EATON

Internal Correspondence

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Copy: See Distribution

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Subject: MONTHLY REPORT-APRIL, 1985

MEDIUM DUTY HYPOID AXLES

In response to requests from GMC at the March 27 meeting, a set of unmarked carrier, bearing cage, and head assembly drawings (required for chassis clearance studies) was sent to Rick Nelson. Also, a memo was written to Marketing to initiate action on brake line bracket studs, and a memo was issued identifying revised ratio requirements.

A meeting was held with Ernie Fasick of IHC on March 28 to discuss product specifications for the new hypoid and two-speed axles. Ernie expressed general satisfaction with the Product Specification Book, but was not prepared to discuss specific issues. Ernie was advised that a revised Product Specification Book would be issued, and was asked to review it in detail. The revised specifications were issued on April 2.

Timken has provided bearing life calculations for the 19050S and 21065S axles. The calculations have not been reviewed in detail, but the results are encouraging.

SKF has also provided bearing life calculations for the 19050S and 21065S axles. However, there were some obvious problems with the calculations. SKF is now revising the calculations.

Both Timken and SKF are working on bearing life calculations for the 15040S.

Purchasing has selected Doktas as the vendor to supply all hypoid axle castings. A meeting was held with Doktas representatives on April 29 to review drawings of the 15040S, 19050S, and 21065S. We discussed the need for an insert on the carrier patterns so that one pattern can make both standard and differential lock carriers.

Manufacturing Services has tentatively selected Grob as the vendor to supply the hypoid carrier transfer line. We are now evaluating several changes to our carrier casting and machining drawings proposed by Grob.

We have reviewed the changes to the hypoid pinion bearing cage drawings proposed by Peter Brown. Engineering is summarizing our conclusions, and will respond to Manufacturing Services.

The LIFE program has been updated to incorporate a more sophisticated model of starting conditions. The previous model was found to be very crude.

Axle Housings

Testing: Housing fatigue tests are scheduled to begin in July.

Design: A meeting was held this month between S. Evans, W. Hails and J. Thompson to discuss European load ratings and transition location requirements. The load rating portion of the meeting came to the following conclusions:

- Load rating calculation method is approximately the same between the U.S. and U.K.
- 15040S rating in U.K. to be 17,000 lbs. England to do immediate resonant wide track testing on 15 Series axle at 17,000 lbs.
- 19050S rating in U.K. to be 20,240 lbs. England to do immediate resonant wide track testing on 17 Series axle at 20,240 lbs.
- 21065S rating in U.K. to be 23,100 lbs. Spindle stresses are no problem. Galesburg testing of 22 Series axle at 23 series loads were excellent so no problem is expected with 21065S arm sections.
- Contingency plans for spindles are as follows: (1) Induction harden inner bearing surface, (2) radius change on spindle inner bearing journal, (3) reduce spindle bore.

The following conclusions were made regarding transition location:

- The MAN Model 3/19050S has approximately 3.5 mm of brake flange overlap into the transition area with current 19050S design and the new Girling brake.
- The following items are changes which could be made to correct the situation: (1) shorten transition area, (2) move transition, (3) weld as is - consult Pamplona and MAN, (4) reduce boss length on backside of brake flange.
- MAN Model 3 can utilize U.S. housing with the new Girling brake and slight housing modification.
- The Bedford 68" track 19050 cannot use the new Girling brake without round arm housing.
- Transition would have to move 19 mm for old Girling brake.
- Track break point for round versus square arm is 68" track. Bedford alternative is to accept 69" track.
- U.S. cannot move transition 19 mm due to customer demands.
- U.K. will discuss this situation with their Marketing people.

Drafting: The only item left to finalize on all hypoid housings is the cutout for the differential lock option. The 30105S housing must be drawn, but the spindle design is not yet final. Drafting is currently working on the newly requested shock absorber brackets for the 1989 GMC coordinated chassis

program. Housings to be installed at Bedford in the May/June time frame, and include our 16, 17, and 23 Series spiral bevel axles. These trucks will then be shipped to the U.S. in August for changeout to hypoids on new two-speed models. Design Services does not feel these brackets can be drawn until May 15, 1985. We are working to complete these as soon as possible.

Timing: On schedule.

15040S Axles - The pinion bearing cage casting sample has been inspected and approved. The right bearing cap casting sample has been recieved and is being inspected. All other casting samples will be shipped to Galesburg by May 10. Purchasing is working to reduce the timing. At this point, we are about three weeks behind schedule.

The 5.29 ratio is ready for lapping. Three different pinion developments have been made for this ratio. The 1315AQ mounting geometry was used for this ratio. The 6.17 ratio will be developed next, also using 1315AQ mounting geometry. The 4.88 and 5.83 ratios will follow the 6.17, and will most likely have 15040S mounting geometry. These ratios encompass four of the five needed for GMC (the fifth is the 7.17).

Manchester Engineering has experienced failures of differential side gear hubs and axle shafts in Volvo vehicle tests of the 15199. These failures may indicate a problem with the 15040S design, as the differential and axle shafts are common between the 15199 and 15040S. Considering that the 15040S will be rated at 17,000 lbs. GAWR in the U.K., there is reason for concern. It is possible that the side gear hub wall will be thickened and that the axle shaft body diameter will be increased.

19050S Axle - All casting samples except for the carrier have been received, inspected, and approved. Prototype quantities of the pinion bearing cage casting, bearing cap castings, and right adjuster casting have been received and shipped to Danroy Boring for machining. The carrier sample has been delayed because the pattern had to be reworked. Engineering is working through Purchasing to pressure Grede to expedite the carrier sample. At this point we are about three weeks behind schedule.

The spider forging is behind schedule. Purchasing is determining what is necessary to obtain higher priority in Marion. If necessary, a small quantity of 19050S differential cases will be machined to accept the current 16 Series differential to avoid delaying dynamometer testing.

