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OFFICE OF DEFECTS
INVESTIGATION
NHTSA

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Lafayette, IN 47904
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LETTER VIA EMAIL – ATTACHMENTS VIA EXPRESS MAIL

April 15, 2008

Mr. Richard Boyd, Chief
Medium and Heavy Duty Vehicle Division
Office of Defects Investigation
National Highway Traffic Safety Administration
1200 New Jersey Avenue SE
Washington, DC 20590

Re: National Highway Traffic Safety Administration (“NHTSA”) Preliminary Evaluation PE08-009 (“PE”)

Dear Mr. Boyd:

TRW Automotive U.S. LLC (“TRW”) is responding to your letter dated February 25, 2008 wherein you requested certain information to assist you in your investigation related to the above mentioned Preliminary Evaluation.

In responding to your letter, we note that your letter defines “Subject Vehicles” as “[a]ll MY 2004 and 2005 Freightliner Century and X-Line model vehicles”, but we also note that the X-Line chassis is not specifically identified in the Freightliner Field Service Bulletin 46-38 (“FSB”), which is defined as the “Subject TSB” in your letter. TRW has included relevant information about the X-Line chassis in this response.

In addition, you define “any failure of the subject component [power steering pump] that results in the reduction of power steering assist as described in the Subject TSB” as an “Alleged defect”. As described below, however, we consider the issue covered by the FSB to be a “failure mode” of the power steering pump. The FSB was issued to notify Freightliner dealers that new repair kits were available to repair a specific power steering pump failure mode. The specific failure mode was a gradual reduction in the “speed of steer” in a hydraulic powered steering system caused by the progressive wearing of the power steering pump flow control valve spool. This valve maintains a relatively constant oil flow rate to the steering gear regardless of engine speed. The “speed of steer” is the speed at which the steering wheel can be rotated with power assist. The speed

of steer is limited by the oil flow rate from the power steering pump. The oil flow rate to the steering gear may be reduced if the flow control valve spool begins to wear. The vehicle still has power assist but the maximum rotational speed of the steering wheel gradually slows as the flow control valve spool wears over time. This gradual loss of speed of steer is evidenced by a noticeable degrading of assist during parking maneuvers when drivers experience much higher rates of steering wheel rotation than they do at highway speeds.

Also, in your letter we note that you made the following two statements: "Power steering pump failures can reduce steering assist potentially leading to difficulty controlling the vehicle and a crash resulting in injury or death" and "ODI considers failures of the steering pumps resulting in reduction of steering assist on a motor vehicle to be a safety related issue." You also sent us a list of nine recalls and three investigations that you cited as related to "increased steering effort as a result of steering component failure." These statements from your letter seem to indicate that the ODI anticipates 100% reliability from steering system components and that any loss of hydraulic power assist will necessarily result in a safety-related issue. TRW takes exception to both of these concepts for the reasons described below.

The nine recalls included in your list include four recalls that are not related to loss of hydraulic power assist: 05V-135, 06V-300, 97V-112, and 07V-289. The other five recalls from your list have dates from 1999 to 2006, and are each in response to a special cause. The 2 investigations in your list include two investigations that are not related to loss of hydraulic power steering. The remaining investigation (SQ99-009) does relate to loss of hydraulic power assist and did not result in a recall. Based on our examination of these items, we did not identify any information that was directly useful in responding to your letter.

We note that there are a number of components in a vehicle whose failure could contribute to loss of hydraulic power assist (including, for example, an engine shutdown situation). All commercial highway vehicle steering systems are made up of manual steering systems with hydraulic power in place to assist the manual system. In the event that the power assist is not available or is diminished, the driver can still control the vehicle with the manual steering system. This design feature has been in place since the inception of power steering on commercial highway vehicles in 1951. Based on this, we believe that that, in the absence of a special cause or circumstance that degrades the manual steering capability of the vehicle, the reduction of steering assist on a motor vehicle alone does not necessarily result in a safety-related issue.

Your requests and TRW's corresponding responses are set forth below.

- 1) *Provide a listing of all power steering pumps manufactured by TRW for use in the subject vehicles as either original equipment or as a replacement parts for the original equipment. Provide this listing by part number, vehicle applications (by make, model, and model years), number produced for original equipment installation (by month/year), and number produced for sale as service replacement parts (by month/year).*

Provide this information in Microsoft Access, or a compatible electronic format, entitled "REQUEST NUMBER ONE DATA." See Enclosure 1, Data Collection Disc, for a preformatted table designed for this submission.

Response: TRW has included an Excel workbook labeled REQUEST NUMBER ONE DATA.xls with the data requested for the 12 pump part numbers identified in the FSB. The workbook tab Q 1 Data contains the quantity of pumps produced from the start of production to 12/31/2005. Enclosed is a document entitled APPLICATION INFORMATION that contains the extent of our information relative to which pumps are used on specific engine models. With a few exceptions, the pump part number is not unique to a truck model. The pump part number is specific to the engine and the steering system configuration.

- 2) *Identify any kits that have been released, or developed, by TRW or Freightliner for use in service repairs to the subject component. State the number of kits that TRW has sold by component name, part number (both service and engineering/production), power steering pump model number(s) that the kit is designed for use on, model and model year of the vehicle in which it is used and month/year of sale (including the cut-off date for sales, if applicable):*

Provide this information in Microsoft Access, or a compatible electronic format, entitled "REQUEST NUMBER TWO DATA." See Enclosure 1, Data Collection Disc, for a preformatted table designed for this submission.

Response: The FSB identifies two service kits. RGT 408025X118 is to be used with pumps that have a 185 bar relief valve (Freightliner part numbers 14-14323-000 through 14-14323-006). RGT 408025X115 is to be used with pumps that have a 150 bar relief valve (Freightliner part numbers 14-14375-000 through 14-14375-004). An Excel work book is attached that includes the production volumes through February 2008.

- 3) *Provide copies of all engineering standards and specifications relating to the subject component.*

Response: TRW has enclosed engineering drawing EV500 and Engineering Performance Test Specification PT-1051-S1.

- 4) *Describe, and provide copies of all documents relating to, all design verification and validation tests of the subject components.*

Response: TRW has enclosed the DVP&R for the qualification of the nickel plated flow control valve spools and the new design anodized flow control valve spools.

- 5) *Describe, and provide copies of all documents relating to, all inspections, tests, and other analyses of subject components returned from vehicles serviced under the subject TSB. Provide a listing of all such pumps that were inspected, tested, evaluated, or assessed by stating the vehicle's VIN, recall repair date, mileage at the recall repair date, pump part number, part serial number (identifying marking), part date of build, and anomalies detected.*

Response: TRW has attached documents related to warranty claims received from Freightliner related to the FSB. This question refers to "recall" information. As noted above, the FSB was not related to a recall or field campaign. The Century class trucks are identified by an "ST*" in the model column. The X-Line trucks are identified by a model number that starts with M*.

- 6) *Describe all assessments, analyses, tests, test results, studies, surveys, simulations, investigations, inquiries, returned part analyses, assessments and/or evaluations (collectively, "actions"), that relate to, or may relate to, the alleged defect in any of the subject components, that have been conducted, are being conducted, are planned, or are being planned by, or for, TRW. For each such action, provide the following information:*
- a. *Vehicle make, model, and model year for which the subject component was or may be used;*
 - b. *Action title or identifier;*
 - c. *The actual or planned start date;*
 - d. *The actual or expected end date;*
 - e. *Brief summary of the subject and objective of the action;*
 - f. *Engineering group(s)/supplier(s) responsible for designing and for conducting the action,*
 - g. *Total number of such parts returned/analyzed, and a description of how they were analyzed,*
 - h. *Reason for specific component analysis,*
 - i. *Any and all material showing the frequencies of failed components as a function of service life or mileage,*

- j. A brief summary of the findings and/or conclusions resulting from the action; and*
- k. For each action identified, provide copies of all documents related to the action, regardless of whether the documents are in interim, draft, or final form. Organize the documents chronologically by action.*

Response: TRW has enclosed a copy of an MS Power Point file entitled, "Freightliner spool presentation 9-23-04." The presentation is a summary of the testing and results that TRW has performed related to the FSB. A second MS Power Point file, "Residual Spool Wear", is enclosed that describes exploratory work that is continuing on pump flow control valve spool coatings.

- 7) *Describe all modifications or changes made by, or on behalf of, TRW in the design, material composition, manufacture, quality control, supply, or installation of the subject component, from the start of production to date, which relate to, or may relate to, the alleged defect in the subject vehicles. For each such modification or change, provide the following information:*
- a. The date or approximate date on which the modification or change was incorporated into production;*
 - b. A detailed description of the modification or change;*
 - c. The reason(s) for the modification or change;*
 - d. The part numbers (service and engineering) of the original component;*
 - e. The part number (service and engineering) of the modified component;*
 - f. Whether the original unmodified component was withdrawn from production and/or sale, and if so, when;*
 - g. When the modified component was made available as a service component; and*
 - h. Whether the modified component can be interchanged with earlier production components.*

Response: The pump flow control valve spool surface coating was changed from anodized aluminum to electroless nickel plating for pumps manufactured between March 11, 2004 and October 21, 2004. The coating was changed to improve the wear characteristics of the flow control valve spool. The flow control valve spool design was modified and the surface coating changed back to anodized aluminum on and after October 22, 2004. The design change altered the land width and spacing to provide better hydraulic balancing of the flow control valve spool. The flow control valve spool coating was changed back to anodized aluminum because the electroless nickel plating was not performing as well as expected in some applications. The part number for the flow control valve

spool remained the same for all changes. See response to request 2 for information related to service kits. All design levels are interchangeable.

- 8) *Provide copies of all documents relating to all communications between TRW and Freightliner regarding the alleged defect in the subject component or the subject TSB. Organize the document copies in chronological order.*

Response: TRW has enclosed a number of documents for this request.

- 9) *Provide copies of all documents transmitted internally within TRW that relate to the alleged defect in the subject component or the subject TSB.*

Response: TRW has enclosed a number of documents for this request.

- 10) *Provide an electronic summary, in a format compatible with Microsoft Excel 2000, of each claim of which TRW is aware of, regardless of whether the claim is against TRW, related to the alleged defect in the subject component. For each such claim, include the following information in the summary:*

- a. Vehicle owner name, address, and telephone number;*
- b. Vehicle model, model year, and identification number (VIN);*
- c. Incident date and vehicle mileage;*
- d. Summary of the claim and evidence provided to support the claim of switch failure; and*
- e. TRWs' assessment of the claim.*

Response: The requested information is contained in the response to request number 5.

- 11) *Furnish TRWs' assessment of the alleged defect in the subject component, including:*

- a. An assessment of the failure mechanism;*
- b. An assessment of the estimated service life of the subject component.*
- c. An assessment of the design factors that may influence the performance of the subject component;*
- d. An assessment of the manufacturing factors that may influence the performance of the subject component;*

- e. *An assessment of the vehicle assembly factors that may influence the performance of the subject component; and*
- f. *An assessment of the use factors that may influence the performance of the subject component.*

Please be as specific as possible in your answers and provide engineering explanations for how various factors affect the switch durability.

Response: The events that led up to the publishing of the FSB were not related to a defect in the pump. The FSB was published to notify Freightliner dealers of service kits that would reduce the time to repair a pump and improve service part availability for a particular pump flow control valve spool failure mode. The failure mode was progressive wearing of the pump flow control valve spool surface coating that eventually could cause increased internal leakage. The increased internal leakage could reduce the oil flow rate to the steering system over a period of time. The effect of reduced flow rate to the steering system is a reduction in the available speed of steer. This would be most noticeable on lower engine speeds and higher steering pressures. However, the mechanical portion of the steering system would still be functional. We have attached an analysis of the mileage on the vehicles that experienced a worn flow control valve spool. The average mileage is 200,000 plus.

The use factors that may contribute to this failure mode include: system temperature (including spikes), duty cycle, and system contamination. The manufacturing factors that may contribute to this failure mode include: clearance between the flow control valve spool and the housing bore and quality of the flow control valve spool coating. The design factors that may contribute to this failure include: flow control valve spool to bore clearance, land design, and surface coating. Factors related to vehicle assembly that may contribute to flow control valve spool wear include: cavitation during system filing and contamination in hoses and reservoirs.

- 12) *Provide the name and contact information of a TRW representative that can answer technical questions concerning the subject of this letter.*

Response: David Hobson, 800 Heath Street, Lafayette, IN, 47904.
Phone 765-429-1768, email Dave.Hobson@trw.com.

- 13) *Produce electronic copies of all service, warranty, and other documents that relate to, or may relate to, the alleged defect in the subject components, that TRW has issued to any dealers, regional or zone offices,*

field offices, fleet purchasers, or other entities. This includes, but is not limited to, bulletins, advisories, informational documents, training documents, or other documents or communications, with the exception of standard shop manuals. Also include the latest draft copy of any communication that TRW is planning to issue within the next 120 days.

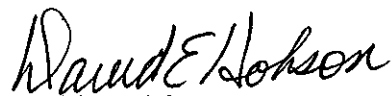
Response: TRW has included a copy of Repair Procedure # PMP-100 entitled, "On Vehicle Spool Valve Assembly Replacement Procedure." April 2006. TRW has no plans to issue any other related service procedures.

TRW is not withholding any documents or information based on a claim that this is "confidential business information." However, TRW objects to producing and will not produce any documents or information that may be covered by the attorney-client privilege, work product doctrine or other similar privilege or immunity from disclosure. Please note that due to the enormity of the information requested in your letter and the shortness of time for TRW's response, it is impossible for TRW to identify such documents and information for which it asserts a claim of such privilege or immunity as requested on Page 6 of your letter. Moreover, TRW wishes to make it clear that it is not in any manner waiving, and TRW expressly reserves the right to assert, such a claim of privilege or immunity as to other documents and information. TRW has made a reasonable search of its records within the time constraints of the PE.

This response is based on a search of records at those locations of TRW where documents that appeared to be called for by your request can reasonably be expected to be found. Responsive documents provide the basis for TRW's response. The records search was conducted after receipt of your February 25 letter and should have resulted in the identification of information received or generated up to that time. It is possible that additional responsive information may have been received or generated by TRW between the time the search was completed and the date of this response.

Please contact me at 765-429-1768 with any inquiries regarding this issue.

Regards,



David E. Hobson
Manager, Quality Services

REQUEST NUMBER 1

PE08-009
 Reuest Number 1
 Application Data

DTNA P/N	Part number	Freightliner application
14-14323-000	EV221618L10101	DD60 engine
14-14323-001	EV181618L10101	Cat C16
14-14323-002	EV181618R10101	Cat C13, C11
14-14323-003	EV221618R10101	Cummins ISX, ISC
14-14323-004	EV251618L10101	DD60 engine
14-14323-005	EV222418R10101	D2 AF Common Chassis
14-14323-006	EV222418L10101	D2 AF Common Chassis
14-14375-000	EV221615L10101	DD60 engine EV221615L for TAS65 application
14-14375-000	EV221615L10101	X-line
14-14375-001	EV181615L10101	3406E(C16) w/20.4:1 ratio gears
14-14375-002	EV181615R10101	N14 engine
14-14375-003	EV221615R10101	ISC engine
14-14375-003	EV221615R10101	X-line
14-14375-004	EV251615L10101	TAS85

REQUEST NUMBER 3

REQUEST NUMBER 4

REQUEST NUMBER 6

REQUEST NUMBER 8

Mr. Boyd
April 15, 2008
1 of 8

LETTER VIA EMAIL – ATTACHMENTS VIA EXPRESS MAIL

April 15, 2008

Mr. Richard Boyd, Chief
Medium and Heavy Duty Vehicle Division
Office of Defects Investigation
National Highway Traffic Safety Administration
1200 New Jersey Avenue SE
Washington, DC 20590

Re: National Highway Traffic Safety Administration (“NHTSA”) Preliminary Evaluation PE08-009 (“PE”)

Dear Mr. Boyd:

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In responding to your letter, we note that your letter defines “Subject Vehicles” as “[a]ll MY 2004 and 2005 Freightliner Century and X-Line model vehicles”, but we also note that the X-Line chassis is not specifically identified in the Freightliner Field Service Bulletin 46-38 (“FSB”), which is defined as the “Subject TSB” in your letter. TRW has included relevant information about the X-Line chassis in this response.

In addition, you define “any failure of the subject component [power steering pump] that results in the reduction of power steering assist as described in the Subject TSB” as an “Alleged defect”. As described below, however, we consider the issue covered by the FSB to be a “failure mode” of the power steering pump. The FSB was issued to notify Freightliner dealers that new repair kits were available to repair a specific power steering pump failure mode. The specific failure mode was a gradual reduction in the “speed of steer” in a hydraulic powered steering system caused by the progressive wearing of the power steering pump flow control valve spool. This valve maintains a relatively constant oil flow rate to the steering gear regardless of engine speed. The “speed of steer” is the speed at which the steering wheel can be rotated with power assist. The speed of steer is limited by the oil flow rate from the power steering pump. The oil flow rate to the steering gear may be reduced if the flow control valve spool begins to wear. The vehicle still has power assist but the maximum rotational speed of the steering wheel gradually slows as the flow control valve spool wears over time. This gradual loss of speed of steer is evidenced by a noticeable degrading of assist during parking maneuvers when drivers experience much higher rates of steering wheel rotation than they do at highway speeds.

Also, in your letter we note that you made the following two statements: "Power steering pump failures can reduce steering assist potentially leading to difficulty controlling the vehicle and a crash resulting in injury or death" and "ODI considers failures of the steering pumps resulting in reduction of steering assist on a motor vehicle to be a safety related issue." You also sent us a list of nine recalls and three investigations that you cited as related to "increased steering effort as a result of steering component failure." These statements from your letter seem to imply that the ODI anticipates 100% reliability from steering system components and that any loss of hydraulic power assist will necessarily result in a safety-related issue. TRW takes exception to both of these concepts for the reasons described below.

