGHLIGHTS

Stephen B. Offler
Week Ending 91-09-13

Handwritten signature/initials



FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

VALIDATION (Truck):

One Light Truck PV device which completed 500K impulse cycles was found to be slightly wet inside, an impending leaker. Suspicion arose that the LT devices also had shortened life, so a group of six which had finished 500K was placed back on test (with switches removed). These began to leak at 621K, and all 6 were dead by 810K. These were built at the same time as the original PC sensors, 91-07-19, on AMI. Their characteristic life is the second-worst in all of our failure testing to date.

The remainder of LT validation testing continues to progress. Parts returning from Fluid Resistance are presently undergoing impulse. Given the results above, there is a finite chance that a LT device will become a leaker short of 500K cycles. Presently, these parts have successfully completed about 280K cycles. Other phases of the PV are ongoing, including vibration, burst, humidity, salt spray, and vacuum. If all goes well with all of these tests, we are on track to complete the ISR on time (91-09-20).

VALIDATION (Pass Car):

It was decided to attempt a rebuild of validation parts in order to get back on schedule for ISR, even though the life problem is not identified/corrected yet. Two failures turned up very early, at 73K and 91K cycles. It was discovered that these two had only two pieces of Kapton. As this test continued to progress, failures began again around 200K. These, however, had 3 pieces of Kapton. We are discovering that the third Kapton station on the AMI is not very reliable.

A second attempt at rebuild was made subsequently, this time with careful monitoring to ensure that all three Kaptons were installed. These were placed on test running in parallel with the LT Fluid Res. impulse parts. Failures began at 248K; at this point three have failed at about 280K.

A third, two-tier attempt at a modified impulse test for Pass Car is now underway. Each tier contains 48 devices (plus spares), such that a full lot of 24 can be run on the modified test and another 24 can be set aside for possible later use on the standard test if all goes well. One lot was built on hand-line equipment, and will be cycled on the production cyclers at the standard 1450 psi, at elevated cycle rate of 640/min, and at a near-room ambient temp. The other lot was built on AMI (hand killed, hand-loaded on AMI crimper, bypassing precrimp) and will be cycled on Stan Homol's cycler at 800 psi, 121 C, and about 200/min. The reduced cycle pressure corresponds to a converter travel of .020" and was chosen because it corresponds with a typical system pressure encountered in a fairly heavy stop.

Parts built with modified washers to reduce converter travel (plus a control lot) amassed 581K cycles without a single failure. This test was pre-empted by the attempts at rebuilds above.

Another potential variable is suggested by the failure data to-date. Every time we build test-lots of sensors along with control lots on AMI, the parts demonstrate good life. However, all failure testing has been conducted with sensors-only, while all validation attempts have been completed devices. Although no good hypothesis exists, it seems that the presence or absence of a switch may be a factor. A test of sensors-only versus completed devices versus completed device with switches removed is suggested.

HIGHLIGHTS
Stephen B. Offler
Week Ending 91-09-06

Handwritten signature and date 9/10/91



FORD MY '92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

VALIDATION:

Results of Kapton lifetesting to date are as follows. Given the Weibull beta's and theta's for each test lot, reliabilities have been calculated for 500K cycles.

Rel @ 500K

Configuration

99.85%
99.77
99.26
97.63
96.75
94.81
14.69

Prod. cup, Hand line crimp, with AMI precrimp
Prod. cup, AMI crimp (built 910828)
Prod. cup, Hand line crimp
Model shop cup, Hand line crimp (9010xx validation)
Prod. cup, AMI crimp without precrimp (910828)
Model shop cup, AMI crimp
Prod. cup, AMI crimp (built 9107xx for PC Val.)

Notably, the lot of standard PC production parts recently built on AMI as a control lot (#2 above) turned out to be very significantly different than the failed validation parts. The hand line crimp displays some slight advantage over the AMI crimp, and the presence of pre-crimp also displays an advantage.

We plan to get Light Track parts, built in July along with the failed PC parts above, on test ASAP. The reason for this is because these parts are now also suspected to have reduced life. One of the LT parts which recently passed Impulse testing was found to be wet inside; it was very close to failure which would have stalled current LT validation progress. Understanding the characteristic life of these LT parts built in this timeframe may shift the focus away from the increased PC converter travel, and towards either component parts or a production problem which has since been corrected.

We are also testing new lots of PC parts which are designed to modify converter travel. One lot actually decreases travel by preloading the disc, hence shortening its throw. The other lot raises the converter relative to the washer, such that the total travel is the same, but is shifted up so at maximum travel the flexure of the Kapton is similar to a LT part. Yet another control lot is included with these parts.

It has been decided to go ahead and rebuild PC validation parts now, even though the cause of the early failures has not been identified and corrected yet. PC control lots built recently are displaying very good life. We plan to get these parts onto the cyclor by the end of the day today, which will allow them to reach 500K roughly mid-day Tuesday if all goes well. During build of these sensors on AMI, we also ran a couple of parts with pressure-sensitive film. The pressure traces on these looked essentially identical to the ones that were taken during the previous AMI build (the one that produced excellent life). We hope that a similar crimp pressure will mean a similar life expectancy.

Another significant tool for solution of this problem is the cross-sections of the original failed parts and controls. However, we have not received the parts from TSL yet, and Paul Sherman has not returned my calls.

HIGHLIGHTS

Stephen B. Offler
Week Ending 91-08-29

Handwritten: 9/10/91



FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

VALIDATION:

The matrix test designed to help identify the cause of early Kapton failures in Pass Car devices is well underway. This includes production cups built on AMI and hand-line, and model shop rebrumps built on AMI and hand-line. All AMI-built parts are dead, with production cups ranging from 307K to 304K, and model shop cups ranging from 341K to 861K. Half of each of the hand-line lots are also dead, with production cups beginning to fall at 830K and model-shop cups at 790K. The test is presently a few hour shy of one week in length, with about 1.1KK cycles to date made possible by significant efforts during and after regular work hours. These results are definitely pointing to the crimp method as the primary contributor to failure, with the cup style a secondary factor.

A second matrix has been placed on this test in parallel, although there are 790K behind the first matrix. This is testing the influence of pre-crimp, since the AMI uses pre-crimp and the hand-line does not. Devices with (control) and without pre-crimp were built on AMI, and a lot with pre-crimp was built on the hand-line. No failures yet.

Devices using pressure-sensitive paper between the Kapton and the washer were built both on the hand-line and the AMI, with and without pre-crimp. Definite differences are apparent between AMI and hand-line, but no difference attributable to pre-crimp. The AMI parts show generally less pressure applied, while the hand-line parts show higher peak pressures in the Kapton area and, significantly, evidence of washer/hexport touching which is absent on AMI. This is further supporting evidence that the hand-line crimp is deforming (elastically) the washer and/or hexport such that the effective Kapton clamp diameter is moved outward, allowing more effective Kapton area to react to the strain of converter motion. Planned cross-sections will help to justify this hypothesis.

MECHANIZATION:

We were able to complete our first pre-effectivity runs yesterday. Small lots were run to develop a correlation between the manual measurement and the check station, which proved to be quite good, with an offset of only about 0.6 mils. Next, a quantity of 57 devices were built, individually serialized, and manually measured for comparison with printed calibration and check station data. 42.1% were good based on manual measurements, and were called good by the machine. 22.8% were junk for various reasons such as mangled or missing components. 15.8% were good but called bad by the machine. Most of these fall outside the correct calibration window, yet manual and check station measurements found them to be good. Given the excellent correlation of the check station, I have proposed that the software be modified so that anything found good by the check station will be considered good. This will eliminate most of the subtle "good parts called bad" and significantly increase yields. Another 15.8% of the parts were bad and were called bad. Most of the problems here are related to abnormal spring geometries which cause erratic correlation between the calibrator and check station, resulting in a part calibrated correctly but failing check. Finally, 1.5% of the parts were found to be bad, but called good by the machine. These are mechanical issues which can be corrected easily with addition of sensors, etc. It is very important that this be accomplished, given the severe consequences of a bad part which is allowed to be built into a finished device. Next, we plan to run the AMI's to build 150 customer samples urgently needed by Kelsey-Hayes. We are in a good position to accomplish this.

HIGHLIGHTS

Stephen B. Offiler
Week Ending 91-08-23

Handwritten: Jeff Off 9/10/91



FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

VALIDATION:

Light Truck 77PS devices have successfully completed the first phase of impulse testing, including 475K mechanical cycles and 25K powered cycles.

The AMI-built Pass Car devices on this same test were aborted at 389K cycles, with 8 of 12 failed due to ruptured Kapton. One hypothesis explored was that the Pass Car converters travel further than the standard design (due to different disc support bump location in the cup) which results in additional strain on the Kapton. This was substantiated with converter force/deflection measurements done on Pete Sampson's equipment. We calculated that the standard design travels .017" at 1450 psi, while both the model shop and production rebump design travels .023". However, previous validation work on 57PS using the model shop rebump crimped on the hand-line did not show any Kapton problems. We are now running a matrix test, with two variables: rebump cup, model shop or production; and crimp technique, AMI or hand-line. The control lot, hand-line model shop rebumps, was taken from the original 57PS CCPS validation, and therefore should pass 500K as before. The test lot, AMI built production rebumps, is taken from the present 77PS validation lot and is expected to turn up failures beginning around 270K. The opposite diagonal of the matrix, AMI-built model shop rebumps and hand-line production rebumps, have never been run before and will help identify which test variable is the major contributor to failure. The plan is to run the test until sufficient failures have occurred in all four lots. Weibull and autopsy will be used to analyze the failures. Due to the extreme priority given to this test, plans are being made to have the test monitored throughout the weekend. I will come in early Sat. AM and noon Sat. Jeff will come in Sunday AM, and I will come in again Sun. PM. When failures are found, they will be removed, the manifold plugged, and the test restarted. Weekend monitoring should allow completion of about 400K cycles by Monday morning, and should turn up significant failures of the test groups which may allow initial conclusions well before all devices ultimately fail.

As yet, we have not decided how to approach the customers with this issue. Kelsey-Hayes is somewhat aware that we are having a problem, because they have requested a quantity of 150 77PS12-1's by 91-08-30 for DVP&R testing, we have been forced to inform them that these may be delayed. If we miss the given date, they will bring this issue to Ford. The plan is to develop a strategy on Monday once we have initial information from the failure test.

MECHANIZATION:

Eastern Automation spent two days here this week, working on the contact feed/shuttle system. Apparently this design is very flaky, but does work okay when dialed in. The riveter has been acting up again; it seems that every time one problem is fixed another one occurs. This equipment is causing significant delays to the planned effectivity runs and the pre-effectivity run. The pre-effectivity run of about 250 pc. is very important from a design standpoint, since we plan to collect all calibration and check-station data for every single part, as well as every machine malfunction, and use this to Pareto-ize problems; establish check/cal/manual correlations, etc. It is unclear at this point when we will be able to perform the pre-effectivity run, although we are now several weeks late and the priority is very high.

HIGHLIGHTS - 910823 - PAGE 2

HEXPORT:

We had a conference call this morning with Elco specifically relating to one of the points raised in Steve Fulton's letter, regarding thread condition and reroll. Steve points out that ANSI B1.1 allows a *plated* 2A thread additional allowance in pitch and major diameter, such that the no-go gage used is still 2A but the go gage is 3A. The difference here is an additional 1.1 mils on the high end. Also, SAE J512 specifically states that the additional allowance applies, and invokes ANSI B1.1. This fact should significantly help in our negotiations with the customers to approve this change. Also per ANSI, if this additional allowance is unacceptable for various reasons (lubricant or sealant clearance required in threads, or very high temperature service where expansion is an issue) then the thread designation on the print must include a "Q", for example: 3/8-24-UNF-2AQ. Of course, our print does not have the "Q" which basically means we are at liberty to inspect per the relaxed ANSI spec. I checked 10 parts which were unacceptable on the 2A go gage, and found 8 of them to be okay on the 3A gage, the other two being marginal and requiring use of the 4.5 in-lb torque technique for arbitration. I believe that this additional tolerance, combined with one of the other ideas presented in Steve's letter (harder material and/or slightly reduced plating thickness) will be sufficient to eliminate the thread reroll and reduce thread rejections to near zero.

HIGHLIGHTS

Stephen B. Offler
Week Ending 91-08-16

Handwritten signature and date 9/1/91



FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

VALIDATION:

The Thermal Cycle test was successfully expedited in order to begin the important Impulse test as soon as possible. Half of the Impulse test is run on virgin devices, and the other half is to be run on parts which have completed the Fluid Resistance test. We are now running the virgin Pass Car and Light Truck parts simultaneously. A significant problem is occurring on the PC devices. We have had three failures to date (325K of 500K) due to fluid leakage. Autopsy of two (thus far) shows fatigued Kapton; no real evidence of foreign matter nor damage to the Kapton during assembly. Stan Hornol is providing valuable assistance in failure analysis. Note that we are running AMI-built PC and LT side-by-side, with no failures of the LT parts, which is directing F/A toward the cap. We are continuing to run the test for two reasons: one, to attempt to complete the LT parts successfully; and two, to continue to fail PC parts to provide additional F/A clues. Hypotheses include: increased converter travel in the rebump design; extraordinarily tight sensor crimp as evidenced by the deformations where the Kapton layers overlap; very flat washers (unlike the norm, which is slightly cup-shaped) which may also contribute to tight crimp. We are giving this matter top priority. At this point, it is safe to assume that the PC parts presently undergoing Fluid Resistance will also fail on Impulse. This means that after the problem is corrected, at the very least the Fluid Resistance test will need to be re-run, or at worst the entire validation will have to be re-run from scratch, which is about a nine-week process either way. We are now trying to determine how to best approach Ford with this news.

MECHANIZATION:

Mechanization has performed repeated measurements on the three AMI gage blocks and three switch assemblies, and Jeff has performed exactly the same measurements manually. The AMI calibrator (measure-only mode) and the check station produced commendable signals, although lack of agreement between the two requires more effort to understand. Jeff's measurements produced signals slightly worse than the automatic equipment. The good news is that it appears that a very good correlation exists between Jeff's manual measurements and the check station. We are planning a "pre-effectivity run" (a.k.a. "final debug run") of a few hundred switch assemblies, collecting all data on each piece and identifying each individually for later analysis. This will provide a statistically significant number of parts for check station vs. Jeff correlations, as well as allow Pareto analysis of problems which occur during the run.

Dave Paripoll has spent quite a bit of time working on the riveter on the Eastern Automation equipment. At present, we've got a hybrid of Milford and Thompson riveter parts, which seems to be running fairly well. However, for the long-term Mechanization is looking into elimination of the rivet. We are working with an ultrasonic welding firm, Stapla, who has provided very impressive samples. I am meeting with them today to provide actual springs and movable terminals, so we can do actual in-product performance and life tests.

Progress on the above items is presently impacted by lack of terminals. We have 27K moveables and 45K stationaries from Basler which were rejected for contamination. The sticky green substance has been identified as the environmentally-friendly cleaner/waxproofing product (Imco 119) that Basler uses to remove the EP sampling tube (Imco 185).

HIGHLIGHTS 910726

Page 2

Wayne Carlson reports that he is making good progress with the check station software, and gave me a quick demo this week. I have asked him to set aside a bagful of parts once he has it completed, along with printouts of the calibrator and check station dimensions. We will then check these using Jeff's manual technique to develop a correlation.

Andre Charpentier has run a lot of 20 77's through the pressure tester, printed results, and delivered the parts back to us to be manually checked. We will have this data available later today.

Eastern Automation personnel visited for two days this week, and Milford rivet people were brought in at the same time, to get the movable terminal equipment running acceptably. They've made good progress, with a fairly low percentage (2.5%) of rivet misfeeds. We will continue to work on this issue. Dave Peripoli has noted that the Thompson riveter used for this same rivet (74171) has a different driver geometry, and will experiment with this. The spring angle is still an issue, but not easily correctable. Our next step is to determine if the present angles are acceptable. On a positive note, the consistency of the angle is presently quite good.

HIGHLIGHTS
Stephen B. Offiler
Week Ending 91-07-19

Handwritten: JTH 9/19/91



FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

VALIDATION

To solve the base cracking problem at final crimp, we asked AFCC to increase the radius at the flange from .025" to .060" (same as 46412). They made this change and delivered parts in both colors in a commendably short time. We ran these bases on the switch AMI yesterday to produce parts for validation. The calibrator's offset was 4.5 mils (down from the previous 6 mils, underscoring its unpredictable nature) and the sigma was roughly 0.7. For the most part, the calibrator cycle now fits into the machine cycle, and the machine ran well. We were not able to get production to build sensors for us yesterday; this is planned for today. We are not using sensors from the previous build attempts because they were not properly salvaged - sensors containing ceramic fragments were mixed with good ones, forcing us to toss them all. We did run a lot of 30 Pass-Car devices with quiet discs on the final asm. mach. for an urgent customer need. The env. seal station is still acting up significantly.

I was contacted by Beth Kill from the Chem Lab. She has confirmed that our schedule for the fluid resistance test will be acceptable. We plan to begin on 91-07-29. We have received about 200 mating connectors no-charge from UTA which are required for this test.

CUSTOMER ISSUES

The writing of the insertion force test was completed and hand-delivered by Dave during his trip earlier this week. It was well received, but they did request some additional information. They'd like to see a plot of force as it varies with insertion position. Fortunately, we had previously collected exactly this information, but chose not to include it in the original writeup. A trivial modification to the document was made to include this. We will duplicate and bind the new document and forward copies to Ford via Joe Schuck.

We were forced to scramble to create very high priority emergency samples for Tim Anderson using Pass Car silent discs. Apparently communication problems existed somewhere in the loop, because Design Engineering had not received the correct paperwork, fundamental to our sample-build scheduling scheme, until about one day prior to required delivery. In an attempt to avoid these situations, Charlie has suggested we build a quantity of spare Pass-Car and Light Truck 77PS devices, using quiet discs since they are universal.

We are getting mixed signals on start-up of quiet LT 77's. After Dave's meeting, the plan was to start the quiet discs on 77PS, however now there is talk of creating another part number, and running snap-77's for VN58 (which has no need for a quiet disc) and starting up quiet 77's when needed for direct M/C mount applications.

MISCELLANEOUS

The Eastern Automation movable-terminal assembly equipment has arrived at Bld. 20. They are beginning the integration process, but it is difficult to predict the amount of time this will require because the EA machine is not 100% complete. One of the main problems is the Milford riveter. We plan to get Milford personnel to visit in order to help debug the problems; in parallel, Mechanization has contracted Bessler to do some developmental work on the rivetless eyelet concept in order to eliminate the rivet.

HIGHLIGHTS, 910719

Page 2

Wayne Carlson reports that he is making progress on the final station on the switch AML, the check station. Plans are to complete it by Aug. 1. This will involve a carefully conducted correlation study, comparing it to Jeff's manual measurements.

We have completed our production piloting technique experiment, with very good results. We calibrated switches to eight different values (at .002" increments) to duplicate the normal pin range, then build all devices using a single pin length. Actuation and release were recorded and differential calculated. Actuation sigma for each lot was calculated, and plotted versus calibration size along with differential, and the ratio of differential to sigma. At the tails of the hatchet curve, the act. sigmas widen considerably while the differential simultaneously narrows. We were able to show that the ratio of these provides an excellent indication of the center of the hatchet curve, which corresponds to the target value which is programmed into the calibrator.

We had our final print review with Bazzler, covering both terminals. Minor print dimensions have been revised slightly as appropriate, and we are now in a position to approve the tools. We will submit ECN's to update the prints ASAP.

