

August 31, 2012

Bruce York, Chief
Medium and Heavy Duty Vehicles Division
Office of Defects Investigation
National Highway Traffic Safety Administration
1200 New Jersey Ave. S.E.
Washington, D.C. 20590

Reference: NVS-rw214
PE12-011

Dear Mr. York:

This letter is in response to your letter of August 2, 2012, received in this office on August 9, 2012, concerning the request for information for a Preliminary Evaluation of an alleged high pressure oil line failing on the MY 2008 Navistar International CE School Buses.

The following information is submitted in itemized format corresponding to your numeric requests:

Item 1 State, by model and model year, how many subject vehicles Navistar has manufactured for sale or lease in the United States. For each engine provide the following:

- a. VIN;
- b. Make
- c. Model
- d. Date of manufacture
- e. Date warranty coverage commenced; and
- f. The part number of the subject component installed on the engine as original equipment

Provide the table in MS Access or a compatible format, entitled "PRODUCTION DATA." A pre-formatted table that provides further details regarding this submission will be emailed to you

Response 1 There were 12,204 CE School Buses built for Model Year 2008 for the United States. Production data is provided in the attached file entitled "Production Data".

Item 2 State the number and provide copies of each of the following, received by Navistar, which relate to, or may relate to, the alleged defect or alleged failure mode in the subject vehicles:

- a. Consumer/fleet complaints;
- b. Field reports;
- c. Reports involving a crash, injury, or fatality;
- d. Reports involving a fire;
- e. Property damage claims;
- f. Third-party arbitration proceedings where Navistar is a party to the arbitration; and
- g. Lawsuits, both pending and closed, in which Navistar is or was a defendant or codefendant

For subparts "a" through "g," state the total number of each item (e.g., consumer complaints, field reports, etc.) separately. Multiple incidents involving the same unit are to be counted separately. Multiple reports of the same incident are also to be counted separately (i.e., a consumer complaint and a field report involving the same incident in which a crash occurred are

to be counted as a crash report, a field report and a consumer complaint). For “f” and “g,” provide a summary of the event.

Response 2

- a. Navistar has received (0) owner or fleet complaints related to the alleged defect.
- b. Navistar has received (3) field reports related to the high pressure oil line. Please note: one of the field reports is for the same vehicle and incident as stated in item “d” below.
- c. Navistar is not aware of any crashes, injuries, or fatalities as a result of the alleged defect.
- d. Navistar is aware of (1) report of fire relating to the high pressure oil line.
- e. Navistar is not involved in any property damage claims related to the alleged defect or failure mode at this time.
- f. Navistar is not involved in any third party arbitration proceedings relating to the alleged defect or failure mode at this time.
- g. Navistar is not aware of any lawsuits pending relating to the alleged defect or failure mode at this time.

Item 3

Separately, for each item (complaint, report, claim, notice, or matter) within the scope of your response to Request No. 2 state the following information:

- a. VIN;
- b. Vehicle’s owner or fleet name (and fleet contact person), address, and telephone number;
- c. Vehicle’s make, model and model year;
- d. Vehicle’s mileage at time of incident, if known;
- e. Failed part number;
- f. Incident date;
- g. Report date;
- h. Concern stated by customer;
- i. Whether a fire was reported;
- j. Data warranty coverage commenced; and
- k. Navistar’s assessment of the incident

Provide this information in MS Access or a compatible format, entitled “REQUEST NUMBER TWO DATA.”

Response 3

Enclosed on file as “REQUEST NUMBER TWO DATA.”

Item 4

State , by make, model, model year, a total count for all of the following categories of claims, collectively, that have been paid by Navistar to date that relate to, or may relate to, the alleged defect in the subject components: warranty claims; extended warranty claims; claims for good will services that were provided; field, zone, or similar adjustments and reimbursements; and warranty claims or repairs made in accordance with a procedure specified in a technical service bulletin or customer satisfaction campaign.

Separately, for each such claim, state the following information:

- a. Navistar’s claim number;
- b. VIN;
- c. Vehicle’s owner or fleet name (and fleet contact person) and telephone number;
- d. Vehicle’s make, model, and model year;
- e. Vehicle’s build date;
- f. Warranty start date;
- g. Incident date;
- h. Report date;
- i. Vehicle’s mileage at time of repair;

- j. Repairing facility's name, telephone number, and address;
- k. Labor operation number;
- l. Problem code;
- m. Replacement part number(s) and description(s);
- n. Concern stated by customer; and
- o. Comment, if any, by dealer/technician relating to claim and/or repair.

Provide this information in MS Access or a compatible format, entitled "WARRANTY DATA"

Response 4

The total number of warranty claims relating high pressure oil line is 470 claims. There was one claim that specifically states oil from the high pressure line sprayed onto the manifold which resulted in a fire (same incident as reported in response 2, item d above) which resulted in minor additional damages to the engine compartment. The complete set of data is provided in the file, "WARRANTY DATA"

Item 5

Provide copies of any service or technical bulletins, product improvement campaigns, announcements, or advisories, and all other communications concerning the alleged defect in the subject vehicles that Navistar has issued or is considering issuing to fleets, dealers, zone offices, or field offices. If Navistar has drafted any such communications, furnish a copy of the draft. For any such communication that have been issued, identify, by name, address, telephone number, and contact person, each entity to which it was sent, the date on which the communication was sent, and the specific equipment to which the communication pertained. For each such communication:

- a. Provide a complete chronology, listing all activities or events, including, but not limited to, incidents, which led Navistar to issue the communication;
- b. Provide a listing (in chronological order) of all testing through which the need for the communication was identified and/or assessed, even if the testing was being conducted for another purpose. Please provide a copy of all relevant information from each test listed; and
- c. State the number of repairs and/or replacements paid for by Navistar that resulted from the communication identified. List your response by repairing dealer (and include the dealer's name, address, and telephone number).

Response 5

Navistar has released two Technical Service Information (TSI) bulletins & two iKNOW (information) articles pertaining to the high pressure hose for the I-6 engine. These documents are released on Navistar's dealer and fleet service portal, and accessible by all dealers and subscribing fleets. The communications listed below are not Navistar authorization for repairs but instructions on how to best repair a concern. They do not include warranty or goodwill reimbursement. TSI 08-12-22 was mentioned on one claim.