Four 17.5 RI ratios are ready for inpact testing - 4.11, 4.63, 5.79, and 6.17. They were be shipped to Galesburg the week of April 29, and are now on test.

Forging of prototype parts was completed on April 19, 1985. We anticipate prototype parts will be available for testing by the end of May considering current manufacturing priorities.

21065S Axle - CAD design completed the "generic" blank drawings for the larger gears and pinions, the clearance study of housing cutouts, and the capscrew for carrier mounting.

The new carrier casting, product and assembly details for the 10 mm larger diameter gearing was also completed. The prototype casting supplier, Total Industries, has already begun to modify the patterns and expects to deliver samples May 15. Engineering and the metallurgical lab reviewed casting and dimensional problems found on the samples with Total on April 26. They will make process adjustments and pattern corrections, and begin pouring Level 1 designs the week of May 6.

Hypoid gear dimensions for twelve of the sixteen ratios were received from Gear Engineering on April 12. Data for the 6.17 ratio is required to complete those needed for GMC. Approximately 300 each of gear and pinion forgings have been received in Glasgow to begin development of the larger gearing. Marion Forge has finally replied that the gear forging die can be altered for larger diameter and face width gears. They have been asked to provide forgings by May 13.

The Level 1 design revisions for larger gearing will cost the 21065S program about six weeks. Scheduled dates for head testing now begin in late June, and production release should occur October 15.

Carrier, bearing cage, pinion, and head assembly details were made available for GMC chassis layout and clearance studies on April 22.

Head assemblies for the 22120 gearing baseline tests were ordered and received. Test results to date have been unsatisfactory and below the levels of previous 22120 tests. Test Engineering is analyzing the results, determining their causes in terms of gearing and test equipment, and will issue a report May 6.

23070S Axle - Progress is being made in drafting, and nearly all drawings have been submitted for checking. Some design problems remain, and are being addressed.

The biggest problem to be solved involves installation clearance between the 3.08 - 3.55 gears and the housing ring. As the designs now stand, we have an interference condition. The solution will most likely require a larger chamfer on the backface of the gears and a larger housing cutout.

Engineering has begun investigating whether or not it would be possible to enlarge gear diameters. Due to the problem mentioned above, it is apparent that the gears could not be enlarged for the faster ratios. It appears that the gears for the slower ratios could be enlarged, although it has not yet determined by how much.

Design Services has been asked to arrange to have a bill of materials prepared for the 23070S.

The design is still scheduled for prerelease by May 13.

23070T Axle - The basis for this model is the 22220. Engineering will analyze the primary gearing, planetary gearing, bearings, differential gearing, and axle shaft with regard to the intended applications. It is anticipated that no changes will be made to the planetary gearing or differential gearing. The primary gearing may be upgraded by material or processing changes, and certain bearings may be upsized. The axle shaft may also be upsized. Our goal is to achieve a satisfactory design and minimize changes to existing tooling and patterns.

Differential Lock Models - In a recent meeting with Manchester Engineering, Bedford identified differential lock chassis clearance as a major issue, both for Eaton and for our competitors. Rockwell CVC and others have encountered problems with differential lock shift unit interference with Bedford chassis. The space restriction for the differential lock shift mechanism has been determined from axle assembly drawings of current production axles. A project engineer from the European Engineering Centre spent several days at Bedford Trucks the week of April 29th to obtain full axle interface details for all Bedford truck models. This should provide more details on the space restrictions. No further differential lock design schemes have been drawn.

Manufacturing Technology Task Force - Electron beam welding (EBW) assembled differential cases are being considered for hypoid axles. The 21065S will be tested with some of the differential case assemblies EBW together. Sales and Service have been contacted to assess the impact on the customer.

Forged flats on the spiders are currently incorporated on the 35327 model. Design work will be initiated in May to incorporate this feature on all remaining models.

Powder metal adjusters have been determined to be financially unattractive.

A team was formed of five manufacturing engineers from the Henderson, Glasgow, and Gallatin plants devoting 100% of their time to investigate the most cost effective way to produce an axle. The objective is to use state of the art production techniques and thereby reduce the cost of the axles. Dick Baugh will interface the team with Product Engineering.

NEW CLASS 8 SINGLE-SPEED AXLES

E2300S - Three 3.08:1 ratio gear sets with vendor shot peening have successfully completed dynamometer fatigue testing with tests being suspended at 200,000 cycles. Slight concave root line pitting was observed on all pinions at the end of the test. Carriers from these tests will be returned to Henderson for inspection to determine if dynamometer loads caused carrier yielding. Impact testing is required prior to release of the 3.08:1 ratio. Three 3.08:1 ratio gear sets without shot peening failed due to pinion tooth bending fatigue at 32,000, 34,000, and 55,000 cycles.

Effective April 11, 1985, all E2300 axles will utilize shouldered pilot bearings that are staked to the pinion stub.

E2300S Housing Program - Drawings have been changed and checked for modification to the ring gear cutouts and CTD clearance cutouts. Currently check changes are being made, and are expected to be released this month.

E2300 CTD - Design revisions are under way to correct the problem of the sliding curvic clutch becoming completely disengaged from the clutch pack. When this occurs, the clutch and plate splines become misaligned, preventing re-engagement of the controlled traction mode. The interim solution will be to attach a pressure plate to the flanged half differential case with structural adhesive to shim the clutch pack over enough to maintain sliding clutch engagement with one clutch plate. A permanent solution will consist of adding material to the differential case, and using shorter springs to allow moving the clutch pack far enough to allow a minimum of three clutch plates to be engaged with the sliding clutch gear when the controlled traction feature is disengaged.

Vehicle data acquisition testing of the E2300 CTD was conducted at the Proving Ground to evaluate bias torque under various operating conditions.