HIGHLIGHTS
Stephen B. Offler
Week Ending 91-07-12

Handwritten signature and date 7/10/91

FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

Mechanization was able to redesign and rebuild the transfer pin station very quickly after discovery that a large percentage of t-pins were fracturing. They are now using a vacuum pick-and-place instead of blowing the pins through a tube. The vacuum head has a feature which locates it relative to the pin guide, helping to ensure that the pin does not collide with the guide and cause fracture. The same vibratory bowl and escapement is used. This station was demonstrated by running 100 parts consecutively with zero problems of any kind.

Completion of the above allowed the second-pass attempt to build validation parts. Bases were salvaged from the first-pass. While these bases were thought to be acceptable, severe cracks turned up during final crimp. Experimentation showed that the cracks were likely present after the first build, but to a lower level which was not noticed until the second build opened them up. The problem is related to the base design. Somehow the fillet at the flange ended up .025"R on the production mold, whereas the 77PS proto mold and the 57PS mold both have .060"R. As confirmation, proto bases were run and no cracks were found. The production mold is being modified on a high priority basis; Steve Walters indicates we can have new parts next Wednesday 91-07-17.

As a result of the cracking issue, we have revamped the validation schedule again. It now shows a completion date of 91-09-20; a total pushout of three weeks from the rough original schedule. Items on the critical path are receipt of the new bases, and the Fluid Resistance Test. I have contacted Hank Griffin and forwarded a schedule; I am now waiting for his confirmation that the timing for the fluid test is acceptable.

Bruce Pease assisted in locating the correct person at UTA to obtain offset-key connectors. I have been informed that these passed ISIR just days ago. UTA is sending roughly 200 no-charge, due to arrive early next week.

Mechanization has been making modifications to the calibrator to speed it up and fit it into the machine cycle. Previously, we found that some offset exists between the cal. measurement and the actual measurement, and this offset seems to change every time the station is modified. A correlation experiment was run to get a handle on the present state of the art. We ran roughly 20 parts at each of several different target values which more than spanned the expected range, from 85 mils to 100 mils (actual). Statistics were collected from the calibrator, and Jeff performed manual measurements on each. We discovered the difference between the cal. average and the actual average was very close to 6.0 mils for every lot. Previously, this was at 4 mils, and started out originally at 2.3 mils. The average of the sigma's (actual) for all lots was 0.8 mils. This sigma is 60% worse than before the speed-up efforts.

The above parts are now being used to build devices for the Production Pilot Technique experiment. About eight parts will be built on the final assembly machine at each of eight different calibration values, spanning the typical pinning window and beyond. They will be checked for actuation and release, and then the data will be creatively analyzed to look for a scheme to determine the center of the pinning window. One hypothesis is that differential arrows as the calibration digresses in either direction from the ideal. Another is that the sigma of the actuation values of several devices built at a given calibration value will be

smallest in the ideal zone. Some combination of these may provide a useful technique to determine the center of the window. This is necessary for Light Truck devices using silent discs, where no creep check can be performed.

We have also begun to experiment with the system of weights and springs that applies loads to the spring during the calibration cycle, in an attempt to minimize the observed offset and possibly reduce the sigma. To date, we have been using a 60g weight over the contacts with a 20g weight on the LVDT at the t-pin bump. In the real world, there is no weight over the contacts and all weight is applied at the bump, so we decided to try switching the weights, putting the 60g at the bump and the 20g at the contacts. The offset dropped to 3 mils, and the sigma dropped to 0.55. Next, we tried even more weight at the bump, up to 110g. This was accomplished by stacking weights, and some sloppy, rocking motion of the weights was observed. Offset dropped to 4 mils, but sigma increased to 0.86 (probably due to the sloppiness). Also, with this much weight the total cal. cycle time slowed considerably. Next, we removed all weight from the contacts, to most closely duplicate the real world. However, nearly every part was crushed, which is the known result if the spring is not held firmly against the stationary contact. More effort needs to be spent to dial in this system.

The writeup of the terminal insertion force test is planned ASAP, to be hand-carried to Dearborn by Dave Czarn during his trip next Tuesday.

HIGHLIGHTS
Stephen B. Offler
Week Ending 91-07-03

Handwritten: 7/11/93



FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE P5

Parts for both the Light Truck and Pass Car validation testing were built on the switch asm. AMI and the final asm. AMI. Both machines ran fairly well, considering we're still in a debug phase. Issues related to the switch machine include: the base feed bowl, which is not integrated yet due to incorrect height of its stand; terminal staking, which is not giving good terminal position yet; Eastern Automation equipment, not in-house yet; calibrator, not up to machine speed yet; and check station, no software written yet. Issues related to the final asm. include: jams at the env. seal station on PC, likely related to the thicker gasket; misfeeds at the t-pin station, related to alignment & size of the feed tube relative to the guide in the cup.

After running about 150 of each, we checked some in the lab and discovered about 20% had continuity problems. Inspection revealed fractured t-pins were the cause in every case. Mechanization is aware of this problem, and will work to modify this station to handle the t-pins more gently. We are decrimping and salvaging all parts. All switches and env. seals will be re-used. Sensors with good t-pins (about 80%) will be reused. Sensors with a chance of having ceramic fragments will be set aside for possible internal use in the future. We plan to rebuild the validation parts as soon as Mech. can complete modifications to the pin station. Also, the pressure tester is reaching a stage where we can run these parts through it. The plan is to label a quantity of parts, then run through the PT and compare the results with a manual check.

Measurement of 32 calibrated switches taken from the validation run showed a sigma of 0.54 mils using the manual check method, and a fairly consistent fixed offset of 4 mils. However, upon running another set of switches at a different calibration setting for Stan Homol's use, we discovered the fixed offset had shifted to 7 mils. We have decided to perform a calibration correlation study as soon as feasible, where we will run a dozen or so parts at each of several calibrator settings, and compare the results with manual measurements to develop a correlation. It is important to note that Mech. has been using high-speed video to identify speed improvements, and they are presently making modifications. We must ensure that our sigma's are not impacted negatively by these speed improvements. Also, the correlation study may point to the need to modify the springs/weights used on the LVDT to more closely match the deflected-spring shape to the actual application.

John K. is issuing an ultimatum to Eastern Automation. Regardless of its condition, we will be qualifying the machine on July 12, and we will bring it in-house by July 19. If it is not ready, we will finish it ourselves and back-charge Eastern.

I have been in contact with Bruce Pease to help in obtaining samples of the offset-key connectors. He has contacted UTA, and reports that the ISIR approval is due any day now. On Monday of next week I will be contacting Gus Morris at the plant in Huntingdon, IN that makes the parts. If the parts are still not approved, we will work with Bruce to determine whether they are dimensionally suitable for our use in validation testing. This issue, combined with fractured t-pins, is going to push out the validation schedule by two weeks, to Sept 16.

HIGHLIGHTS

Stephen B. Offler

Week Ending 91-06-27

(no highlights W/B 91-06-21 due to travel)

FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

77PS ISSUES: Steve McCosy and I visited Eastern Automation last week to oversee their assembly equipment debug and guide them in correcting dimensional issues. We discovered the major issue at present is related to the Milford riveter; malfunctions at this station are very likely to cause jams downline, unlike most of the other stations. We (Mech. & Purch.) are becoming involved with Eastern's dealings with Milford, to help get qualified riveter experts to aid in debug. We were able to bring back about a dozen strips of terminal assemblies, 2-3' in length, for use in build of validation parts if needed. Fortunately, Eastern was able to make a few quickie modifications which allowed them to run a couple strips greater than 10' in length (with about 90% good parts). They overnighted these to us, and ultimately these were used to build validation parts. One outstanding design issue is the spring angle. The bend tool is basically fixed at 90°, and the final angle (spec'd at 95-100°) is wholly determined by springback. We will be modifying the 77 Design Confirmation test to include the greater anticipated range of spring angles. Better control of this angle, if possible, will probably require tool modification by Mechanization at a later date. Our own estimate of EA's delivery, based on the level of competence we saw, is about 3 weeks.

Mechanization is making significant progress in debug of both the Base Arm Mach and Final Arm Mach. Over the last couple of days, we were able to reach the point where build of parts for the 77PS Production Validation/ISIR testing was accomplished. The calibrator has been improved to the point where Jeff's measurements show a sigma of 0.34 mils, approaching the level we attained originally on benchtop. Efforts are now being spent in speeding up this station to match the rest of the machine. High-speed video is being used to help reduce the cycle time while simultaneously locating possible sources of calibration error.

Jeff created a first-cut validation schedule based on the previous work on 57PS, which has since been fleshed-out using Microsoft Project for Windows. The entire schedule is based on the assumption that validation must be complete by Sept 1. Working backwards, this requires that the Fluid Resistance test be underway by July 8. The chances of meeting this date are near zero, however. For the Pass-Car devices, we need off-the-shelf mating connectors from UTA. I am presently pursuing this, but making little headway. I have been informed that they cannot release connectors until Ford approves their ISIR submission. The gentleman I have been speaking with seems to understand my situation, but do not know the status of the ISIR nor whether any quantity of parts exist. I'm trying to involve Bruce Pense to help expedite this.

CUSTOMER ISSUES: We have made progress in completing the connector insertion force test. Parts run with terminals offset .010", .015", and .020" show little difference in peak insertion force. We've also plotted force versus connector penetration, to help show where the peak force is obtained. A writeup is planned ASAP which will be designed to convince Ford that terminal position is basically inconsequential.

We have several recent requests for various samples, including 77PS physical samples for Light Truck to experiment with assembly on Toledo M/C's; quiet Pass-Car devices in 57 and 77 varieties for Bruce and the SHO Taurus group and Tever for the SHO application.

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TL-NHTSA 016636

HIGHLIGHTS
Stephen B. Offler
Week Ending 91-06-14

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FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

CUSTOMER ISSUES: We have partially completed the connector insertion force test. So far, four groups have been run: no terminals, terminals in ideal position; both terminals out .015" in the same direction, and terminals out .015" in opposite directions. The plan is to analyze the results and decide if further test-lots are required, and in what configuration. The lot with no terminals requires (average) 1.98 kg to insert; the lot with ideal position requires 3.77 kg; the lot with .015" offset in the same direction requires 4.11 kg; and the lot with .015" offset in opposite directions requires 4.18 kg. The presence of terminals makes a significant difference in insertion force, 90% greater than the lot without terminals. The position of the terminals makes a much smaller difference, only 9.0% and 10.9% greater compared with terminals in the ideal position. Since the terminals in opposite directions seems to be worst-case, and it is the typical real-world condition, further test-lots will test this condition only for expediency. Additional lots at .010" and .020" are suggested. Upon completion, the plan is to draft a formal report for submission to Ford.

A lot of twenty devices has been shipped to Hillis Ind. (Surfaces/Plats) for the Ford-required hydraulic testing. This completes our responsibilities for all three Tier-1's.

77PS DESIGN ISSUES: Eastern Automation is presently working to finalize the movable assembly tooling. They have had various issues with their chrome plater, including lost parts and incorrect plating thicknesses. Their submission on Tuesday of this week looked terrible; we're told the reasons for this are all directly related to the above. As of yesterday, Scott Bellows was reporting that they were making progress on all issues, and were on track to ship the final configuration for receipt today. Measurement of the spring remains an issue. They do not have a toolmaker's microscope, and instead rely on an optical comparator. The trick involves location of the "magic point in space", that is, the intersection of imaginary lines drawn from the vertical and horizontal surfaces in side view. All key spring dimensions are referenced off the magic point in space. My technique to locate this point with a TM is not exactly duplicatable with an OC. Scott and I have agreed upon a measurement technique which he will be using.

We are progressing on the 77PS Design Confirmation test. This test will be running a matrix of devices with highest and lowest spring angles combined with highest and lowest "pin" (actually calibration) dimensions. Jeff has completed sensors and has manually set springs to the specified angles. We need the calibrator running to the best of Mechanization's ability in order to complete this experiment.

An experiment is being planned to provide information which will be used to determine the best way to pilot gage devices in production. The concept involves a pin-window style experiment, using switches built to various calibration targets (rather than using a variety of pin sizes). This assumes the calibrator is running properly. Several devices at each calibration point will be built, actuation and release will be collected, differentials calculated, and hatcher-curves drawn. We will then explore the data for relationships between the optimum pinning window versus measured variables. It has been suggested that differential may be a good indicator of pin-window, since it is widest in the pin window and tapers off at either side. Also, we hypothesize that actuation sigma's will be wider outside the pin window. Possible

HIGHLIGHTS 91-06-14

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combination of these measurable variables should allow inference of pin window on silent devices.

Another experiment is being planned to provide information on crimp-shift. This phenomenon has been noted during pin-window experiments in the lab. It involves a change in the location of the center of the pin-window between pre and post crimp. The hypothesis is that the switch assembly compresses slightly during crimp, which shifts the required pin length downward. (This applies to lab pin experiments; production pin experiments are done on finished devices so the shift is automatically accounted for.)

I have spoken with Tom Olson at Maxwell Laboratories, regarding the prototypes we sent him for experimentation with the Magnaform process. He is shipping us the results of the experiment, due to arrive roughly today. He reports they had mixed success. He discussed four "discontinuities" on the aluminum crimp rings which caused "wrinkles" on the finished product. He refers to the hanger marks. They machined the hanger marks off some crimp rings and had much better success. One important note: they are assembling upside-down, such that the hexport is "up" rather than the switch "up" as in our crimp process. This was done to avoid damage to the base as the crimp ring material is thrown inward by the magnetic pulse.

TI-NHTSA 016638

HIGHLIGHTS
Stephen B. Offiler
Week Ending 91-06-07

Handwritten initials and date:
JMS
7/1/87



FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

CUSTOMER ISSUES / SAMPLES: Bruce Pease has responded with information on the Ford spec. ES20000-S100, thought to possibly contain thread-gaging information which could help to serve as arbitrator on the Hillight rejection. However, this spec. apparently covers surface finishes, not gaging. Bruce spoke with Jan Leavitt from Ford's fastener group about gaging. It seems that Ford policy does not officially recognize GO/NOGO type gages; rather, they promote use of Johnson tri-roll gages. Since our goal of finding an official Ford spec. covering gaging will not be fulfilled, this leaves us to deal with Hillight on our own. Jim Watt is handling this. We will continue to promote use of the GO gage with torque wrench set at 4.5 lb-in for objectivity. This procedure comes directly from GM spec 6102M. Also, we will involve the other Tier-1's as well.

We have created a detailed plan to carry out the connector insertion force test required by Light Truck. The goal is to characterize insertion force versus terminal position. Several lots of test switches will be individually measured and tweaked to specific positions. Connectors will be installed using a peak-hold force gage. This test will be underway soon.

We learned that the Light Truck samples with quiet discs shipped last week to Kevin Zajac were actually destined for WIN88, which is a Taurus-based platform and therefore should actually require Pass Car spec's. Joe Schuck addressed this situation, and learned that these switches are exactly what Kevin needed, because he's considering raising the pressures on WIN88 into the Light Truck range.

Bruce Pease has informed us that the very low volume MY93 SHO Taurus will place the pressure switch directly in the master cylinder. The M/C is a Teves unit, part of their Mark VI (7) ABS/Traction Control system. Joe will be proactively following-up with Teves USA. Bruce has requested a few quiet Pass Car spec. switches ASAP, anticipating the noise situation discovered in Light Truck will be an issue here as well due to the hydraulic similarity. I have explained that we're still developing quiet discs in this pressure range, and could have switches to him in a couple of weeks. This timing is acceptable. I'm communicating with Ted Ballard to get the status of these discs.

We have completed the formal "8D" Concern Analysis Report for Kelsey-Hayes. They returned a device which failed after many salt-water submersion cycles. The gist of the CAR is that our device is not submersible, and TI accepts no responsibility for the failure. This same information was previously conveyed to K-H using an informal format.

PRODUCTION ISSUES: Eastern Automation is experiencing schedule problems, apparently related to their chrome-plating supplier. Mechanization and Purchasing are hounding EA to do whatever is needed ASAP. We should have already had their next iteration for analysis of the spring geometry, and should have been well on the way to approving the tool and bringing it in-house. Now, it will be early next week before we can analyze the spring. This tooling is required to finish the base AMI, which will be needed very soon to build 77PS validation parts.

HIGHLIGHTS 91-06-07

Page 2

We met with Valentine to determine if tooling changes could be made to 27713 to correct the environmental-seal gland relative to 27288. The basic answer was no. Any changes made to this area (not dimensioned on the print) would directly affect more critical geometry in the cup-bump area. This answer came as no surprise to us. We will continue to evaluate solutions to determine the correct permanent fix for environmental seal compression. This includes two different seals, or a change to the seal size and/or diameter such that one seal could be used for both cups, and/or changes to the geometry of the base flange which compresses the seal.

Work to determine the best way to pin silent sensors is ongoing. Using a 'scope, we were not able to find repeatable electrical phenomenon on a gross-creeper versus a good device. This effort is complicated by the fact that our test ramp-rates were manual and therefore limited in consistency.

Another hypothesis we are working on to help determine pin window on silent sensors is the change in differential. Diff. is largest in the middle of the pin window, and decreases at either end. Combining this fact with some other fundamentals may provide a creative means of determining pin window; for example, low-act. plus low-diff. indicates a device to the left of the ideal pin window, and high-act plus low-diff indicates a device to the right. Piloting each disc lot would still be required to set control points.

To determine if creepers are a problem in Ford's system, it was decided to build test-lots of devices pinned as gross creepers at both ends of the window, and run on a powered impulse test. This has been completed, including one device per lot run without a flyback diode such that it saw the full inductive kick. We had no catastrophic failures; in fact, devices run with the normal diode in place look quite normal. Devices without diode show obvious arcing effects: heating (based on spring discolorations) contact erosion, and silver transfer. Millivolt drop on these diodeless devices is significantly higher than normal; one of the two was out-of-spec. at 280 mV. However, this test is far more severe than would ever be seen in the application. The failure mode which would cause concern is welded contacts, and we've yet to see any evidence of this. The conclusion is that, from a system standpoint, a creep device is not a problem.

HIGHLIGHTS
Stephen B. Offler
Week Ending 91-05-31

Handwritten signature and date 9/10/91



FORD MY '92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

SAMPLES: One hundred 77PS samples for Tokion were completed late Wednesday. A very high level of effort was required to stay on the aggressive schedule. We are now waiting for final instructions on exactly where to ship these samples.

Light Truck has requested another half-dozen silent 57PS's for further evaluations. At present, they have received only two silent samples, built with early lab-developed incipient discs. We plan to ship these N/C to Joe Schuck for hand-delivery mid-next-week to Kevin Zajac. *Fr: sb*

We have placed an EEO with Ted Ballard for test-lots of low-differential discs at the Pass-Car specification. We will look at differentials of about 2, 4, and 6 psi to determine relative silence and manufacturability. Bruce Pease and WIN88 have both requested non-priority silent samples, which we should be able to build with these discs.

Hillite Industries (Pitts/Surfaces) has finally responded with their needs for special samples for Ford-required hydraulic tests, with some prodding from Bruce Pease. We immediately submitted a model shop job to create the special hexport dimensions. These will be built in a timely fashion but certainly not with any special priority.