The nine recalls included in your list include four recalls that are not related to loss of hydraulic power assist: 05V-135, 06V-300, 97V-112, and 07V-289. The other five recalls from your list have dates from 1999 to 2006, and are each in response to a special cause. The 2 investigations in your list include two investigations that are not related to loss of hydraulic power steering. The remaining investigation (SQ99-009) does relate to loss of hydraulic power assist and did not result in a recall. Based on our examination of these items, we did not identify any information that was directly useful in responding to your letter.

We note that there are a number of components in a vehicle whose failure could contribute to loss of hydraulic power assist (including, for example, an engine shutdown situation). All commercial highway vehicle steering systems are made up of manual steering systems with hydraulic power in place to assist the manual system. In the event that the power assist is not available or is diminished, the driver can still control the vehicle with the manual steering system. This design feature has been in place since the inception of power steering on commercial highway vehicles in 1951. Based on this, we believe that that, in the absence of a special cause or circumstance that degrades the manual steering capability of the vehicle, the reduction of steering assist on a motor vehicle alone does not necessarily result in a safety-related issue.

Your requests and TRW's corresponding responses are set forth below.

- 1) *Provide a listing of all power steering pumps manufactured by TRW for use in the subject vehicles as either original equipment or as a replacement parts for the original equipment. Provide this listing by part number, vehicle applications (by make, model, and model years), number produced for original equipment installation (by month/year), and number produced for sale as service replacement parts (by month/year).*

Provide this information in Microsoft Access, or a compatible electronic format, entitled "REQUEST NUMBER ONE DATA." See Enclosure 1,

Data Collection Disc, for a preformatted table designed for this submission.

Response: TRW has included an Excel workbook labeled REQUEST NUMBER ONE DATA.xls with the data requested for the 12 pump part numbers identified in the FSB. The workbook tab Q 1 Data contains the quantity of pumps produced from the start of production to 12/31/2005. Enclosed is a document entitled APPLICATION INFORMATION that contains the extent of our information relative to which pumps are used on specific engine models. With a few exceptions, the pump part number is not unique to a truck model. The pump part number is specific to the engine and the steering system configuration.

- 2) *Identify any kits that have been released, or developed, by TRW or Freightliner for use in service repairs to the subject component. State the number of kits that TRW has sold by component name, part number (both service and engineering/production), power steering pump model number(s) that the kit is designed for use on, model and model year of the vehicle in which it is used and month/year of sale (including the cut-off date for sales, if applicable):*

Provide this information in Microsoft Access, or a compatible electronic format, entitled "REQUEST NUMBER TWO DATA." See Enclosure 1, Data Collection Disc, for a preformatted table designed for this submission.

Response: The FSB identifies two service kits. RGT 408025X118 is to be used with pumps that have a 185 bar relief valve (Freightliner part numbers 14-14323-000 through 14-14323-006). RGT 408025X115 is to be used with pumps that have a 150 bar relief valve (Freightliner part numbers 14-14375-000 through 14-14375-004). An Excel work book is attached that includes the production volumes through February 2008.

- 3) *Provide copies of all engineering standards and specifications relating to the subject component.*

Response: TRW has enclosed engineering drawing EV500 and Engineering Performance Test Specification PT-1051-S1.

- 4) *Describe, and provide copies of all documents relating to, all design verification and validation tests of the subject components.*

Response: TRW has enclosed the DVP&R for the qualification of the nickel plated flow control valve spools and the new design anodized flow control valve spools.

- 5) *Describe, and provide copies of all documents relating to, all inspections, tests, and other analyses of subject components returned from vehicles serviced under the subject TSB. Provide a listing of all such pumps that were inspected, tested, evaluated, or assessed by stating the vehicle's VIN, recall repair date, mileage at the recall repair date, pump part number, part serial number (identifying marking), part date of build, and anomalies detected.*

Response: TRW has attached documents related to warranty claims received from Freightliner related to the FSB. This question refers to "recall" information. As noted above, the FSB was not related to a recall or field campaign. The Century class trucks are identified by an "ST*" in the model column. The X-Line trucks are identified by a model number that starts with M*.

- 6) *Describe all assessments, analyses, tests, test results, studies, surveys, simulations, investigations, inquiries, returned part analyses, assessments and/or evaluations (collectively, "actions"), that relate to, or may relate to, the alleged defect in any of the subject components, that have been conducted, are being conducted, are planned, or are being planned by, or for, TRW. For each such action, provide the following information:*
- a. Vehicle make, model, and model year for which the subject component was or may be used;*
 - b. Action title or identifier;*
 - c. The actual or planned start date;*
 - d. The actual or expected end date;*
 - e. Brief summary of the subject and objective of the action;*
 - f. Engineering group(s)/supplier(s) responsible for designing and for conducting the action,*
 - g. Total number of such parts returned/analyzed, and a description of how they were analyzed,*
 - h. Reason for specific component analysis,*
 - i. Any and all material showing the frequencies of failed components as a function of service life or mileage,*
 - j. A brief summary of the findings and/or conclusions resulting from the action; and*
 - k. For each action identified, provide copies of all documents related to the action, regardless of whether the documents are in interim, draft, or final form. Organize the documents chronologically by action.*

Response: TRW has enclosed a copy of an MS Power Point file entitled, "Freightliner spool presentation 9-23-04.ppt." The presentation is a summary of the testing and results that TRW has performed related to the FSB.

- 7) *Describe all modifications or changes made by, or on behalf of, TRW in the design, material composition, manufacture, quality control, supply, or installation of the subject component, from the start of production to date, which relate to, or may relate to, the alleged defect in the subject vehicles. For each such modification or change, provide the following information:*
- a. The date or approximate date on which the modification or change was incorporated into production;*
 - b. A detailed description of the modification or change;*
 - c. The reason(s) for the modification or change;*
 - d. The part numbers (service and engineering) of the original component;*
 - e. The part number (service and engineering) of the modified component;*
 - f. Whether the original unmodified component was withdrawn from production and/or sale, and if so, when;*
 - g. When the modified component was made available as a service component; and*
 - h. Whether the modified component can be interchanged with earlier production components.*

Response: The pump flow control valve spool surface coating was changed from anodized aluminum to electroless nickel plating for pumps manufactured between March 11, 2004 and October 21, 2004. The coating was changed to improve the wear characteristics of the flow control valve spool. The flow control valve spool design was modified and the surface coating changed back to anodized aluminum on and after October 22, 2004. The design change altered the land width and spacing to provide better hydraulic balancing of the flow control valve spool. The flow control valve spool coating was changed back to anodized aluminum because the electroless nickel plating was not performing as well as expected in some applications. The part number for the flow control valve spool remained the same for all changes. See response to request 2 for information related to service kits. All design levels are interchangeable.

- 8) *Provide copies of all documents relating to all communications between TRW and Freightliner regarding the alleged defect in the subject component or the subject TSB. Organize the document copies in chronological order.*

Response: TRW has enclosed a number of documents for this request.

- 9) *Provide copies of all documents transmitted internally within TRW that relate to the alleged defect in the subject component or the subject TSB.*

Response: TRW has enclosed a number of documents for this request.

- 10) *Provide an electronic summary, in a format compatible with Microsoft Excel 2000, of each claim of which TRW is aware of, regardless of whether the claim is against TRW, related to the alleged defect in the subject component. For each such claim, include the following information in the summary:*

- a. Vehicle owner name, address, and telephone number;*
- b. Vehicle model, model year, and identification number (VIN);*
- c. Incident date and vehicle mileage;*
- d. Summary of the claim and evidence provided to support the claim of switch failure; and*
- e. TRWs' assessment of the claim.*

Response: The requested information is contained in the response to request number 5.

- 11) *Furnish TRWs' assessment of the alleged defect in the subject component, including:*

- a. An assessment of the failure mechanism;*
- b. An assessment of the estimated service life of the subject component.*
- c. An assessment of the design factors that may influence the performance of the subject component;*
- d. An assessment of the manufacturing factors that may influence the performance of the subject component;*
- e. An assessment of the vehicle assembly factors that may influence the performance of the subject component; and*
- f. An assessment of the use factors that may influence the performance of the subject component.*

Please be as specific as possible in your answers and provide engineering explanations for how various factors affect the switch durability.

Response: The events that led up to the publishing of the FSB were not related to a defect in the pump. The FSB was published to notify Freightliner dealers of service kits that would reduce the time to repair a pump and improve service part availability for a particular pump flow control valve spool failure mode. The failure mode was progressive wearing of the pump flow control valve spool surface coating that

eventually could cause increased internal leakage. The increased internal leakage could reduce the oil flow rate to the steering system over a period of time. The effect of reduced flow rate to the steering system is a reduction in the available speed of steer. This would be most noticeable on lower engine speeds and higher steering pressures. However, the mechanical portion of the steering system would still be functional. We have attached an analysis of the mileage on the vehicles that experienced a worn flow control valve spool. The average mileage is 200,000 plus.

The use factors that may contribute to this failure mode include: system temperature (including spikes), duty cycle, and system contamination. The manufacturing factors that may contribute to this failure mode include: clearance between the flow control valve spool and the housing bore and quality of the flow control valve spool coating. The design factors that may contribute to this failure include: flow control valve spool to bore clearance, land design, and surface coating. Factors related to vehicle assembly that may contribute to flow control valve spool wear include: cavitation during system filing and contamination in hoses and reservoirs.

12) *Provide the name and contact information of a TRW representative that can answer technical questions concerning the subject of this letter.*

Response: David Hobson, 800 Heath Street, Lafayette, IN, 47904.
Phone 765-429-1768, email Dave.Hobson@trw.com.

13) *Produce electronic copies of all service, warranty, and other documents that relate to, or may relate to, the alleged defect in the subject components, that TRW has issued to any dealers, regional or zone offices, field offices, fleet purchasers, or other entities. This includes, but is not limited to, bulletins, advisories, informational documents, training documents, or other documents or communications, with the exception of standard shop manuals. Also include the latest draft copy of any communication that TRW is planning to issue within the next 120 days.*

Response: TRW has included a copy of Repair Procedure # PMP-100 entitled, "On Vehicle Spool Valve Assembly Replacement Procedure." April 2006. TRW has no plans to issue any other related service procedures.

TRW's response to your letter does not include , and we are not producing, documents or information that may be covered by the attorney-client privilege, work product doctrine or other similar privilege or immunity from disclosure.

Please note that due to the enormity of the information requested in your letter and the shortness of time for TRW's response, it is impossible for TRW to identify such documents and information for which it asserts a claim of such privilege or immunity as requested on Page 6 of your letter. Moreover, TRW wished to make it clear that it is not in any manner waiving, and TRW expressly reserves the right to assert, such a claim of privilege or immunity as to other documents and information. TRW has made a reasonable search of its records within the time constraints of the PE.

This response is based on a search of records at those locations of TRW where documents that appeared to be called for by your request can reasonably be expected to be found. Responsive documents provide the basis for TRW's response. The records search was conducted after receipt of your February 25 letter and should have resulted in the identification of information received or generated up to that time. It is possible that additional responsive information may have been received or generated by TRW between the time the search was completed and the date of this response.

Please contact me at 765-429-1768 with any inquiries regarding this issue.

Regards,

David E. Hobson
Manager, Quality Services

-----Original Message-----

From: Floyd

Sent: Thursday, May 20, 2004 3:59 PM

To: DSM-FTL/STL; RSM-FTL/STL

Cc:

Subject: Steering Pumps - Low RPM Output

The current info on TRW aluminum body EV type power steering pumps.
You may have been encountered the symptom: *low assist (low steering pump output) at idle or when backing up.*

TRW has recognized that some pumps may develop wear on the flow control shuttle or "spool". There has been little in terms of this problem in past years, but warranty shows an increase for trucks mfg very early 2003 and later. TRW continues work to determine the root cause but began nickle coating the spools beginning as early as Feb 2004. An est. equivalent FTL build date is early March 2004.

Until we know more about this issue we suggest the following steps:

- 1) Take all the prescribed diagnostic steps for the power steering system. These steps are found in the Workshop manual under the steering gear section. Pump testing information and test parameters are included.
- 2) As always; if the pump fails pressure or flow testing, replace the pump. It is not recommended to replace the spool only - it's possible the interfacing portions of the pump may also be worn.

When we know more information we will pass it on.

TRW Power Steering Pump Spool Valve Assembly Replacement

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General Information

Some vehicles may exhibit reduced steering assist or below normal steering pump performance when turning at slow speeds, backing up, or at low engine rpms.

If the vehicle is exhibiting these symptoms and the power steering pump was built prior to January 1, 2005, use the instructions under "Diagnostic Procedure" and "Spool Valve Assembly Replacement" in this bulletin to remedy the situation.

Parts Required

See Table 1 for the correct kit number for each type of power steering pump. Check the bottom row of numbers on the tag on the steering pump for the applicable Freightliner part number (e.g., 14-14323-000). See Fig. 1.

Steering Pump Part Number (Freightliner)	Kit Part Number	Qty.
14-14323-000 through 14-14323-006	RGT408025-X1-18	1
14-14375-000 through 14-14375-004	RGT408025-X1-15	1

Table 1, Parts Required

Inspection Procedure

1. Park the vehicle on a level surface, apply the parking brakes, shut down the engine, and chock the tires.
2. Open the hood.
3. Check the serial number on the power steering pump to determine the build date. On the sticker, the serial number is the top row of numbers, starting with "TRW." See Fig. 1 .

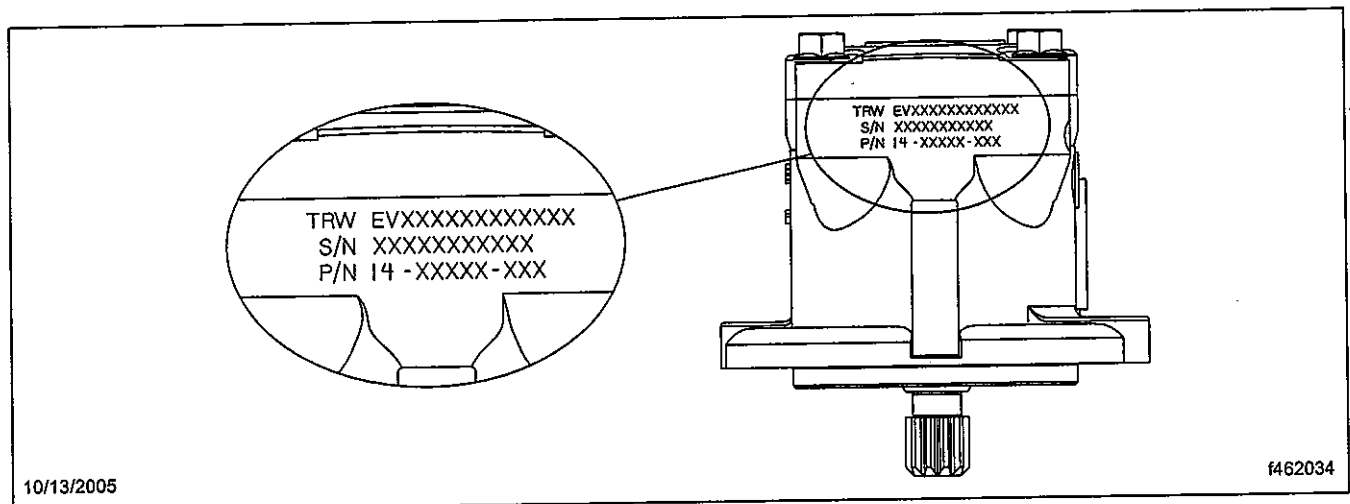


Fig. 1, Power Steering Pump Identification Numbers

4. The serial number digits have the following meanings:
 - The third through seventh digits of the serial number represent the build date, for example P3040532190.
 - The third and fourth digits, 04, represent the year 2004.

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- The fifth through seventh digits, **053**, represent the day of the year. In this case, **053** is the 53rd day of the year.

NOTE: The build date for the example above is February 22, 2004.

5. If the build date on the pump is after January 1, 2005, nothing more needs to be done. Close the hood and remove the chocks from the tires.

If the build date on the pump is prior to January 1, 2005, go to "Diagnostic Procedure" in this bulletin.

Diagnostic Procedure

IMPORTANT: The following diagnostic procedure must be completed before replacing the spool valve assembly.

NOTE: A Power Steering System Analyzer (PSSA) consists of a flow meter, a shutoff valve (which acts as a load valve), and a pressure gauge. The PSSA will allow you to measure flow and pressure, and provide a load on the power steering pump in the hydraulic lines of the steering system.

For instructions on correct installation and use of the PSSA, see TRW Commercial Steering Systems, Steering System Maintenance Guidelines. A free download in English or Spanish is available at www.trucksteering.com.

1. If not already done, open the hood.
2. Install a PSSA in the pressure line with the load (shutoff) valve fully open. Install a temperature gauge in the reservoir and begin the procedure with the fluid temperature between 125 to 135°F (52 to 57°C). See Fig. 2.
3. If necessary, check and adjust the fluid level.
4. Start the engine and let it idle.
5. Record the flow and pressure at engine idle with the load valve fully open. Increase the rpm to 1500 and record the flow and pressure. Enter all values in Table 2.

CAUTION

When closing the power steering system analyzer load valve, do so slowly and monitor the pressure gauge. Do not allow the system to exceed 3000 psi (20 684 kPa) for safety and to prevent damage to the vehicle.