Rockwell R-170 high pack clutch kits have been received, and will be used to complete the rotary actuator clutch breakaway torque comparison of Eaton and Rockwell biasing differentials.

NEW ELECTRIC SHIFT SYSTEM

The third electric shift unit task force meeting was held on April 30, 1985. Key activities to take place prior to the fourth meeting on May 21, 1985 will include:

- Vehicle Data Acquisition
- Redefine Test Plan
- Evaluation of New Components
- Consolidation of FMEA (CORD-MC, CORD-DC, Axle & Brake Division)

An additional 65 IHC warranty return units have been anaylzed in addition to the previous 54 IHC units. Failure analysis results were similar to the group of 54 units.

A parallel effort to the CORD-MC project has been undertaken by Axle & Brake Division and CORD-DC Materials Departments to understand switch contact contamination phenomena. A joint meeting is being rescheduled for the week of May 13, 1985. Analysis remains ongoing.

Baseline shift unit truck testing has been completed, resulting in swivel block and swivel block pin separation at the following cycles: 250, 416, 550, 617, 660, and 857. The first comparison set will consist of hot upset swivel block pins with an orbital spun swivel block attachment process. The second comparison set will consist of sliders with orbital spun swivel block pins and swivel blocks.

Swivel block tensile tests have been conducted. The original Boehm process was replaced with the Rockford process on March 29, 1985 as an interim improvement before the orbital spun process could be evaluated. The orbital spun process will be implemented in production on May 6, 1985.

The swivel block pin attachment process is also being evaluated. On March 29, 1985, the Boehm process was replaced with the Konigslow hot upset process. Comparisons of the Boehm cold upset, Konigslow hot upset, and VSI orbital spun processes will be made using lab and truck test methods when samples have been received.

CENTRAL TIRE INFLATION (M939 REBUY)

Prototype Program - The installation and debugging of prototype control components in the M939 concept truck is complete. All features (including software improvements) work as intended and deflate time improvement is being verified. The truck will be available at the Marshall Proving Grounds for evaluation.

We have been informed by the U.S. Army TACOM that we will be able to obtain an M939 cargo truck. Necessary paperwork is being forwarded to us for purposes of documenting our request. All CTI componentry is available for retrofit, and should be installed four weeks after receipt of vehicle. This does not include the necessary acquisition of wheels and tires, nor the hubs with internal cast passages. A source for the hub (Webb) has designed and costed a hub for this application, and will provide us with a quote by May 10, 1985.

Test Program - A seal test fixture has been designed at ERC to test three seals at once, and fabrication is under way. A test schedule for both the seals and control components is being finalized, and will be distributed when complete.

Cold testing of the Williams 616A quick release valve has shown that it will not function at temperatures below -28°F due to the hardening of the diaphragm. Williams has been contacted to determine what changes can be done to assure operation at colder temperatures.

Miscellaneous - Gary Schultz made a presentation to Transport Canada and Canadian Army officials at the ARMX-85 exposition in Ottawa, Canada, on April 22, 1985. It was well received; however, a rate of deflation of under 15 seconds is required for the airport crash vehicles which are of present concern. This rate is not achievable with our current equipment. However, a simple deflate only system can be devised using our wheel seals which would meet the 15 second objective at far less cost than they are currently considering. This approach wil be detailed in a separate memo.

NEW MILITARY AXLE

A meeting was held on April 25, 1985 with GMC Military Vehicles Operation to discuss their axle needs for the new medium family. They were excited to hear of our interest in designing a new axle for this program, and will be very willing to help evaluate our concepts for suitability to their vehicle approach. They did comment that our "competition" appeared to be pushing an approach that was less than desirable to GMC, and asked that we keep in touch on a monthly basis for purposes of mutual direction. Meetings are being scheduled with other OEMs to review their needs also.

Hydreco-Hawworthy declined to supply us one of their hub reduction axles, so we will not be able to review their design.

The search for candidates for this program continues. Ads have been placed, and new resumes are being reviewed.

TANDEM AXLES

Output Shaft Failures - Output shaft testing is now being handled by Product Validation.

Test pieces for our steel-on-steel testing, where the bushing is eliminated from the output shaft bore, have been completed. The initial test pieces will run with 0.0045" diametral clearance, and one oil flat .337" wide. If testing shows that an additional oil flat is required, a second will be machined.

Biasing of the rear cover bearing bore by .070" TIR for a field fix (service cover) has been put on hold due to possible adverse loading on the cover bearing generated by the intentional misalignment.

Henderson is working on producing a rear cover with the bearing bore biased toward the 3:00 position by .015" (.030" TIR). This will become the production cover.

Testing continues to determine if the use of a crowned input shaft in the field fix can eliminate awkward cover alignment procedure. One test based on worst case misalignment has resulted in bushing walkout. Causes of this are under review.

D460-P New Design Lube Pump Drive Gearing - Pump gear blank samples of HR C-4130 steel have been received from Wisconsin Fineblanking for metallurgical review. Also received was their proposals for round tooth tips which are being reviewed by Engineering.

Twenty-two prototype pump gears were given to Manufacturing Engineering as part of the material requested by Don Harbin for installation in additional Canadian trucks.

The second set of parts completed 400 hours of testing, was inspected, and continues at 700 hours. The pump gear had minor wear across 1/2 to 3/4 of the tooth drive side face widths and the input shaft had less wear. This high contact ratio design continues to show significant improvement in durability.

Oil Pump Cover No. 102607 - Burgess-Norton has removed the groove that surrounded the gear pocket. They removed this for reasons not yet defined, but it could be because they ran some efficiency tests and found substantial loss in performance.

The idea of changing the outside contour to be identical to Transmission Division's part is an excellent idea, however we were never approached to make sure no other characteristics are different. We believe the O-ring groove depth in our part is shallower than Transmission Division's. We will verify this.