It has been decided that we will build a few evaluation samples to determine our ability to meet the JI Case NBO. The spec calls for an actuation of 120 psi max, with release of 90-106 psi. The general plan is to use the low-differential PC discs to gain a better understanding of the amplification ratios yielded by the rebump cup, to help forecast if we could attain such tight tolerances and differentials in a finished device. A standard cup (27228) gives an actuation ratio over 9, and the release ratio is always lower, around 8. This makes it nearly impossible to build a low-differential device, since it calls for discs with almost zero or even negative differential. However, the rebumps (27713) seem to have a release ratio which is a little higher than the actuation ratio, which may make the JI Case spec achievable, but expect yields to be rather low.

57PS / PRODUCTION ISSUES: I have spoken with Bruce Pease about the thread situation with Hillite. He has promised to obtain a copy of ES20000-S100, which is referenced on certain Ford hexport prints. We assume this contains information pertaining to the 4.5 in-lb torque spec on the "OO" gage; if so, this will be used to create an objective thread-gaging standard for the Tier-1 customers which matches our internal standard.

Analysis of environmental seal compression is underway. The rebump cup is about .004" larger in the gland area than the standard cup, resulting in less compression. Several potential solutions are being considered: a slightly thicker gasket, which would result in compression in the 20-something percent range on the standard cup and low teens on the rebump; working with Valeation to try to make the gland dimension equivalent on both parts; a change to a smaller flange on the base with a correspondingly thicker gasket, such that the .004" difference becomes fairly insignificant in the percentage-compression calculation.

To appease engineers at Ford Light Truck on the terminal position issue, we are planning to perform a connector insertion force test. We will attempt to correlate terminal position with

understand the baseline; next we'll ask Elco to quote hexports built to some hardness specification TBD. A related issue is the outer edge of the dog point, which is damaged in a fashion similar to the thread. We are looking into a small chamfer or radius to break this edge. Unfortunately, SAB 1512 does not explicitly state that breaking sharp edges is allowable in a general sense; therefore, we will probably need to obtain Ford's permission to make this slight change.

with
CRACKED BASES: We have completed a test where bases cracked during final crimp were impact tested, then thermal cycled from -40 to +121C 20 times. The parts have been dye penetrated, and while final cross-sectioning still needs to be completed, the good news is that no evidence of dye can be found inside the switch cavity, i.e. no cracks propagated all the way through. On a related topic, it has been discovered that actual dimensions in the environmental seal area of the sensor differ between 27288 and 27713, which could affect seal compression, and the cracking issue. Prior stackups have been blamed. A quick paper analysis shows the internal dimensions in this area (no external dim's on either print) are almost identical; 27288 shows .100-.107 directly, while 27713 shows a stackup which results in .102-.107. Differences may come from the molding geometry, which on 27713 has been iterated to give fairly sharp corner radii per the print, which may also affect things like material stretch and ultimately the unspecified external dimensions. Application of external dimensions to the prints has been discussed; however, this would require further tooling modifications to meet, and could affect other dim's negatively.

QUIET DISCS: We have characterized a total of three lots of quiet discs: 5.3 diff, 2.7, and 4.1. Jeff reports that the 4.1 lot, bulk into sensors, has a very subtle sound with significant amplification. Ted proposes that we spec. differential at 3 psi +/- 1.

MISC: Maxwell Laboratories Inc. has received the package of 57PS sensors, switches, and aluminum crimp rings, and has taken an initial look at it. They report that their process would be much better suited to crimping over the sensor, whereas now we crimp over the base. I've instructed them to try both methods for the sake of information. Otherwise, they are very positive about the suitability of their process to our design. They don't think there will be any problems with the internal components being affected by the magnetic pulse.

HIGHLIGHTS
Stephen B. Giffler
Week Ending 91-05-10

FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

CUSTOMER ISSUES: We learned this week that Ford is sourcing their Light Truck master cylinder business for MY93 and beyond with Tokico. At this point, Tokico requires an external-hex device with a max. diameter slightly smaller than the 77PS. They seem to be unyielding on their envelope requirements. Apparently Hystat has a device under development which meets these envelope size requirements, although rumor has it that the Hystat device cannot meet the 7000 psi burst, is snap-action (rather than our "quiet" device which was warmly received at Ford), and at present uses a Chrysler connector, and an O-ring seal versus the J512 we helped develop. Furthermore, their price is somewhere in the upper-\$2 range versus our \$2.21. Logic would seem to indicate that technically and financially we have significant advantages, but apparently certain persons within Light Truck Brake Engineering enjoy playing manipulation games with suppliers and logic is out the window. We will be receiving a Tokico master cylinder today, which will give us a much better feel for the envelope size issues. Prints received to date are not to scale and basically unclear.

Jim Watt, Matt Sellers, and I have completed a markup to the present 57PS DFMEA which makes it specific to 57PS1.5-2 and -3. Essentially, we updated part numbers, changed references from hydraulic oil to brake fluid, and deleted O-ring information and replaced it with J512 information.

PRODUCTION ISSUES: Hexport thread rejections began to surface on the production line. We discovered the "reject" threads were okay on Receiving Inspection's gage. Although our on-line gage is in calibration per the sticker, we discovered the gage is so good. This gage will reject parts if one side is used but accept them (just like the R.L. gage) if the other side is used. Since the thread condition of these parts leaves them on the hairy edge of acceptability, very slight gage differences will equate to "accept" versus "reject". Matt and I have made the decision to use the hexports and ignore the questionable gage.

The problem with the thread condition is rapidly becoming very familiar. The first thread or so is deformed, and the general consensus is that it happens during plating at Elco. This will indeed become a chronic problem. Unless a very gentle plating operation can be developed, the obvious correct solution is to use a harder thread which will better resist deformations. We have contacted Elco and spoke with Bob Hendershot about material changes and subsequent heat-treatment. The 10B21 previously suggested by Elco is a hardenable material, and they are well equipped to perform heat-treating operations. We plan to ask Elco for quotes.

We have been planning to thermally cycle several cracked base 57's in order to convince ourselves that the cracks are a surface phenomenon and do not propagate through the material thickness. Our new programmable chamber was recently vacated, and after calibration of its thermocouples we will run some cracked devices over the weekend. I plan to see -40 to +121 C with sufficient soaks to ensure each extreme is attained.

A meeting was held by QC to discuss equipment modifications for on-line inspections. A new, higher-pressure gage is required for the burst tester, as well as a valve to isolate the test device from the pressure source. This valve has always been a requirement of the ES and

HIGHLIGHTS, 91-05-10

Page 2

QAS, generally ignored until now. Also discussed were modifications to the software of the manual calibration check station; improvements to the evacuating equipment used to empty test devices of hydraulic fluid; and in-process requirements for the Vacuum test. The vacuum test equipment was recently surplused because 1) the test was ignored and 2) the requirements are only once every six months anyway. We now plan to support the vacuum test using lab equipment.

We have been supporting the on-line burst test requirements using lab equipment, until the above is resolved and the correct gage is in place on the line. However, it was discovered that our gage has never been calibrated because we do not have 10,000 psi capability on-site. We immediately air-shipped the gage to Esco in Chelmsford, MA for calibration. They will calibrate today and air-ship back for receipt on Monday, which will allow production to continue.

DESIGN ISSUES: We have received samples of Eastern Automation's second iteration springs. I will analyze these soon, to allow Mechanization to respond to EA. Visually the bumps look much better this time. We hope to be able to get a few hundred springs from EA for upcoming evaluations; bent would be ideal but flat would be acceptable.

Matt and I have drafted up some plans for evaluation of the production 77 switch assembly. We expect Bassler to deliver both terminals by Monday, along with bases from molding. With EA springs (or model shop springs as a fallback) we will be evaluating terminal dimensions per envelope print; spring force, angle, and deflection; strip cutoff stations (?) on the AMI; AMI terminal staking and pushout; AMI calibration; and finally spring life testing if all goes well with the above.

Jeff continues evaluations of the Disc Dept "quiet" low-differential discs. We discovered the 2.7 diff. lot produces silent sensors, with the tradeoff being a somewhat reduced pin window. We are also developing a technique to test a sensor's characteristic curve, with spring-load present, without using X-Y equipment. This technique is similar to a pin-window experiment, where many different pins are used and calibration points are plotted versus pin length. Results of the technique look promising, when judged against an actual X-Y curve (without spring load).

I have sent 57 sensors and switches to Maxwell Laboratories, Inc. for prototyping of their non-contact crimping process called Magneform. Final assembly prints and partially-crimped devices were included as well to demonstrate our current technique. I labelled everything with the TI Proprietary Information stamp; nondisclosures seemed to be extreme and non-expedient.

HIGHLIGHTS
Stephen B. Offiler
Week Ending 91-05-03

Handwritten: 91-05-03



FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

CUSTOMER ISSUES: Joe Schuck has had meetings recently with the new Light Truck players, John Pelkey and Norm Modl. Some concerns were raised over the changes to the JS12 spec; Joe responded by putting them in contact with Bruce Pease, and I have sent a copy of the tolerance relaxation report. Joe continues his efforts to win over Modl, who at present is still not a TI ally. He has been asking specific questions related to disc characterization, which Joe is handling carefully so as not to aggravate him, yet not disclose too much of our proprietary information. I have sent Joe hand-sketches of a snap-disc curve and an incipient curve which were purposely not overly accurate in detail, and furthermore marked them with the TI Proprietary Information stamp. The quiet devices we sent George Randall, using lab-developed incipient discs, have been a huge success; both Pass Car and Light Truck are planning on requiring this type of switch action for 77PS production. I have sent Joe a rough idea of the revalidation efforts required for a disc change, as called out in the ES. Thirty-six devices must undergo calibration, proof, vibration, thermal cycle, impulse, burst, and vacuum; this would take roughly two weeks to complete.

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PRODUCTION ISSUES: As reported last week, surface cracking of the brown bases has been an issue. Work has been ongoing to understand the magnitude of the problem, using dye penetrant to assess the extent of the cracks. Cracked devices have been impact tested, using the production test fixture also used for in process inspections per the ES, then examined with dye. The worst cracks seem to date extend through roughly 20% of the material thickness. We plan to thermal cycle some devices to get a better handle on the long-term effects; time constraints and equipment are delaying this activity. Presently, parts are individually inspected, and the cracks considered minor are being allowed to ship.

Issues related to on-line in-process inspection have begun to surface. Most significant is the failure of one device (out of four) during burst testing. While this device actually passed the requirement of the ES, which is holding 7000 psi for 30 sec. without leakage, upon release of pressure the cup crimp was found to have loosened. We reacted immediately by running three lots of six devices each on our own burst test as follows: hand-line parts with steel crimp rings, hand-line parts with aluminum crimp rings, and AMI parts with steel crimp rings were held at 7000 psi as in the ES, then pressure was released, then the parts were pressurized all the way to failure. The failure results were analyzed with Weibull techniques. Please note that none of the 18 failed after the 7000 psi portion of the test; the one failed device that caused this effort appears to be a fluke. We found the weakest to be the hand-line parts with aluminum crimp rings, which have a 7325 psi burst using Ford's requirement of 72% reliability at 90% confidence; next are the hand-line parts with steel crimp ring at 7985 psi; finally, the AMI parts could not be included here because they were so good that we could not get them to fail at the limits of our equipment, 9400 psi. Other than this burst issue, we have found that some inspection equipment needs modification. The gage on the burst equipment only goes to 5K; a 10K gage is needed. The pressure device itself is good for 10K. The manual check station also needs modification. It's programmed pre-cycles do not fall low enough to allow release of the Pass-Car device, and its ramp rate is too fast to catch actuation.

DESIGN ISSUES: The second-pass 77PS contact test has been completed successfully. Jeff found a malfunctioning load which was apparently responsible for the poor results of the first-pass test. Of the twelve devices, the six that were pinned normally looked excellent while

HIGHLIGHTS, 91-05-03

Page 2

the six pinned to give very low contact gap still looked very good. No evidence of erosion, no perforation of the silver plate, and no significant millivolt drop change was observed.

Ted Ballard has delivered a total of six lots of low-differential discs, with various levels of differential ranging from 5.3 down to 1.4 psi. We have characterized the first, 5.3 psi lot, and found minimal snap sound on the finished sensor. However, the downside is a loss of throw, from about .012" useful range on a standard sensor to about .008" on these quiet devices. Ted reports that pre-heat-treat, these discs have quite a bit of differential hence they can be heard easily and there is no particular manufacturability issue. He conjectures that this will be true down to a differential of about 2.5 - 3.0; hence, the next lot we will characterize will be the 2.7 psi diff. lot.

We are looking into a unique process to crimp the aluminum crimp rings. Called Magneform, it is based on non-contact magnetic principles. The company, Maxwell Laboratories, has literature which shows automotive drivshafts and shock absorbers, ammunition, etc. being assembled. It does not require that the crimp ring be a magnetic material; it must be an electrical conductor. I have spoken with an applications engineer, and plan to send sketches and parts to them for trial runs. They report that they provide this initial service for free, and it should take roughly 2-3 weeks to get results.

HIGHLIGHTS
Stephen B. Offler
Week Ending 91-04-26

FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

CUSTOMER ISSUES: We learned from Joe Schuck this week that George Randall at Light Truck has handed pressure switch release responsibility over to a LT Brake Engineer, John Pelkey (analogous to Bruce Pease at Pass Car). John Pelkey's supervisor is the infamous Neri Modl. The 77PS truck print has been updated for terminal position tolerance, and is being sent to Joe, for hand-delivery to John.

We received a returned device from Kelsey-Hayes. We are not treating it as an official RMR, because it failed during a development test (not any official validation testing) while undergoing a salt water submersion test. We immediately responded that A) our device is not submersible, and that B) potential problems with the environmental seal on the mating connector can cause problems which are completely out of our control. We've learned that the device, installed on K-H's prop. valve asm., would not open on pressure rise after 264 cycles of 5 min. submersion in 5% salt water at 100 P followed by 55 min. drying. The device carried 5.5 mA current at 12 VDC during the test, but was not pressure-cycled. The mV drop remained good at about 30-40 mV even after failure. Our failure analysis showed that the disc still snapped, but indeed the contacts did not open. The current leakage was extremely large, so large that an ohmmeter was used rather than a hipot tester; measurement was 40K ohms. Disassembly showed that a rather large amount of salt water had entered the device, and inspection of all potential leak paths showed that entry was via the connector. The transfer pin was stuck, and the hinge side of the movable terminal asm. was severely corroded, explaining the no-continuity-change. The contacts themselves still looked OK, explaining the low mV drop. K-H has requested an SD, which will be forwarded to them within a couple of weeks.

We have begun to mark-up the existing 57PS FMEA for this program. The only significant work to be done is to remove references to the O-ring seal and replace it with analogous information pertaining to the J512 seal. Other than that, references to "hydraulic oil" are being replaced with "brake fluid."

DESIGN ISSUES: Mfg. Eng. has been experiencing alleged cracked bases during final crimp on 57PSLS-3 (Pass Car, brown color). The problem manifested itself after successfully crimping 57PSLS-2 (Light Truck, black color). Initially it was thought that some difference in material between black and brown may be the culprit. Steve Walters was consulted, and his impression was that any pigmented material would be weaker than natural, but there should be no significant differences between various pigments. I did some experimentation with dye penetrant and sectioning, and discovered that the "cracks" were not propagating through the thickness at all; they were basically a surface phenomenon. Nonetheless, they are a concern cosmetically, because they look like cracks. Furthermore, Terry (group leader on 57PS line) mentioned that she sees this occasionally on all color bases and with steel crimp rings, and at some point in history it was proven that these parts are shippable. Matt Sellers pointed out that different cups are used for car and truck; measurement of the critical sensor height showed the car parts are .010" larger. They have opened up the crimp tools to compensate for this, and have had much better success. Matt has singled out a few of the worst ones that still show the "cracks", which we are presently analyzing with dye penetrant. I expect to show that these are again a surface phenomenon and there is no cause for concern.

HIGHLIGHTS 91-04-26

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The latest lots of 36900 hexports have arrived, and have been approved. The thread condition remains an issue; it was necessary to send the gage out for fresh calibration to ensure accuracy because these parts do drag on the gage, however they are consistently below the limit of 4.5 in-lbs. They also drag on Weatherhead mating fittings, which tells us that the customer(s) may be unhappy with the thread condition. However, this drag is subjective while the freshly calibrated gage is the objective final arbitrator. We are looking into having Elco build a prototype lot using a higher-carbon material (10B20 vs. present 10L10). To be truly representative of production, this lot must be plated using the production process with production quantities in the barrel, etc.

We are working on the rerun of the 77PS contact test. Jeff has discovered a bad resistor on one of the loads which would have the effect of increasing the inductive kick, which helps explain the two drastically worse parts from the previous test. That test was run in two halves, which is why one bad load would produce two bad parts. Furthermore, Jeff always puts devices on manifolds in order, and the two bad parts were #6 and #12; these two had the same load, which presumably was the bad one.

We received a small quantity of production spring arms (unbeat, however) from Eastern Automation. I did a quick analysis of the dimensions, and found the bump is quite poor. They have no transition radius from the plane of the spring to the bump; there is a sharp discontinuity here which would surely lead to cracked arms. Steve McCooey and Matt Sellers are communicating with EA about this; they have delivered 55PS arms to demonstrate the way the bump should look.

Ted Ballard is working on some very low differential discs to try to meet the need for "quiet" devices. After his first attempts, to get him up the learning curve, we plan to sit down to discuss the results Jeff has had to date along with Ted's results.

HIGHLIGHTS
Stephen B. O'Neil
Week Ending 91-04-19

*Not off
week*



FORD MY '92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

CUSTOMER ISSUES: In response to the audible noise/feel issues at Ford, we are working on incipient snap discs to produce "quiet" sensors. Jeff DiDomenico has gone through several developmental iterations with .0122" 301V stainless, and has reached a point where it is clear that a thinner material is indicated. We will continue iterations with .010" material. The best lot to date was built up into sensors, shooting for the LT actuation of 200-300 psi, using standard amplification ratio parts (27288 cap). We discovered that pin throw is severely limited, measuring about half that of a standard sensor (.010" versus .020"). The "snap" range of the sensor has a significant slope, at about 6 psi per mil. Four of these sensors were run to 500K on production cycling equipment with no problems. At George Randall's urgent request, we shipped him two devices built with these sensors. He wants to have these at his immediate disposal in case Nehru Modi (a much-feared manager at LT) becomes involved.

Bruce Pense has requested and received his latest print revision, showing the new terminal position tolerance of $\pm 0.25\text{mm}$, up from ± 0.20 . Also, Bruce and George are comparing notes on the WIN88 noise/feel issue, and Bruce has asked for a couple quiet devices like the ones we sent George. Bruce does not indicate any rush is needed. More disc development will be required, since using the low amplification ratio cap (27713) will limit pin throw to an even greater degree compared with the above.

We are pulling together the hydraulic testing requirements for Kelsey-Hayes and for Dana-Weatherhead, and plan to submit a model shop job to create hexports to specific J512 dimensions. Pits has promised to forward their requirements also, but after repeated contact we still do not have any information from them.

PRODUCTION ISSUES: It has been determined that, for the present, Elco will be re-rolling the threads on 36900-1. To avoid the removal of chromate during wash after re-roll, we will be supplying Elco with vanishing oil (which eliminates the need for the wash). We have not reached any final conclusion on this thread-damage issue. Elco is looking at their plating process to determine if less agitation can be used; a change to a harder material has also been suggested. The idea of doing an SPC-controlled thread-chasing operation on our assembly line is not being taken seriously.