6. With the engine at idle speed, adjust the load valve to 500 psi (3447 kPa) and record the flow. Adjust the load valve to 1000 psi (6895 kPa) and record the flow. Adjust the load valve to 1500 psi (10 342 kPa) and record the flow.
7. With the engine speed at 1500 rpm, repeat the previous step, and measure and record the flow readings.

CAUTION

Do not keep the load valve closed for more than five seconds at a time. Doing so could damage the system due to excessive heat buildup.

8. Fully close, then open the load valve and record the maximum pressure reading. Repeat this step three times. Record the maximum pressure reading each time.

TRW Power Steering Pump Spool Valve Assembly Replacement

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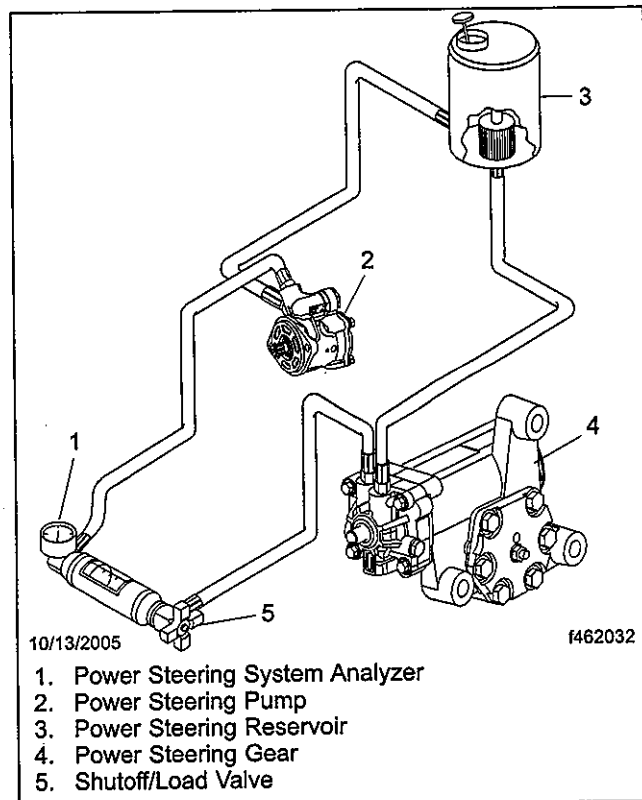


Fig. 2, Power Steering System Analyzer Installation

9. Determine the recommended flow range and maximum pump relief pressure for the steering system being used by referring to the power steering troubleshooting procedures in **Group 46** of the applicable vehicle service/workshop manual.
10. Compare the minimum and maximum flows, and the relief pressure measured, to gear and pump specifications shown in **Group 46** of the applicable vehicle service/workshop manual.
11. If the minimum measured pump flow is less than the minimum recommended flow for the steering gear used, the pump may not be putting out enough flow for an adequate steering speed. If the maximum system pressure is lower than that specified for the pump, it may not be developing enough pressure to provide maximum power assist. If either case exists, the pump may need to be repaired or replaced.

Flow and Pressure Data for the Power Steering Pump Diagnostic Procedure	
Vehicle Identification Number:	
Repair Date:	
Measured Flow	
Fluid Temperature:	_____ °F or _____ °C
Fluid Temperature:	_____ °F or _____ °C

Flow and Pressure Data for the Power Steering Pump Diagnostic Procedure		
Load Valve	Idle	1500 rpm
Open		
500 psi (3447 kPa)		
1000 psi (6895 kPa)		
1500 psi (10 342 kPa)		
Relief Valve Pressure		
No. 1: _____ psi or _____ kPa		
No. 2: _____ psi or _____ kPa		
No. 3: _____ psi or _____ kPa		

Table 2, Flow and Pressure Data for the Power Steering Pump Diagnostic Procedure

- Shut down the engine.
- Remove the PSSA and connect the hoses. Check the fluid level and bleed the air from the hydraulic system using the instructions in "Assembly," under the "Spool Valve Assembly Replacement" heading in this bulletin.

Spool Valve Assembly Replacement

NOTE: If access to the power steering pump is restricted, you may remove the power steering pump in order to perform the replacement procedure. For instructions on removing the pump, refer to **Group 46** in the applicable vehicle service/workshop manual

Disassembly

- Place the tires in the straight-ahead position.
- Remove all dirt from around the fittings and hose connections.
- Place a drain pan under the power steering pump, then disconnect the hoses from the fittings on the pump. Plug the hoses and cap the fittings to keep out dirt and to prevent fluid from leaking.
- Replace the power steering system filter.

NOTE: Be careful when removing the hydraulic plug from the power steering pump housing, as the spring preload will force the hydraulic plug from the housing.

- Remove the hydraulic plug from the power steering pump housing. Remove and discard the O-ring that is attached to the plug. See **Fig. 3**.
- If the spring did not come out when the hydraulic plug was removed, remove the spring.

TRW Power Steering Pump Spool Valve Assembly Replacement

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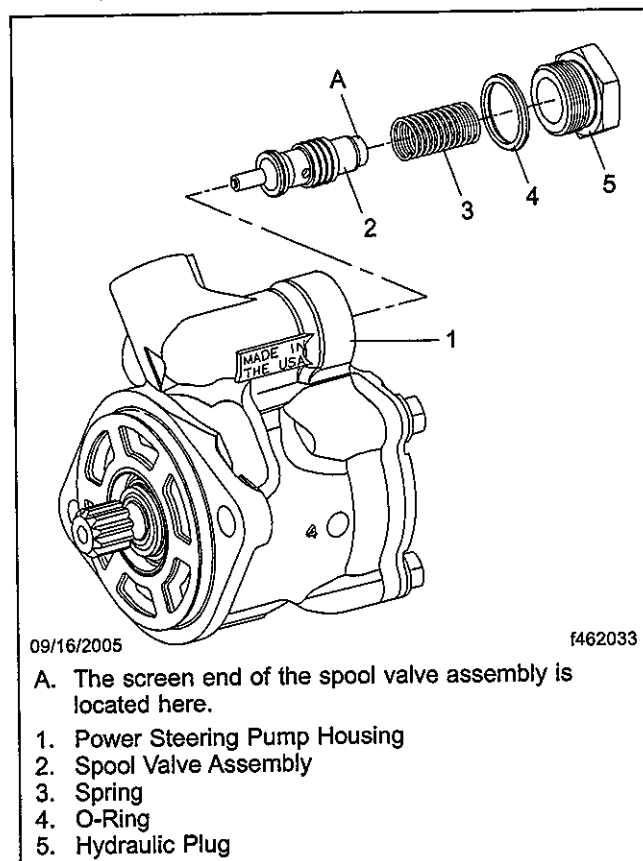


Fig. 3, Remove the Spool Valve Assembly (EV model shown)

NOTE: Take care to prevent damage to the spool valve or spool bore surface when removing the spool valve assembly.

7. Remove the spool valve assembly from the housing. The assembly should slide freely out of the housing. On some PS Series power steering pumps, the orientation of the pump may cause the spool valve assembly to fall out of the housing. The screen end of the spool valve assembly is closest to the hydraulic plug when correctly installed.

Assembly

1. Select the spool valve assembly replacement kit according to the information in Table 1 under "Parts Required" in this bulletin.
2. With the screen end of the spool valve toward the outside of the housing, install a new spool valve assembly in the power steering pump housing. See Fig. 3.
3. Make sure the new spool valve assembly slides freely in the housing. If it does not slide freely, replace the power steering pump.
4. Install the spring in the housing.
5. Install a new O-ring on the hydraulic plug.

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6. Using a petroleum-base chassis grease, lightly lubricate the threads and O-ring on the hydraulic plug.
7. Install the hydraulic plug in the power steering pump housing. Torque the plug 65 lbf-ft (88 N·m).
8. Fill the power steering reservoir with the approved power steering fluid. See Table 3.

Approved Power Steering Fluids		
Fluid Type	Approved Fluid	
Automatic Transmission Fluid *	Dexron® II	
	Dexron® III	
Heavy-Duty Engine Oil * IMPORTANT: Do not use heavy-duty engine oil in vehicles built from November 4, 2002.	Union	10W-40
	Texaco	10W-40
	Chevron	10W-40
	Mobil Super	10W-40
	Union	15W-40
	Unocal	15W-40
	Shell Rotella T	30W

* Do not mix engine oil with automatic transmission fluid (ATF). Use the same lubricant for parts as is used in the power steering system.

Table 3, Approved Power Steering Fluids

9. Start the engine to purge the system. Increase engine speed to prime the pump.
10. Shut down the engine and check the fluid level in the reservoir. Add fluid if necessary.
11. If necessary, bleed the power steering system.
 - 11.1 Check the fluid level in the power steering reservoir and, if needed, fill it to the correct level.
 - 11.2 Start the engine and let it idle for several minutes.
 - 11.3 Turn the wheels to a full-left and full-right turn. Repeat three times.
 - 11.4 Check the fluid level in the power steering reservoir. Add fluid as necessary to the full line on the reservoir or dipstick.
 - 11.5 Shut down the engine.
12. If full system performance is not restored after following this procedure, it may be necessary to replace the power steering pump. Follow the instructions under "Diagnostic Procedure" in this service bulletin to determine if replacing the pump is necessary.
13. Close the hood and remove the chocks from the tires.

Warranty

Normal warranty applies. See Table 4 for damage code and time guide information. Use the Freightliner part number (e.g., 14-XXXX-XXX) on the power steering pump as the failed part number, and enter the number of this bulletin in the story of the claim.

TRW Power Steering Pump Spool Valve Assembly Replacement

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Damage Code and Time Guide Information			
Damage Code	Operation Number	Description	Time: hours
539-001640590	539-5002A	Spool Valve, Power Steering Pump, R/R	0.8

Table 4, Damage Code and Time Guide Information

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Description of Revisions: *This bulletin replaces the version dated June 2006. Information from TRW has been added to "General Information," procedures have been revised, and time guide information has been added.*

General Information

Some Freightliner vehicles equipped with TRW power steering pumps may exhibit reduced steering assist. Use the instructions under "Diagnostic Procedure" to determine if the power steering pump is the problem.

If the vehicle was built before January 1, 2005, and the problem is found to be with the power steering pump, it may not be necessary to replace the entire power steering pump. A kit to replace the spool valve assembly is available; use the instructions under "Spool Valve Assembly Replacement."

If the vehicle was built after January 1, 2005, and the problem is found to be with the power steering pump, replace the entire power steering pump using the instructions in the applicable vehicle service/workshop manual.

IMPORTANT: Before replacing the spool valve assembly or the power steering pump, you must complete the diagnostic procedure in this bulletin to determine if pump performance is the true cause of the reduced steering assist problem. If performance is not to specification, and the vehicle was built before Jan 1, 2005, TRW requires the replacement of the spool valve assembly and a subsequent performance test before further repairs.

Parts

See Table 1 for the correct kit number for each type of power steering pump. Note that these kits apply only to vehicles built prior to January 1, 2005.

Check the bottom row of numbers on the tag on the steering pump for the applicable Freightliner part number (e.g., 14-14323-000). See Fig. 1.

Steering Pump Part Number (Freightliner)	Kit Part Number	Qty.
14-14323-000 through 14-14323-006	RGT 408025 X1 18	1
14-14375-000 through 14-14375-004	RGT 408025 X1 15	1

Table 1, Parts

Diagnostic Procedure

IMPORTANT: The following diagnostic procedure must be completed before replacing the spool valve assembly or the power steering pump.

NOTE: A Power Steering System Analyzer (PSSA) consists of a flow meter, a shutoff valve (which acts as a load valve), and a pressure gauge. The PSSA will allow you to measure flow and pressure, and provide a load on the power steering pump in the hydraulic lines of the steering system.

For instructions on correct installation and use of the PSSA, refer to *TRW Commercial Steering Systems, Steering System Maintenance Guidelines*, at www.trucksteering.com. A free download is available in English or Spanish.

1. Open the hood.
2. Remove all dirt from around the power steering pump fittings and hose connections.

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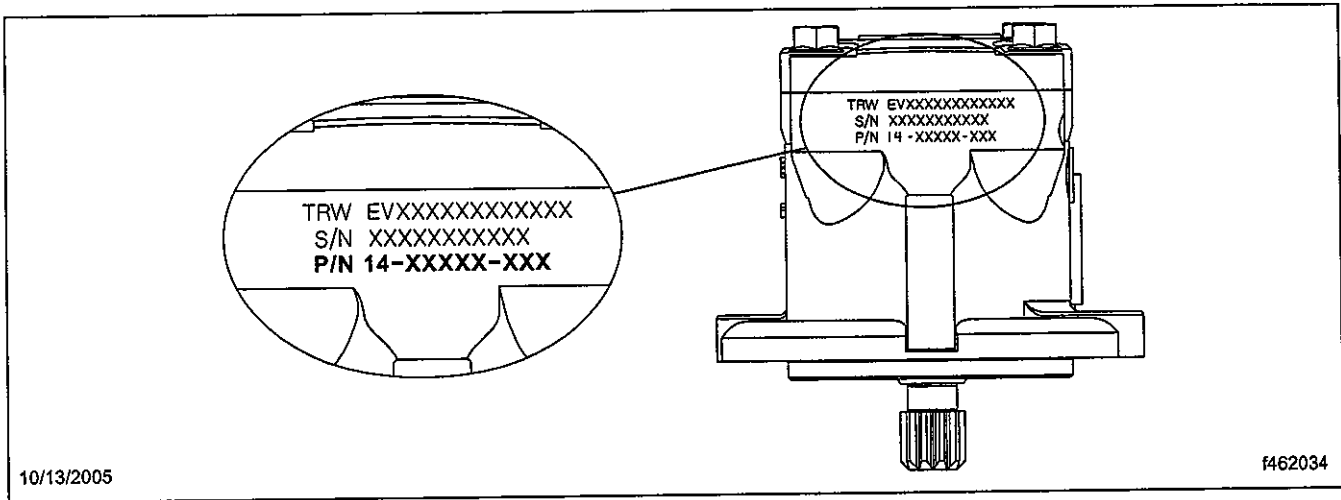


Fig. 1, Power Steering Pump Identification Numbers (EV pump shown)

3. Install a PSSA in the pressure line with the load (shutoff) valve fully open, and place a temperature gauge in the reservoir. See Fig. 2.

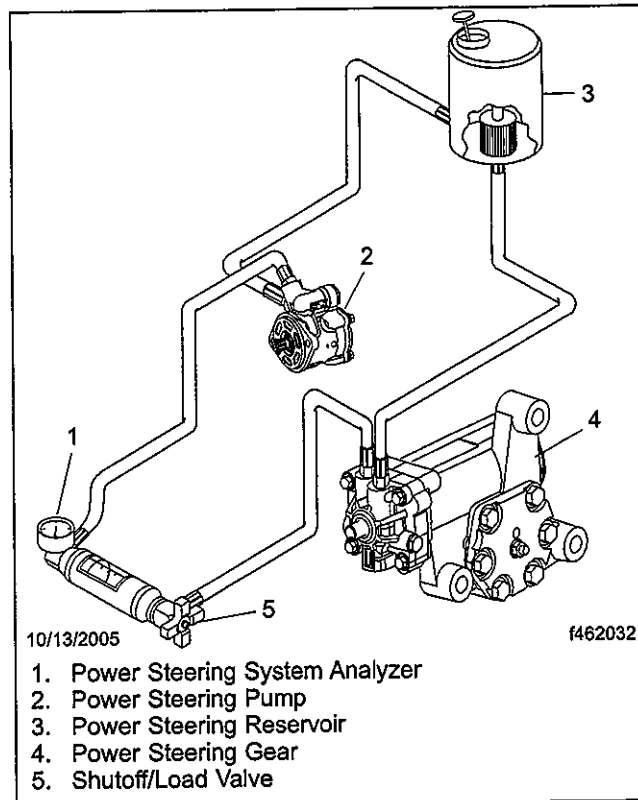


Fig. 2, Power Steering System Analyzer Installation

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4. Check the fluid level, and adjust it as needed. See Table 2 for approved power steering fluids.

Approved Power Steering Fluids		
Fluid Type	Approved Fluid	
Automatic Transmission Fluid*	Dexron® II	
	Dexron® III	
Heavy-Duty Engine Oil* IMPORTANT: Do not use heavy-duty engine oil in vehicles built from November 4, 2002.	Union	10W-40
	Texaco	10W-40
	Chevron	10W-40
	Mobil Super	10W-40
	Union	15W-40
	Unocal	15W-40
	Shell Rotella T	30W

* Do not mix engine oil with automatic transmission fluid (ATF). Use the same lubricant for parts as is used in the power steering system.

Table 2, Approved Power Steering Fluids

5. To bleed air from the system, start the engine and let it idle.
6. If air is still present, bleed the power steering system, as follows.
 - 6.1 Raise the front of the vehicle so the front tires clear the ground.
 - 6.2 Turn the wheels to a full-left and full-right turn. Repeat three times.
 - 6.3 Lower the front of the vehicle.
7. Check the fluid level, then partially close the load (shutoff) valve to raise the fluid temperature to 180°F (82°C). When the fluid in the reservoir is up to temperature, open the load valve and begin the test procedure.
8. Record the flow and pressure at engine idle with the load valve fully open. Increase the rpm to 1500 and record the flow and pressure. Enter all values on the **Flow and Pressure Data for the Power Steering Pump Diagnostic Procedure** sheet, attached to this bulletin.

⚠ CAUTION

When closing the power steering system analyzer load valve, do so slowly, and monitor the pressure gauge. Do not allow the system to exceed 3000 psi (20 684 kPa), both for safety, and to prevent damage to the vehicle.

Do not keep the load valve closed for more than five seconds at a time. Doing so could damage the system due to excessive heat buildup.