- iKNOW IK1200296 dated August 2008 Description: 70 and 90 Degree High Pressure Oil Fitting O-ring Replacement Procedure. Applies To: International I-6 engine with a build date of July 2008 and later.
- TSI 08-12-22 dated January 2009 Description: The high-pressure oil hose assembly, elbow fitting assemblies, and mating part assemblies have been redesigned with larger diameter O-ring seals, hose, and threaded fittings. One claim states it was performed per 08-12-22.
- Excerpt from Engine Service Manual EGES-265-2, copy rite 2009 – DT 466, DT 570 and HT 570 Engine Service Manual - 2004 Emissions with EGR; which details high pressure line installation.
- iKNOW IK1200483 dated April 2010. Description: I-6 High Pressure Oil System Design Change Applies To: Engine Family: International® MaxxForce. DT, 9, and 10 Diesel Engines, 2007-2009 Model Years

- TSI 10-12-03 dated August 2010 Description: High-pressure Hose and Elbow Assembly Kit 1893940C91 contains a high-pressure hose assembly and three high-pressure elbows. This kit replaces elbow assemblies 1873463C92 or 1873460C92 and/or Hose Assembly Kit 1883605C92.

These documents are provided in the file, "TECHNICAL BULLETINS"

Item 6

Provide a detailed chronology of all events regarding the alleged defect starting from the time Navistar first became aware of this issue to present. Describe how Navistar first became aware of the alleged defect and state the date on which Navistar first became aware of the possibility of the alleged defect. Include all information including dates of both internal and external meetings, meetings with fleets, manufacturers, or any others involved in this issue and discuss the resolution, planned action, and/or the manner in which Navistar plans to address this issue. Also separately, provide a copy of any/all document(s) and presentation materials that were used during the meeting(s) whether Navistar generated the document(s) or the document(s) were generated by others.

Response 6

8/26/2006 – Engineering meeting to review supplier seepage issues which were leading to low confidence in design and investigating alternate designs.

12/15/2006 - High pressure oil line part # 1832031C92. Added robustness improvement against fitting leaks thru increased radial seal groove, and improved maximum squeeze, and surface finish.

5/23/2007 – R&Q review of alternate design review.

9/13/2007 – R&Q & Engineering meeting to discuss line change from 1842571C91 to 1842571C92 when it becomes available.

12/4/2007 – Supplier and Engineering meeting to discuss socket shoulder measurement inspection.

2/8/2008 - High pressure oil line part # 1879761C91. New supplier. Robustness improvement has higher oil pressure dynamics, radial seal O-ring cross section increase, cylinder head port fitting redesign.

6/30/08 - Navistar advised by Midwest Transit Equipment Inc. of high pressure oil line failure. Vehicle towed to shop for repairs.

11/14/2008 - High pressure oil line part # 1879761C92. Hex nut size increased from 1 1/8 to 1 1/4. Assembly torque specification changed from 34 Ft-Lbs to 48 Ft-Lbs,

5/25/2010 - Navistar advised by Wolfington Body Co. of high pressure oil line failure stating oil had sprayed on manifold causing a thermal event. Vehicle towed to shop for repairs. (reference Response 2 item "d")

6/03/2010 - Navistar advised by Wolfington Body Co. that high pressure oil line leaks and shut down vehicle.

6/8/2010 - R&Q meeting to discuss production start date of part# 1842571C91, and use of convoluted tube as an outer cover.

7/22/2010 - Navistar receives warranty claim for above Wolfington body Co. failure dated 5/25/2010

8/29/2011 - High pressure oil line part # 3033222C91. Addition of 4" Fluoropoly shrink wrap

Item 7

Describe all modifications or changes made by, or on behalf of, Navistar in the design, material composition, manufacture, quality control, supply, or installation of the subject components, from the start of production to date, which relate to, or may relate to, the alleged defect or alleged failure mode in the subject vehicles. For each such modification or change, provide the following information:

- a. The date on which the change was incorporated into production;
- b. A detailed description of the change;
- c. The reason(s) for the 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, inventory(s) 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 7

The vehicle population for the build period in question used 2 distinct engines; I-326 and I-313. The I-313 is a 2004 emission engine and the I-326 is a 2007 emission engine. With the progression of the emission levels, there is also an increase the pressures that go through these high pressure lines. Navistar notes that as the technology for the higher pressure hoses for the newer emission engines was developed for the I-326, this technology was then incorporated into the service parts that were used to support the I-313 engine. So some of the changes listed below were not necessarily a result of field failures, but more to incorporate technology improvements.

The following change history relate to the high pressure line used on I-326 engines installed in IC buses

2/8/2008 EMR 5105 High pressure oil line part # 1879761C91

Effective 5/1/2008 thru 3/12/2009

Engine Serial Number 3040001 thru 3070137

Supplied by: Kongsberg

Reason:

- a. Robustness improvement for I-326 compared to I-313 engine,
- b. radial seal cross section increased to improve robustness,
- c. change in cylinder head port machining,
- d. hose crimp nut change to accommodate face seal o-ring,
- e. Adjacent harness routing away from hose to ensure there is no contact with hose.

11/14/2008 EMR 5105C High pressure oil line part # 1879761C92

Effective 3/12/2009 thru 5/14/20012

Engine Serial Number 3070138 thru 3114697

Supplied by: Kongsberg

Reason:

- a. Supplier quality improvement,
- b. Testing showed hose assembly failed at hose Barb insert & hex nut. Analysis showed marginal design even though it had passed prior test requirements. Hex wall thickness was minimal and hose insertion depth was critical.
- c. Improved hose service installation instructions.

8/29/2011 EMR 5356 High pressure oil line part # 3033222C91

Effective 5/14/2012 to date

Engine Serial Number 31146498 thru current

Supplied by: Kongsberg

Reason:

- a. Robustness improvement
- b. Addition of 4" Fluoropoly (shrink wrap material) used on both ends of the hose to improve durability and reduce sensitivity to installation misalignment.

The following changes relate to the high pressure line used on I-313 engines installed in IC buses:

High pressure oil line part # 1842571C91
Effective 3/1/2004 to 12/30/2006
Engine Serial Number 2000001 thru 2174106

7/07/2007 (Service Part only) EMR 5087 High pressure oil line part # 1842571C92

Supplied by: Eaton

Reason:

- a. Improved hose robustness
- b. Hose reinforcement was increased to 4 spiral and 2 stainless steel braids

1/10/2008 (Service Part only) EMR 5108 High pressure oil line part # 1842571C93

Supplied by: Eaton

Reason:

- a. Vendor Root Cause concludes a potential design issue at MMC condition that increases stress concentration resulting in hose failure
- b. Hose assembly crimp socket is redesigned to mitigate failure mode

2/8/2008 (Service Part only) EMR 5105 High pressure oil line part # 1832031C94

Supplied by: Eaton

Reason:

- a. Released the 13/16-16 thread high pressure hose assembly .

Released 11/14/2008 (Service Part only) EMR 5105C High pressure oil line part # 1832031C95

Supplied by: Kongsberg

Reason:

- a. Resourced to new supplier
- b. Size increased from 15/16 hex to 1 1/8 hex
- c. Material change from 1215 to 12L14
- d. Hose insertion depth over hose bard dog lock.