Another potential hexport problem has surfaced. In a recent RFQ for a J512 with snubber, Elco's quote as usual listed several exceptions. The significant one relates to .285-.290 on the dog-point O.D. - they want to double this tolerance. The issue lies with the fact that this dimension also appears on 36900-1; however on this part they have not yet mentioned this exception. We immediately measured 20 parts for this dimension, expecting to find them incorrectly built to the doubled tolerance. Instead, all were found to be very near the max. of .290; fully half exceeded the spec. slightly. Visual inspection shows the outermost edge to be damaged in a fashion similar to the thread, with a rolled-over appearance, that also serves to increase the effective O.D. This will become an issue because the TDR chamfer gages rely on this O.D. for alignment and a part that is too large will not fit the gage.

DESIGN ISSUES: Visual inspection of the 77PS contacts run under powered impulse last week shows two distinct conditions: 10 of 12 show very little wear and tear, while the other two look terrible, with globs of silver at the interface, a blackened appearance, and bare

HIGHLIGHTS
Stephen B. Oller
Week Ending 91-04-12

VACATION: Steve, Monday 91-04-15
Jeff, Friday 91-04-19

FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

CUSTOMER ISSUES: The audible noise problem from switch snap on WIN88 was experienced by George Randall, alerting him to a potential problem on his vehicles (VN58 van, F-series trucks). He has discovered a couple of related issues: a "feel" in the brake pedal, and a audible resonance from the brake booster diaphragm, which are occurring simultaneously with our switch's actuation. I have had a couple of conversations with George, and at present we're leaning towards an iscipliant disc to address these issues. George has asked us for anything we can come up with (i.e. characteristics not necessarily within his spec.) so he can do some quickie testing. Jeff DiDomenico is presently working on an iscipliant disc, and after several iterations he is making very good progress. We are, of course, shooting for a disc that will yield a device within the truck spec. When we have a disc (mid-next week at the present rate) we plan characterizations and life-testing before shipping anything to George.

We plan to ship 100 samples of 77PSL2-3 (Truck) today. These use prototype switches from the AMI calibration iteration, which were Impulse, Powered Impulse, and Thermal Cycle tested to verify the functionality of this kluged design. Jeff has built sensors using the Elco CNC lathe hexports built to the original J512 spec. Production aluminum crimp rings and the production crimp equipment will be used. Final testing must be done in the lab; 77PS switches are too short to fit the production 57 tester.

We have received requests for engineering samples from Weatherhead and Kelsey-Hayes for the Ford-required verification of the modified J512 seal. We planned to get all three Tier-1's requirements before sending hexport jobs to the Model Shop, however Pitts is dragging their feet. When they finally give us their needs, they will be charged a higher piece-price.

Regarding the SREA's to relax terminal position from 0.30-0.70 to 0.25-0.75, George has signed off but Bruce's supervisor (a new individual, not Frank Jannet) has raised the feared question: "why have we been shipping lots of spec-57PSF3-X's?" This subject will be relatively easy to dance around, since we have zero RMR's relating to terminals. We (QC) owe Ford a letter explaining the situation. Also, along with the SREA's, Bruce has asked for updated prints. The ECN for these has been filed.

PRODUCTION ISSUES: Elco's latest submission of 36900-1 hexports has been rejected for threads. We met with Mark Godbout in R.I. who demonstrated that the "go" gage required greater than the spec. of 4.5 in-lbs torque, but the tri-roll PD gage showed the parts near nominal. Careful inspection using an optical comparator with a thread template showed the initial threads to be damaged. With Stan Hopol's inputs, we have determined that these threads were most likely damaged during plating. It looks like the same re-rolling operation that has become necessary on other 52/57 hexports will be needed here.

I have completed a set of tables for use with the TDR chamfer gages. Since the calculation of chamfer diameter and angle is very sensitive to gage ball diameter, separate tables were created for each anticipated ball diameter. For a given set of gage ball sizes, the tables

HIGHLIGHTS 91-04-19

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copper showing through the silver plated movable contact. These switches were taken from the kludged AMI calibration run, and were very inconsistent in terms of spring angles and contact gap. We are hypothesizing that these two bad switches had very low contact gap, therefore poor arc extinguishing, which explains the damage. This test can be re-run fairly quickly (25K cycles at 2 Hz, about 3.5 hours). Only switches with consistent geometry will be used, and contact gap will be controlled at high and low extremes by planing.

While assembling prototypes recently, we did a quick characterization of pin-shift due to final crimp. Typically, to determine pin length, a sensor and switch are held together manually while various pin lengths are used; creep actuation indicates short pin and creep release indicates long pin. With the incipient sensors, no creep can be measured, so instead we recorded actuation values for a given pin length held manually, then compared these values after final assembly and crimp. A shift of 15-20 psi was observed, which roughly corresponds to about 3 mils using the given slope of 6 psi per mil. This information will be very useful in the future when choosing pin lengths.

HIGHLIGHTS 91-04-12

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tabulate the actual readings obtained from the gage for the larger and smaller ball, and provide a calculated diameter and angle. A set of tables for each gage has been reproduced from the originals, which I plan to keep. The tables are extremely important; without them the \$3200 each gages are useless.

77PS DESIGN: During the above-mentioned 77PS prototype verification testing, we also piggybacked another test. During powered impulse cycles, we ran half the switches at the open of 2 Hz, and the other half at 0.2 Hz. This was an attempt to determine if the relatively high and unrelaxing 2 Hz had a negative effect on the contacts. All devices passed; the fast cycled contacts show marginally more wear but nothing significant. One device had a very high millivolt drop (131 mV versus about 10 for all others); we plan to analyze this further. Devices were purposely placed at the extremes of the pin window, and the high mV device was one that was placed high i.e. potential creep release and minimum contact gap.

BCN's are in the process of being placed for various 77PS components. We are going through the exercise of tweaking production tools and/or tweaking prints to match the parts. This includes 46515 (base), 27713 (rebump cup), 36900 (hexport), 36887 and 8 (terminals) and 36889 (spring). Of all of the above, the spring requires the most effort. I plan to submit the other 5 on an BCN, then spend significant time on the spring. We have learned from prototypes that the spring in reality does not deflect exactly as assumed when studied on paper. Effort must be spent to understand how well the prototype parts match the prototype prints, how well the prototype prints match the production prints, then determine how well the prototype assemblies match the production prints, then make tweaks as needed so the all the features of the production parts fall into the proper places.

GEORGE RANDALL WILL DATE 7/21/91...

02/11/91

1/1/91 4/15

HIGHLIGHTS

Stephen B. Offler
Week Ending 91-04-03

FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

57PS & CUSTOMER ISSUES: 56 production 57PSL3-5's for Pitts' ISIR were expedited on Thursday, 91-04-04. This had been planned for 04-11, but apparently the urgency for these parts was miscommunicated. Several issues arose during the build which required the intervention of many individuals, including Matt Sellers, Jeff DiDonato, Bob Robichaud, Dave Peripoll, Rusty Struble, and myself. Exactly 62 good parts were ultimately completed; 56 for Pitts and 6 for the Q.A. dimensional check. The major problem encountered was final crimp of the aluminum crimp ring. Serious burns are still forming, and in general the crimp operation is visually poor and obviously out of control. We are still working to understand why this iteration caused so much difficulty. Mfg. Eng. is working on various angles on the precrimp tool and various heights of the crimp post. At one point during the build, it was realized that the tools have no preload device to push the switch down onto the sensor; addition of urethane bumpers to perform this function seemed to help. Bob R. is planning to design spring-loaded preload devices into these tools. Also, Jeff has pointed out that in his experience a slotted precrimp tool (as used on Bendix APT to clear the connector key) makes a large improvement. We hypothesize that this is because crimp ring material is not forced to compress as it is moved inward; rather the slot gives material a place to go. We are looking into ways to prototype this concept.

Regarding the Tier-1 hydraulic testing, I have spoken with all three players. Gary Innocelli of Dana-Weatherhead has given me his requirements, and I have requested that Jim Cousins of Kelsey-Hayes and Jack Hutcheson of Pitts give me their requirements by Monday of next week. Our model shop will be building roughly three dozen parts with maximum J512 chamfer runout and another three dozen produced to "ideal" dimensions to represent best and worst case. We plan to charge the three Tier-1's accordingly for these.

We have rectified the conclusion of the terminal position issue. Dave P. and Matt have been able to demonstrate significant improvements, and we can now hit 0.50 ± 0.25 with a Cpk approaching 1.33. Ford has recognized our efforts, and granted a tolerance relaxation. We expedited SREA's for all four parts, and I am trying to expedite the 57PSL3-2 envelope print to George Randall because he has not entered it into his system yet, but needs it now. In order to issue the change request for this print, it was necessary to spend time to learn the Electronic Change Notice system.

As part of our efforts on the calibration specification experiment, I have learned that the Valentine 27713 cup and the model shop rebumped 27283 perform very similarly, which means that all our Pass-Car disc development efforts with rebumps will carry over to production.

77PS ISSUES: We have received the two TDR J512 chamfer gages. Matt and I did another R&R on both gages; results look good. Exercising the equations I've developed (using a Lotus spreadsheet) we've discovered that the latest Elco hexport submission looks good on the chamfer diameter but the angle is low, measuring 40.5 degrees against a spec. of 41-43. Furthermore, I have confirmed the accuracy of the gage readings of the angles by sectioning a part and measuring it myself.

TI-NHTSA 016663

HIGHLIGHTS 91-04-05

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We have finished calibrating all of our prototype 77PS switch assemblies, using the calibrator on the AMI with Mickey-Mouse'd nests and controls. Our results were much worse than the initial iterations with the calibrator stand-alone on a bench. Only about 32% of the parts fell into the target window. We have sorted the remainder, and should be able to use them by planing individually. We have a total of 170 usable parts. The reasons why this iteration fared so poorly are definitely related to the fact that everything is just slapped together. We will continue with serious iteration when we have production-representative parts available and the calibrator is properly tied into the AMI mechanically and electrically, roughly 2-3 weeks.

We had a meeting with Steve Walters on the 46515 FAI (77PS production base mold). We are down to the point of working out details; making minor tool mod's and/or changing the prints as needed. The parts are looking quite good.

The 77PS test to check the slotted terminal prototypes and to experiment with slow vs. fast powered cycles for contact design reasons is progressing. We should be able to finish the powered cycles over the coming weekend and have results early next week.

MILITES 91-03-28

* CIR's for 77PS parts are in-process; planned to submit next week under mandatory EIS system

76900 - adding note re: 41-44° & , how to measure

27713 - Fixing corner radii to reflect actual R found on 27288. will allow approval of tool.

36867/8 - minor updates to re-spec curved chamber in blades

46518 - multitude of minor rev's primarily to clarify print or correct errors; no chg's to design intent

36889 - entire spring design needs review based on geometry learned on prototype

* Matt: I ran a quick abbreviated R&R on TDR's JF72 chamber gage. We began to develop a technique which helps improve precision. I have developed a Lotus spreadsheet to input gage measurements & output actual cham of p & Ø. TBD is how to train Elco on our developing techniques.

* Lou Janucilli of Weatherhead called. He would like devices with constant as used in air tolerance relaxation experiment. Bruce Pease is requiring Tier-1's to perform various checks of hydraulic seal integrity. We have been expecting this request for a couple months. Also, we're expecting similar requests from Alts & K/H. I'd like to get a feel for how many total parts req'd for all 3 Tier-1's so the model shop only needs to do this once. Qty and pricing is T-B-D w/ M&T repts.

* Jeff D has completed initial measurements on all 100 parts undergoing cal. gage. test. Data crunching is upcoming, as well as a plan for the verification portion of the test.

TI-NHTSA 015555

310520

HIGHLIGHTS

Stephen B. Offler
Week Ending 91-03-22

FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

CUSTOMER ISSUES: The thread lead-in chamfer angle, found out of spec. on Elco's first production submission of 4300 parts, will be cause to reject these parts. Dave Czerny solicited Ford's opinion on this during his trip Wednesday, and they will not entertain a print change nor an SBEA to use these parts, citing reduced thread engagement with the bad chamfer. We do not agree that this is a functional issue, since only a fraction of one thread is missing, but we have nothing to offer Ford in negotiation. This issue is having significant impact on scheduled pilot runs, from which we had planned to ship small quantities of production samples. We are now handling the small quantities of production samples as if they were engineering samples. A total of 28 57PSL-5-2 devices shipped this week: 10 with 3PP tags; and quantities of 13 and 5 others, which should have been only one order for 18, but was miscommunicated through customer service and marketing to us resulting in duplicated efforts and some wasted time. On a positive note, we used the production crimp die for the aluminum crimp rings, and the parts looked excellent.

27713 REBUMP CUP: We have resolved almost all the measurement issues with Valentine. Still remaining is the issue of the very tight (.005 max) inside radii, in two areas: where the washer and converter mate with the cup. We have made very careful measurements of both 27713 and 27288 (standard production cup) and discovered that radii on both are above the .005 max spec, and 27713 is actually tighter than 27288. Given the fact that we're using 27288 regularly, the radii on 27713 are probably adequate. A detailed analysis of the tolerance stack-ups between cup, washer, and converter is planned in order to determine if it is theoretically permissible to loosen the radii spec. on the prints.

36887 TERMINAL: We met with Rick Bessler to discuss discrepancies between his FAI submission and our own R.I. measurements. It appears that just about every issue is related to measurement technique, and we do not find anything fundamentally wrong with Bessler's techniques. We have scheduled a meeting with Jeanne Gentes to review our techniques relative to Bessler's.

PROTO 77PS: The model shop has restamped the rivet holes in the movable terminals to move the spring down by the appropriate amount. We have begun to assemble devices (quantity roughly 230). We'll be ready early next week to calibrate these devices. Mechanization reports that by early-mid next week we should be able to use the calibrator on the AMI (rather than standalone as before). We plan to do a combined Impulse/Powered Impulse/Thermal Cycle test to expose any weakness in the slotted rivet joint. The "slow" versus "fast" Powered Impulse evaluation will be piggybacked on this test. The goal is to get parts on test over the long weekend next week.

The calibration specification experiment is underway. The goal of this test, which was conceived and planned in conjunction with Mfg. Eng., is to determine how tolerance stackups in the sensor and variations in hysteresis curve affect the pin-window. The expected size and variation of the pin window in turn determines the required accuracy of the calibration operation, and whether piloting will be required for each lot. This test will require significant time to complete, since we are taking measurements on a total of 100 parts for statistical significance.

HIGHLIGHTS

Stephen B. Offiler
Week Ending 91-03-15

FORD MY '92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

Maria Crossland called this morning to inform me that she is receiving requests from Ford for 57P5LS-2 production devices. She reports the following needs for -2 (truck):

260	Service	91-02-xx
21	Lorraine B&A	91-03-18
103	"	91-04-22
171	"	91-07-01
476	"	91-09-01

ON PS LINE ?

Our plan for the Service parts is to ship parts from the pilot run later this month. However, the 21 for Lorraine are slated for pre-production assembly and should not be delayed. The only holdup to building truck parts is the 36900 hexports, which are being replated in the AFCC and also have one dimensional discrepancy. They are being replated because Elco used clear chromate, not yellow as spec'ed. Also, visual inspection revealed a problem with the thread lead-in chamfer angle (not included on IQP). It is spec'ed as 40-50 degrees, and it was obviously way off even with the naked eye. We sectioned one and measured the chamfer as 25 degrees. Neither the angle nor the AFCC plating will be a problem functionally; so, one option is to use these parts on an SRBA.

Valentine's second FAI submission on the rebump cup (27713) still had certain discrepancies. However, it was unclear whether these were actual problems, or measurement technique difficulties, or deviations that were minor in nature and could be rectified with print changes. Matt Sellers and I studied the issues, and I have remeasured them myself. The first, a diameter with a spec. of 0.835-0.839", was measured as 0.8394 by Receiving Inspection but I came up with 0.837-0.838" with a caliper and 0.8374" on a X-section using a TM. The second, a transposition callout of .003" on the disc support bump, was measured by RI as .0109 but I came up with .0020" using a TM. The third, a .003 R MAX callout in two places, is okay in one place but measures .010 in the other. I agree with RI on this one, and Valentine will have to fix the tool. The fourth is a non-critical radius spec'ed on the print as .003-.007" (directly from 27288) but is measuring .015. Based on the geometry in the area, I have calculated that the absolute max we can stand is .030R; but I'd like bank off from that and use .015R MAX. I plan to change the print for this dimension.

We had an informal meeting with Rick Bessler on the progress of the stationary tool. He presented a difficulty they have run into. Basically, if a flat print is developed from the present 36888 part print, it becomes clear that there is an area that requires a very narrow punch, less than one material thickness. Opening this up removes material from the area which is used to apply force to push the terminal into the base and to support it during staking. We are attempting to reach a compromise.

Jeff has built and measured devices using slotted movable terminals. We have assumed that the pre-calibration bump height should be roughly .005" less than the target of .092". We have determined that a slot of .025" will put the bump in this position pre-cal. We will next determine the best way (stamp, mill) to slot all of our inventory of movable terminals.

HIGHLIGHTS
Stephen B. Offler
Week Ending 91-03-07

VACATION: Steve, 1 day 91-03-08

FORD MY92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

Twelve Tokico samples will ship to TI Japan tomorrow. These are Light Truck specification 77PS's, with nickel-plated J512 hexports. Also, a total of nine engineering samples will ship today to Ford W488. Six use standard snubber J514 hexports, and three additional parts were built with snubbers drilled out for use as controls. W488 has been complaining of audible snap noise, and these parts will be used to determine if the snubber will help reduce the noise. Finally, two 57P8L5-2 production-representative parts were shipped to Ford, to M.A. Krcach (new name in the Ford crowd) use unknown.

We have updated both of Pass-Car's prints to show the new base color, brown, and the new terminal alignment tolerances of 0.30-0.70mm. These went out today. Also, at Bruce Pease's request, we have sent copies of the J512 tolerance relaxation experiment report to each of the three Tier-1's.

All of the information required to add dash numbers to existing 57PS prints, and to create Parts Lists and Bills of Materials, has been handed over to Drafting. They are presently working on this.

We are in the process of determining how to go about modifying the prototype 77 spring arms and movable terminals in order to get them to better match the prints. We have milled slots of various sizes in the terminals, which places the spring at various heights relative to the base. The plan is to build a few, and use pin-window experiments to determine where we stand. Then we will have the model shop modify the rest, which will be used for the next rounds of planned 77PS testing and customer samples. Mechanization needs a couple days' notice to re-set-up the calibrator for these parts. This looks like it may happen late next week.

Basler has informed us that they will be recutting one of the stations in the production movable terminal tool. A couple of noncritical dimensions were out slightly, but they made the decision to rework because of concerns over the future.

A marked-up 27713 cup print was completed, and is being used for PAI on Valentine's second submission. This print helps clarify certain areas where very tight radii are required; and it also grants slight relaxation of true-position tolerances on certain features to aid the measurement procedure for Valentine and for TI.

HIGHLIGHTS
Stephen B. Offler
Week Ending 91-03-01

FORD MY92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

CUSTOMER ISSUES: We are preparing for the Tokico samples. J512 hexports have been stripped and replated with Nickel .0002" min. Although historically we used a chromium-over-nickel system, APOC has no chromium capability. These hexports are bare nickel. We have two weeks left of the original four week quoted leadtime. No problem meeting this.

Bruce Pease called this week to confirm the changeover in color of the Pass-Car base, from gray to brown. I spoke with Stan Homel and Steve Walters, and no one is indicating that this will cause any issues. Bruce would like prints soon, showing the color change as well as the new terminal alignment tolerance. I plan to issue a CR to drafting right away. Bruce also indicated that we should send copies of the J512 tolerance relaxation report to the Tier-1's, Kelsey-Hayes, Dana-Weatherhead, and Surfaces.