SHIFT CONTROL SYSTEMS

Midland Berg Inter-Axle Differential Shift Unit - Midland-Berg is currently preparing tooling for the .565" stroke piston (straight air, non-lube pump). They are concentrating on reducing the lead time of 26 weeks to 20 weeks. They are also beginning design work on the unit to be used with dual range tandems.

We have contacted ERC concerning testing of the Midland-Berg shift unit. They will submit a revised cost outline of the test program, basically excluding the salt spray test. They will also figure cost for performing data acquisition to be utilized for lab testing. ERC suggested that this be done under a program opened by Axle & Brake Division for data acquisition.

R-Head Shift Unit - Part No. 84798 is now undergoing checking. The drill and tap dimensions were used to fabricate an R-head unit with provisions for an electrical switch attachment (No. 56658). The dimensions worked out well for location and depth. As soon as the drawing is checked, it will be submitted to Purchasing for a formal quote.

CTD Air Shift Unit for LVS Vehicle - It appears at this time that Eaton will perform the drill and tapping of the shift unit housing so that the relief valve can be installed. We may also be installing the valve itself. This is not firm, but Manufacturing is reviewing this at the request of Marketing. It may be a good idea for Eaton to do the required operations, because if Oshkosh were to do so, it would be necessary to provide them with shift units partially disassembled, include a cork gasket, and drawings. Accurate Die Casting has already verbally responded regarding the removal of the now existing vent in the side of the No. 84798 and No. 84797. Removal would require the absence of the core pin which can be removed from the die. Accurate Die would want some notice and idea of how many would be needed.

Timed Inter-Axle Differential (IAD) Shift System - Purchasing has not yet responded regarding the issue of purchasing the switch from TRW with Ford Motor Company's permission.

Have received eight prototype wire harnesses from Murphy Industries.

We have ordered enough components to put together ten prototype systems; six for testing at ERC, the remaining 4 will be used for initial in-vehicle testing.

ALL-WHEEL DRIVE SYSTEMS

Georgia Power Front Output Shaft Failure - Georgia Power has not yet installed the replacement parts in the 230T4 axle. They plan to purchase ten more vehicles using our 220T4; but need assurance that a similar failure does not occur in the 220T4's. Therefore, Marmon-Harrington asked that an Eaton representative along with Marmon representatives meet with Georgia Power and explain why the 230T4 failed and what was changed to prevent a repeat failure.

Technical Services attended this meeting and found that the undersized helical chamfer was not the problem that caused this failure. We reinforced the fact that if the parts would have been returned for proper analysis, the problem could have been cleared up. Georgia Power agreed, and have no intentions of letting this event alter their plans to purchase the 220T4 axles. The parts were returned to Eaton. Initial inspection shows no dimensions in the area of failure to be out of specification.

Visual inspection shows that the shaft diameter and gear inside diameter reached a high temperature and caused the metal to smear, build up, and seize. Note that the area of distress does not cover the entire length of the diameter where the shaft and gear interface. Further analysis is required and a report will follow.

No. 119894 Front Output Shaft Request - Glasgow has requested that the mill cut radius at the end of the oil flat be changed from .090"-.125" to .030"-.050". This would use the same milling tool used on the 110823 and 110805 input shaft oil flat. Stress calculations show that decreasing the radius would increase stresses 21%. Because the Plant's objective is to commonize tooling, Engineering is recommending that the 110823 and 110805 oil flat radius be upsized to the 119894 dimension.

NEW ON-HIGHWAY 38K TANDEMS

A bearing selection study has begun for new tandem axle designs. Downsized gearing (15.5" spiral bevel and 14.5" hypoid) and extended bearing life (600,000 miles) are the relative design features. The concept study for the "R" head assembly has been completed, and is being reviewed.

16.5" x 7" DRUM BRAKES

Carlisle Lining Structural Integrity

Initiated testing of latest production shipments of MMD39A lining to examine state of friction level and material structural integrity. Carlisle testing of revised D39A material formulation that had displayed drum metal "pick up" at high temperatures is continuing. No progress has yet been reported. Awaiting IHC Engineering's action plan on problem. IHC is the only OEM still using this lining as a standard.

Initiated test program to evaluate Carlisle's R31 lining for similar problems. Field complaints possibly related to this lining are increasing in number (currently standard on Eaton trailer axles). First testing indicates friction level is higher than original levels. Lining structural integrity testing now under way.

Fleet Testing of Low Friction Nonasbestos Linings

The first "controlled hardware" tests comparing Abex 3030-67, Carlisle MME145A, and Abex 551C are currently running on fifteen Freightliner vehicles at Stoops Transport. Hardware procurement for Ruan, the next target fleet, has been stalled due to problems with obtaining IHC components to convert the subject vehicles from air disc brakes. These vehicles are the only ones Ruan is willing to use for this test.

A joint IHC/Eaton trip to inspect fleet test vehicles at Viking Truck is being scheduled. These units were equipped with E145A and 3030-67 materials approximately the same time frame as the Schneider Transport vehicles that first displayed problems. This inspection anticipated by mid-May.

Inspections of early Eaton installations of 3030-67 and E145A on new trailer axles are being scheduled at Certified Grocers, Shipper's Rental, and Amcap.

Customer Programs

Ford - Engineering specification test procedures for the final approval of the crowned brake shoe have been completed. Summarized results have been supplied to Ford. A complete, detailed report will be submitted when dynamometer and structures test reports are finalized. All brake assembly part numbers required for this change have been released.

Assisted Ford Engineering and Field Service personnel in the installation of prototype noise suppression kits on a CL-9000 tractor operated by Caldwell Freight Lines. As indicated as a possibility to Ford prior to the trip, kits were not effective in this case. However, due to the sensitivity of their Field Service organization to this problem, the vehicle has been returned to Galesburg for further analysis.