Item 8

Describe all assessments, analyses, tests, test results, studies, surveys, simulations, investigations, inquiries and/or evaluations (collectively, "actions") that relate to, or may relate to, the alleged defect in the subject vehicles that have been conducted, are being conducted, are planned, or are being planned by, or for, Navistar. For each such action, provide the following information:

- a. Action title or identifier;
- b. The actual or planned start date;
- c. The actual or expected end date;
- d. Brief summary of the subject and objective of the action;
- e. Engineering group(s)/supplier(s) responsible for designing and for conducting the action; and
- f. A brief summary of the findings and/or conclusions resulting from the action.

Response 8

Testing and analysis occurred over several months when Navistar was experiencing an above normal failure rate with the high pressure oil line. Improvements carried out in hose revision levels which occurred during this period and after have substantially improved hose robustness. Testing involved in development of the hose changes are found in the attached file titled, "Item # 8 Testing"

Item 9

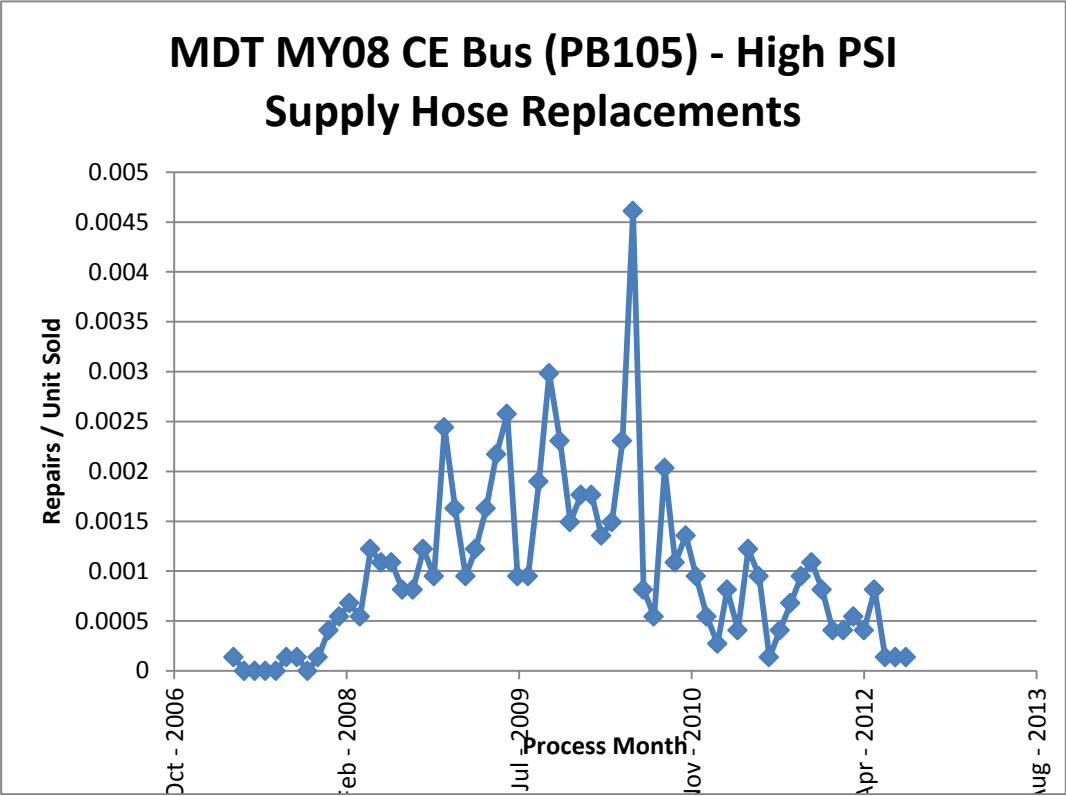
Furnish Navistar's assessment of the alleged defect in the subject vehicles, including:

- a. The causal or contributory factor(s);
- b. The failure mechanism(s);
- c. The failure mode(s);
- d. The risk to motor vehicle safety that it poses; and
- e. What warnings, if any, the operator and other people both inside and outside the vehicle would have that the alleged defect had occurred?

Response 9

- a. Navistar did have some early design and supplier quality issues related to high pressure oil line material, and hose ID dimension which contributed to initial failures of early production of MY 2008 bus high pressure oil line hoses.
- b. The hose design was not robust enough for the pressure and duty cycles required. Installation practices are also critical for the long term reliability of the hose to ensure no twisting occurs, which introduces a pre-stress condition.
- c. In this high pressure oil line application, the fluid pressure fluctuates between high and low pressure during normal operation of the engine. Over time the hose could eventually get to a failure point based on the number of pressure cycles, and given the material and hose wall thickness, if there was a twist in the hose as a result of improper installation, and the severity of bend in the hose or near the fittings. Generally, there is no visible evidence that the hose is near the failure point. Therefore, failure could be immediate, resulting in a loss of oil and possible engine shut down.
- d. To date there has been one reported fire resulting from a ruptured high pressure oil line. The hose does have a protective conduit over the hose that prevents the oil from spraying over the engine compartment in the event of a leak or hose failure. However, there is a potential risk for engine shut down as a result of oil loss, since there is generally no prior indication of hose degradation.
- e. Generally, there is no visible evidence on the outside of a hose to indicate if it is getting close to the failure point. The outer conduit over the hose assembly would have to be removed to perform an inspection. One possible short term warning would be a noticeable loss of oil pressure which may be noticed by the driver when a hose does start to leak.

Note that while the data may suggest some early reliability issues with the high pressure oil line, the chart below indicates a significant improvement in the reliability of high pressure oil line on model year 2008 bus claims since the November of 2010 claim process date.



Based on the data obtained for this response, Navistar has initiated its own investigation to further understand the failure modes, determine the potential scope of the issue, and determine what actions should be initiated. If you have questions or require additional information, do not hesitate to contact me at 331-332-1590.