In a conversation with George Randall, he indicated that the best way for us to push the change in J512 specifications is for me to join the SAE committee and champion the effort. Otherwise, relying on Stan Bragdon to perform this on a low-priority basis means it could very well die in committee. George indicates that joining the committee is typically as simple as writing a letter to the chairman.

Ford WIN88 is indicating that audible noise is a problem in their application (MY94 I believe). They are asking for 6 samples with snubber due next Friday, and quotes of a device with J512 and snubber. Joe Schuck is confirming with them that the first 6 will be J514 o-ring. We are putting together a mark-up print of a J512 with snubber for Elco to look at. This may be the right time to look into a pressed-in snubber rather than machining it.

57PS ISSUES: It looks like all print details which needed to be addressed for the 57PS parts lists and bill-of-materials have been cleaned up. The CR will be transferred to Drafting right away.

We have received second submission of Valentine's 74797 aluminum crimp ring and 27713 cap. The crimp ring looks good; we are holding off inspection of the cap until I complete a mark-up to 27713 which grants relaxation of certain tolerances.

77PS ISSUES: Matt Sellers and I are working on a real-world determination of the required calibration tolerance for the 77PS base assembly. At present, the calibration operation is showing a \pm three sigma capability of \pm 1.2 mils, which is considered quite good. We are building three lots of sensors for dimensional analysis and hatchet curves, to study on paper the worst-case pla window. We will then build parts and cycle them as a verification.

We are working to modify the model-shop movable terminals to compensate for the fact that the MS springs are slightly too long, which places the bump too high in the base and requires excessive stationary terminal deformation to reach the correct dimension during calibration.

Matt and I met briefly with Rick Bassler to discuss dimensional issues he's having with the movable terminal tool. The interference bumps are too low by several mils, and another non-critical feature is also out by a few mils. He's hoping we'll grant print changes to avoid extensive punch and die rework. It looks like this won't be a problem.

HIGHLIGHTS
Stephen B. Offler
Week Ending 02/22/91

FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

CUSTOMER ISSUES: Communication with TU via Charlie Douglas regarding Tokico continues. They've clarified their need for a nickel-plate hexport. The master cylinder itself is made of aluminum (not Al/Cu alloy as reported earlier), but the brake lines are copper. Any zinc entering the system will cause corrosion of the brake tubing and potential failure. They seem quite firm on this issue. Charlie has met with Bob Babolen, who confirmed the above. He further indicated that a nickel-plate hexport, assembled to a zinc-plate cup and an aluminum crimp ring, will not be a problem. We have a verbal sample request for 12 77PS's with nickel-plate hexports, now due in 3 weeks. We will strip and replate hexports to meet this need. Matt Sellers is speaking with Denis Villard regarding a nickel-plating specification. Historically, we have used a chromium-over-nickel plating system on 52PS hexports, which shows excellent salt-spray resistance at a premium price.

We have just received a fax from TU showing an assembly of the Tokico master cylinder with pressure switch in place. Immediately apparent are: 1) they are using an O-ring seal; 2) they are allowing about 46mm for overall switch length minus thread, our device is 47.75mm; and 3) they are allowing 30mm max for overall diameter of the crimp ring, our device is 32.5mm. Of these issues, the O-ring is good news, the overall length may not be much of a problem (we may shave 1.75mm of the hex flats) but the diameter is a potential killer. Reducing this means redesign/retooling of the hexport, washer, cup, and converter, and possibly a move to a smaller disc as well.

We have shipped the balance of 63 77PS's to Ford Light Truck to complete their order of 75. Also, we shipped 3 77PS's (Pass-Car spec) to Bendix to complete their order.

77PS ISSUES: A dimensional study of the Model Shop prototype parts has highlighted areas which are contributing to the problems with the spring position. The movable-terminal end of the spring is too high, forcing the calibration operation to push the stationary contact down excessively in order to reach the predetermined bump height. The fact that the end is too high seems to be a stackup of the spring hole too low, the movable-terminal hole too high, and the base too short. We plan to restamp the hole in the movable terminal (producing an oval slot) to bring the spring down where it belongs. This will require careful riveting. This is actually a problem related to prototype parts not meeting print; the prints themselves seem correct. A separate issue is the position of the bump, which is drastically off-center. I have updated the production print to correct this. A markup has been delivered to Mechanization to be forwarded to Eastern Animation.

Powered impulse testing of the 77PS contact system, using the 7408 low-current contact, shows acceptable performance but the contacts are obviously nearing the end of life. We plan some more extensive testing and formal analysis of the contacts.

→ REG/INT FOR ANAL: W/ TO COMPLET

Some analysis of the calibration data taken last week has been completed. The calibrator's reported measurement of each of 25 devices was compared with a manual measurement taken by Jeff DiDomenico. Six devices were also measured repeatedly by the calibrator and Jeff to determine gaging errors. We found the calibrator gage error to be slightly higher than Jeff's, sigma of roughly 0.12 mils vs 0.15 respectively. The data on the 25 devices shows very good agreement between the calibrator and Jeff; both have sigma's of 0.52 mils. Removing gage errors, it looks like the calibrator is capable of a sigma of about 0.4 mils.

HIGHLIGHTS
Stephen B. Offler
Week Ending 02/15/91

FORD MY92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

CUSTOMER ISSUES: I have forwarded finalized envelope prints to George Randall, including the relaxed J512 tolerance and the widened terminal position tolerance. We also owe Bruce Pease new prints. He already carry the relaxed J512, so it is just a matter of the terminal position tolerance. These are planned within the next couple of weeks; Bruce is not indicating a priority is needed.

We're communicating with Tom Kuzma of TI regarding Tokico. Tokico inquired about 57PSL3-2, but we are steering them directly to 77PSL3-3 given their rough schedule which shows SOP 3Q92. Charlie has sent them envelope drawings. Tokico has expressed a concern about zinc plating on the hexport, citing galvanic corrosion. The material of their mating part is an aluminum/copper alloy according to TI. Tokico has suggested nickel plate as their preferred hexport finish. They'd like prototypes with nickel plate in four weeks. We have not formulated a response on this yet.

Charlie has received advance notice from Ford for Phase II production switches (Light Truck 57PSL3-2). They need 19 thru the end of March and additional 106 thru the end of April. These must be built on production equipment.

We have shipped twelve 77PSL3-3 (Rev "A", tight J512) samples to George Randall on a priority basis against his order for 75. These are the first fully functional 77PS devices shipped. They use bases calibrated on the Mechanization calibrator. To confirm that nothing would go wrong with these first-pass 77PS calibrated switch assemblies, we did a full impulse test including 25K powered cycles before samples shipped. All devices passed. We are now preparing the balance of 63.

77PS: We have run two trial lots of 77PS switch assemblies on the Mechanization calibrator. The first lot of 100 is being used for customer samples and in-house testing. A geometry problem was resulting in the calibrator deforming the spring arms, but luckily the calibration operation was still successful and the parts easily passed life testing. The calibrator has been modified, and the second trial run showed no spring deformation. However, there is now a problem with our spring/movable terminal geometry. This problem was originally masked because the calibrator was deforming the spring. The second lot, which was run on 25 parts to collect measurement statistics, has shown that the end of the spring which rivets to the movable terminal is too high. This forces the calibrator to deflect the stationary terminal excessively in order to get the t-pin bump to the desired height, and leaves the spring arm at an acute angle at contact transfer rather than perpendicular as intended. Further analysis is required to determine if the rivet hole in the spring or the movable terminal is out of position, and to correct the situation. This will receive high priority because it has immediate impact on Eastern Automation's progress.

PRODUCTION COMPONENTS/ISSUES: We met with representatives of Valentine to discuss discrepancies on FAI's of the rebump cup 27713 and the aluminum crimp ring 74797. All issues should be rectified using three approaches: Valentine is reworking the tools, we are refining the prints, and we are resolving differences in measuring techniques.

We visited TDR to tour their facility and discuss details of the J512 ball gage fixture. I have calculated the ideal ball sizes, and done some work to show correlation of this

HIGHLIGHTS 91-02-15

Page 2

technique relative to known "standards", using the chamber blocks Mett had built up originally for the optical gage R&R. My results look promising. We explained the concept of gage R&R to TDR, and expect that they will be supportive if R&R problems arise.

We have completed a disc lifetest on production-lot disc using production equipment. We ran .0122" passivated and .013" non-passivated in Pass-Car and Light-Truck ranges. No failures turned up. Free-disc characterizations pre- and post-test showed miniscule drift over life.

HIGHLIGHTS
Stephen B. Offler
Week Ending 02/08/91

FORD MY '92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

CUSTOMER ISSUES: George Randall has asked for new prints ASAP. He is accepting the new, relaxed J512 tolerances we proposed, 5.58 - 5.83mm (.2197" - .2303"). However, he wanted 5.60 and made a significant issue out of the 0.02mm (.0008") before finally agreeing, then only because Bruce Pease already had.

On the removal of the terminal position tolerance from the print, George misinterpreted the SREA we presented, assuming we meant removal of the true-position GDT callout and replacement with a conventional co-ordinate dimension. Our goal was to take the tolerance off and replace the basic with a reference dimension. This quickly became a major issue. George needed to know what new co-ordinate dimension was going to be used on the next prints. A statistical terminal position study on four different lots of production 57PS's showed our present capability is poor. The better terminal had a Cpk of 0.20. In other words, we are shipping production 57PS's every day that do not meet the customer print. I proposed a tolerance of 0.5mm +/- 0.5, five times the present tolerance. George strongly refused this. Our negotiations finally stalled at 0.5mm +/- 0.2, which is the tolerance George's new prints will carry. We must now spend effort to attempt to improve the 57PS staking process.

SAMPLES: The 20 Ford of Australia devices shipped Thursday 02-07. They used custom CNC lath-metric barports using M10x1.25 thread and 14mm hex. They used O-clips rather than J512, using this opportunity to steer them towards O-rings. We included complete information on the J514 O-ring gland details, the O-rings themselves, and brake-field compatible materials, all from the Parker O-Ring Handbook. We also included a copy of the Engineering Specification, a set of mating connectors, and a cover letter.

George Randall indicates that he needed/expected his 75 77PS samples before 91-02-22 which is the date on our paperwork. He has very few 57PS's on the shelf, and truck builds are ongoing. We must first do an Impulse test to validate this latest iteration of the prototype switch assembly. This in turn requires that we "mock-calibrate" the bases; that is, as-built uncalibrated they need very short pins, out of range, so we must deflect the stationary terminal to roughly its midpoint so they can be pinned traditionally. I have contacted Wayne Carlson, who indicates the calibrator is at a stage where he can bend to some pre-determined value. It is not capable of a true calibration yet. We plan to mock-calibrate about 100 bases, do an Impulse test ASAP on 12, and use about 10 of the remaining to build expedited parts for George. These will ship after successful completion of the Impulse test, possibly as early as next Thursday. Subsequently we will build and ship the remaining 65 well ahead of the 02-22 date.

HEXPORT: I have received data generated by Elco, using their version of the ball-gaging method. They included data using two different ball sizes as well as optical TM measurements. I have begun to analyze this data, and preliminarily it looks like their angles were off, my calculations on their data showing 40.75 degrees (spec 42 +/- 1). Also, correlation with the TM readings is not very good. TM readings of the chamfer diameter are always lower than the ball readings, by an average of .0042" with SD of .0012". However, we know the difficulties in using optical measurements, and I still tend to trust the ball readings.

HIGHLIGHTS

Stephen B. Offiler
Week Ending 02/01/91

OVERTIME: Jeff DiDomenico, 91-02-02, 4 hrs

FORD MY'92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

EXPORT: The tolerance relaxation report was apparently well-received at Ford. George Randall is very close to accepting the relaxed tolerance part. His primary concern now is that cost deltas associated with 1512 vs. 1514 are not charged to Engineering. Bruce Pense indicates that the Tier-1's should receive copies of the report as well. One concern Bruce had was that our testing was conducted with devices tightened to 1/8 turn (this tolerance guideline is per an earlier conversation with Weatherhead). Bruce wished to correlate this to a torque value. A quick experiment on 3 devices showed 1/8 turn roughly corresponds to 5 ft-lbs. Bruce was pleased with this information, since typical torque values on these fittings are roughly 10-18 ft-lbs. Thus, we have demonstrated a good seal at torques well below those in actual use.

CUSTOMER ISSUES: Both Bruce and George have signed off the SREA's which allow us to remove the very tight terminal positional tolerance from the envelope prints. This resolves the last outstanding issue on the 57PS ISR, clearing the path for full approval. I will be updating the envelope prints to remove this tolerance.

Prototype metric exports for the Ford of Australia application have been completed by Bld. 20's CNC lathe operation. They look dimensionally excellent. They have been sent to plating, and expected back mid-next week. This will allow us to build and ship the 25 customer samples by late next week.

77PS: The very first prototype 77PS devices have been built. These are supposedly NON-FUNCTIONAL samples, labelled as such, for Bendix. Actually, the devices are functional but have not had extensive testing yet. Jeff manually "calibrated" the devices; that is, he deformed the stationary terminal to obtain a dimension for which we have pins in stock. He also reports no significant differences between the 77 devices and corresponding 57 devices, in terms of pin window, snap sound, and actuation/release values.

Light Truck has requested 77PS samples, quantity 75, for shipment 91-02-22. We will be building more 77 switch assemblies soon for use in testing and for these samples, assuming all testing goes well.

Mechanization has approx. 40 switches in their possession for calibrator debug. Steve McCooey reports that first, they will be doing simple mechanical debug (basically ensuring that all geometry is correct) then moving to the heart of the matter, which is debug of the electrical aspects.

We have begun force-deflection type testing, which will be useful in understanding the nuances of calibration, and also to understand the impact of spring angle on forces which will help determine the range of adjustability needed for the spring forming tool.

DRAFTING: We are presently working to update 57PS components and substantially drawings to include new dash numbers to cover the 57PSLS-2 and -3 switches. This effort is required prior to completion of the parts lists, which are underway.

HIGHLIGHTS
Stephen B. Offiler
Week Ending 01/25/91

FORD MY92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

EXPORT: Stan Bragdon of the SAB J512 committee has recontacted us regarding our proposed changes to J512. He agrees with our graphical analysis, and is leaning towards bringing our recommended changes to the committee. However, he must perform similar analyses on each nominal tubing size; our analysis concerned itself only with our particular size. Furthermore, he feels that a deformable element must be present; normally this is the flared brake tubing. Of course, no tubing exists with our plug geometry. Stan referred me to J5134, Refrigeration Plugs, where a "Flare Gasket" is described. He's looking into the possibility that J512 is in error, and that a gasket of this type was originally intended for J512 in the absence of tubing. Bottom line: resolution of this issue will come eventually now that the ball is rolling, but it will not be quick enough to be useful in our negotiations with George Randall.

I have completed a 32-page report of the results of our testing of the new, proposed J512 dimensions. All combinations of worst-case tolerance stack-ups passed all tests. We noted that in every case, the steel hexport (plug geometry) deformed the brass mating port in making a seal. This lends credence to Stan's idea of a flare gasket, although its application would be required only in the case of steel-on-steel. Dave Cram is hand-delivering copies of this report today to Bruce Pease and George Randall, and I have sent one to Stan as well. Additional copies are available, see me.

We have met with Howard Nelson of T-D-R Co. Inc. regarding a real-world implementation of the J512 chamber gaging concept using spherical shapes. We brainstormed an approach and developed very rough sketches of the required fixture. He has responded with a rough quote of \$6400 for design/build of two gages, one for us and one for Elco. We plan to proceed with this. Mfg. Eng. will impose some type of contract with T-D-R which holds them responsible for guaranteeing an acceptable R&R. Elco has tentatively agreed to pick up half of the tab.

SAMPLES, CUSTOMER ISSUES: SREA's (Supplier Request for Engineering Approval) have been written, proposing the removal of the problematic terminal-position tolerance on the envelope prints. Our position on this issue is described in the verbiage: the tight tolerance is based on insert-molding process capabilities; none of our present Ford power-steering or brake switches include this tolerance; and we have shipped approx. 10KK switches to date with zero terminal-related RMR's. Dave Cram is hand-delivering the SREA's today.

Bruce Pease requested that the latest envelope print iteration include a description of the revisions directly on the print. This is because the latest changes are all J512 related, and he wants absolutely clear documentation. Drafting has added the revision detail in the upper-right corner of the prints. These were overmiked to Bruce yesterday. He is releasing these prints, which casts the new, modified J512 tolerances in concrete.

Twenty "Functional Build" Light Track STPS's were shipped. These are production-level parts, which assume completion of ISIR, and which are shipped directly to B&A. The required special paperwork was completed, along with a functional build tag affixed to each of the twenty switches.

HIGHLIGHTS 91-01-25

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SAMPLES, CONTINUED: Six Pass-Car samples were shipped to Surface. These are the first parts shipped (other than a few direct to Bruce) to use the offset key bases. We are coloring the keys black (on gray bases) at Bruce's request to help differentiate these parts. This procedure will continue until SOP.

Mike McHugh reports that he is presently building metric hexports for the Ford of Australia samples. Part of the delay has been caused by the need to obtain the correct latex collet and the correct material. I have informed him that in the future he may use certain alternate materials which are typically available from APCC Screw Machines. Charlie has contacted F of A to inform them of the delay. These parts originally should have shipped 01/10 for receipt by 01/17.

77PS: The final review of the production 46515 base mold design was held. Various items such as cavity ID's, tolerances in historically problematic areas, and interference tab details were discussed and will be updated on 46515 as soon as possible.

Dave Peripeti has completed tool modifications to allow riveting and staking of prototype 77PS components. We have built about 50 switch assemblies to date. Most of these will be used by Mechanization in calibrator debug. We are making plans to build more, and to have the model shop create more terminals and springs, to be used for spring life testing, contact testing, pin window experiments, calibrator debug, and customer samples.

A meeting was held with Mechanization to discuss details of the 77PS pressure tester. Highlighted items include: millivolt drop measurement and continuity definition; design of the polyurethane seal, recognizing the geometry of the J312 hexport end; leak check rates at the lower 77PS act/rel pressures and the minimum resolution of the transducer; accommodations in fixturing for the offset-key bases; and categorization of failures, recognizing the deficiencies of the present failure prioritization system.

STAN

MISCELLANEOUS: We are presently working with Drafting to set up Parts Lists for the 57PS Pass-Car devices, which also involves the addition of dash numbers to various established 57 component and subassembly drawings. We are holding off on Light Truck until the end of January when resolution of the hexport issue is expected.

NO HOLE SPACER, STAN?

ALL HOLE W/O HOLE

-3-

HOW PART, MAKE FROM...

-2. WE HAVE NO HOLE

-1 ONLY ONE W/ HOLE

HIGHLIGHTS
Stephen B. Offler
Week Ending 01/18/91

FORD MY '92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

HEXPORT: No news from Stan Bragdon of SAE yet. I will recontact him mid-next week if I do not hear from him sooner.

We are looking into the chamfer gaging method using spherical shapes as opposed to cylindrical. I have completed calculations of the geometries involved to determine the best ball sizes to be using and the resolution they will provide. The larger-size ball (9/32") yields a total travel of 3.3 mils when applied to the standard J512 4 mil total tolerance, while the smaller-size ball (7/32") yields travel of 5.5 mils. We are prototyping this idea using ball bearings and a dial indicator. We plan to meet with TDR this morning to discuss the implementation of this concept, and after digesting this meeting we plan to recontact Elco as well. The spherical idea was conceived by Elco, and furthermore it is ultimately their responsibility to control/measure their process. We find ourselves involved because the final gaging technique must meet Ford's approval; that is, if we do not *directly* measure the chamfer and angle, then we must demonstrate to Ford via our control plan that the technique we use to *infer* these measurements is accurate.