Completed the release of all part numbers required for Ford release of nonasbestos linings. Releases for Ford program to remove slack adjusters from brakes, as purchased from Eaton, is now in progress.

Dustshield problems:

Rear: Awaiting sourcing of heavier dustshield design by Purchasing to resolve Ford in-plant handling problems.

Front: Awaiting quoting of heavier, modified dustshield for resolution of similar problem on 15" x 4". Potential exists for this configuration to also resolve IHC problem with exterior lip hazard.

Freightliner - Continued review of customer proposal for creation of 17" x 8" brake. Program for joint development of a "first hardware", prototype test phase to be generated and presented to Freightliner management.

General Motors - Met with new GMC Engineering personnel assigned to the coordinated chassis program to review existing and new brake component requirements. New designs required for the 5,000 kg axle, the derated 6,610 kg axle, and the 9,090 kg axle. Layouts and prototype hardware for fitup studies are planned.

Initiated prototype brake build for F-070 axle mockup. Recent changes to the steer arm may alleviate problems with dustshield and bracket interferences.

Approved GMC request for crowned brake for installation on 250 vehicle build for Anchor Motor Freight. This build will proceed the official approval of the crowned brake by GMC as dynamometer testing/extrapolation to GMC parameters is not yet complete.

International Harvester - Assisted Manufacturing and Quality Assurance with preparations for IHC Engineering and Quality Control personnel visit to Gallatin. Review of status of Eaton SPC/control characteristic program was requested by IHC. Potential impact of outcome of this meeting on pending supply proposals was considered significant. Actions included:

- Identification of additional control characteristics on 16.5" brake components critical to IHC Engineering approval of program.
- Drawing changes to add all control characteristics to drawings.
- Discussions with IHC Engineering, prior to Gallatin trip, to clarify dimensioning on major brake component control characteristics (wing, cam, spider, and shoe).
- Two pre-meetings with Gallatin and Quality Assurance personnel on current component problems and anticipated IHC questions.
- Three Engineering and three Quality people from IHC visited Gallatin on April 25. Extensive presentation by Gallatin personnel and Quality Assurance was very well received. Customer was impressed with extent of implementation of SPC/control characteristic plan.

Visited first "Future Brake Requirements" study fleet, Commercial Carriers. Two-day investigation of fleet records on brake service of 1979 and 1984 vintage equipment has shown sufficient detail to warrant full investigation including use of new brake balance analyzer to survey state of vehicle braking systems. This and two other fleets will eventually be studied to determine the necessity of major changes to foundation brake design in the future.

Kenworth (Paccar) - Prepared information for meeting called by PACCAR personnel on short and long-term brake needs of the U.S. industry. Addressed issues on:

- Larger front brakes.
- Enhancement of current air systems (limiting valves and load proportioning).
- Air disc brakes.
- Nonasbestos linings.
- Cam opposite vehicle installations.
- Automatic slack adjusters.
- Antilock brake systems.

Follow-up items to be reviewed along with demonstration of Eaton brake balance analyzer within two months.

Mack - Informed Mack Field Service Engineering of Eaton's legal staff's request for information on anti-skid control valve testing. Mack had asked for functional testing of unit from a vehicle involved in an accident, although unit had been disconnected. Mack legal staff to contact Eaton staff directly.

ON-HIGHWAY STEER AXLES

Peterbilt - Prototype axle build is on schedule for the new Peterbilt conventional. A possible delay could result if steer arms are not received from Sifco soon. Don Winn's request for improved steer stop design has resulted in a new concept which meets all the requirments. Drawings are now being finalized for costing. Kenworth and IHC have expressed an interest in the same features. Depending on cost, Eaton might consider standardization on this new concept.

IHC - A visit was made to IHC Engineering to discuss 12F4 and 18F3 steer axle opportunities. Their testing of our prototype 12F4 is not complete, and they are unwilling to discuss results so far. There appears to be general willingness to use Eaton's 12F4 if it is specified by the end user. The variables required to supply IHC with 18F3 axles were discussed. The short I-beam (not yet tooled) is dwindling in usage at IHC. The knuckle machining required to mount Rockwell brakes (and some Eaton) is required. Marketing has requested Gallatin to stock a small volume of these knuckles so at least a few could be built as prototypes. Again, the IHC engineers seemed open to using Eaton heavy duty steer axles.

Kenworth - Received a request to supply greater wheel cut ability in our 12F4 for use on the new T-600A vehicle. The steer arms available to achieve various wheel cut angles were outlined to Kenworth Engineering. An ERR has been submitted for this model.

The first order from Kenworth for the 18F3 axle has been received. An ERR is currently being processed.

General - The decision is anticipated to switch from Kahr to Garlock bushings and from chromed to phosphated kingpins across the board. The ECR's have been submitted for the 12F4 axles, and all involved parties have been informed. Garlock must supply some dimensions to finalize the bushing for the larger axles. ECR's will be submitted soon on these.

HEAVY DUTY STEER AXLES

New axles have been released for Ingersoll-Rand and FMC. Crane Carrier has requested increased wheel cut (from present 45° up to 47° or 48°) to compete with Rockwell FL-941. Apparently Rockwell just "leapfrogged" Eaton in the department with changes to the Ackermann arm and/or beam. A study will be made to determine what is required to accomplish similar features.

TRAILER AXLE BRAKES

Assisted Quality Assurance with problem analysis of brake shoe tables that have been shifted on RABA produced shoes. Apparent tooling discrepancies have caused a rotation of the table toward the anchor end of the spider. The resultant relaxation of the retainer springs has not been found critical to the function of the brake on testing conducted to date; however, RABA produced shoes will not fit a stamped spider and therefore could cause problems at reline since part number is common.