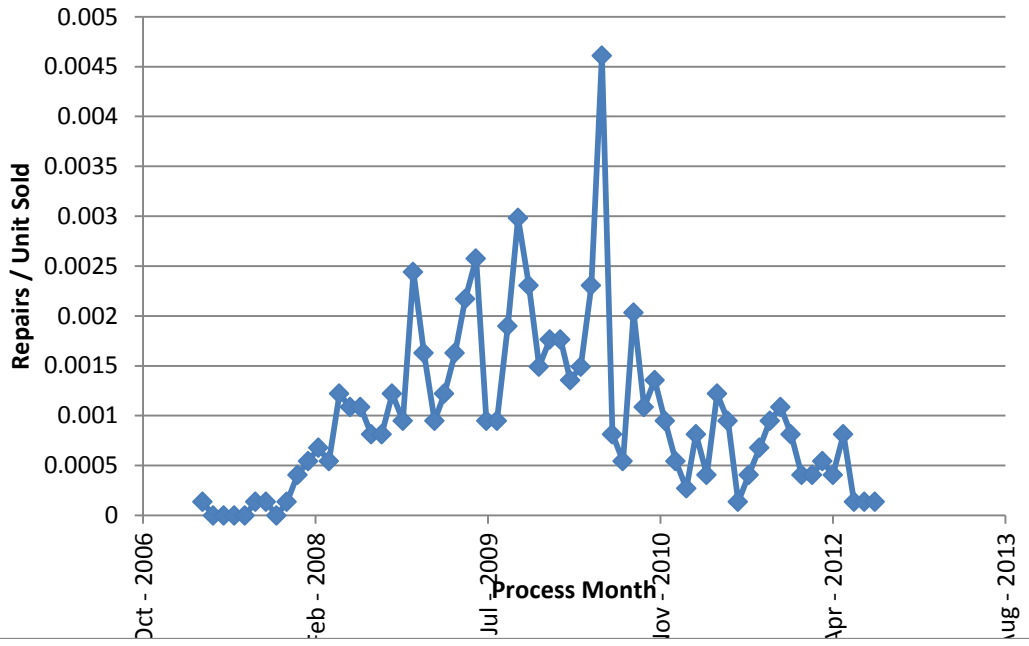
Respectfully submitted,

NAVISTAR, INC.

R. L. Van Laar
Product Integrity and Compliance Manager

Cc: T. R. Cellitti
T. J. Stewart

MDT MY08 CE Bus (PB105) - High PSI Supply Hose Replacements



PE12-011

NAVISTAR

8-31-2012

ITEM #5

TECHNICAL BULLETINS

AND

ITEM #8

TESTING,

Fatigue Study Rev1

PE12-011

NAVISTAR

8-31-2012

ITEM #5

TECHNICAL BULLETINS

Technical Service Information



ANAVISTAR COMPANY

TSI-08-12-22

Date: January 2009
Subject File: Engine

Subject: I6 High-pressure Oil System Design Changes

Engine Family: International® MaxxForce™ DT, 9, and 10 Diesel Engines, 2007-up Model Years

Description

The high-pressure oil hose assembly, elbow fitting assemblies, and mating part assemblies have been redesigned with larger diameter O-ring seals, hose, and threaded fittings. The high-pressure oil hose fitting thread size has changed from 13/16-16 UNC-2B to 1-1/4 UNS-2B. The diameter of the O-ring seal on the hose elbow fittings has changed from 0.070 in. (1.78 mm) to 0.103 in. (2.61 mm).

The new larger diameter high-pressure oil hose assembly requires mating part assemblies (high-pressure oil pump and cylinder head) which have larger threaded fittings to accept the new high-pressure oil hose assembly.

Serviceability Effects

Determine if you have a larger or small diameter high-pressure hose (see Figure 1 on page 2). Order parts for engines with the larger hose from Table 1. Order parts for engines with the smaller hose from Table 2. New service kits are available for both high-pressure oil hose configurations and all related parts.

NOTE: Do not modify any parts to adapt either old-to-new or new-to-old part assemblies.

NOTE: High-pressure pump kits include low-pressure fuel pump, 90° elbow fitting, and an IPR valve. Low-pressure fuel pump, 90° elbow fitting, and IPR valve may also be ordered separately.

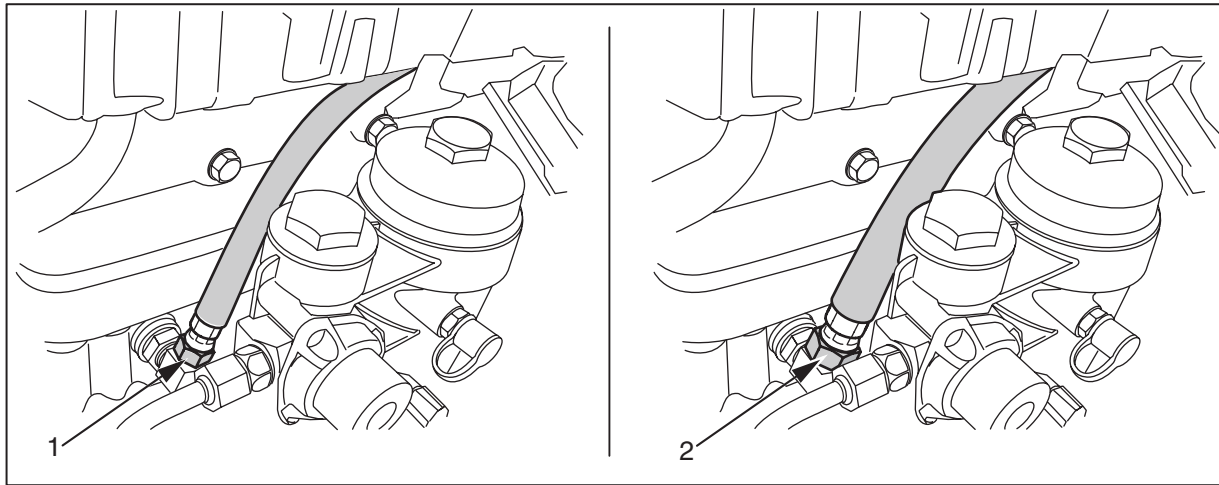


Figure 1 Small vs. large high-pressure hose and fittings

1. Small diameter 13/16-16
UNC-2B
2. Large diameter 1-1/4 inch
UNS-2B

Parts Information

Table 1 Large Diameter High-pressure Oil Hose and Associated Components

| Kit or Part Description | Engine Model | Part Number |
|-----------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-------------|
| High-pressure Pump Kit (12 cc) Includes: Low-pressure fuel pump, 1-1/4 in. 90° elbow fitting adapter and IPR valve | International® MaxxForce™ DT (below 285 hp) | 1882258C91 |
| High-pressure Pump Kit (16 cc) Includes: Low-pressure fuel pump, 1-1/4 in. 90° elbow fitting adapter and IPR valve | International® MaxxForce™ DT (285 hp and up) and all International® MaxxForce™ 9 and 10 | 1882259C91 |
| Low-pressure Fuel Pump Kit | All | 1876108C92 |
| High-pressure Oil Hose Assembly Kit | All | 1884829C91 |
| 70° Elbow Fitting Adapter Assembly | All | 1879757C91 |
| 90° Elbow Fitting Adapter Assembly | All | 1879753C91 |
| IPR Valve and Connector Seal Kit | All | 1878629C92 |
| IPR O-Ring Kit | All | 1842615C92 |
| Cylinder Head Assembly | International® MaxxForce™ DT (245 hp and lower) | 1882594C92 |
| Cylinder Head Assembly | International® MaxxForce™ DT (above 245 hp), 9, and 10 | 1882593C92 |

Parts Information (cont.)