The tolerance relaxation experiment is complete. A report is planned ASAP, to be forwarded to interested Ford parties and to Stan Bragdon to support the paper analysis. No evidence of leakage whatsoever from any of the test matrix. Sectioning/disassembly is complete as well. The runoff (included purposely) leaves obvious evidence; inspection shows the deformation of the brass seat to be obviously off-center. If both mating parts were similar grades of steel and runoff was present, then it is reasonable to assume that significantly higher installation torques would be required to deform the components to the extent required to form a seal. Breakage of the hexport could become a factor in this instance; however we know of no such practices (steel on steel) in automotive brake fitting practice. All mating fittings pertinent to this program are aluminum or brass.

77PS PROTOTYPES: The model shop has delivered both terminals and spring arms, quantity 200. We have plenty of bases. Matt Sellers and Dave Peripoli are working on riveting and staking fixtures to allow build of completed switches. We expect to start building early next week. Parts will be built for calibrator evaluations, spring arm life testing, movable contact selection, and customer samples. Exact plan TBD soon.

SAMPLES, TESTING, MISC: We have received a request for five 77PS samples from Bendix. They conveyed an immediate need, but Charlie was able to ascertain that the need is for physical samples, with functional samples needed later. We will ship two non-functionals ASAP (clearly labelling them as such) with the balance of three functional devices to be shipped after life testing builds confidence in the design. Also, George Randall has a need for seventy-five 77PS devices in February.

We have missed the ship date for the Ford of Australia parts. The holdup is due to material and a collet required for the CNC lathe in B20 to produce metric hexports.

We are working with Print Control to put together parts lists for this program. We plan to begin with the Pass Car (57PSLS-3) parts list, holding off on the Truck (57PSLS-2) parts list until a hexport decision comes from Ford.

HIGHLIGHTS
Stephen B. Offler
Week Ending 01/11/91

FORD MY '92 ELECTRONIC SPEED CONTROL DEACTIVATE PS

HEXPORT: The SAE committee which writes J512 was contacted. The chairman referred me to the expert in automotive fittings, Stan Bragdon of Parker-Hannifin Brass Products Div. We learned that just before Christmas someone filed a ballot to increase the tolerance on J512 Figure 8, Table 5 (the male plug, which is the geometry we use) from $\pm .004"/0$ to $\pm .005"$. See MSG# 30387 (91-01-06) for more detail. I have forwarded to Stan a report summarizing the dimensional studies conducted by myself, Bruce Pease at Ford, and Jim Coskus at Kelsey-Hayes. I expect a reply late next week or so. Ideally, Stan will accept our conclusions and change the ballot to include our new dimensions, and the committee will approve this ballot. No reading on the likelihood of this or the timing.

We have received inputs from Elco's gaging experts regarding the use of spherical-shaped gaging for the J512 chamber. After discussing this matter with me last week, they have outlined a method using two different size balls, allowing calculation of chamfer diameter and angle, while being insensitive to roundness errors and resistant to changes due to wear of the gage surfaces (unlike my cylindrical gaging idea). Matt Sellers and I plan to look at this in detail early next week.

The experiment to test the new, relaxed J512 tolerances is within 100K impulse cycles and one thermal cycle of completion. At this time, all parts look good, with absolutely no evidence of leakage. Next, one-half of the parts will be sectioned and one-half will be disassembled for examination of the metal-to-metal seal.

77PS: The model shop is working on the prototype terminal and spring stamping tools. The schedule for these tools is slipping; the holdup was in Bld 20 at the EDM. The model shop now has the EDM components, and is working on finishing the tools. They report that bending tools are complete. Matt has been working to ensure we have sufficient quantities of materials on hand to produce several hundred of each part.

Revisions to the 77PS production base mold (46315) to correct various minor errors/discrepancies on the print have been completed. Due to the urgency conveyed by Steve Walters, a mock-up was completed first and delivered to him early this week to be overhauled to the mold builder in Chicago. Drafting has completed the official version as well.

Matt Sellers and Dave Peripoli are presently working on tools to stake 77PS prototype terminals into the base, and to rivet both the contact and spring/inovable terminal rivet. We have provided prints and a few parts for this purpose. These tools will be used to construct test parts to exercise the calibrator when it becomes available and for any other engineering test samples or customer samples.

CUSTOMER ISSUES: Bruce Pease has sent a letter to everyone (TI, Tier-1s, Ford Purchasing, Engineering, SQA, etc.) outlining details of the Pass-Car program. This includes dates for incorporation of offset-key connectors, the changeover from 57PS to 77PS, our J512 dimension revisions, and a requirement that the Tier-1s and TI mutually

HIGHLIGHTS 91-01-11

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conduct certain tests at dimensional extremes to validate these new dimensions. The Tier-1's will need us to supply custom-machined hexports; no contact from them requesting parts as yet.

Bruce is re-releasing our switches with the new J512 chamber dimensions. Ford part numbers will go to rev level "B", i.e. the 57PS is now FZVC-9F924-BB and 77PS is FZVC-9F924-AB. Because of the sensitive nature of the new dimensions (in terms of politics and cost), he has required that we document on the envelope print in the revision column exactly what has changed between his A-level and B-level switches.

Work progresses well on the Pass-Car BS test report, due today. It follows the same format as the Light Truck report, including most of the same appendices, etc.

SAMPLES, TESTING, MISC: We have obtained production-representative discs to be bulk and life-tested on production equipment. The matrix includes a range of discs for the Pass Car calibration, using .0122" non-passivated material; a range of discs for the Light Truck calibration also using .0122" NP material; and single lots of .013" passivated material, one each for PC and LT.

We have learned from Mike McQueen that the metric hexports for the Ford of Australia application do not carry priority at this time, and will not be delivered for SEVERAL WEEKS unless we obtain a higher priority. They are scheduled to be produced on CNC lathe equipment.

HIGHLIGHTS
Stephen B. Offler
Week Ending 01/04/91

FORD MY72 NEXT-GENERATION SPEED CONTROL DEACTIVATE PS

HEXPORT: The tolerance relaxation experiment has progressed successfully through 4 of 25 thermal cycles and 80K of 500K impulse cycles. At this rate, we are on track to finish up by the stated date of 91/01/17. After review of notes taken during the Ford visit last September, the final procedures have been changed from sectioning all 16 to sectioning 8 and disassembling 8.

I received a call from two Elco gentlemen, Russ Peterson and Tom Vowels, who are working on the J512 chamfer gaging issue. After discussion of the difficulties of using optical techniques, they proposed use of a ball-type gage. I described my idea of using two different size gages (cylindrical, spherical) which allows calculation of both diameter and angle. They liked the idea, and are laying this out in order to determine appropriate ball sizes, etc. I expect a fax from them detailing the outcome of our discussion.

An informative meeting was held with Dick Shaw and Gamal Farish from AFCC Screw Machines. We discussed the possibility of using a Hydromat machine to produce hexports. They are not concerned about the .233-.237 versus the .220-.230 diameter dimensions, and claim the Hydromat is capable of doing either for the same end cost. There are at least a couple of very good reasons why we cannot use some capacity off the "one-piece-hexport" Hydromat which is to be delivered soon: we need about 14-15 stations and that one has 12; and we need 1-1/16" stock and that one is 1" max. AFCC has already quoted this business, and their price for either the tight- or loose-tolerance part is very similar to Elco's loose-tolerance part. They are going to take a hard look at the quote, as well as experiment with their CMM to determine if they can measure the chamfer. Design related concerns include the strength of a cast (Hydromat/screw-machine) part versus a forged (Elco) part, which relates directly to burst pressure capability.

77P3 BASE: Matt Sellers and I had a brief meeting with Steve Walters yesterday. We went over several minor issues that Steve raised with the 46315 print, involving slight drafting errors, location of cavity ID's, etc. An outside house is presently working on the design of the 4-station production mold, and these issues need to be cleaned up right away to avoid delays.

77P3 TERMINALS/SPRING: Parts were expected from the Model Shop today. I was informed that the EDM stamping tools have not yet been completed, and I'm trying to find out where we stand in that queue. The Model Shop has the bending tools ready to go.

K21 10 1.7.

HIGHLIGHTS
Stephen B. Offiler
Week Ending 12/21/90

FORD MY '92 NEXT-GENERATION SPEED CONTROL DEACTIVATE PS

HEXPORT: The experiment to test the new, modified SAE J512 spec's is well underway. The model shop has built 16 hexports, all at the maximum ranget and minimum dog point length, eight at the very low end of the diameter spec, and eight at the very high end. We have measured and sorted our Weatherhead mating fittings, to obtain eight at the low end of the cone seat diameter and eight at the high end. We have no good way to measure runout on these parts, so it was ignored. We have built a 2 x 2 matrix, high/low hexports with high/low Weatherhead fittings. These have progressed through the 4000 psi proof test, with 100% passing (very significant - proves hydraulic seal integrity). After the Christmas break, these parts will undergo a Thermal Cycle test and an Impulse test, followed by another proof test, and finally all 16 will be cross-sectioned to examine the fit between the sealing surfaces.

After communicating with Jim Cousins at Kelsey-Hayes, I have put together a possible gaging method suitable (T-B-D) for either the standard or modified J512. K-H uses a cylindrical plug with some given gage diameter, and measures how far down the cone seat this plug falls. My plan uses this technique, but instead uses two different size gage pins, in order to measure both the diameter and the angle. I plan to have the Model Shop create the appropriate fixturing so we may experiment with this technique. George Randall has already given tentative approval. Details of this technique will not appear on the envelope prints, however; instead, it will be detailed in our control plan (IQP/QAS).

Various quality-related problems were observed on the Elco CNC hexports during recent sample builds. We have manually inspected just about all of the 1660 parts and sorted out the bad parts. A summary was created and delivered to QRA along with representatives of each problem. From a Pareto standpoint, the largest problem was relating to chatter marks on the J512 chamber (61 parts). This could be a very significant issue, since the marks are radial in nature and therefore could very definitely result in leakage (although limited proof testing did not substantiate this). In my opinion, these chatter marks were deep enough that the parts could not meet the 100 microinch finish requirement.

Drafting has completed the production hexport print, #36900. This print shows the above, related J512 dimensions. Copies delivered to Mfg. Eng. and to Purchasing.

CUSTOMER ISSUES: The complete matrix of envelope prints has been updated. This includes 57PS and 77PS for both car and truck. The car prints carry the new, modified J512 dimensions while the truck prints carry the standard dimensions. All show the new connector internal dimension of 11.4 - 11.9, up from 11.63 - 11.84. Minor updates were made to ensure all metric-converted dimensions match on all four prints. Truck prints now carry four significant characteristics, which had been removed for a period of time at George's request. Also, George will not be releasing an ES at all; he is simply using Bruce's, so therefore all prints now reference the same ES number.

SAMPLES: Four devices were assembled for Joe Schuck this week for show-and-tell usage. These include a device with centered polarity tab, a device with an offset polarity tab, a device with old lock tabs (steep ramp) and a device with new lock tabs (extended ramp). These will be used to help Ford personnel understand these recent revisions.

HIGHLIGHTS

Stephen B. Offler
Week Ending 12/14/90

FORD MY'92 NEXT-GENERATION SPEED CONTROL DEACTIVATE PS

HEXPORT: Bruce Pease is finalizing the consensus on the dimensional changes to SAE J512. This includes my proposed decrease in chamfer diameter and increase in tolerance, from .233 - .237" to .220 - .230", and Jim Cousins' (Kelsey-Hayes) proposed lengthening of the dog point from .030 - .050" to .043 - .055". I am presently working to plan an experiment to test these changes.

Drafting is presently working on production print 36900, which is a hexport component print showing the above relaxed dimensions. I have given Purchasing hand-dashed versions of the above as well.

The model shop is working on hexports for the Ford of Australia application. These hex's use a "hybrid" J514 - that is, a standard J514 o-ring gland, but instead of the 3/8-24 thread and 9/16 hex, these will use an M10x1.25 thread and a 14mm hex. We're also working on adapters so we can fit these hexports on our pressure check stations.

CUSTOMER ISSUES / ISIR / VALIDATION: Bruce Pease has requested print updates to both his 57PS and 77PS prints to include the new J512 spec's. George Randall has also requested print updates, but as yet will not sign up to Bruce's new dimensions. I have explained Bruce's position and my hexport experiment to George and posed the question: would George consider switching to the relaxed J512 if the experiment proves good seal integrity? His answer was a reserved "probably". George will be releasing the 57PS print with the standard J512 tolerances, but can and will re-release at a later date if he finally agrees to the new relaxed spec. He will not be releasing the 77PS print until March '91.

An obvious concern is that once George releases the standard J512 print, we'll need to build parts that meet it and be able to measure it. I have discussed our efforts in this area with him, and he agrees that this is a very difficult dimension to measure. Furthermore, I have talked to Jim Cousins at K-H and discovered that they have developed their own technique which involves establishment of a reference dimension somewhere in the middle of the chamfer. He is fax'ing me detailed information on this. George will allow us to use this kind of technique to measure the chamfer, and use the control plan to explain the technique rather than try to deal with it on the envelope print.

On the issue of the Light Truck ISIR dimensional problems, George has located a fuel injector print which shows 11.9mm (max) whereas our print shows 11.84 and our parts measure 11.87. George will allow us to increase this dimension to 11.9. This issue is therefore resolved with Truck, but we still need Bruce's permission to change this dimension on his Pass Car prints. I am working on this. On the downside, all of the P.I. prints George has been able to dig up show a terminal position tolerance of 0.2mm, exactly the same as what we show, and far below our present capability. This is not a dimension that Ford will allow us to increase, or to remove from the print. More work is required on our part to determine our capability.

All Pass Car ES validation tests are complete. We have delivered six P/C ISIR dimensional parts to Quality. The ISIR will be submitted to the Tier-1's rather than to Ford; they require it by 01/15/90. The ES writeup will be completed in this timeframe.

HIGHLIGHTS 12/14/90

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We have forwarded two sets of contacts to Al Hopkins for analysis. Both have completed 25K powered cycles; one also underwent the Field Resistance test. While these contacts showed obvious signs of age, they were not extensively pitted or burned, and showed no millivolt-drop problems. We are analyzing these primarily to provide information to Gary Kilgler, who raised a concern when one of our prototype plated contacts developed zinc oxide problems.

SAMPLES: A problem with the final-crimp stripper, discovered during our pilot run last week, has been resolved. The stripper was found to be jammed at an angle in its guide, preventing any motion and damaging the end of the hexport.

The first five P/C devices with offset polarity keys have been shipped to Bruce Pease. At Bruce's request, the key will be colored black on all offset key samples to allow easy visual identification until start of production.

77PS & MISC PARTS: We have received the next iteration of the 77PS prototype bases. These incorporate changes patterned after Karl's Volvo switch, to better position and stake the terminals. They also have interference tabs, although they are so tiny that they are not doing any good. Molding, for whatever reason, did not comprehend the offset key in this mold as they were instructed to do.

The Model Shop is progressing on the stamping tools for the 77PS terminals and spring. These should be available around the end of next week.

We have received approx. 500 aluminum crimp rings from Bob Jacques, which will be delivered to Mechanization for their bowl feeder development.

HIGHLIGHTS
Stephen B. Offler
Week Ending 12/07/90

FORD MY'92 NEXT-GENERATION SPEED CONTROL DEACTIVATE PS

HILITES IND. SAMPLE BUILD: We have successfully completed this 650-piece order. 698 parts were built. Temporary modifications to the automatic pressure tester were made so this pressure range could be tested. Matt Sellers is working with Mechanization to perform permanent software modifications. According to the tester, we ended up with 647 good parts (92.7%); 40 creep releases (3.7%); 7 continuity failures (1.0%); 2 low releases (0.3%); and 2 high actuation (0.3%).

Parts which the pressure tester called bad were rechecked in the lab. Of the 40 creep releases, we found only 19; of the 7 continuity failures, we found only 1, which was attributed to an out-of-place disc; of the 2 low releases, we found good snap but no continuity change which was caused by an incorrectly gaged base on one device and a particle between disc and T-pin (possibly from a finger cot) in the other; and the 2 high actuations were found to be leakers caused by misplaced gaskets. To make up the balance of 650, we shipped a few of the 21 devices which were creep releases on the P.T. but were okay in the lab.

One other significant issue uncovered in the pilot build: The stripper in the final crimp die was discovered to be bottoming, resulting in a slight arc-shaped depression on the J512 chamber, on every single part. While visually this may be a concern to the customer, we checked several parts with a proof test and with a chamfer runout measurement, and found no functional problems. We've asked Matt to deal with this as soon as possible; certainly within the next few days because we've got to build 5 samples which go directly to Bruce Pease at Ford, and 6 parts for the PC ISIR dimensional check.

Finally, a new type of import quality problem was discovered: one import had totally missed the second-up's on the flange side. In addition, we found another two which missed the thread-rolling operation, and a fairly large number (20-30) with chatter marks on the chamfer. We are collecting all of these parts, eventually to summarize the information and relay it back to Elco.

CUSTOMER ISSUES: Bruce Pease, and Jim Coombs of Kelsey-Hayes, have finally pulled together all recommendations on the tolerance relaxation of the J512 feature. Bruce has officially okayed the increase in the key tolerance from $\pm .002$ " to $\pm .005$ ", and has made minor revisions to the dog point length and thread chamfer spec's. He has asked us to incorporate these revisions on both 57 and 77 envelope prints. I am in the process of doing this now.

I spoke with George Randall regarding the J512 work, and the out-of-spec. dimensions on the ISIR. He is still against any changes to J512. He has asked me to develop a 77 print for him, using standard J512 dimensions. This will be done, and stamped "preliminary" to prevent this print being released into Ford's system until we can get Bruce and George to reach a consensus, or until Charlie is able to pull together the financial information which will highlight the large cost increase to use the tight J512 standard tolerances.

Regarding the ISIR, George has checked with the connector people and has taken a position against our proposed increase in tolerance. I feel that he does not fully understand that the questionable dimension is a clearance only; it is not used to reference or align the

HIGHLIGHTS 12/07/90

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mating connector. We need to close with George on this. I also checked with Paul Theroux, supervisor of the AFCC Molding toolroom. He informed me that the core which creates the dimension in question also forms the terminal slots; any decrease in this core will also decrease the slots and possibly throw off the terminals (even farther, that is).

The above ISIR issue will also apply to the Pass-Car ISIR. We have checked several molded bases with offset polarity keys and found the same dimension out-of-spec. The general plan is to resolve the issues with Light Truck, and then request the same changes from Pass-Car. However, at the rate we're progressing, the PC ISIR date (12/21) will be upon us before any resolution can be made.

FORD OF AUSTRALIA: Charlie and I spoke with a brake engineer at F of A, Andrew Houshaw. We learned that these are more like MY93, not 92, programs. We need to get program timing charts from Kilgior. We have a purchase order forthcoming for 20 devices, for use in VP-type car builds. Andrew graciously accepted our recommendation that the SAE J514 O-ring seal be employed (at least for these first samples). These will use special hexports, however, since they need an M10 x 1.25 thread. I plan to have these made in the model shop. Longer-term, Andrew will be discussing the final choice of hydraulic seal with his master cylinder supplier. We informed him that, due to the looser dimensions which can be tolerated with an O-ring type seal, device cost is significantly impacted. Presently, the M/C has a "spare" port which is designed for a metric tube nut and is simply plugged.