9. With the engine at idle speed, adjust the load valve to 500 psi (3447 kPa) and record the flow. Adjust the load valve to 1000 psi (6895 kPa) and record the flow. Adjust the load valve to 1500 psi (10 342 kPa) and record the flow.
10. With the engine speed at 1500 rpm, repeat the previous step, and measure and record the flow readings.
11. Fully close, then open the load valve and record the maximum pressure reading. Repeat this step three times. Record the maximum pressure reading each time.

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12. Compare minimum and maximum flows, and measured relief pressure, to the pump specifications provided at www.trucksteering.com.
13. Shut down the engine.
14. If the power steering pump is not performing to specifications, and the vehicle was built prior to January 1, 2005, go to "Spool Valve Assembly Replacement," in this bulletin.

If the power steering pump is not performing to specifications, and the vehicle was built after January 1, 2005, replace the entire power steering pump using the instructions in the applicable vehicle service/workshop manual.

If the power steering pump is performing to specifications, go to the next step.
15. Remove the PSSA and reconnect the hoses.
16. Bleed the power steering system, and add fluid, if needed.
17. Shut down the engine.
18. Remove the chocks from the tires.

Spool Valve Assembly Replacement (vehicles built prior to January 1, 2005)

NOTE: If access to the power steering pump is restricted, you may remove the power steering pump in order to perform the replacement procedure. For instructions on removing the pump, refer to **Group 46** of the applicable vehicle service/workshop manual.

Disassembly

1. Place a drain pan under the power steering pump.
2. Replace the power steering system filter.

NOTE: Be careful when removing the hydraulic plug from the power steering pump housing, as the spring preload will force the hydraulic plug from the housing.

3. Remove the hydraulic plug from the power steering pump housing. Remove and discard the O-ring that is attached to the plug. See Fig. 3.
4. If the spring did not come out when the hydraulic plug was removed, remove the spring.

NOTE: Take care to prevent damage to the spool valve or spool bore surface when removing the spool valve assembly.

5. Remove the spool valve assembly from the housing. The assembly should slide freely out of the housing. On some PS Series power steering pumps, the orientation of the pump may cause the spool valve assembly to fall out of the housing. The screen end of the spool valve assembly is closest to the hydraulic plug when correctly installed.

Assembly

1. Select the spool valve assembly replacement kit according to the information in Table 1 under "Parts" in this bulletin.
2. With the screen end of the spool valve toward the outside of the housing, install a new spool valve assembly in the power steering pump housing. See Fig. 3.

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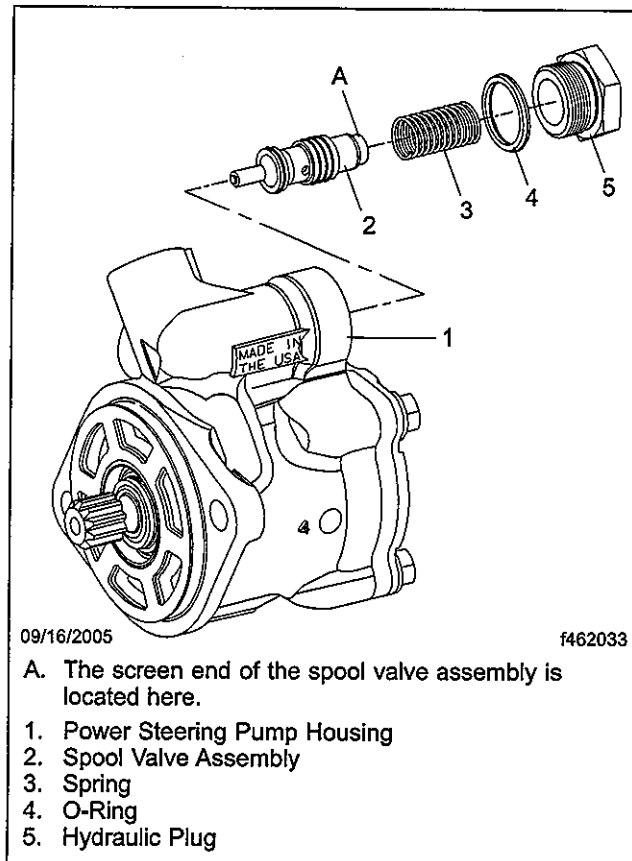


Fig. 3, Spool Valve Assembly (EV model shown)

3. Make sure the new spool valve assembly slides freely in the housing. If it does not slide freely, replace the power steering pump.
4. Install the spring in the housing.
5. Install a new O-ring on the hydraulic plug.
6. Using a petroleum-base chassis grease, lightly lubricate the threads and O-ring on the hydraulic plug.
7. Install the hydraulic plug in the power steering pump housing. Torque the plug 65 lbf-ft (88 N-m).
8. Fill the power steering reservoir with the approved power steering fluid. See Table 2.
9. Start the engine to purge the system. Increase engine speed to prime the pump.
10. If necessary, bleed the power steering system, as follows.
 - 10.1 Raise the front of the vehicle so the front tires clear the ground.
 - 10.2 Turn the wheels to a full-left and full-right turn. Repeat three times.
 - 10.3 Lower the front of the vehicle.
 - 10.4 Check the fluid level in the power steering reservoir. Add fluid as necessary to the full line on the reservoir or dipstick.
11. Test the flow and pressure of the pump again, as done previously in "Diagnostic Procedure."

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12. Remove the PSSA.
13. Compare the minimum and maximum flow and measured relief pressure to the specifications provided at www.trucksteering.com. If full system performance has not been restored after replacing the spool valve assembly, replace the entire pump using the instructions in the applicable vehicle service/workshop manual.
14. Bleed the power steering system, and add fluid, if needed.
15. Shut off the engine.
16. Unchock the tires.

Warranty

Normal warranty applies. See Table 3 for damage code and time guide information. Use the Freightliner part number (e.g., 14-XXXX-XXX) on the power steering pump as the failed part number, and enter the number of this bulletin in the story of the claim.

Damage Code and Time Guide Information			
Damage Code	Operation Number	Description	Time: hours
539-001640590	539-5002A	Spool Valve, Power Steering Pump, R/R	1.2
539-001A06130	539-5002B	Spool Valve and Power Steering Pump, R/R	2.2

Table 3, Damage Code and Time Guide Information

Flow and Pressure Data for the Power Steering Pump Diagnostic Procedure

Vehicle Identification Number: _____

Repair Date: _____

Measured Flow

Fluid Temperature: _____ °F or _____ °C

Load Valve	Idle	1500 rpm
Open	_____	_____
500 psi (3447 kPa)	_____	_____
1000 psi (6895 kPa)	_____	_____
1500 psi (10 342 kPa)	_____	_____

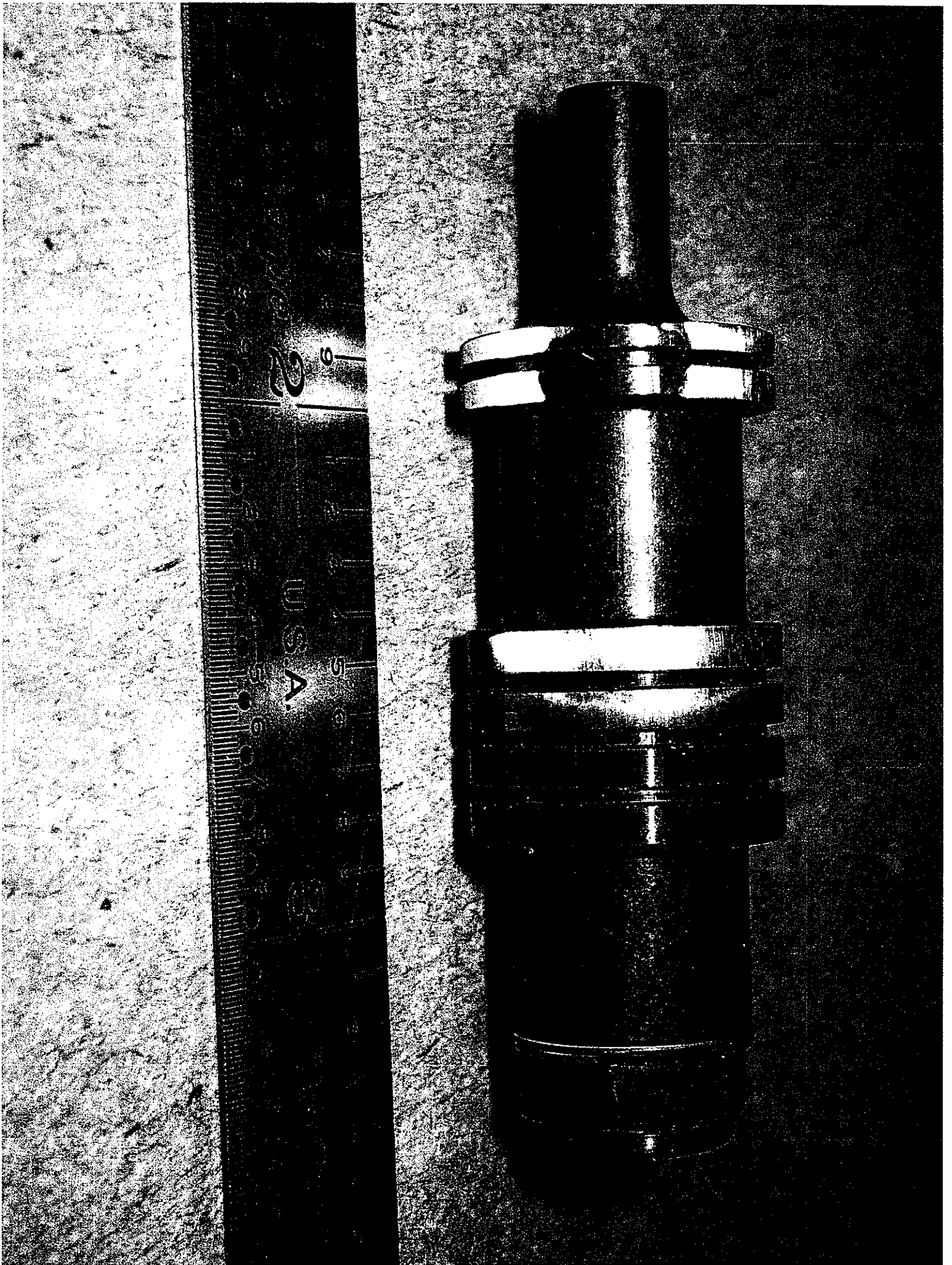
Relief Valve Pressure

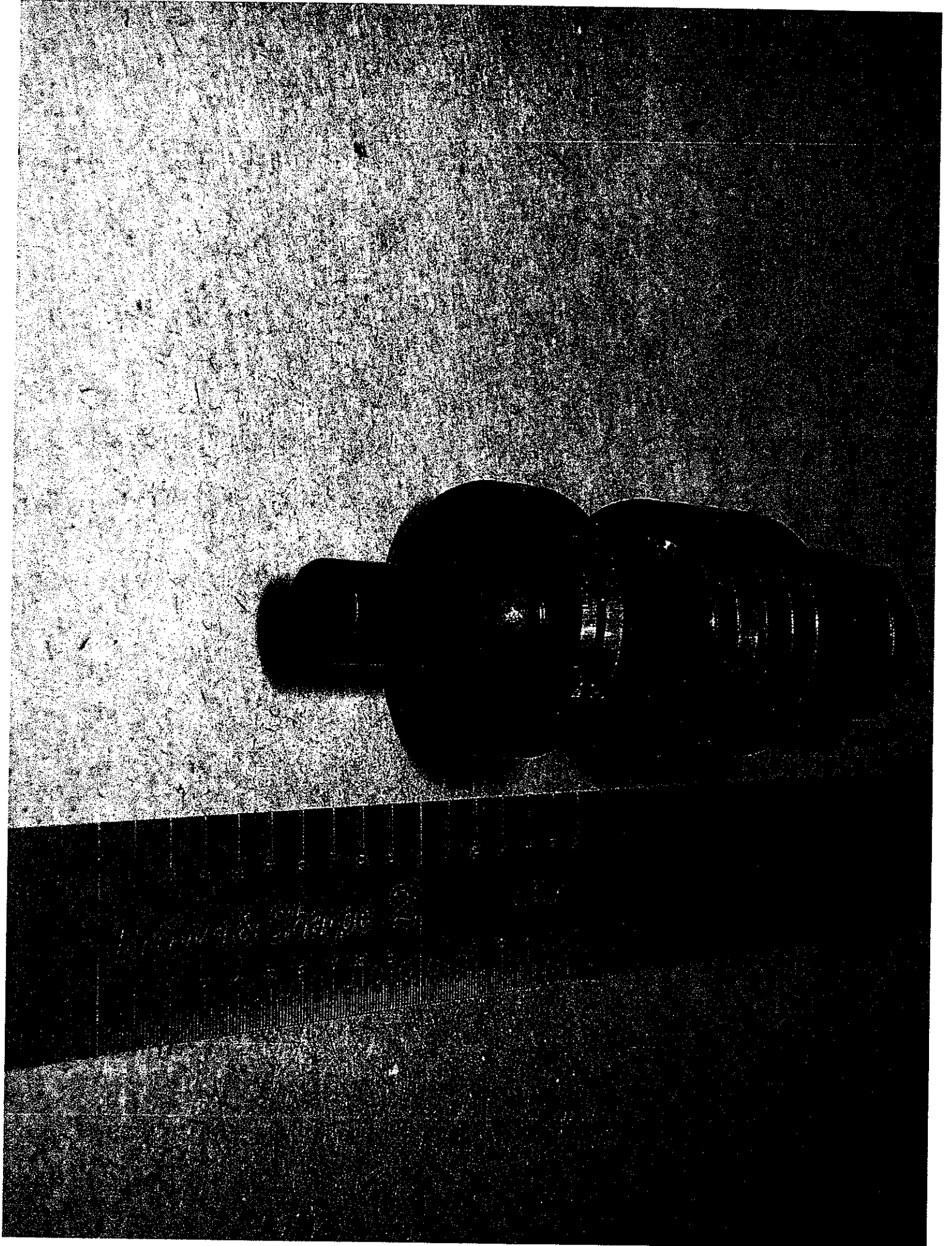
No. 1: _____ psi or _____ kPa

No. 2: _____ psi or _____ kPa

No. 3: _____ psi or _____ kPa

REQUEST NUMBER 9





Freightliner Warranty

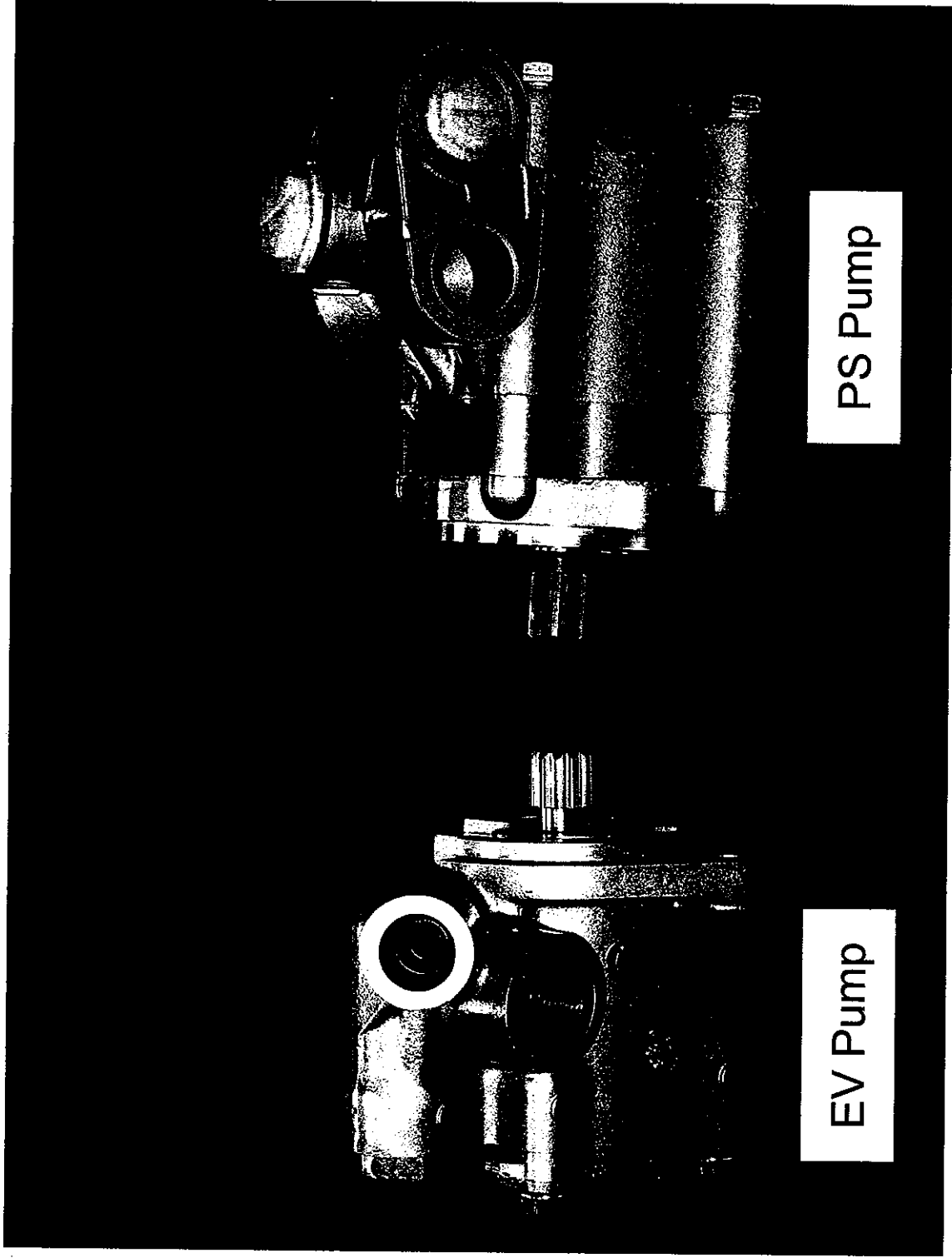
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EV and PS Series Pumps