Table 2 Small Diameter High-pressure Oil Hose and Associated Components

| Kit or Part Description | Engine Model | Part Number |
|----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------------|
| High-pressure Pump Kit (12 cc) Includes: Low-pressure fuel pump, 13/16-16 90° elbow fitting adapter and IPR valve | International® MaxxForce™ DT (below 285 hp) | 1876105C93 |
| High-pressure Pump Kit (16 cc) Includes: Low-pressure fuel pump, 13/16-16 90° elbow fitting adapter and IPR valve | International® MaxxForce™ DT (285 hp and up) and all International® MaxxForce™ 9 and 10 | 1876106C93 |
| Low-pressure Fuel Pump Kit | All | 1876108C92 |
| High-pressure Oil Hose Assembly Kit | All | 1883605C91 |
| 70° Elbow Fitting Adapter Assembly | All | 1873463C92 |
| 90° Elbow Fitting Adapter Assembly | All | 1873460C92 |
| IPR Valve and Connector Seal Kit | All | 1878629C92 |
| IPR O-Ring Kit | All | 1842615C92 |
| Cylinder Head Assembly | International® MaxxForce™ DT (245 hp and lower) | 1847673C92 |
| Cylinder Head Assembly | International® MaxxForce™ DT (above 245 hp), 9, and 10 | 1854648C92 |

Technical Service Information

MAXXFORCE®

ADVANCED DIESEL POWER

TSI-10-12-03

Date: August

Subject File: Engine

Subject: High-pressure Hose and Elbow Assembly Kit

Engine Family: International® MaxxForce® DT, 9, and 10 Diesel Engines, 2007–2009 MY (ESN Range: 3000001–3049999)

Description

High-pressure Hose and Elbow Assembly Kit 1893940C91 contains a high-pressure hose assembly and three high-pressure elbows. This kit replaces elbow assemblies 1873463C92 or 1873460C92

and/or Hose Assembly Kit 1883605C92. Job 1/Gen 1 high-pressure hose and high-pressure hose elbows are replaced.

NOTE: See Instruction Sheet 1172007R1 for installation of required kit parts.

1515
11-9-2011

High-pressure Hose Assembly

The high-pressure hose assembly was modified as a production running change from (high-pressure hose - generation 1 to high-pressure Hose with 70 and 90 Degree Elbows - generation 2).
See removal and installation procedures for (high-pressure Hose - Generation 1 and High-pressure Hose with 70 and 90 Degree Elbows - Generation 2), listed in the Table of Contents in this section.

High-pressure Oil System

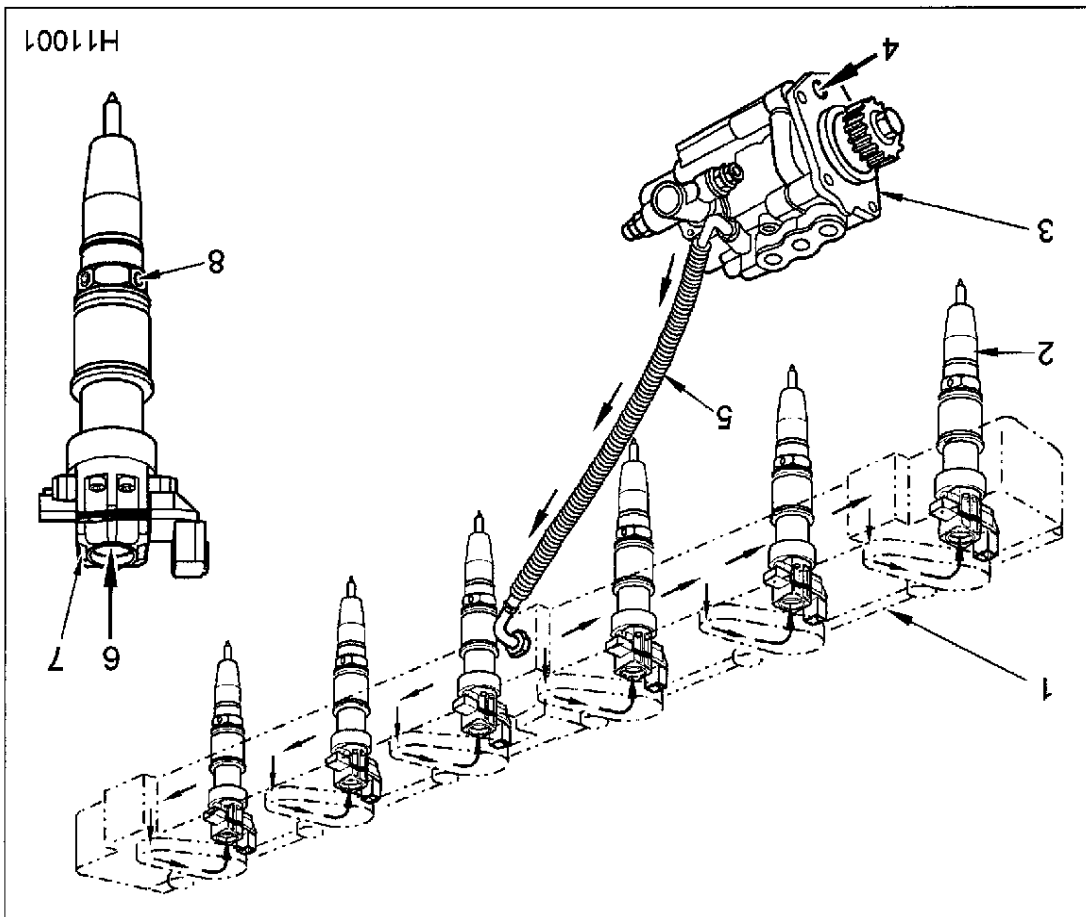


Figure 521 High-pressure oil system

- 1. High-pressure oil manifold
- 2. Fuel injector assembly (6)
- 3. High-pressure pump assembly
- 4. Oil inlet from front cover reservoir
- 5. High-pressure hose
- 6. Oil inlet from high-pressure oil
- 7. Oil outlet (2)
- 8. Fuel inlet port (4)

EGES-265-2

Read all safety instructions in the "Safety Information" section of this manual before doing any procedures. Follow all warnings, cautions, and notes.

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The high-pressure oil system draws oil from the front cover reservoir into the high-pressure oil pump. The high-pressure oil pump pressurizes this oil which is forced through the high-pressure hose, high-pressure oil manifold, and sent to the oil inlet on top of each fuel injector. High-pressure oil increases fuel pressure inside the injectors, which deliver high-pressure fuel to each cylinder.

High-pressure Hose Assembly - Generation 1

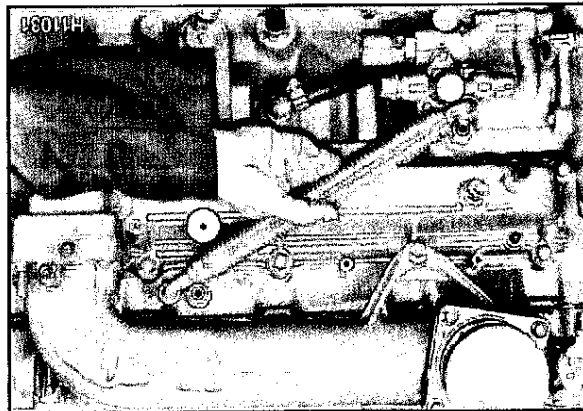


Figure 536 Removal of high-pressure oil hose assembly

1. Remove the high-pressure oil hose assembly and between the high-pressure pump assembly and cylinder head.
2. Remove and discard O-ring at each fitting.
3. If necessary, remove high-pressure hose fitting located at cylinder head.