HIGHLIGHTS
Stephen B. Offiler
Week Ending 11/30/90

FORD MY'92 NEXT-GENERATION SPEED CONTROL DEACTIVATE PS

HILITE INDUSTRIES SAMPLES: We are preparing to build 650 samples to complete Hilite's order for 800. Actions required to build this large quantity follow:

Matt Sellers informs me that Dave Paripoli will be temporarily modifying the production 37PS pressure tester so it will be compatible with our 90 - 160 psi actuation spec. The fallback solution would be to obtain a production worker to manually check the devices. Matt is working with Mechanization to perform permanent software changes to this piece of equipment for future use.

Jeff and Ron have rebumped a quantity of 900 cups for use in this build and subsequent sample and engineering needs. This is a three-step process including stamping the new bump, rezing, and redrilling the transfer pin guide.

Our inventory of appropriate discs (23.5 psi actuation) has been depleted by previous sample builds. We are working to expedite an HEO placed a couple of weeks ago. Discs must arrive by noon on Friday 11/30 so we can do a standard disc life test over the weekend. Assuming good results, these discs will be used for the sample build.

We await receipt of the character "V" needed for the Ford part number (F2VC-9F924-BA) which is required on these devices. For previous sample builds with lower quantities we have been hand-stamping the "V". These devices are using steel crimp rings rather than aluminum because modifications to the coder are required to eliminate magnetic handling.

In order to meet the customer's required date of 12/07, we will need to overtake ship these parts. I have a concern that this will be very expensive. 650 parts weigh approx. 100 lbs without packing materials.

MISCELLANEOUS SAMPLES: Bruce Pense has sent me a quantity of 20 preliminary offset-key mating connectors, and informs me that the supplier (UTA) will be preparing to mold large quantities soon. He has requested 5 devices, no rush, with the offset polarity key. We will ship these no-charge in the next couple of weeks. We have offset-key 46412 bases, need only coded aluminum crimp rings.

We are building one physical sample of the 77PS per the request of TJ. This will be shipped along with a copy of the Engineering Specification.

VALIDATION: The Pass-Car Fluid Resistance test is complete. Devices now go to Impulse, Salt Spray, and Humidity. Also completed are Vibration and Thermal Cycle.

COMPONENTS: Stan Homol is ordering a quantity of 2000 aluminum crimp rings from R.W. Jacques & Sons. These should cover Stan's needs, my sample and eng. needs, and Mechanization's needs until we get production devices from Valentine in March.

Mechanization requested that we supply 1,000 of each pin length for use in development of feed bowls. A quick calculation of required pin lengths was completed. This was based on pin-window experiments done for recent sample builds. The minimum pin is 1.5" and

HIGHLIGHTS
Stephen B. Offler
Week Ending 11/16/90

FORD MY'92 NEXT-GENERATION SPEED CONTROL DEACTIVATE ES

VALIDATION: The Light Truck ISIR package, due at Ford next Wednesday, is being pulled together today. The ES test report has been completed. We are dealing with minor difficulties such as the lack of an up-to-date envelope print released into Ford's system; and various dimensional discrepancies uncovered in the FAI. After discussion, we have reached a consensus on the deflation of "production" parts as applied to the crimp ring and the hexport.

The Pass-Car validation testing is progressing according to schedule. George O'Leary is working next week, and our vibration test will be conducted at that time. Fortunately, no Field Resistance test actions are needed during shutdown next week.

SAMPLES: We again utilized the 57PS hand line to build customer samples with good results. 130 parts were owed to Kelsey-Hayes. We built 200 using a new die lot to help center the distribution and improve yields over last week's build. Finished devices shipped without incident.

Our next sample requirement, the largest to date, is 630 parts to complete Hilma Industries' order for 800. This was originally due 11/28, but Charlie Douglas was able to push it out to 12/07. The reason for the delay is due to four factors: we've got to build 600+ rebar cups in the model shop; we need more discs; we need characters for part number coding; and most importantly we need to modify the software on the pressure tester to handle the Pass-Car spec of 90 - 160 psi actuation and 20 minimum release. Matt Sellers is working with Mechanization to get this done. I've spoken with Scott Martin and Terry (group leader on 57 line), who indicate that these can be done as soon as we're ready.

CUSTOMER ISSUES: I received a call on Tuesday from Bruce Pease. It seems that a three-car fleet on test in Florida was having speed control problems, and for no apparent reason Bruce was contacted rather than the correct person, Gary Klingler. No system debug has taken place yet; any blame directed to our switches is arbitrary and preliminary. Nonetheless, I overruled 3 replacement switches to Florida to please them. Bruce will bring Klingler into the loop so the real problem can be determined, and ultimately our "questionable" switches will be returned to us.

HEXPORT (Miscellaneous issues): We built and impulse tested 24 devices for a disc life test, also using new Elco CNC hexports to test the hydraulic seal. All 24 worked well. As we continue to build samples with these hexports, we are checking them individually for quality problems based on last week's experience. A new one surfaced: we found a hexport that completely ruined the thread rolling operation.

I received a call from Bob Hendershot, Applications Engineer at Elco. He had some questions about the -59 EX print, which is the one that shows the unfinished cold-headed blank. Rather than answer his detail questions (tolerances, etc) I tried to give him the bigger picture: simply tell us how much it will cost to purchase cold-headed blanks without any second-op's. He also mentioned a possible change in material, from C10L10 to "10B20". Costs were not discussed. He claims this material is generally easier to machine and slightly stronger as well. This change would effect all of our Elco hexports, meaning requalification.

HIGHLIGHTS
Stephen B. Offler
Week Ending 9/11/09

FORD MY'92 SPEED CONTROL DEACTIVATE PRESSURE SWITCH 77PS

HEXPORT: 1660 parts were received from Elco on Tues, 11/06. They were routed through the normal Receiving Inspection channels with minor incident. The required priority was not appropriately relayed at first, and the inspectors raised objections to inspecting EX parts. The parts visually looked good in general; obvious tool marks from single-point CNC lathe tool were evident; the I512 chamfer diameter was quite close to nominal (.235") on 5 parts we checked optically. Visual inspection of approx 225 parts during sample build showed at least three different quality problems: several had significant chatter marks on I512 surface (radially oriented, a definite leak path); a few were found to have large chips from the drilling operation left inside the thru-hole; and at least one had a large gouge on one of the hex flats. A proof test was performed on a few good parts to build confidence in the sealing ability.

AL CRIMP RING & REBUMP CUP: Drafting has completed these prints. Matt Sellers, George Lavoie and I met with Valentino this week on these two parts. They are getting the rebump business since they already do the 27288 cup, and they are being seriously considered for the crimp ring based on the outcome of a previous quote cycle. We discussed tooling modifications to 27288 to make the rebump. Their tooling quotes on EX3423-34/35 (\$10,900 and 12 weeks) which are similar to the final design, will still apply. There was a brief discussion of the crimp ring tool. This tool is not as simple as I first guessed. It will contain at least eight stations (counting "skip" stations) and take about 18 weeks to produce. Presently, we need prototype crimp rings for sample builds and for design of the bowl feeder; counting several hundred for Stan Hornel's use we estimate a need for 3000 to be ordered from R. W. Jacques & Sons. Also, the coder on the production line needs modifications to eliminate magnetic handling.

SAMPLES: -A total of 215 parts are due today, 11/09, to three different customers as follows: 20 to Ford WIN88 to complete a partial shipment; 15 to Weatherhead also to complete a partial shipment; and 180 to Hillite Industries which together with 20 previously shipped represent 25% of their order for 800 parts for ISIR use.

The good news: These samples represent the first time we have utilized the hand-line on the 57PS line to produce samples. We got excellent co-operation from Scott Martin & team. At Scott's request, Ron Ruggieri was present on the line during build to ensure that everything went correctly the first time. Pressure test was performed the slow way in the lab because the automatic equipment on the line is not yet set up to handle our pressure ranges. Both Jeff and Ron are to be commended for the extreme level of effort they expended in completing these devices on time.

The bad news: We discovered that, on the line, the three pieces of Kapton are not carefully played in a twelve-point configuration as they are when we hand-assemble. They basically end up stacked. In theory, this has two potential effects: one, if stacked not played there is no tendency to "wedge" which tends to bend the washer and predeflect the disc; and two, the Kapton clamping action between the washer and hexport is fundamentally different, resulting in differences in wetted area. In practice, we discovered the devices built on the line have actuations 10 - 15 psi higher than hand-built. This fact, together with the fact that discs with actuations slightly too high were used ("correct" discs had not yet been life-tested) caused a final yield of about 75%. We simply shorted Hillite's order; they

HIGHLIGHTS, 90/11/09

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ended up with about 130 not 180. All devices shipped had actuations showed to the very top side of the 90 - 160 psi spec range.

We have 130 parts due on 11/14 for Kelsey-Hayes, and 650 due on 11/28 to complete Hillis's order. I have relayed this info to Scott. He seems to favor doing the 130 on one day, then doing half of the 650 on each of two subsequent days. We will close with him on this. Other issues we need to close on include automatic pressure testing, receipt of proper characters for coding crank rings with customer P/N's, and the need for more rebump caps from the model shop.

DISCS: Jeff Melton has delivered our next-iteration discs; 28 psi for use in Light Truck 250 psi applications which replaces the 26 psi discs previously used, which chronically produced devices showed low; 23.5 psi for use in Pass-Car applications, also replacing the 26 psi discs, which chronically ran high. We are now performing a standard disc life test on these. In addition, half of each disc lot will use splayed Kapton and the other half stacked Kapton, and all devices will be using the new Elco hexports to further test the integrity of the seal.

VALIDATION: Light Truck parts have completed all tests; most have completed final characterization as well. Final writeup of results will commence soon. This must be complete by next Friday; rough draft by approx. next Tuesday. Pass-Car tests are well underway and on schedule. Luckily, the Thanksgiving shutdown will not adversely affect the PC schedule.

HIGHLIGHTS
Stephen B. Offler
Week Ending 90/11/02

HEADSTAMP: Jack Varns reports that Elco has made 500 of our 2000 pieces. If necessary, these could have been hand-plated for expediency. It was decided to let Elco finish all 2K and use their standard production plating. There are expected early next week to be received via normal incoming inspection channels. Parts will be available for sample builds, etc. by mid-next week assuming they are in-spec.

I've created an BXX drawing of the Elco cold-headed blank. Mfg Eng will use this to obtain second-op quotes from various favored screw-machine houses and a couple places (including AMCC) known to have Hydramat equipment. We conjecture that the cold-headed blank should cost (ballpark) 15¢ but we have not approached Elco with this idea yet.

GEORGE GUP: Parts built in the Model Shop to the new specifications seem to be working out quite well. A production part number (27913) has been reserved, and marked-up drawings with final dimensions have been delivered to Mfg Eng for final quotes.

ALUMINUM CRIMP RING: Production part number (74707) has been reserved, and marked-up drawings delivered to Mfg Eng.

DISC: We have completed a RTe test of 27/12 and 26/11 discs (postmilled parts) using rebar wps. Both lots passed easily. With the latest rebar iteration, the ratio has changed slightly. To compensate, we have ordered 2AS rebar discs to build 125 psi devices.

VALIDATION: Light Truck testing still progresses on-schedule. This is a significant achievement in my opinion. Ron Ruggieri has been instrumental in coordinating this test program. All tests are successfully complete save the terminal strength and Impact test. We are approaching the end of Impact; the last 20K cycles are run planned. Ron is now finishing up the load time needed for this. Pass Car validation is also progressing on-schedule.

SAMPLES: 4 devices shipped to Monroe Auto Equipment to support an emergency need. These are air-devices; ultimately, a modified A/C switch may fill this need more cost-effectively. 6 devices shipped to fulfill an order to PHS, and 20 devices to Ford WINCO.

HIGHLIGHTS
Stephen B. Oeller
Week Ending 9/10/26

Handwritten signature/initials



FORD MY '92 NEXT-GENERATION SPEED CONTROL DEACTIVATE PS

HEXPORT: No new news. Elco parts still expected 9/10/31. I plan to mark-up the J512 EX print (EX3423-31) with my latest dimensions and deliver it to Matt Sellers. These dimensions still pending Ford and Tier-1 suppliers approval.

REBUMP CUP: Thirty-six Pass Car validation devices were built late last week using old, first-iteration (predeflection) rebumps. The deadline for delivery to the Chem Lab was rapidly approaching and newer iterations were not ready. For consistency, we will build the remainder of the validation parts using the same cups. This will use up most of our stock of this iteration, and the tool that created them no longer exists.

We have been through several more iterations with Model Shop support, and have arrived upon a cup design which seems acceptable. Dimensionally, this design strikes a compromise between predeflection, tooling simplification, and avoidance of converter bottoming. The bump height, 15.5 mils nominal on standard production cups, has been lowered to 12 mils to provide relief from predeflection, while still insuring that the bumps force the disc overcenter before the converter bottoms. We have built about 350 of these and tooling exists to build more.

A mini-Design Review is being planned to finalize the details of the above.

VALIDATION: Still progressing on schedule. The Light Truck parts have completed the Fluid Resistance test and have been delivered to the appropriate subsequent tests: Humidity, Salt Spray, Tensile Strength, and Impulse. The Pass Car schedule is now getting underway.

Jeff DiDomenico has completed rebuild of the cycler, successfully installing the T1315 PLC in place of the 5T1. We are now using the PLC appropriately, running all inputs and outputs through it, rather than the previous Mickey Mouse setup which partially bypassed the 5T1 with a conglomeration of relays and latching relays. All subsystems have been tested and are functional.

Ron Ruggieri is in the process of completing the inductance load bank, required to complete the final 25K cycles of the 500K cycle impulse test for validation. Additionally, this equipment is planned for use in lifetesting Andy McKenna's 77PS switch design. He has run to 2X life on the spring arms with good results, however this testing has been unpowered. Powered lifetesting to failure will allow Weibull analyses and iterations to the contact system if required.

MISC. PARTS: Production prints of the offset-polarity-key 46412 base, the aluminum crimp ring, and the rebump cup are planned.

HIGHLIGHTS

Stephen B. Offler

Week Ending 10/18/90

OVERTIME: Ron Ruggieri, Saturday 10/20, 4 hours

VACATION: Jeff DiDomenico, 10/19 and 10/22

Steve Offler, 10/19

FORD MY'92 NEXT-GENERATION SPEED CONTROL DEACTIVATE PS

HEXPORT: I have conveyed the results of the J512 tolerance relaxation study to Bruce Pease for his meeting with Jim Costas at Kelsey-Hayes. We're now awaiting word from Bruce on the finalized detail changes to J512. We will begin to test the new tolerances immediately when they are finalized and approved by all.

Elco will not be able to ship CNC hexports by 10/22; it presently looks more like 10/31. We are giving this matter as much attention as possible, although it appears that Purchasing does not view this as being as critical as we do. We've received another 100 hexports from the model shop. The decision was made to plate them in Bld 11 (rather than ship them back to Elco to receive a "production-insert" plating). These will be used to begin to fill our customer sample backlog. We plan to partial-ship to everyone with Marketing inputs; furthermore we may need to have yet another 100 parts cut in the model shop to finish out the orders, TBD.

I have double-checked with Keith Roberts regarding APCC screw machine doing final-op's on Elco blanks or partially-finished parts. The situation is we never got a formal reply, but rather word-of-mouth between Keith and Gamal Abdel-Fattah. APCC made an attempt to second-op 27372's with very poor results, leaving them very non-committal and vague about doing this in production.

REBUMP CUP: Of the three possible configurations, we were leaning towards the lowered-bump, above the "standard" parts producing pre-deflection and the deeper draw parts which require extensive tooling changes. We have been working with the model shop to create prototypes of these. This has required several iterations. After restamping to move the bump, it was found to be too large (deep). This required the cup to be inverted and squeezed down. Then, we found the pin guides too small, and had to redill them. Then, we built a few devices and found very high actuations, around 160 psi when we expected 125 psi. This effort has reached an imperative level. Cups are needed to build devices which must be completed and delivered to the Chem Lab this Monday at 2:00 pm for the fluid resistance test. The decision has been made to use "old" rebumps (the original iteration), which produce pre-deflected discs but also produce devices with correct actuations.

We are planning a mini informal design review for early next week to go over the above, and to decide upon the best bump configuration for the rebump keeping in mind the cost and complexity of making substantial changes to the present Valentine stamping tool.

VALIDATION: Light Truck is progressing on-schedule. Gating Horn on Pass Car is build of 36 devices for the fluid resistance test. Also needed to prep devices are 36 sets of dummy wire leads and J512 plugs to seal both ends of the devices. I have spoken with Joe Schuck regarding the SREA that Bruce has requested which gives us permission to use non-production centered polarity tabs on the Pass-Car devices. Our marketing people have the blank form that is required, and this should present no problem at all.

HIGHLIGHTS
Stephen B. Offler
Week Ending 10/12/90

Handwritten signature/initials
10/12/90



FORD MY'92 NEXT-GENERATION SPEED CONTROL DEACTIVATE PS

HEXPORT: The J512 paper study was completed. I have arrived upon 5.45 - 5.85 mm for the diameter of the sealing surface chamfer. Our next step is to have the model shop create parts at these extremes for testing. My results were fax'ed to Bruce Pense in time for a meeting between Bruce and Jim Coombs of Kelsey-Hayes. Jim has proposed different changes to our part, lengthening the dog point to eliminate the chance of thread bottoming. We must reach a consensus between Bruce, George Randall, Jim, any other suppliers of the mating part, and TI. Ultimately I plan to communicate the final dimensions to the SAB committee which writes J512.

We have built 80 hexports for Pass-Car validation in the model shop, and had them plated by Elco. These parts were received on-time yesterday. We've done a quick check on the threads and on the J512 chamfer (old spec) and they look okay.

REBUMP CUP: We asked the model shop to build parts to each of the three potential configurations. These are 1) just moving in cup bump; 2) moving in cup bump and increasing draw depth; 3) moving cup bump in and reducing its height. This effort is to allow us to assess the magnitude of the disc predeflection issue, and whether it is really an issue at all. All previous model shop rebump cups, used for testing and samples to-date, have been configuration #1 above. They made a tool to stretch the draw depth dimension (configuration #2), but the parts they delivered to us were over the spec by an average of 7.5 mils. They also made an attempt at configuration #3, but these were under the spec by an average of 12.2 mils and the sigma was more than 1 O.M. worse than the other two lots. I plan to speak with Ed McPherson to attempt to rectify this situation.

I have reopened the paper study on the cup/converter/disc dimensional stackup which was partially completed a few months ago. I have written a computer program which uses disc crown height (amongst other variables) to calculate the disc's geometry and the required cup bump and converter bump dimensions. Executing this program, I am leaning towards configuration #3 as the final solution. The program shows that the minimum bump height needed for rebumps is .0086" while for standard bumps is .0135". The only other issue to deal with is whether Valentine can stamp a (nom.) .010" high bump while maintaining a suitable radius.

One other issue that this paper study highlights is the bending of the washer that takes place during crimp, which has the effect of reducing the available room for the disc. (The other problem this bending creates is that it widens the gasket gland, reducing compression.) For simplicity my paper study assumed a flat washer. The reason that the washer bends is because the three square pieces of .005" Kapton have a full .015" thickness at the center, which tapers to .010" at some radius and to .005" at the outermost. When constructing test parts I plan to build a few with full-round Kaptons, which will maintain the .015" thickness all the way to the edges.