AXLE HOUSINGS

Square Edge Housing Qualification - Samples have been received from Humboldt for test in their last attempt to get Ford approval on 5/16" wall heat-treated housings.

As-Forged Spindles - Engineering went on record this month that spindles purchased in the near net or forged to size conditions should meet our current semi-finished spindle dimensions and tolerances for bell end O.D., bell end concentricity, bell end perpendicularity, and inner bearing shoulder to end of bell end length. Supplier cannot currently hold our tolerances.

Wide Track Housing Capability Tests - Vertical testing was resumed this month. Product Engineering and Test Engineering must mutually agree on a new test program and timing to feel comfortable about increasing our ratings. Vertical testing indicates that we are very conservative with our derating system.

Transverse Torque Rod Bracket Failures - The bracket still needs to be redesigned; however, priorities do not permit.

Stud to Capscrew Conversion - Capscrew testing is being piggybacked with the output shaft testing on the Kenworth. Caps were installed with no Loctite and their position marked. Upon completion of test, caps will be checked for location and torque. Engineering will request this month that we install capscrews in the Godfrey fleet trucks we are monitoring. There are four trucks running 20,000 miles/month and in our garage every 50,000 miles. Product Engineering and Test Engineering must agree on a complete test program.

Nonheat-treated Axle Housing Material - We have received housings produced from 11/32" plate nonheat-treated. They will be tested this month. Tests are currently being run on Spanish 5/16" thick nonheat-treated 17 Series. Results have been excellent.

Arm Height Tolerance - Marketing is currently approaching the OEs with a deviation allowing an additional +2 mm in tolerance for nine months on all medium bowl products. Spain will correct this problem.

Spanish Flame Cut Blanks - Testing was completed this month on Humboldt housings produced for Spanish flame cut blanks. No edge milling was done. Testing was done on 380 housings P/N 303222 with the following results:

Vertical test results were very good. Brake stop results do meet our B10 requirements of 50,000 cycles, but we are concerned about the observed scatter in results. Reasons for such scatter must be further understood before Engineering approval is given.

Ford U.K. Axle Test - Testing for Ron Felgate started this month in an attempt to compare a Rockwell nonheat-treated axle housing to an Eaton nonheat-treated axle housing. The test procedure and inconclusive test results were discussed with Ron, and it was felt that a brake stop test will not show that heat-treating is not necessary. Ron will advise on how to proceed. Test loads were reduced from .6 g to .4 g decel due to the inability to hold torque on the small flanges.

Housing Prints - During J. Thompson's visit to Spain this month, many questions arose regarding print interpretation, gauging techniques for SPC, and datum definitions. These points need to be resolved as soon as possible. Knowing that print changes would have to be made based on SPC results, it is a good opportunity to set up the hypoid housing prints to the latest and greatest thinking. A task force has been recommended be set up to define the print which would include Product Engineering, Design and Drafting, Manufacturing Engineering, and Quality Assurance. Mutual agreement must be reached.

GEAR ENGINEERING

DP650 Planetary Reduction Redesign - Finite element stress analyses were completed on April 18 on the sun gear and the idler pinions for the current production design and both a 4-planet and a 3-planet replacement design. As a result of these calculations, a modified 4-planet design appears more desirable than for the 3-planet version. Marked up prints of the new design have now been provided to Design Services.

Near Net Forging of Ring Gears - A meeting was held at Manufacturing Services Center in Willoughby Hills, Ohio, on April 12 to discuss changes needed in the Battelle forging program "SPBEVL" in order to handle hypoid gears and generated gears and to open up the possibility of finishing profiles using tilt instead of modified roll. It was generally agreed that the most flexible

end program would result if we developed pre- and post- processing programs that could convert machine settings we know or need into or from the type settings with which "SPBEVL" is known to successfully work.

Effects of Near Net Gear Forging and CBN Grinding - Conventional (standard production forgings) pinion forgings have been received from Marion. These are all of the same heat lot and in a quantity large enough to cover the entire test program as it currently stands.

Gleason Works has responded with a verbal cost estimate for development, Zeiss inspection, and single flank inspection required to process the test lots associated only with the 16.5 P.D. 4.33 ratio. A written quote is expected to follow shortly.

Soft Test Procedure and Practice - Recently Production experienced problems while attempting to lap Model 23220, 6.17 ratio (53172 and 53171) gear set in terms of tooth contact interference between the top of the gear tooth and the flank of the pinion tooth. This is not an acceptable condition due to the high noise level generated by running interference as well as the eventual tooth surface related failures (pitting or spalling), which would occur were these gear sets to be placed in service. Gear Engineering personnel have evaluated both single and two-speed soft masters as well as a hard finished sample. All parts checked are out of specification in terms of gear whole depth and chordal thickness, and pinion chordal thickness.

Based upon these findings, it is recommended that single and two-speed gear sets produced since March 11, 1985 be scrapped versus being sent to the warehouse for reprocessing and distribution at a later date. To avoid a repeat of this situation, it is recommended that chordal thickness be measured and verified on all existing masters, and again measured when replacement production masters are made. This responsibility must fall within the soft test procedure, and be a required practice of those individuals responsible for generating replacement production masters.

DESIGN SERVICES

Data Conversion - Currently two third party software houses have been reviewed to write a translator that would allow us to transfer Applicon files to CADAM so we can communicate graphics to our customers that use CADAM. The cost of this translator is approximately $20,000. Octal, Inc. has received files from us on an axle installation drawing to perform a benchmark of their translator.

A BRAVO! user manual ('BUM') has been outlined to help establish correct techniques to be used in Galesburg and possibly at our plant locations. Individuals performing tasks outlined in the manual are asked to contribute techniques and use techniques previously established. CAD meetings are tentatively scheduled about every ten days.