High-pressure Hose Assembly with 70 and 90 Degree Elbows - Generation 2

1. Remove the conduit cover from the high-pressure hose assembly.

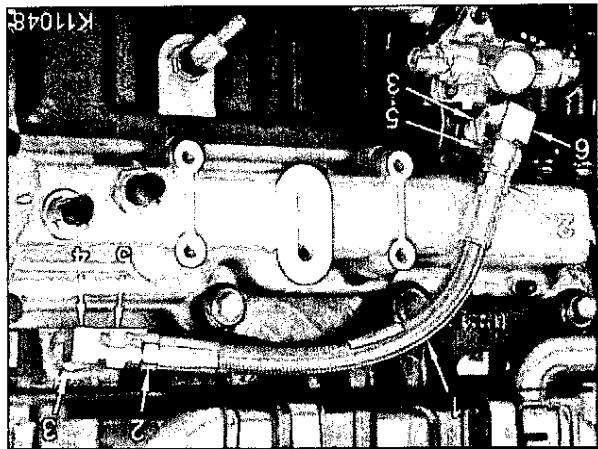


Figure 537 High-pressure hose assembly connections (typical)

1. High-pressure oil hose
2. High-pressure oil hose nut (2)
3. Elbow jam nut (2)
4. 70 degree elbow
5. Swivel nut (2)
6. 90 degree elbow

2. Remove high-pressure oil hose swivel nuts from 70 and 90 degree elbows. Use one wrench to hold the high-pressure oil hose nut in place while loosening its corresponding swivel nut using another wrench. Remove the high-pressure hose.

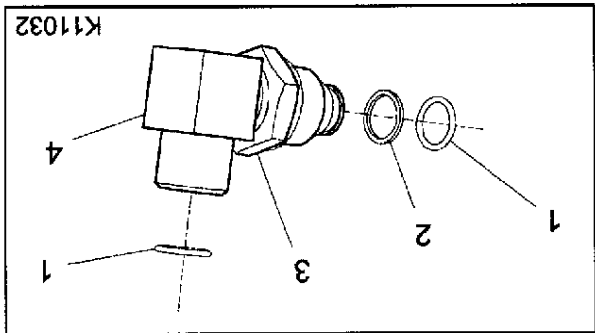


Figure 538 High-pressure oil elbow (typical)

1. O-ring seal (#14) (2)
2. Back-up ring
3. Elbow jam nut
4. Elbow

Read all safety instructions in the "Safety Information" section of this manual before doing any procedures. Follow all warnings, cautions, and notes.

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EGES-265-2

3. Loosen jam nuts on each elbow.
4. Remove 70 and 90 degree elbows.
5. Remove and discard each elbow back-up ring and O-rings.

High-pressure Pump and IPR Valve

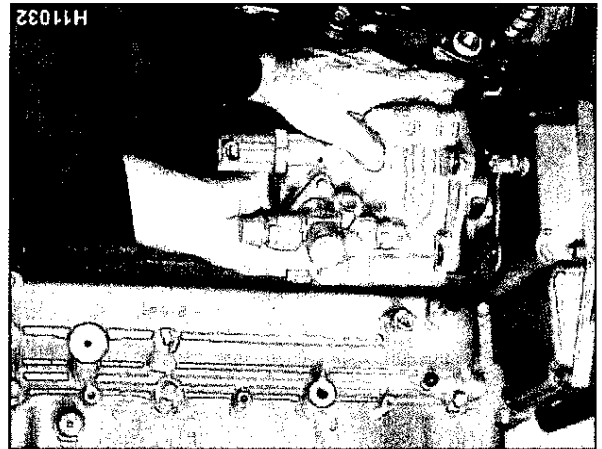


Figure 539 Removing the high-pressure pump assembly

1. Remove two bolts (M8 x 100) behind pump and two (M8 x 30) bolts securing the high-pressure pump to the front cover. Remove pump assembly and discard seal.

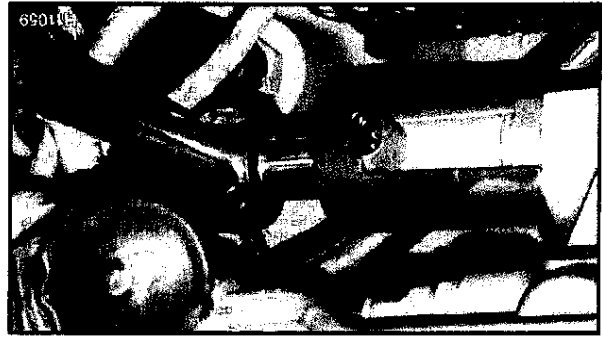


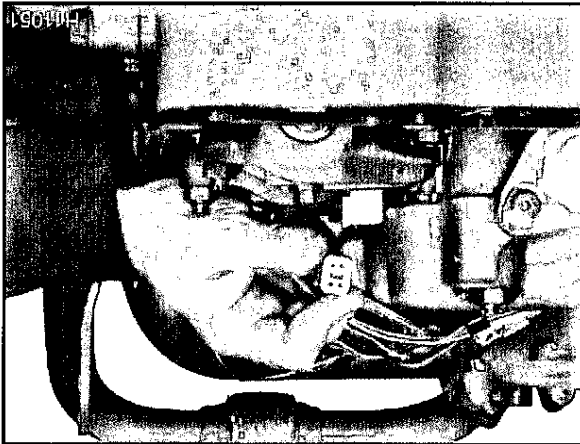
Figure 540 Removing the IPR valve

2. Use an IPR removal / installation tool (Table 48) to remove the IPR valve. Check inlet screen for restrictions. Remove O-rings and discard.

1. Remove valve cover. See (Valve Cover, page 129) in the "Cylinder Head and Valve Train" section of this manual.

High-pressure Oil Rail Assembly

Figure 541 Removing the injector harness connector



2. Disconnect the injector harness connector at the top of each injector.

WARNING: To prevent personal injury or death, get assistance to remove and install the high-pressure oil rail assembly.