VALIDATION: The Light Truck production validation testing is progressing on schedule. We completed the thermal cycle test without incident, and ETL has completed the vibration test. For the Pass Car testing, we are beginning to put plans in place. We've contacted the

HIGHLIGHTS
Stephen B. Offler
Week Ending 10/03/90

FORD MY'92 NEXT-GENERATION SPEED CONTROL DEACTIVATE FS

HEXPORT: The paper study of the J512 tolerance stackups is nearly complete. Three conditions are being studied: 1) reaching the end of the female thread before the sealing surfaces make proper contact; 2) bottoming on the dog point before the seals make proper contact; and 3) sealing contact too soon, such that insufficient sealing surface is utilized. Both Ford and Kelsey-Hayes have uncovered a concern over condition 1 above, however my layout shows this condition really isn't a problem if the thread is chamfered properly. More importantly, I found a problem with condition 2 above which everyone else seems to be ignoring. This is significant because the fix for this condition will also have a positive impact on condition 1. In order to insure that the cone surfaces meet before the dog point bottoms, the maximum diameter of the female cone (our hexport) must be reduced. J512 calls out .237" max dia, which allows 1.3 mils clearance at worst-case tolerances BUT with zero runout. (Including worst-case runout, there is the potential for 11.3 mils clearance.) To completely avoid this, I have calculated that the female cone max diameter should be no larger than .221". To help in determining the minimum diameter, I called Bob Henderson at Elco to find out if tolerances looser than their stated $\pm .005$ will further reduce the price. His answer was "no". I am completing the paper study assuming the new size of the female cone is .204" - .220". (I am using $\pm .006$ simply to help Cpk look better.) Upon completion, I plan to share this information with Ford, and to begin testing parts built in the model shop to the new size limits.

Elco has informed us that they cannot meet our 10/12/90 date with CNC hexports due to a problem with their collet supplier. Our last-ditch fallback, which incidentally breaks the ISIR rules into a pretzel, is to build Pass-Car ISIR hexports in the model shop and send them to Elco for plating, so that at the very least they have a production-representative plating process. The model shop will deliver 80 parts on or before 3:00 pm, 10/11/90. We will overnight these to Elco to be hand-carried through their plating process and returned to us the same day via overnight so we have parts in-hand for ISIR build on Monday 10/15/90. Note that we are assuming a lot of cooperation and absolutely top priority on everything. We hope to have a quantity of about 2000 CNC hexports for use in customer sample builds by the end of the month.

REBUMP CUP: We have three options available to us with Valentine and the present 27288 cup tool. The first is both modifications: bump diameter and draw depth. This is quoted at \$17.75K and 18 weeks. The second is only the diameter change. This is quoted at \$10.9K and 12 weeks. The third is changing the bump diameter and also reducing its height which negates the need to change the draw depth. This is also quoted at \$10.9K and 12 weeks. The first option is the "right" way to do it. The second will result in disc pre-deflection. The third may cause problems because the radius of the bump may be inconsistent and have drastic effects on amplification ratio and ultimately device sigma's. We are presently working with Mfg. Eng. to develop a test plan to determine if pre-deflection (option 2) is really a problem.

REVALIDATION: The Light Truck validation testing is progressing on schedule. The thermal cycle test will be complete today. After 23 of 25 cycles we have observed no problems whatsoever, which means the planned second iteration of this test won't be needed. Ron Ruggieri has been communicating with George O'Leary to insure that our Environmental Labs tests will be completed on schedule as well.

HIGHLIGHTS 10/05/90

Page 2

Because we cannot obtain offset-polarity-key mating connectors in time, the Pass Car ISIR testing will be conducted with standard bases. I spoke with Bruce Pease about this, and he has given us a verbal okay. We must do some paperwork to make this change official. This is an SREA - Supplier Request for Engineering Approval. I have asked Joe Schack to complete this, although I've gotten no response as yet. Parts built for the dimensional study will in fact use the offset key, because those must match the envelope print.

SAMPLES: As of now, we have given up trying to obtain accurate estimates of everyone's sample requirements. This effort false-started several times and ultimately was a waste of time. At this point, our sample plan is to keep an adequate inventory of at least several hundred of everything, and to continue to utilize the production line as needed for actual builds.

We have been verbally informed that Surfaces will need 800 samples for use in their ISIR to Ford. This will require Elco CNC hexports expected at the end of October, as well as co-ordination with the 57PS line. Charlie Douglas has asked us to calculate a true sample build cost, since he plans to drop the sample price from the present \$50/each as quantities increase.

We have shipped 25 samples for George Randall. This has basically used most of our inventory of model-shop J512 hexports.

We owe Gary Klingler 100 devices; 50 at the Pass Car spec and 50 at the Light Truck spec. We have discovered that we can use o-ring hexports for these for expediency.

We got an emergency request for 20 devices from Jack Hitchcock at Highlight Industries. These are being used in brake subsystems being sampled to Ford and as such require the J512 hexport. We are so low on inventory that we have begun to disassemble ISIR validation devices to re-use the hexports. We are partial-shipping about 6 devices today, and the balance whenever we can get more hexports.

~~Auto (Quick-D)~~

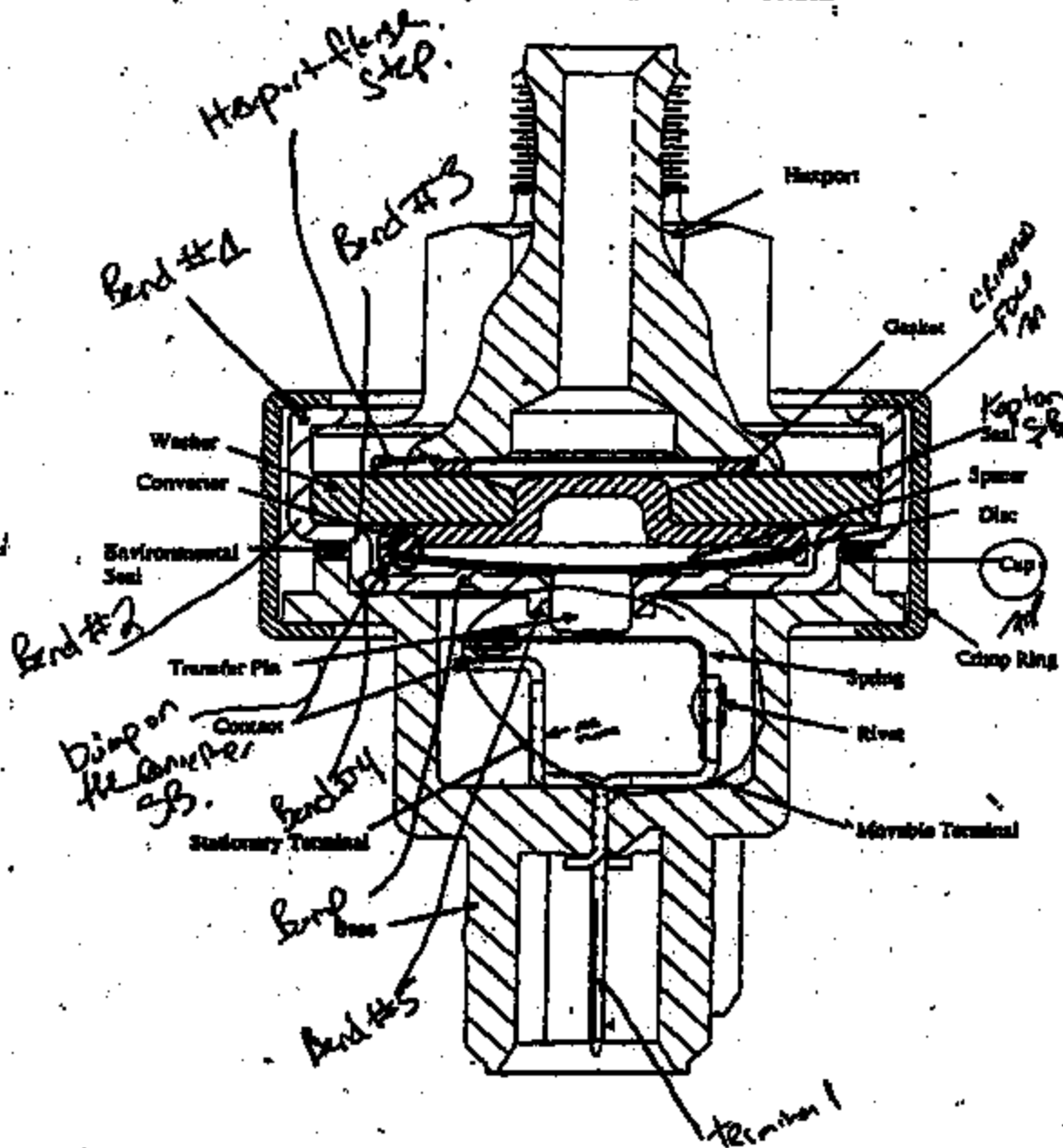
Charlie was recently contacted by one of the WINES guys working with Phil Goncalves. Apparently they are looking for devices with LOWER actuations, below 100 psi (!). We owe them a response on our low-link capability by Monday.

CYCLES: This week we experienced our third STI sequencer failure in several months. This STI equipment is archaic, and becoming scarce and expensive to service. I am strongly in favor of complete replacement of our STI system with a modern TI 315 PLC. We are presently working with Mike Glis of Mechanization to determine if the 315 will meet our needs. It is the least-expensive member of TI's PLC lineup... somewhere in the \$400 range. Mechanization is beginning to use 315's wherever they can. Furthermore, complete rebuild of our cycler's controller will allow us to rectify several problems which were not properly debugged when the cycler was first built. For example, we recently discovered that the low-hydraulic-fluid circuit was either improperly designed or improperly programmed, rendering our cycler unfit to be offered to our customers.

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ATTACHMENT 6

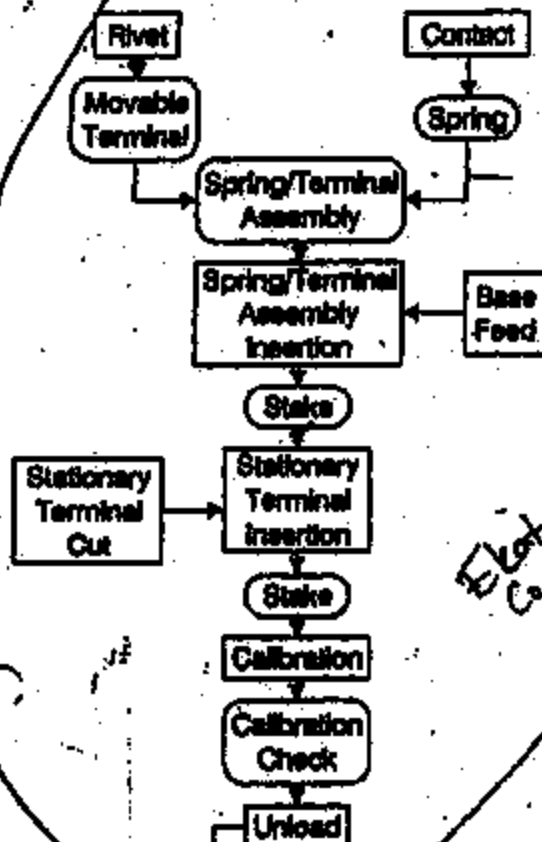
Hydraulic Pressure Switch Cross Section



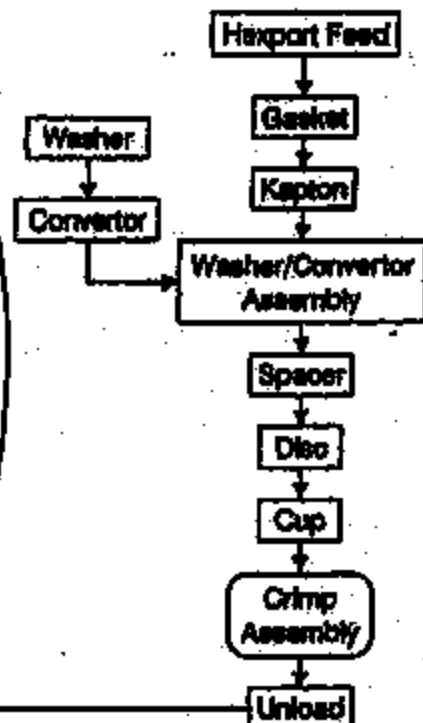
FORD NEXT GENERATION SPEED CONTROL

PROCESS FLOW CHART 77P8L2-1/2-3

BASE ASSEMBLY

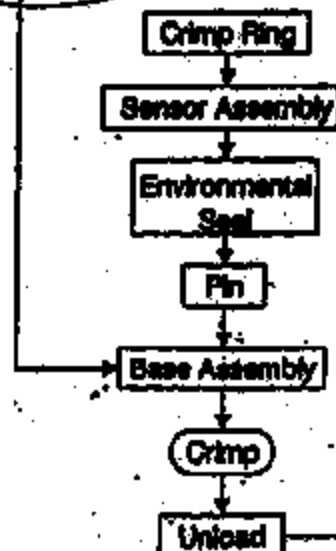


SENSOR ASSEMBLY

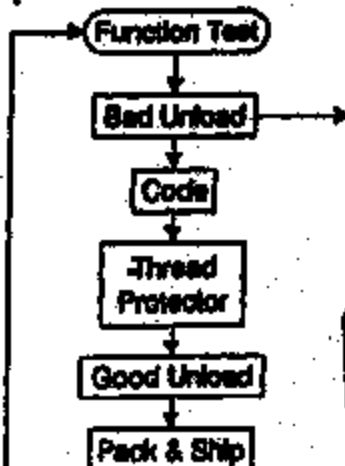


CONFIDENTIAL

FINAL ASSEMBLY



PRESSURE TESTER



EXHIBIT

3

SPC Operation

Standard Operation

TI-NHTSA 015587

MN 05/27/01

IN THE CIRCUIT COURT OF JACKSON COUNTY, MISSISSIPPI

PLAINTIFFS

VERSUS

CASE NO. CI-99-0211(3)

FORD MOTOR COMPANY, D & L, INC. OF
COLLINS Div. D & L, FORD, INC., WOOLWINE
FORD LINCOLN-MERCURY, INC., Successor in
Interest to D&L FORD, INC., E.I. DU PONT DE
NEMOURS AND COMPANY, AND TEXAS
INSTRUMENTS INCORPORATED

DEFENDANTS

**PLAINTIFFS' RE-NOTICE OF INTENTION TO TAKE ORAL AND
VIDEOTAPE DEPOSITION OF
TEXAS INSTRUMENTS INCORPORATED**

TO: Texas Instruments Incorporated
c/o Stephen W. Barrow, Esquire
Collins, Williams, Heidelberg, Steinberger & McElhenny, P.A.
Post Office Box 1407, Pascagoula, MS 39568-1407

PLEASE TAKE NOTICE that pursuant to the Mississippi Rules of Civil Procedure,

Plaintiffs will take under oath and before a qualified court reporter, the oral deposition of Texas
Instruments' corporate representative(s) on Friday, June 30, 2000 at 9:00 o'clock a.m. at the
Courtyard Marriott, 35 Foxboro Boulevard, Foxboro, Massachusetts (Tel: 508-543-5222).

The Corporate Representative(s) shall have knowledge of the following subject matters:

1. All issues related to the design and manufacture of hydraulic pressure switches by
Texas Instruments.
2. All issues related to the specific design and method of manufacturing the 77PS2-1
switch.
3. All issues related to alternative designs considered by Texas Instruments for the
77PS2-1 switch and other brake pressure switches.
4. The history of Texas Instruments' design and manufacture of brake pressure
switches.

EXHIBIT

4

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5. The identity of all claims and lawsuits which allege that any under the hood vehicle fire was caused by a brake pressure switch manufactured by Texas Instruments.
6. The identity of all claims and lawsuits wherein Texas Instruments inspected the plaintiff's vehicle.
7. All issues related to Texas Instruments' investigations into and conclusions regarding the cause and/or origin of any under the hood vehicle fire.
8. The date and form of notice received by Texas Instruments regarding any under the hood vehicle fire.
9. Any aspect of Texas Instruments' communication with Ford, Depong, or any other party about the design and manufacture of hydraulic switches, the investigation of alleged under the hood fires, the recall of Ford vehicles, and any other issue related to the above referenced cases.
10. The identity of every photograph, document, and report in the custody of Texas Instruments relating to any under the hood vehicle fire.
11. The gathering and production of documents in response to the Plaintiffs' discovery requests.
12. Texas Instruments' document retention and data storage policies.
13. All issues related to the use of Kapton in Texas Instruments' hydraulic pressure switches.
14. All issues related to the process of crimping Kapton onto Texas Instruments' hydraulic pressure switches.
15. All issues related to the identity of other Texas Instruments employees with knowledge related to the above referenced lawsuits.

The Witnesses shall produce the following documents:

1. All documents which relate to the design and manufacture of the subject Texas Instruments' speed control deactivation switch.
2. All documents related to the specific design and method of manufacturing the 77P52-1 switch.
3. All documents related to alternative designs and alternative components considered by Texas Instruments for the 77P52-1 switch and other brake pressure switches or recommended by any person or entity.
4. All documents reflecting all considerations regarding the design and manufacture of the subject Texas Instruments' speed control deactivation switch.
5. All documents necessary to identify all claims and lawsuits which allege that any under the hood vehicle fire was caused by the subject Texas Instruments' speed control deactivation switch or any substantially similar switch.
6. All documents necessary to identify all claims and lawsuits wherein Texas Instruments inspected the Plaintiffs' vehicle.
7. All documents necessary to establish findings and conclusions of Texas Instruments' investigation(s) into the cause and/or origin of any under the hood vehicle fire allegedly caused by the subject Texas Instruments speed control deactivation switch or any substantially similar switch.
8. All documents necessary to establish the date and form of notice received by Texas Instruments regarding any under the hood vehicle fire in which the subject Texas Instruments' speed control deactivation switch was the suspected or alleged cause.

9. All documents necessary to reflect all communications Texas Instruments has had with Ford, DuPont, or any other person or entity relevant to the design and manufacture of hydraulic switches, the components used or suggested for the subject switch, the investigation of alleged under the hood fires involving the subject Texas Instruments' speed control deactivation switch or any substantially similar switch, and the recall of the subject Ford vehicles.

10. All photographs, documents, and reports in the custody of Texas Instruments relating to any under the hood vehicle fire involving the subject vehicle line and any other vehicle line utilizing the subject Texas Instruments' speed control deactivation switch or any substantially similar switch.

11. Texas Instruments' document retention and data storage policies.

12. All documents discussing or which relate to the process of crimping Kapton on the subject Texas Instruments' speed control deactivation switch.

13. All documents discussing the Kapton specifications and criteria used, selected, considered and/or suggested by any person or entity for use with the subject Texas Instruments' speed control deactivation switch or any substantially similar switch.

Dated: June 21, 2000

Respectfully submitted,

ON BEHALF OF THE PLAINTIFFS


SCOTT C. TAYLOR, ESQUIRE

OF COUNSEL FOR THE PLAINTIFFS:

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TI-NHTSA 015591

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Fax: (228) 762-3223

CERTIFICATE OF SERVICE

I, Scott C. Taylor, do hereby certify that I have this day, sent via facsimile, a true and correct copy of the above and foregoing pleading to all counsel of record.

This the 21st day of June, 2000.



SCOTT C. TAYLOR

~~11/11/00/11/11/00/11/11/00~~