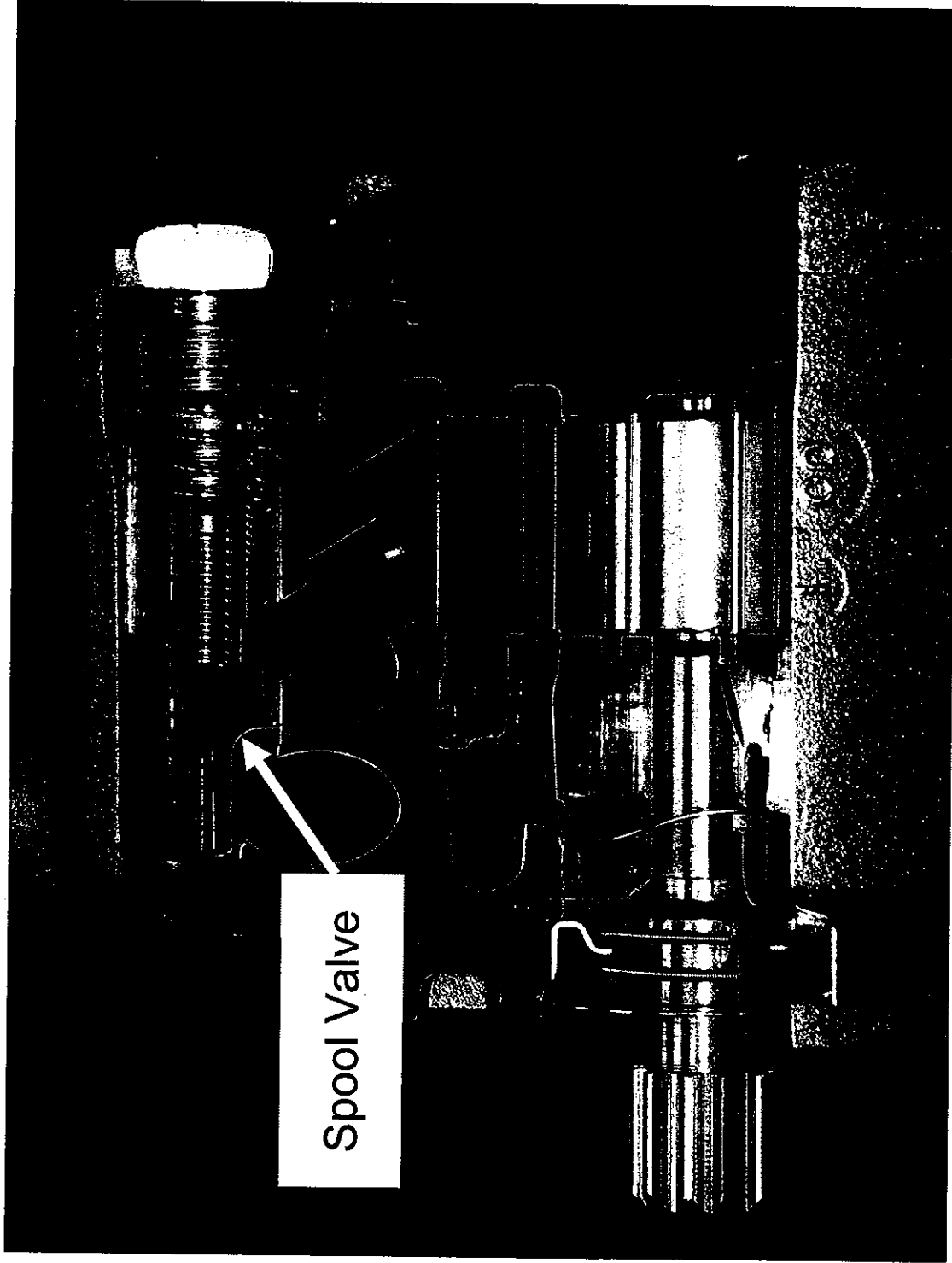


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EV Series Pump



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Warranty Claims Received

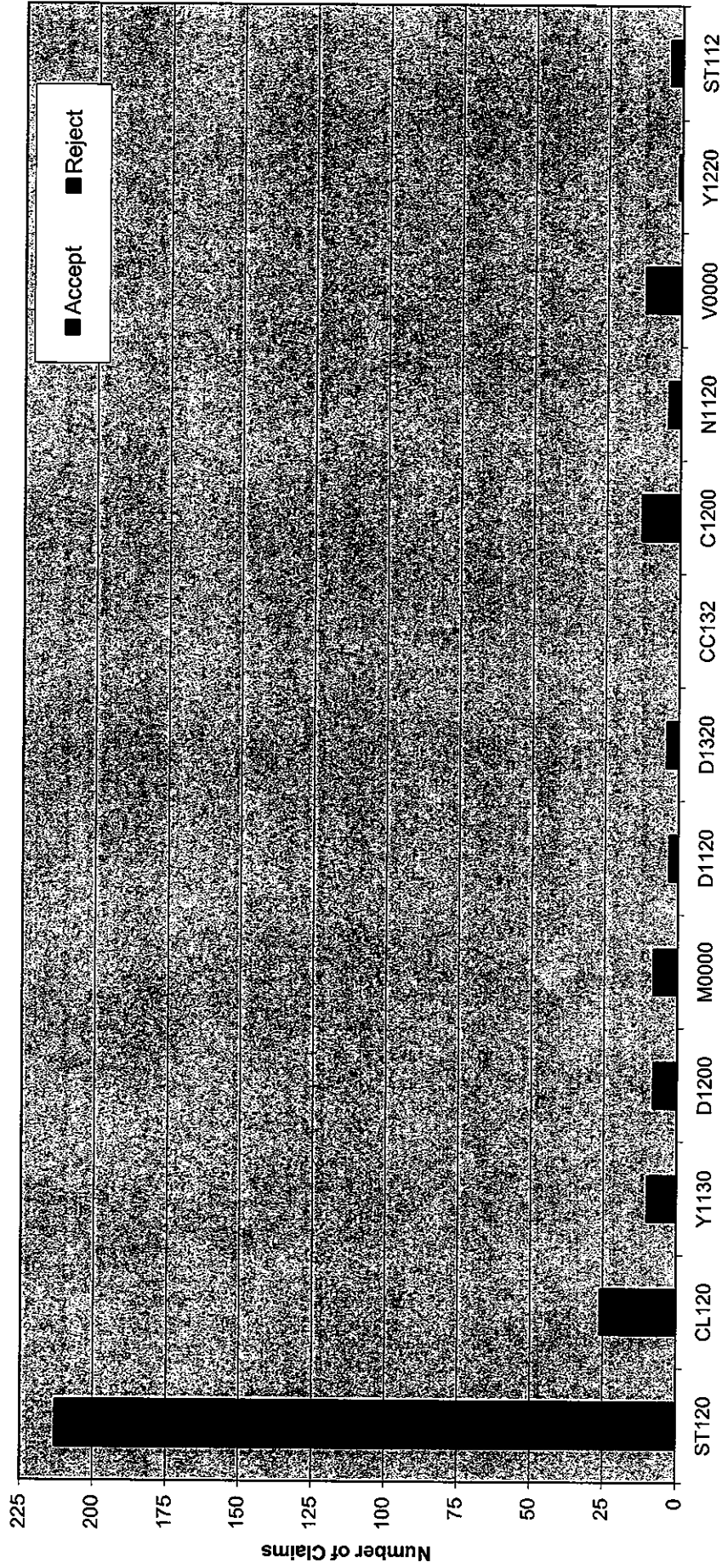
In-Service Year	No. Accepted	No. Rejected	Grand Total	% Acceptance
2001	104	214	318	32.7
2002	199	169	368	54.1
2003	205	99	304	67.4
Grand Total	508	482	990	51.3

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TRW Pump Warranty
 Freightliner Models
 2001 In Service Dates

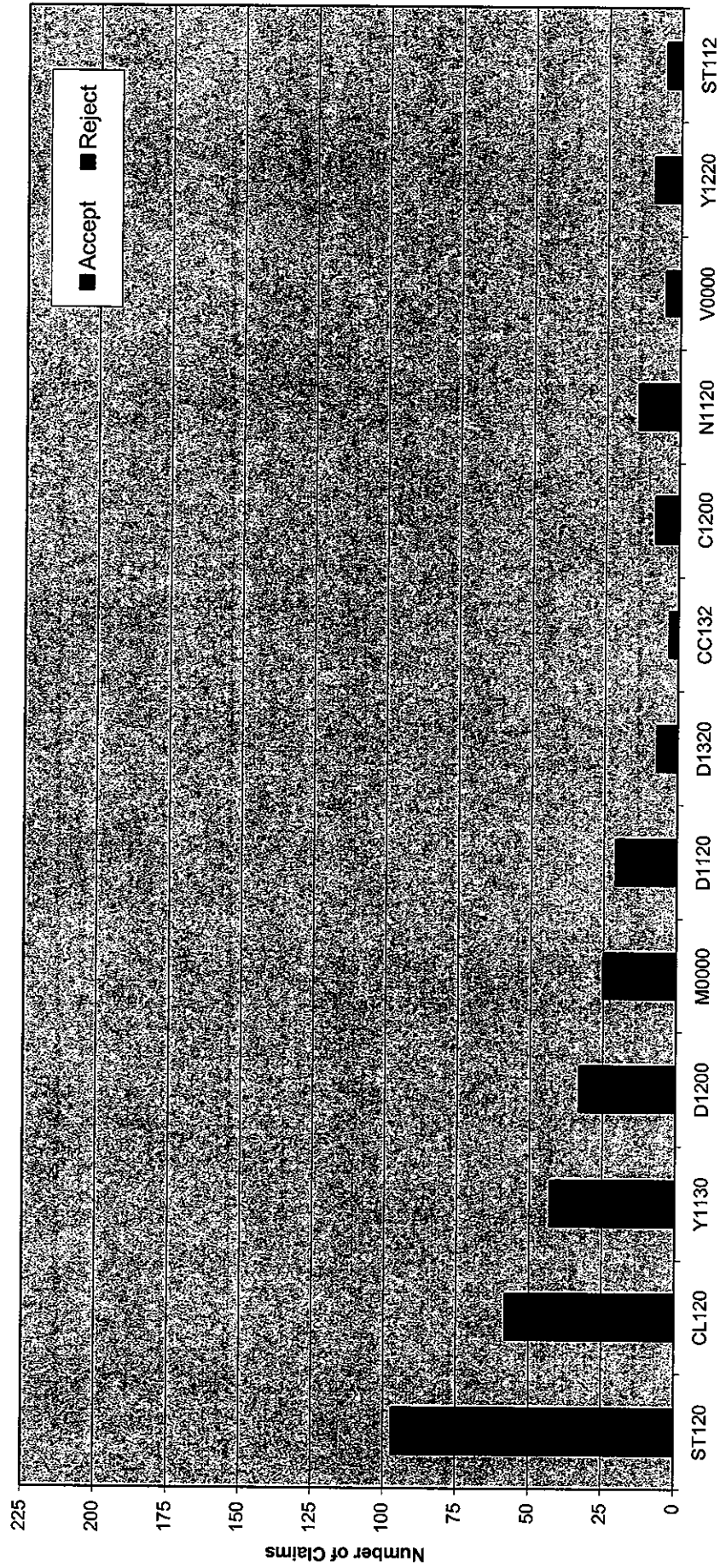


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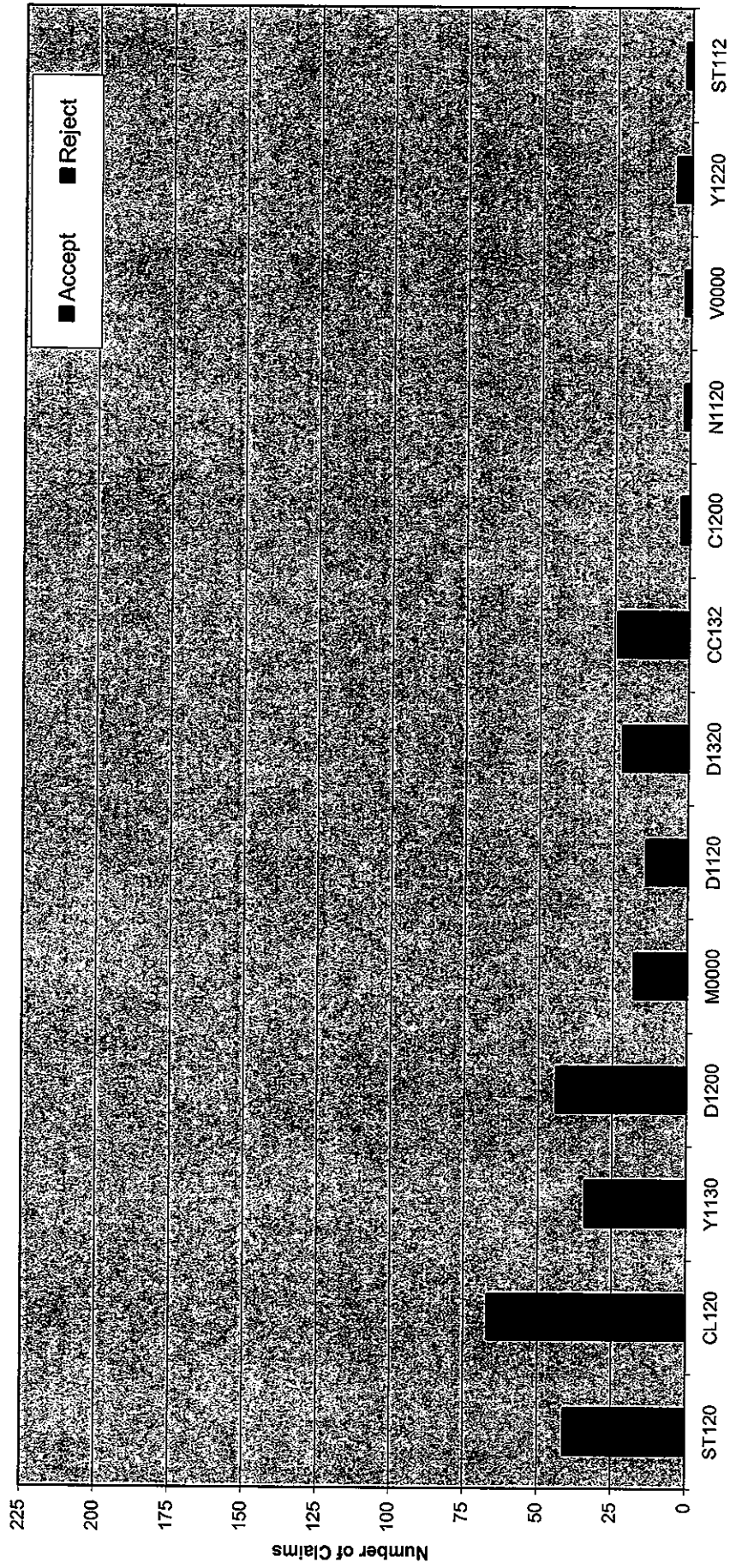
TRW Pump Warranty
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 2002 In Service Dates



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TRW Pump Warranty
 Freightliner Models
 2003 In Service Dates

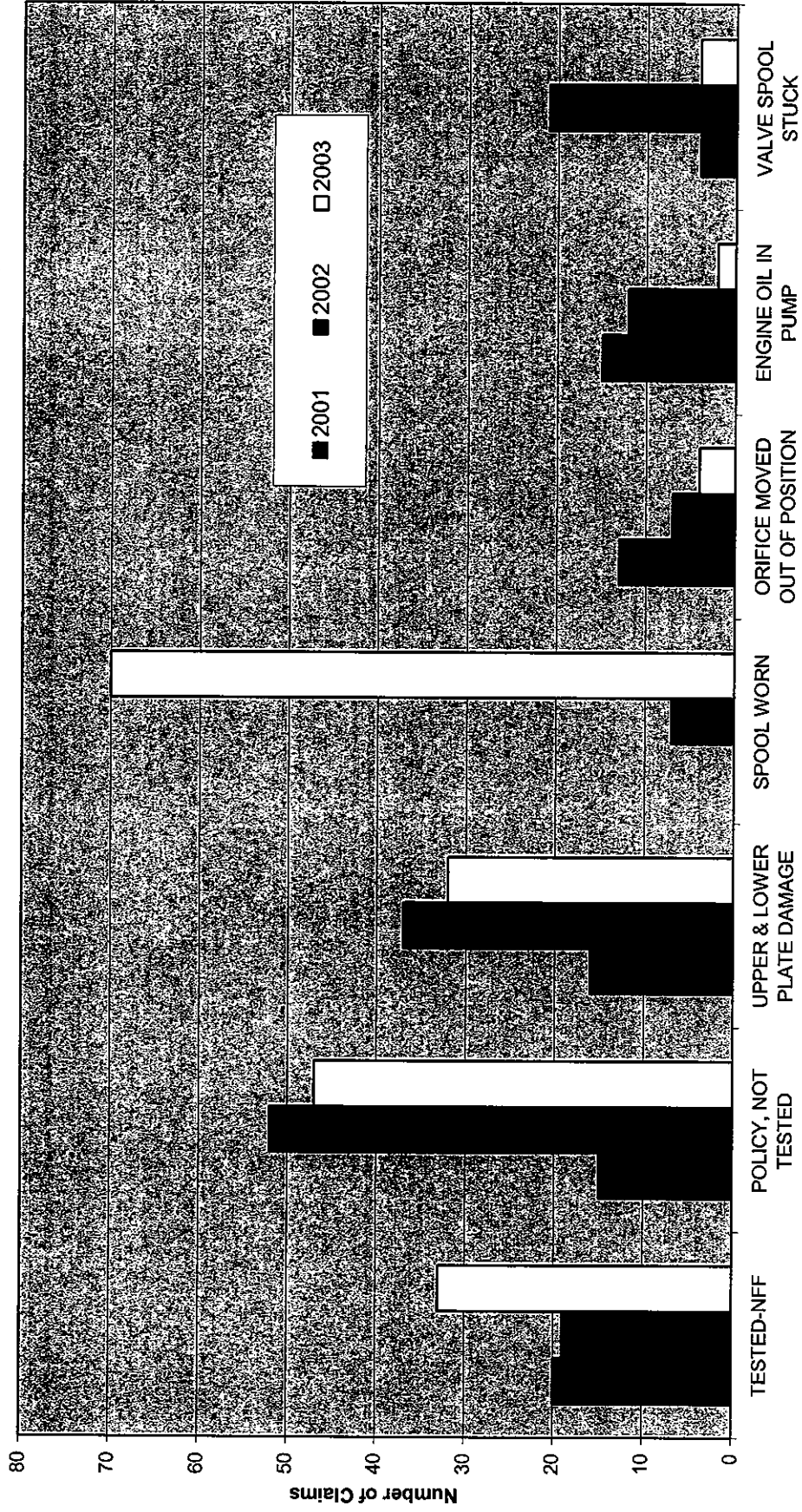


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TRW Pump Warranty Accepted Claim Pareto
(Based on In Service Date)