3. Remove 12 bolts (M8 x 90) securing high-pressure oil rail to cylinder head.

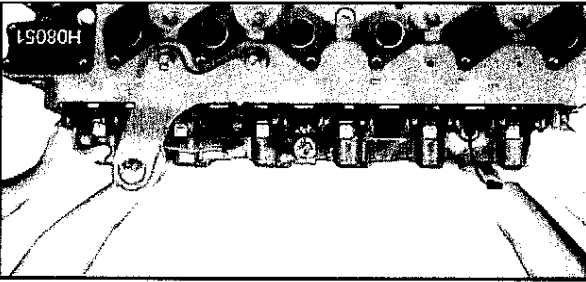


Figure 542 Removing the high-pressure oil rail

4. Remove all bolts and lift high-pressure oil rail up just enough to drain as much oil out of high-pressure oil rail before lifting it away from cylinder head.

Read all safety instructions in the "Safety Information" section of this manual before doing any procedures. Follow all warnings, cautions, and notes.

2. Install a new O-ring seal onto the high-pressure fitting (M18) at the cylinder head before installing the high-pressure hose assembly.
3. Orient hose fitting assembly at the cylinder head at $0 \pm 7^\circ$ relative to horizontal. Tighten swivel nut by hand.
4. Using a crowfoot, tighten both swivel nuts to the special torque value (Table 47) making sure hose is not under any excess tension.

High-pressure Hose Assembly with 70 and 90 Degree Elbows – Generation 2

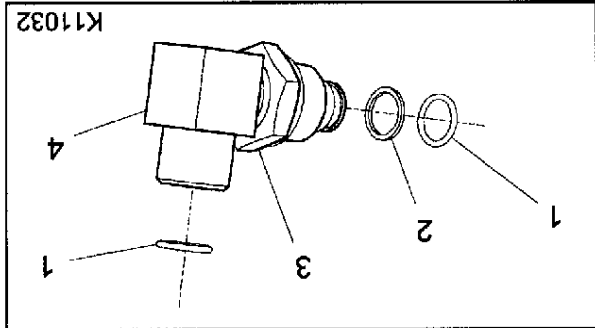


Figure 567 High-pressure oil elbow (typical)

1. O-ring seal (#14) (2)
2. Back-up ring
3. Elbow jam nut
4. Elbow

1. Rotate both elbow jam nuts all the way to the base of the elbows.
 2. Install new O-rings and back-up ring on the 70 and 90 degree elbows.
 3. Lubricate new O-rings with clean engine oil.
- CAUTION:** To prevent engine damage, make all adjustments to the high-pressure oil elbows within 15 minutes of applying Loctite®.
4. Apply two beads of Loctite® 246 Threadlocker (Table 48) to the threads of both high-pressure oil elbows.

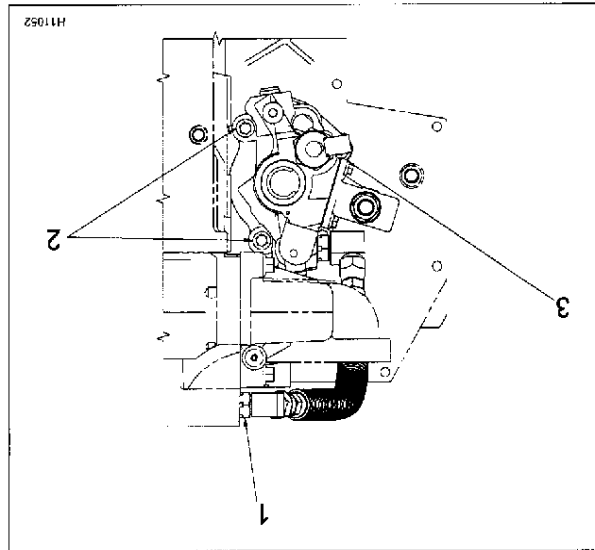


Figure 565 IPR orientation

1. Fitting assembly, M18
2. Bolt, M8 x 100 (2)
3. Bolt, M8 x 30 (2)

3. Install two bolts (M8 x 100) behind pump and two bolts (M8 x 30) outside, securing the high-pressure pump to the front cover. Tighten bolts to the special torque value (Table 47).

High-pressure Hose Assembly – Generation 1

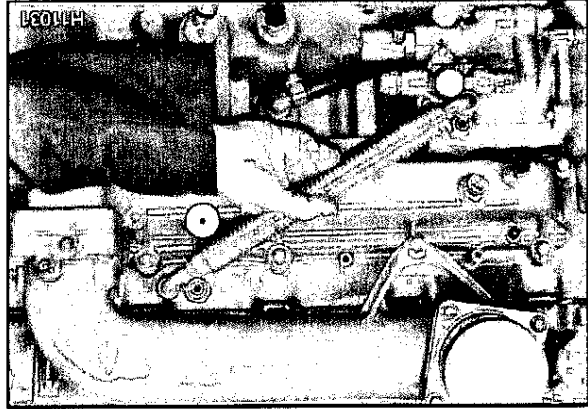


Figure 566 Installation of high-pressure hose assembly

1. Install a new O-ring seal onto the high-pressure pump assembly before installing the

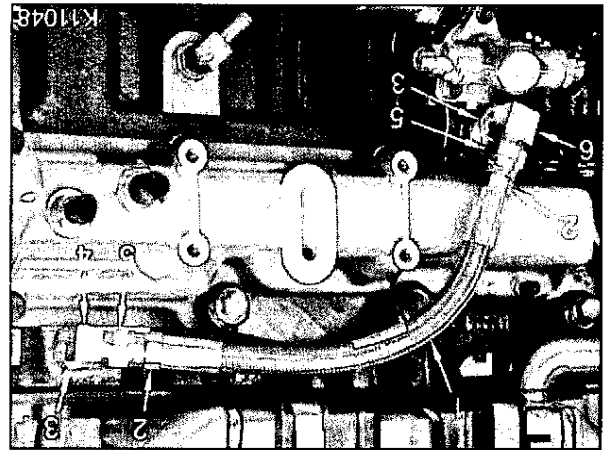


Figure 568 Good position and alignment of new high-pressure oil hose (typical)

1. High-pressure oil hose
2. High-pressure oil hose nut (2)
3. Elbow jam nut
4. 70 degree elbow
5. Swivel nut (2)
6. 90 degree elbow

5. Install 70 degree elbow into high-pressure oil port on intake side of the cylinder head. Run fitting all the way in finger tight and then back fitting off (less than one full turn) to orient fitting toward the front of the engine.
6. Install 90 degree elbow into high-pressure oil pump. Run fitting all the way in finger tight and then back fitting off (less than one full turn) to orient fitting.
7. Connect the high-pressure oil hose to the 70 and 90 degree elbows and finger tighten swivel nuts.