We received the backplane expansion assembly required to mount our Decnet communication boards for the plant locations. Installation will be scheduled when the new computer room is rearranged. 9.6KB dedicated phone lines to the plants from Galesburg will be installed at the end of May. A month-to-month lease will be established instead of a two-year lease for the modems as suggested by TCC. This was decided because a much better modem technology will become available shortly, and this will allow us time to monitor the amount of line traffic and determine the actual capacity required. Dave Stephan was asked to determine the potential difference in grounding between Axle & Brake and Transmission buildings before running an Ethernet coaxial cable underground. A fiber optics cable will be required if the coax proves not to be feasible.

A set of six video tapes for the complete BRAVO! instruction series have been edited to include lesson titles, and four duplicates have been made. Tapes were sent to Glasgow, Henderson, Gallatin, and Manchester.

Application Engineering at Applicon arranged to have support at each one of our plants during the week of April 22nd. Steve Slesinski assisted in the visits. Topics covered included: system management techniques, VMS, backup procedures, hardware overview, installing software, plotting, installed printers, and VT200's and librarian commands. A three-day training session on advanced techniques will be held for our plants in Chicago at a later date. Applicon has agreed to this additional training at no charge.

S. Slesinski attended a meeting at TCC to discuss integrating of CAD/CAM in the division with J. Nehring, R. Wolfarth, S. Howe and F. Kozlevchar.

Engineering-Henderson

New specification activity for the month numbers 103. This includes 64 new specification numbers assigned and 39 which were raised in suffix level. Specifications on hold pending more information include the following:

1. Freightliner - DS/RS460P - These specifications were set up with a housing that had the torque rod location in the wrong position for this customer. In addition to signing off on an alternate current housing, this customer is planning on reassigning their part number to this specification. Marketing will advise upon receipt of the above.

2. J. I. Case - 22121 - With this purchase order, Case is asking for an 8.5C mechanic's flange for our 22 Series axle. We currently do not have this in our system. Marketing will advise when part number is assigned.

3. Sperry New Holland - 15201 - This is a square edge housing update and awaiting a new customer part number. Marketing will advise.

4. Crane Carrier - TP/RP650 - This order requires a brake assembled on the axle. An Engineering request has been submitted to design a new brake to fit Crane's specification.

5. Little Giant - DS/RS341 - Engineering in Galesburg is looking for a current brake assembly to fit this axle. They will advise.

6. Mack Truck - DT/RT480P - Received new print for this order and discovered a duplication of the forward axle assembly. Waiting for response from Mack as to which one they want to use.

7. Mack Truck - 23421 - Upon receipt of Mack's print for this order, found the ratio requested is not available in the model (3.55). Another instance where it is shown incorrectly on our EA108 Condensed Specification brochure. Customer to get back to us with direction.

8. GMC - DS/RS381 - Still awaiting prints from customer.

Other specifications pending from last report (Timberjack - WR6; Savage Riteway - DS406P/RS401; Eimco - 23120; GMC - DS/RS480P; Autocar - 35327; Thomas Bus - 23 Series) all have been resolved.

Active/Inactive (Reactivations) - Again reactivations were up this month with the total for the month being 38. Many of these were for Service requests for head assemblies and "truck downs" (7 truck downs). The accumulative total to date is 611.

13-15 Series Single-Speed Product Changes - All changes, newly released bills of material, superseded assemblies, and releases have been written and are in checking. Specifications pending involve only one OEM (Ford), and we are awaiting new part numbers from Ford. The Timberjack release is completed, specifications written, and awaiting distribution. This will finally put an end to this product change.

35327, 580/650 Two-Speed/Planetary Product Change - This package has been checked and is ready to be released. The distribution will go sometime near the actual availability of the new parts. Bearings are not expected until June. At that time, we can begin writing new axle specifications. We still have only limited information as to new customer numbers or phase-in timing of this change.

17 Series, R341/381/401 Carrier Consolidation (Universal) - Project still on hold. We have not heard or read anything which gives us any direction on completing this product change. D. Bryant is asked to help us on this.

Bill Of Material Accuracy - This month service kits and assemblies were addressed from product code 500. Approximately 700 bills were corrected and have become the drawings of record. Product code 501 will be addressed next; those are also service assemblies or kits. This may not get completed due to a rearrangement of the activities of S. Thomas to brake EPL conversion. Should this project end this month, it should be noted that the majority of key bills of material (standards, heads, specifications, SPL's, and many service kits) are databased to the satisfaction of Engineering. There are, however, still some pockets of assemblies which should be addressed, i.e., housing assemblies (cast steel).

Databasing SPL's - This project has been completed and the Engineering release written. The package will need to be checked, released, and distributed to all OEMs. In all, 72 SPL's have been databased over the last three months, and 82 SPL's set up last year, for a total of 154 databased SPL's which should cover our product line for axle assemblies.

Projects/Issues On Hold

1. 17 Series R341/381/401 carrier consolidation.
2. 23105C (standards, heads) release and distribution - awaiting release of design and drawings from Galesburg.
3. Cast steel housing bills of material.
4. Large tandem product changes (pinion pilot bearing, input shaft, pump drive gear and sliding clutch) - awaiting availability of parts - June time frame.
5. Housing ring bar stock size reduction.
6. Wheel bearing nut and lock change.
7. Insertion of Ford service housing in assemblies in their specifications (kills "Ford Only SPL's").
8. Thrust screw change for 23105S.

Product Problems

Super 23-23105S - Plant changed to shouldered pilot bearing, Part No. 120080, April 2, 1985, and Tocco and staked pinion pilot bearing effective April 10, 1985, 23105S and 23105C. All remaining inventory will be reworked by Glasgow.