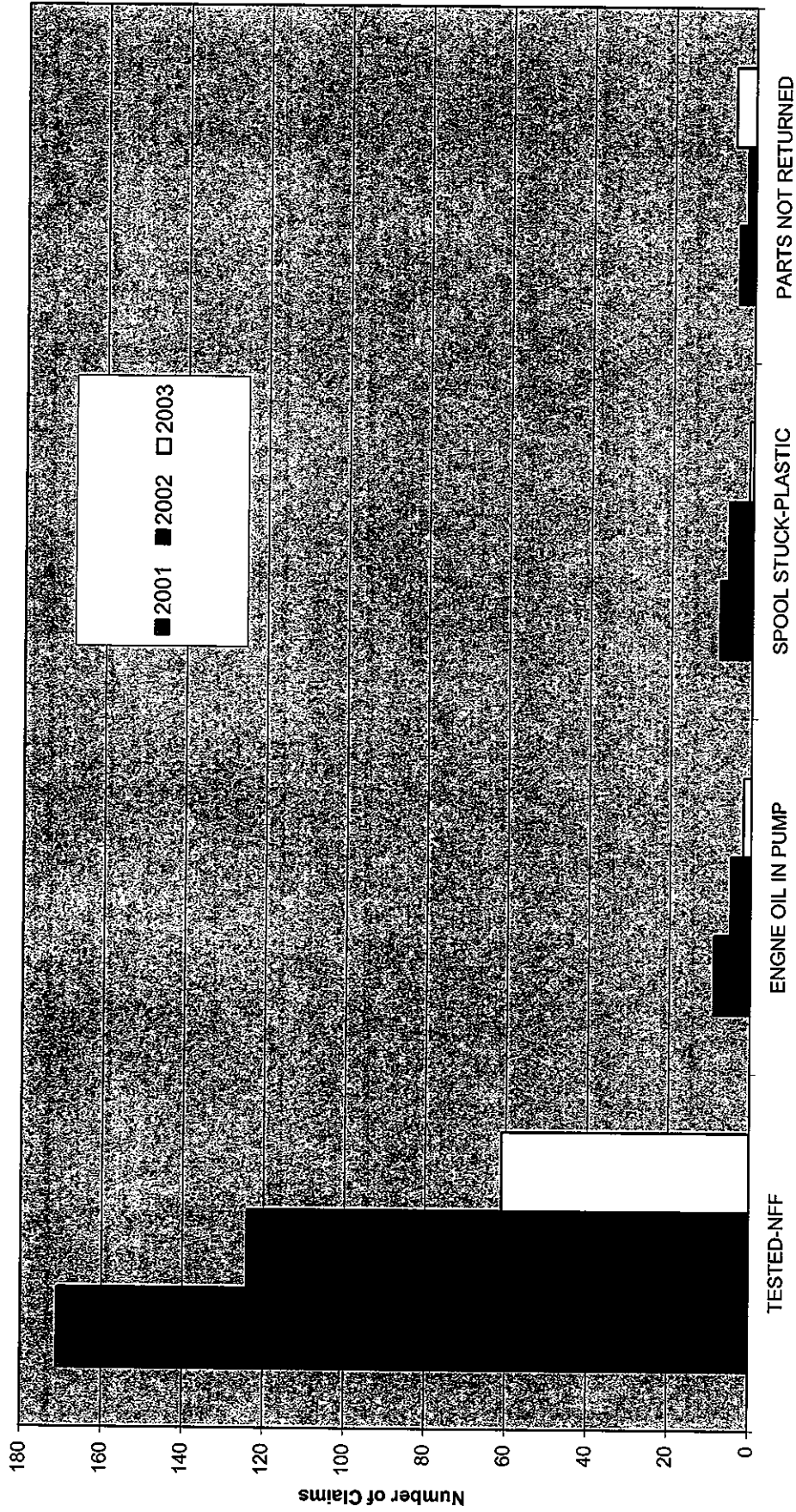


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TRW Pump Warranty Rejected Claim Pareto
(Based on In Service Date)

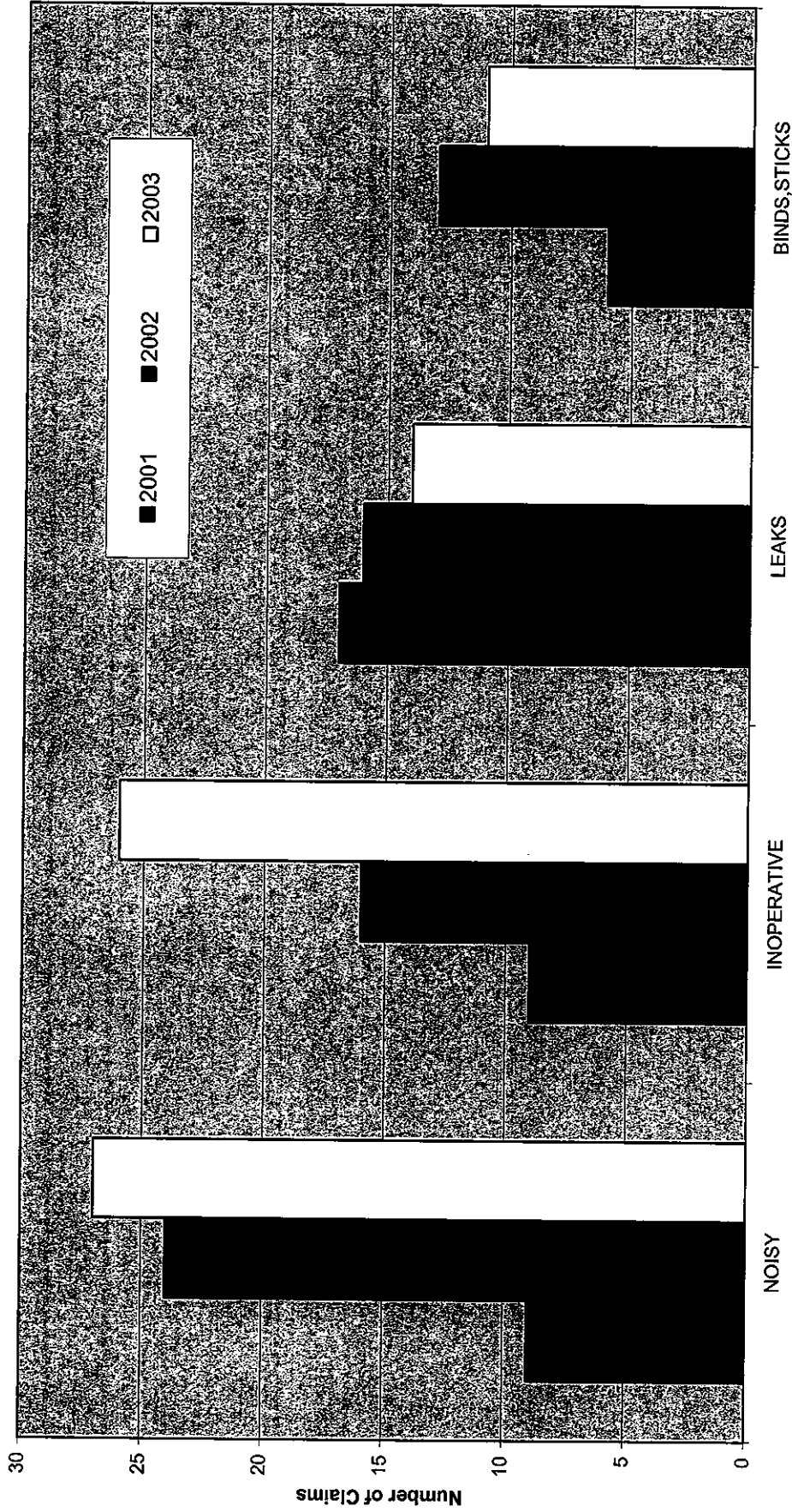


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TRW Pump Warranty - Policy Payment Symptoms

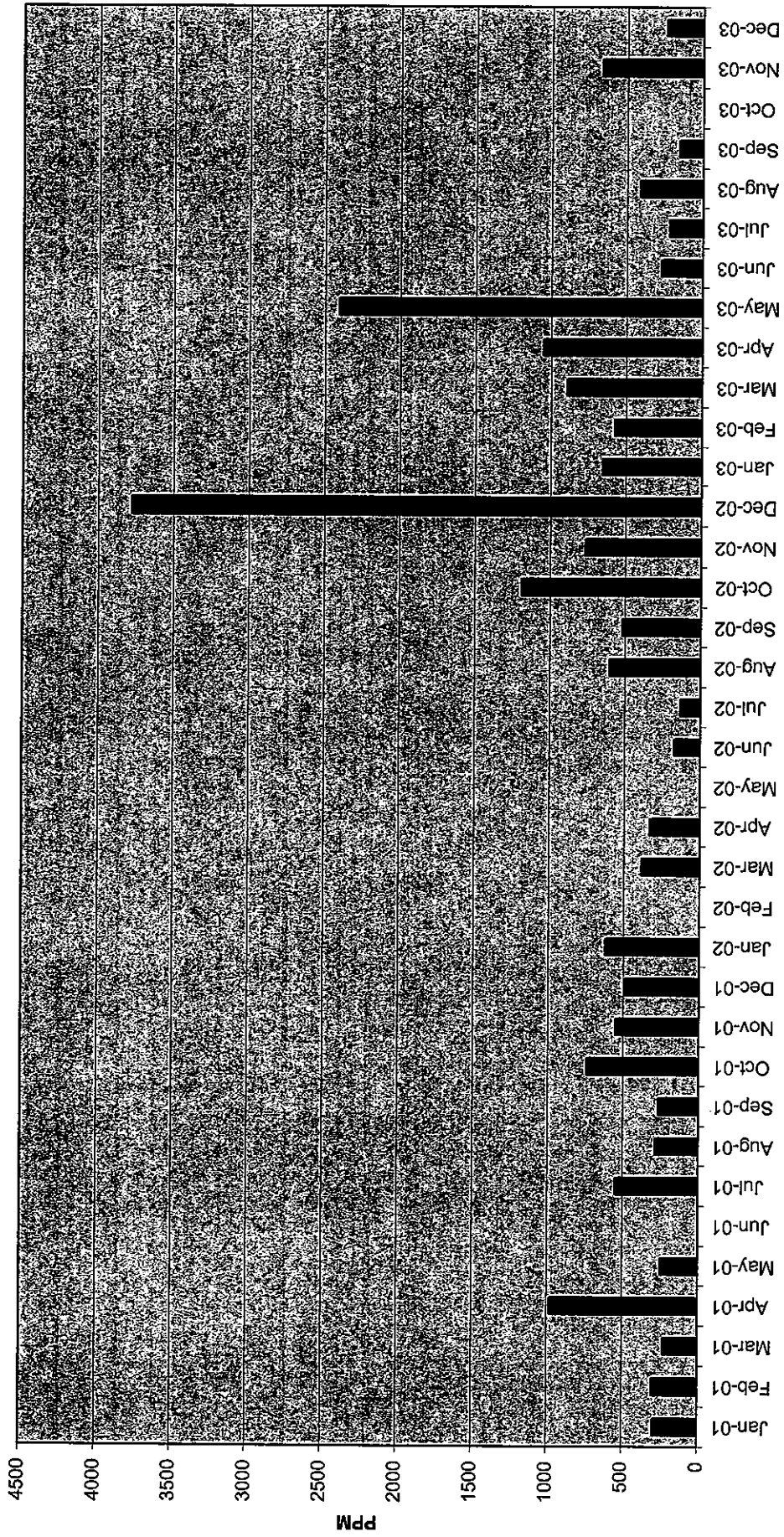


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TRW Pump Warranty
Upper & Lower Plate Damage

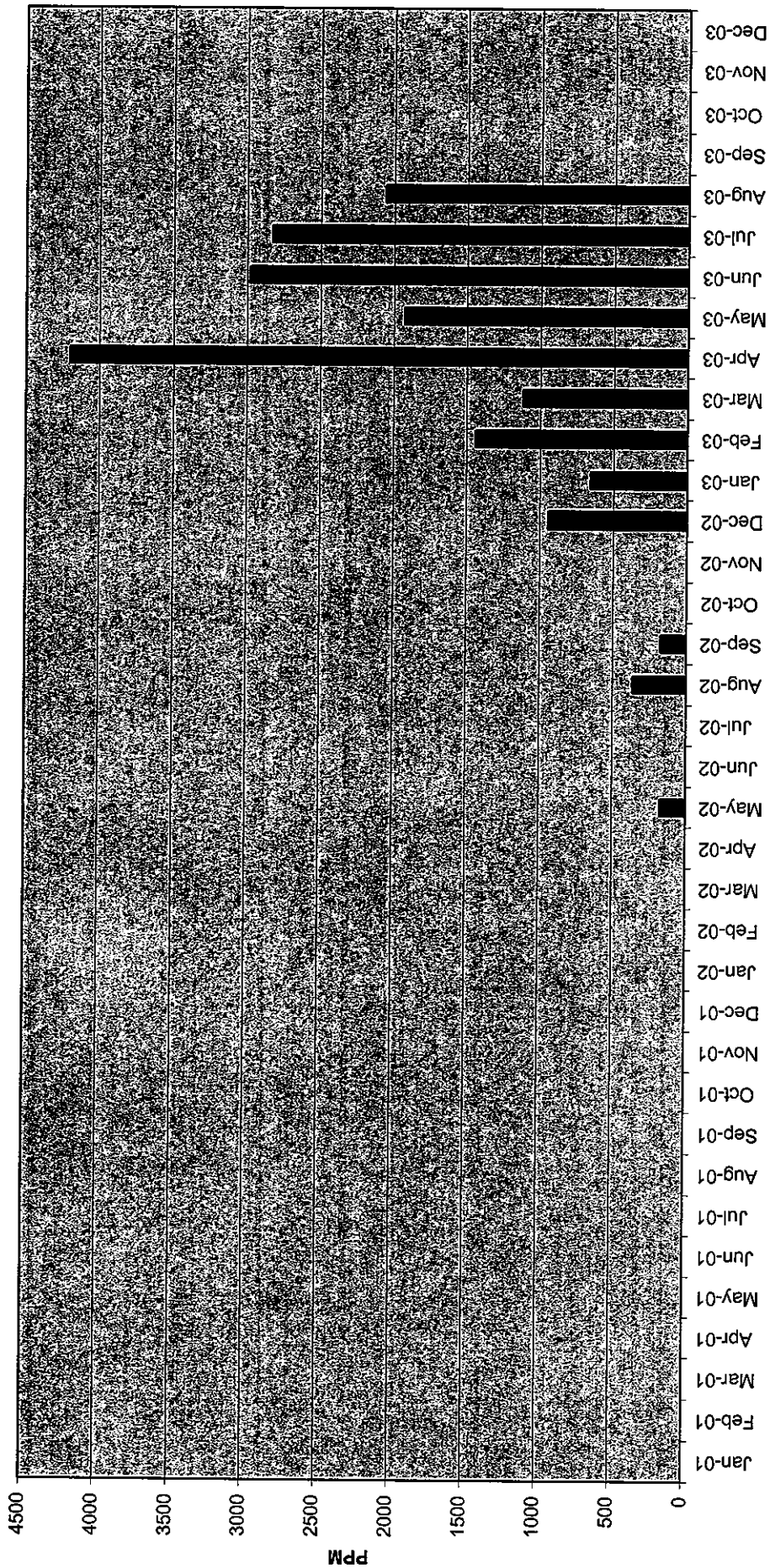


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TRW Pump Warrnty
Spool Worn

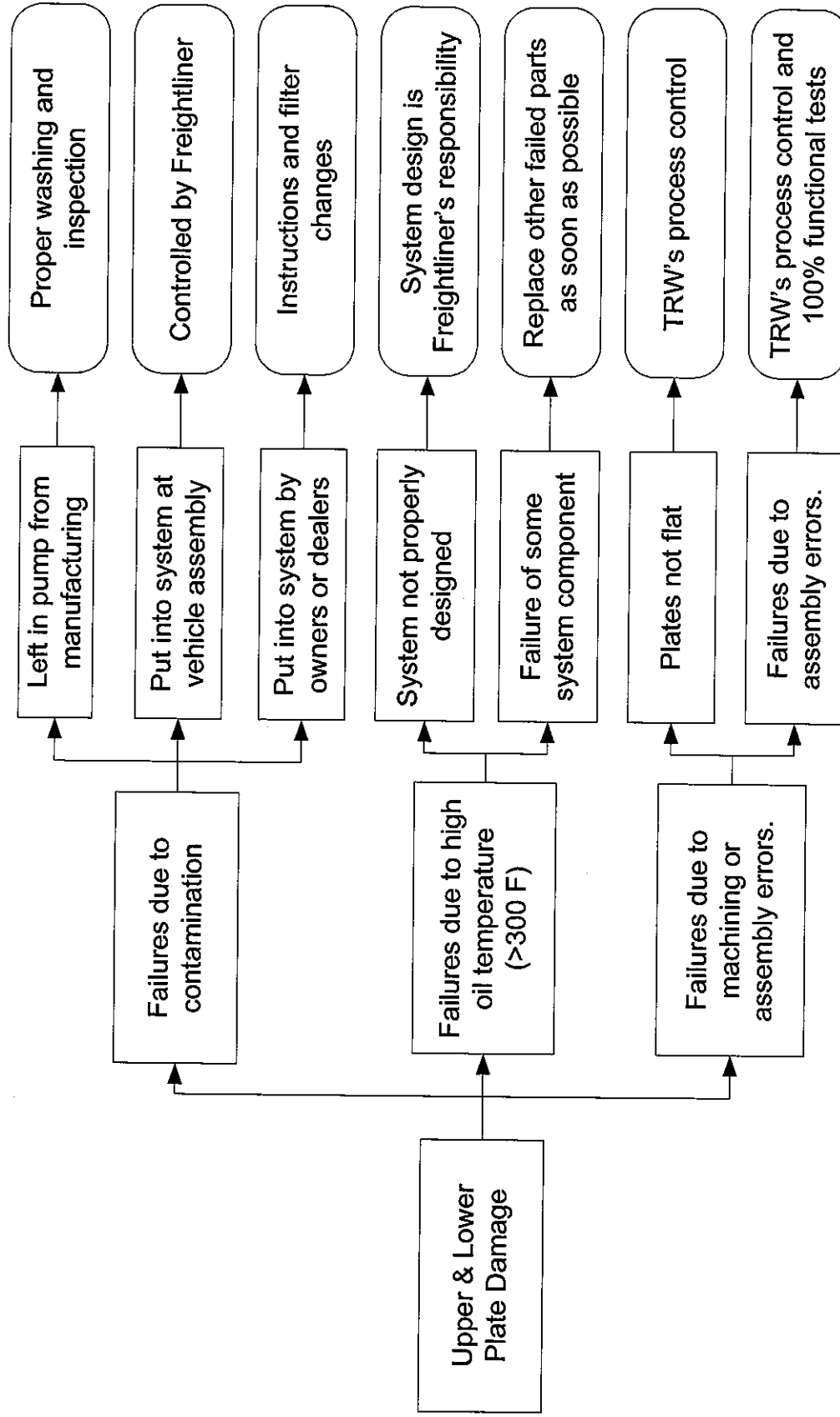


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Upper & Lower Plate Damage

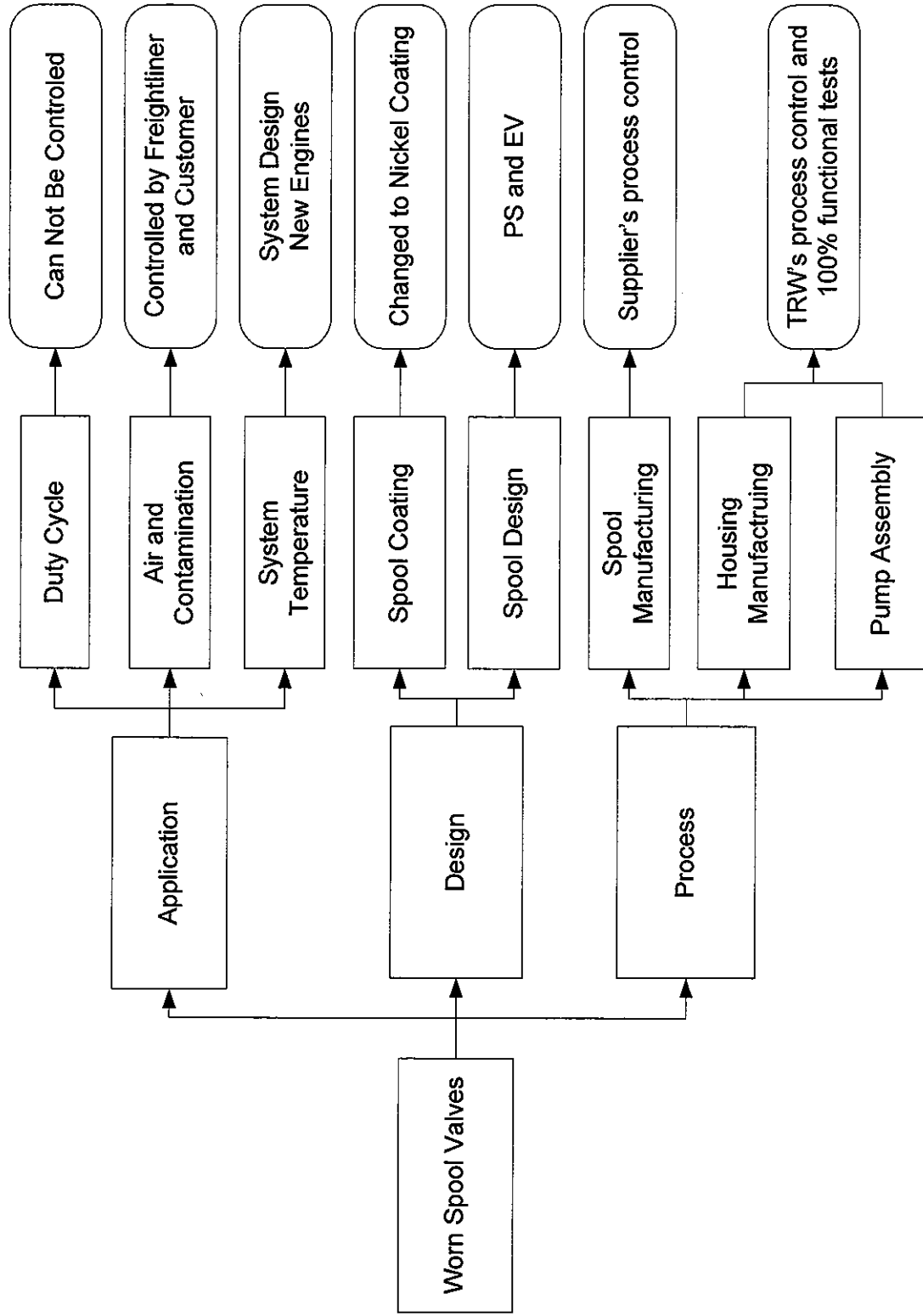


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Worn Spools



TRW PROPRIETARY INFORMATION

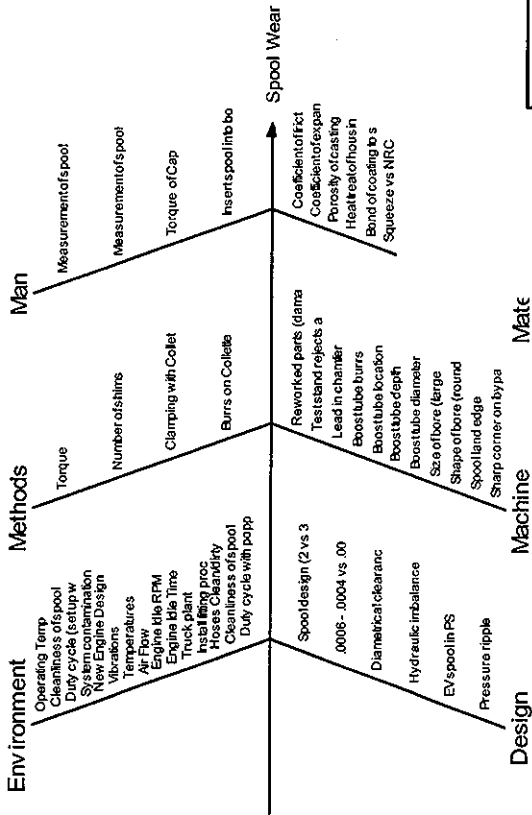
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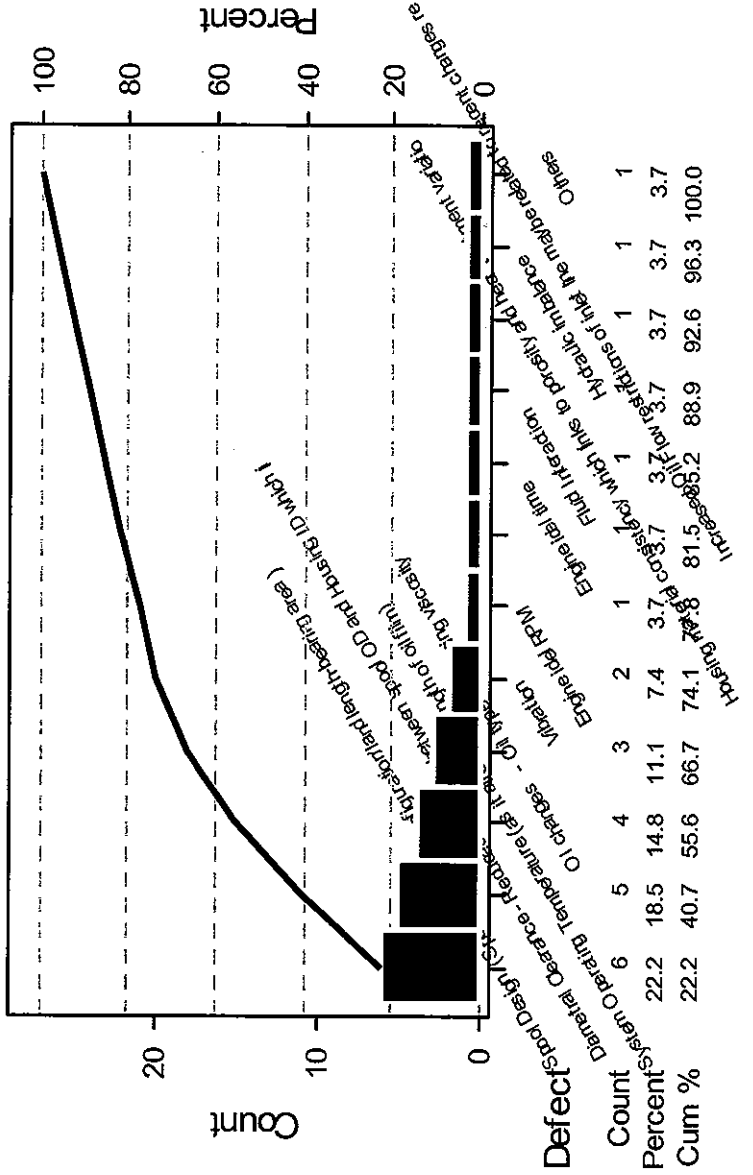
Pump Spool Wear



Fishbone Analysis



Pareto Chart for Spool wear C

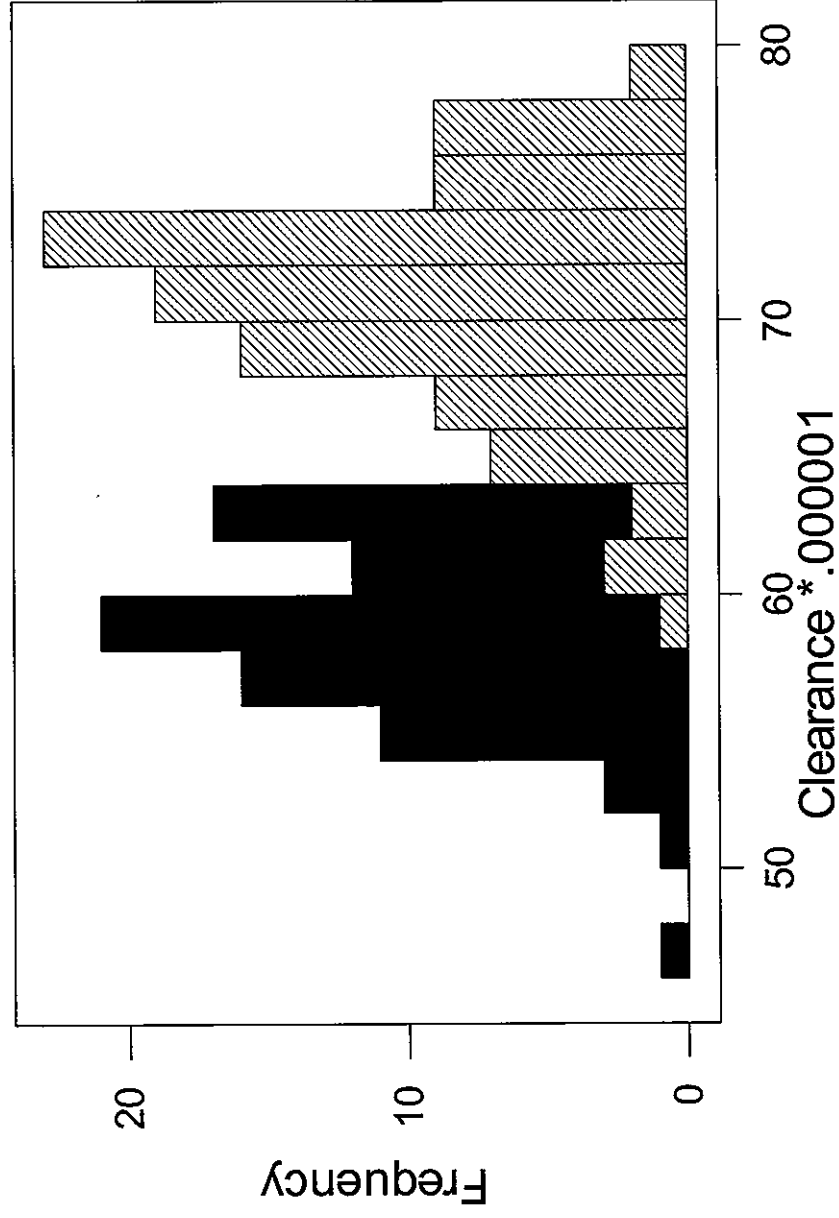


Who:

- Andy Broughton
- Barry Stombaugh
- Bob DuCharme
- Bruce Noah
- Fred Coleman
- Garrett Kolo
- Marty Nemani
- Phil Peterson
- Tim Strueh



Histograms

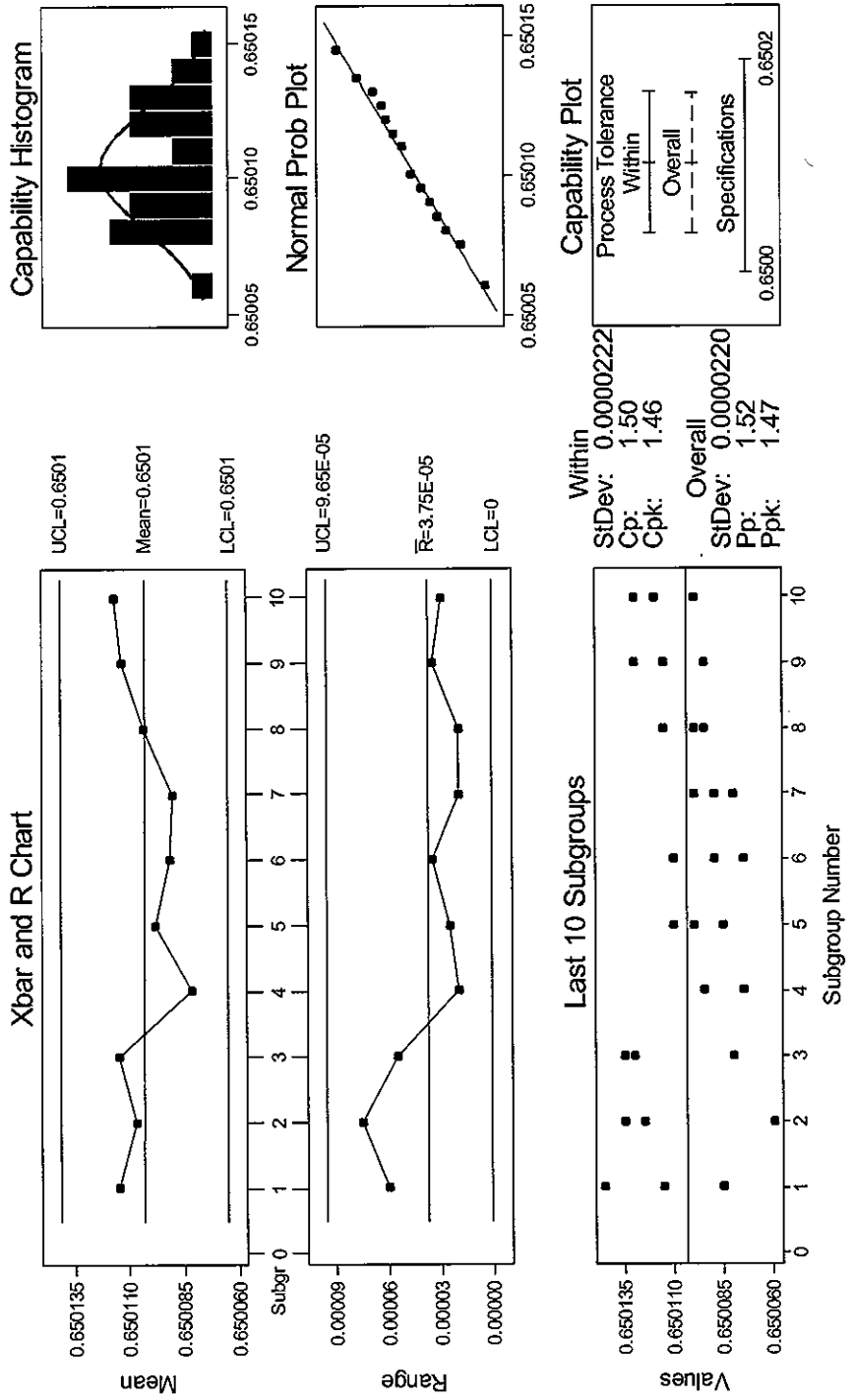


Apr 03 (Dark) vs May 04 (lite) Clearance histograms



Spool Cpk at 0.0002”