23105C - Yellow Freight - While preparing for build of two qualified 23105C heads for Yellow Freight, an engineering problem was discovered in the shift area. When the friction plates were removed to accommodate bias torque, problem developed; sliding curvic clutch pulls back out of engagement with clutch pack and will not shift back into engagement. Control traction version of 23105 on hold until "fix" developed. Awaiting direction from Galesburg Product Engineering.

15 Series Pinion Threads - Assembly reports that we continue to strip pinion threads occasionally. Quality problem with pinions will have to be corrected before Engineering evaluation.

RABA Wheel Hubs - The "test" of installing cup in bore within Engineering specifications confirmed bore did not open up due to cup being installed and a .001" shim would not fit between bore and cup O.D. Manufacturing continues to rework (bore oversize, metalize, and rebore to specification) which is quite expensive. We have also received WR6 only hubs with change to hub in bearing cup area. RABA added extra wall material. Understand Field Service and Timken Bearing representatives reviewing units in the field to determine if current bearing cup fit has been in other units in the field and effect on bearing wear and life. This information could then be used to adjust our current standard. If a .001" shim will fit between cup and bore, rework is required.

Engineering-Glasgow

SPC/IMIP Meetings - Review meetings have been extended from two to three days a week (Tuesday through Thursday from 1:00 to 3:30 p.m.). In conjunction with this increase, M. Meredith has removed himself as a permanent member of the Committee. He is now attending on an "as needed" basis. The meetings are being held in the Gear Lab conference room which makes his part-time attendance a workable situation. Four clutch plates, three side pinions, and one hypoid drive gear were reviewed this month.

Carrier Deviations - All "D" carrier deviations have been resubmitted and approved for bearing cage and pilot bore to the "R" holes relations to .020. The deviations were approved to allow time for a bank of parts to be run prior to planned machine shut-down for the month of July. M. Meredith called two meetings in Glasgow. The first was on March 29 to discuss plans for additional data gathering to determine the daily statistical capability of Snyder II for (1) bearing bore to output bore, (2) bearing bore to "R" holes, (3) pilot bore to "R" holes, and (4) output bore to "R" holes. This data has since been gathered on a daily basis on all 22 pallets.

An additional check (output bore to "R" holes) was made on all 22 pallets to determine the direction in which the error was located. The results were inconclusive in that the direction and magnitude of the error varied from pallet to pallet. It would appear that if the pallets are brought into line this would further improve the machine capability.

A second meeting was held week of April 22, 1985 to update operations management as to our findings. In addition, a request was made of Plant Engineering for a better defined breakdown of planned repairs. Further checks are to be made on Snyder II on a daily basis on the output bore to "R" holes to determine if stock variations and vendor changes have any significant bearing on the machine capability for this dimension.

Henderson Reshimming - The reshim rate on Head Line No. 5 is again running about 5% for all ratios and models. An extensive gauging analysis in Henderson has revealed that modifications to the current production shim station gauges were necessary to accommodate the tolerance stack-up in the crossbore to crossbore pedestal locations. A lot of carriers were checked for this relationship in Henderson, and found to have a large variation in this relationship requiring the gauge modification necessity.

With all of the improvements noted, one problem still needs to be addressed and that is the legibility of the pinion pilot etchings. The surface finish is very poor and therefore creates an unacceptable surface for electrode transfer of the hard test readings. The print specification for this characteristic is 50 RMS micro and parallel to .002. This specification is not being met, and this problem must be addressed in order to make further improvements on solving this problem. A memo was written to R. Primel explaining this problem and requesting a solution.

Spiders - Manufacturing continues to have problems developing a radius contour to the print specifications. Deviations have been submitted and approved to allow a variation to the specified contour. Problems have been encountered on both tandem and differential spiders.

Engineering-Humboldt

Square Edge Housings -.313" wall 17 Series housings for Ford validation have been completed, and were shipped to Galesburg on April 17. They were produced with seam weld origination near the bowl, and torch travel going from the bowl towards the end of the arms. The general feeling here is that this method of welding increases the weld penetration in zone 2 (the outboard transition), which has been the typical failure location.

Housing half drawings were marked up per the latest input for the square edge program. These drawings were circulated among the Humboldt staff for review in the form of a request for engineering change, and forwarded to Product Engineering in Galesburg on April 23. The changes made to these housing half drawings must satisfy Humboldt, Spain, and Galesburg. The request identification number is HUM-011.

TEST SERVICES

Equipment

New Hydraulic Rotary Actuator - Actuator work is proceeding. The manifold, load cell, and R.V.D.T. mounting plates are complete. Awaiting encoder for final completion.

Vertical Fatigue Test II - Awaiting hard plumbing of 3000 PSI hydraulic system. The housing clamp fixturing has been completed. Spindle adaptors will be designed as schedule permits.

Axle Dyno "D" - G.E. motors have been received; basic fixturing is approximately 70% complete. Slight delays being encountered with Cutler Hammer drive due to Division closing and relocation.

Roto-stroker II - Machine being rebuilt for servo control system.

Proving Grounds - Five vehicle demostration/presentations/tours were given during April. The major efforts performed in support of Axle & Brake requests were as follows:

- Output shaft testing.
- RABA trailer axle brake performance testing.
- Electric shift unit vehicle tests.
- CTD data acquisition.
- RABA trailer axle seam crack investigation.

Scheduled track repairs are being accomplished as crews are available. Dust control products have been applied to all gravel roads.

Divisional Expansion Project - The office portion of expansion project has been made available for occupancy. Those items remaining to be completed will be accomplished on "as necessary" basis. The lab portion is proceeding at an acceptable rate. At this time there dosen't appear to be any manpower or equipment hold-ups.

PERSONNEL

The following people joined the Engineering Department during April:

Tom Furdek - Senior Product Engineer
Jeff McKenna - CADD Operator
Richard Wood - Technician

Russ Golemba, CADD Operator, has left the company.

W. W. Hoenes

WWH/bac
(2643E)