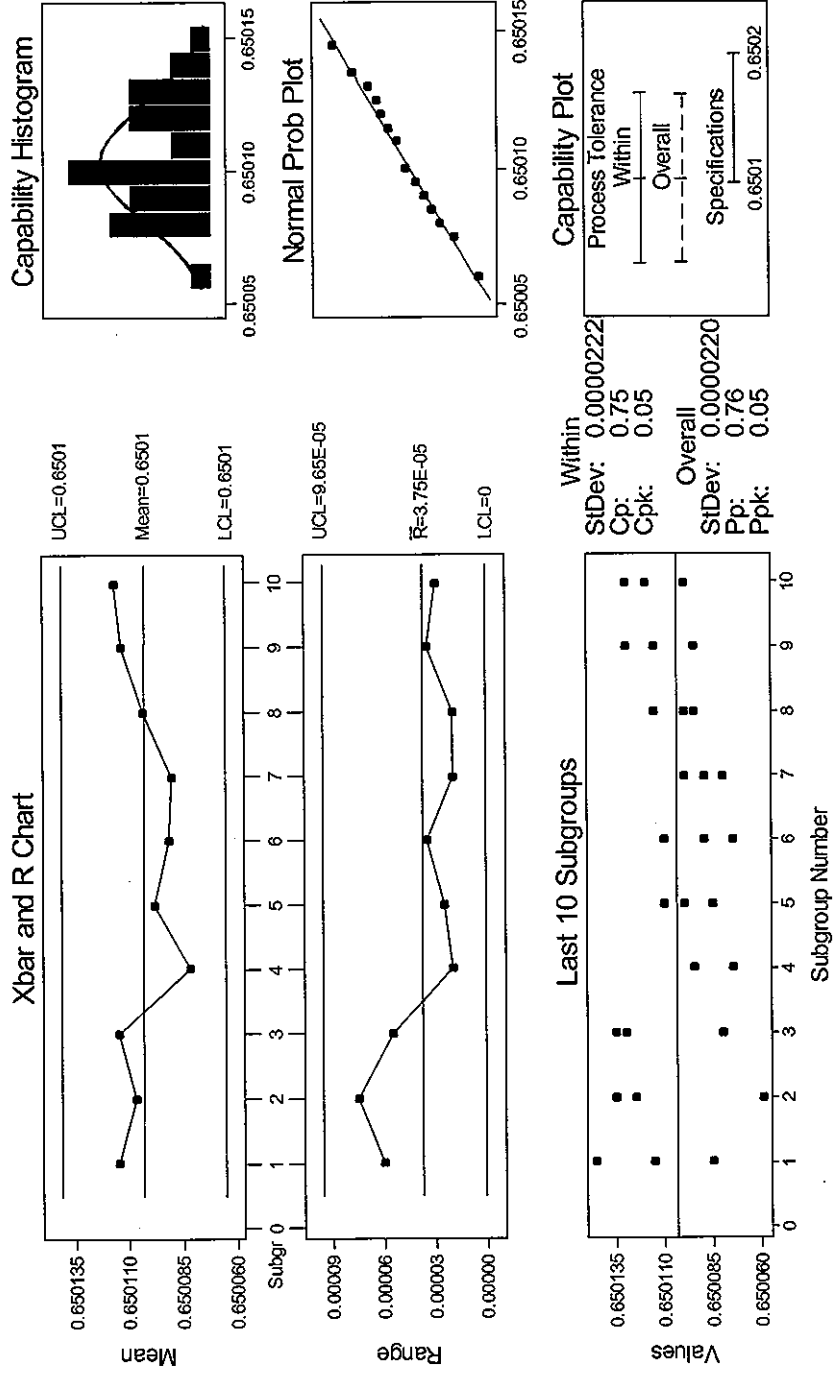
Process Capability Sixpack for Diameter





Spool Cpk at 0.0001”

Process Capability Sixpack for Diameter





Spool Diameter "b" at 69 F

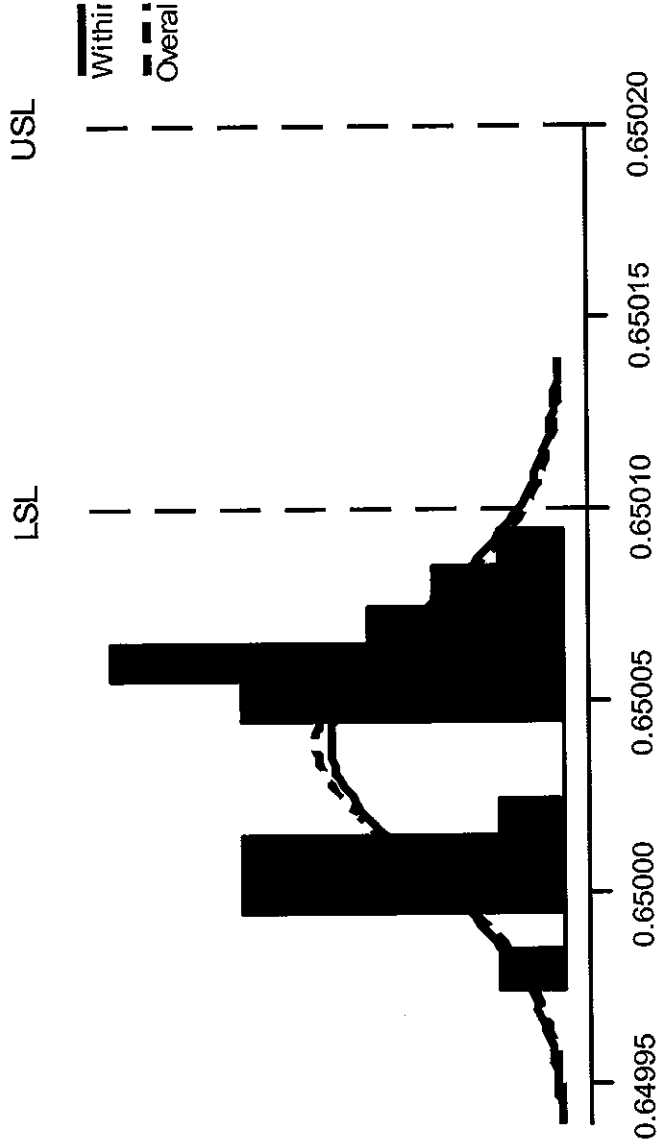
Process Capability Analysis for b

Process Data

USL	0.650200
Target	*
LSL	0.650100
Mean	0.650039
Sample N	30
StDev (Within)	0.0000333
StDev (Overall)	0.0000314

Potential (Within) Capability

Cp	0.50
CPU	1.61
CPL	-0.61
Cpk	-0.61
Cpm	*



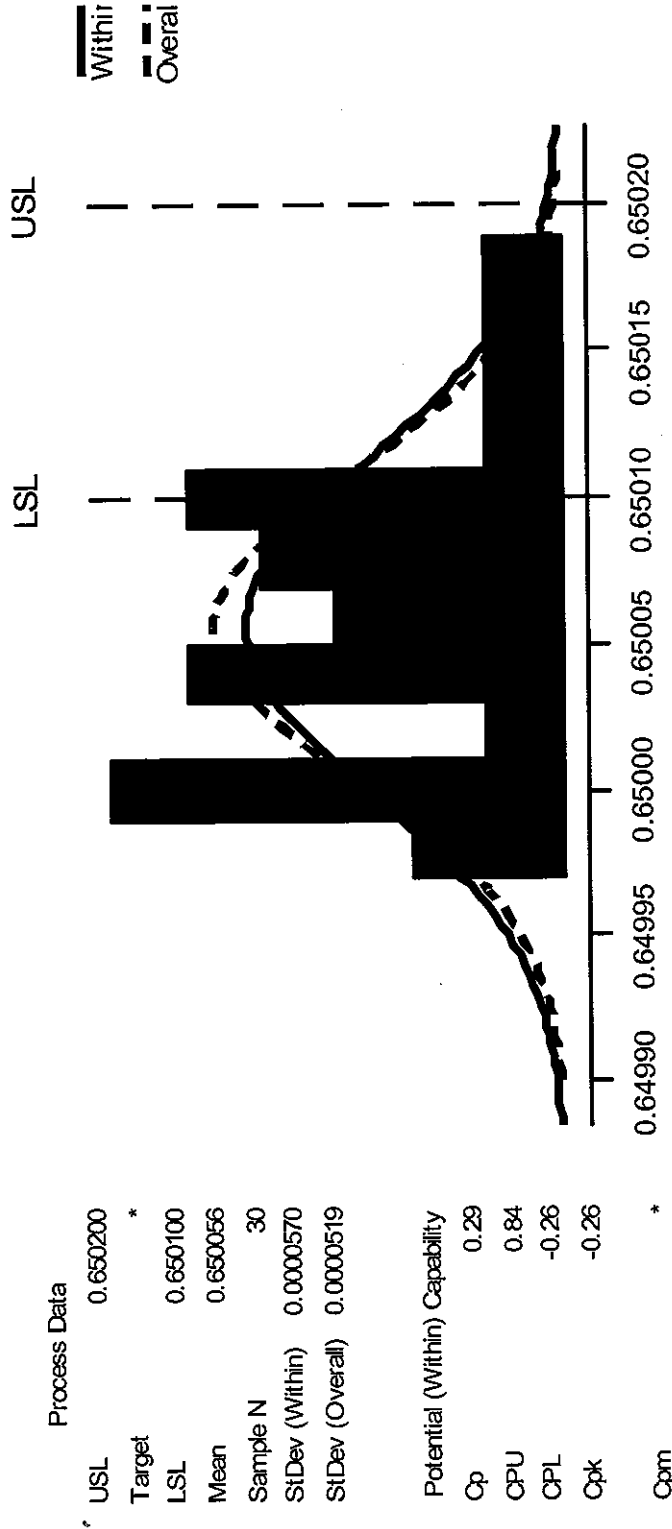
Overall Capability	Observed Performance	Exp. "Within" Performance	Exp. "Overall" Performance
Pp	PPM < LSL	PPM < LSL	PPM < LSL
PPU	PPM > USL	PPM > USL	PPM > USL
PPL	PPM Total	PPM Total	PPM Total
Ppk			

0.53	1000000.00	965671.32	973148.8
1.70	0.00	0.71	0.1
-0.64	1000000.00	965672.03	973149.0
-0.64			



Spool Diameter "b" at Plant temp

Process Capability Analysis for b2



Process Data

USL	0.650200
Target	*
LSL	0.650100
Mean	0.650056
Sample N	30
StDev (Within)	0.0000570
StDev (Overall)	0.0000519

Potential (Within) Capability

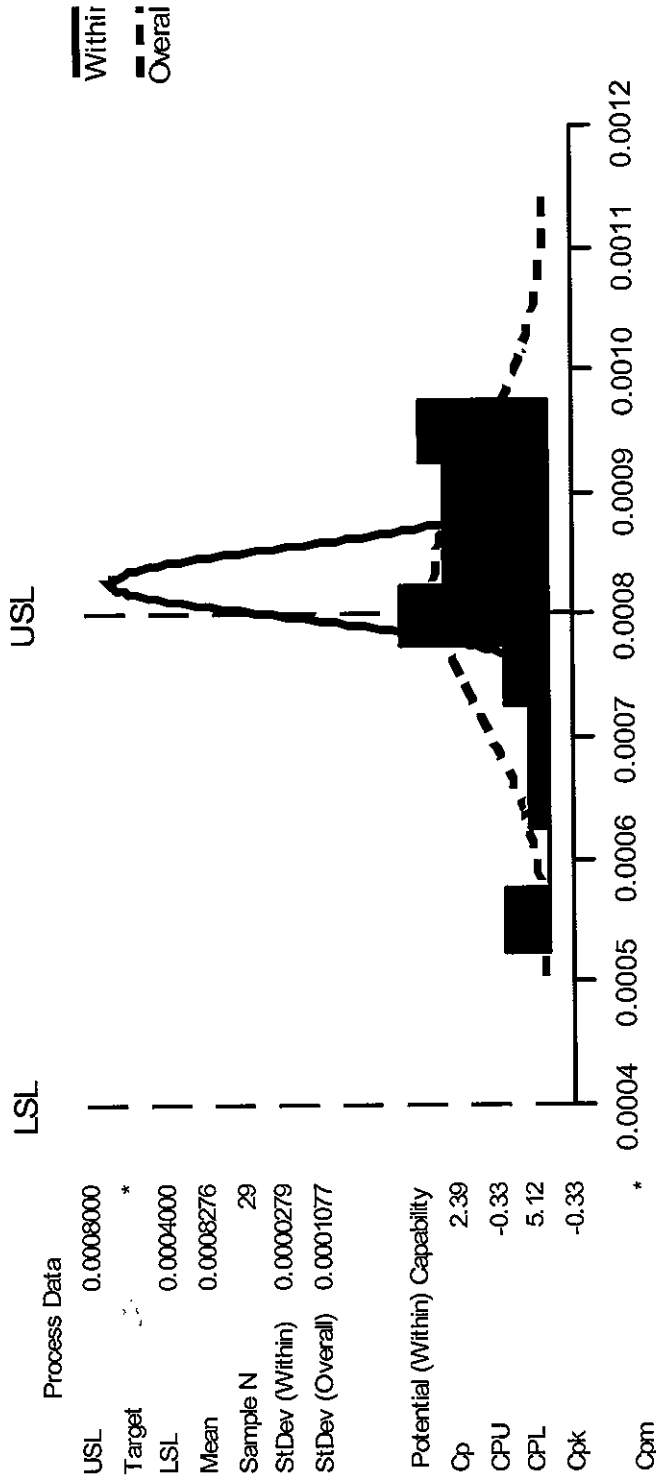
Cp	0.29
CPU	0.84
CPL	-0.26
Cpk	-0.26
Cpm	*

Overall Capability	Observed Performance	Exp. "Within" Performance	Exp. "Overall" Performance
Pp	0.32	PPM < LSL 779402.05	PPM < LSL 801424.2
PPU	0.92	PPM > USL 5814.12	PPM > USL 2768.5
PPL	-0.28	PPM Total 785216.17	PPM Total 804192.7
Ppk	-0.28		



DOE Clearance Study

Process Capability Analysis for Clearance

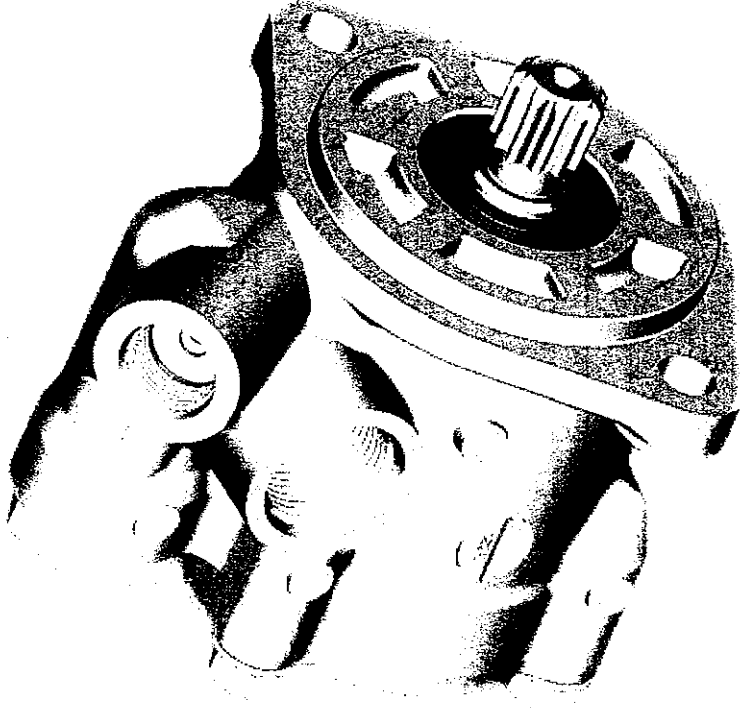


Overall Capability	Observed Performance	Exp. "Within" Performance	Exp. "Overall" Performance
Pp	0.62	PPM < LSL 0.00	PPM < LSL 35.8
PPU	-0.09	PPM > USL 689655.17	PPM > USL 601094.2
PPL	1.32	PPM Total 689655.17	PPM Total 601130.0
Ppk	-0.09	PPM < LSL 0.00	PPM < LSL 35.8
		PPM > USL 838935.92	PPM > USL 601094.2
		PPM Total 838935.92	PPM Total 601130.0

Pump Spool Design & Coatings

Customer

September 2004



REQUEST NUMBER 11