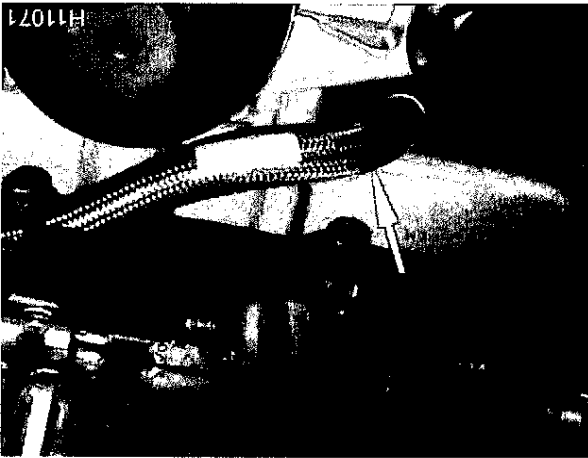


Figure 569 Bad alignment of high-pressure oil hose (hose twisted)

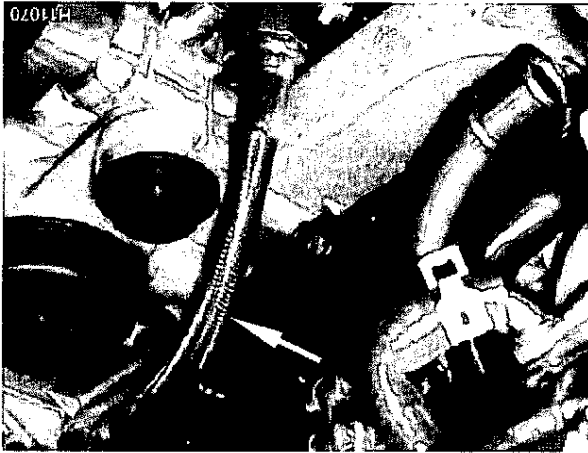


Figure 570 Good alignment of high-pressure oil hose (hose not twisted)

- CAUTION:** To prevent engine damage, the high-pressure oil hose must be positioned and aligned in a smooth arc, not twisted, under excess tension or touching engine components.
8. Position and align the high-pressure oil hose, so the hose is not under excess tension or twisted. Tighten each swivel nut on the high-pressure hose, using one wrench to hold the hose nut, while using another wrench to tighten the swivel nut to special torque value (Table 47).
 9. Position and align the high-pressure oil hose, so the hose is not under excess tension and the hose bends in a smooth arc. Use one wrench to hold

2. Install a new O-ring seal onto the fuel valve assembly (air bleed and pressure test port) and install into port located towards the front of the intake manifold. Tighten to the special torque value (Table 47).

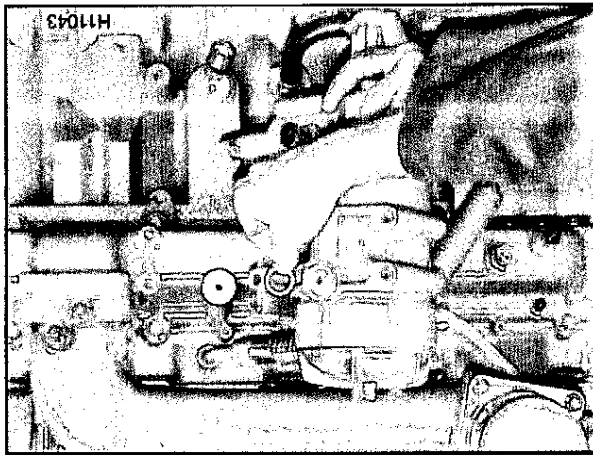


Figure 573 Installing the fuel filter outlet gasket

3. Coat the fuel filter outlet gasket with petroleum jelly and set into recess located on backside of fuel filter header. The petroleum jelly will help it stay in position while the filter header is being oriented into position.

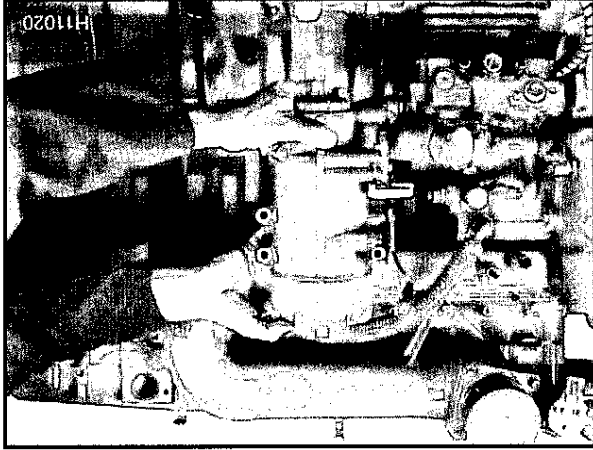
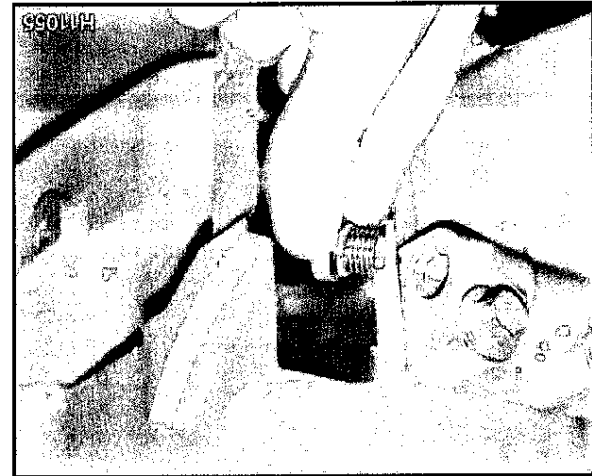


Figure 574 Installing fuel filter header

4. Install the fuel filter header and three mounting bolts (M8 x 100) to the intake manifold.

10. Install the conduit cover onto the high-pressure hose.



Fuel Filter Header Assembly and Intake Manifold

Figure 571 Installing the fuel rail plug assembly (2)

1. Install a new O-ring seal onto the plug assembly (M12) and install into each end of intake manifold. Tighten plug to the special torque value (Table 47).

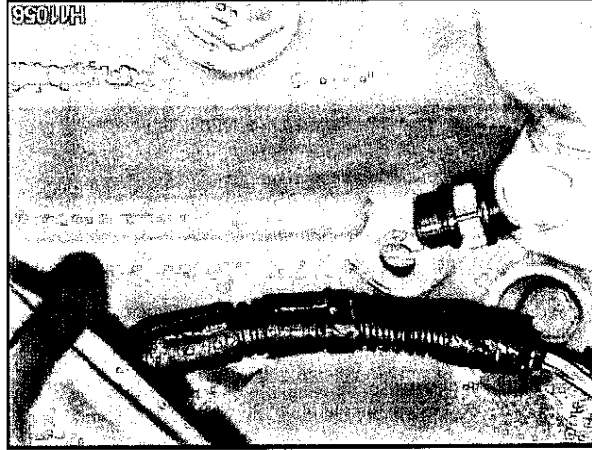


Figure 572 Installing the fuel valve assembly (air bleed and pressure test port)

Specifications

Table 46 Fuel System Specifications

| | |
|---------------------------------------------------|----------------------------------------|
| Fuel heater switching points | On: 2 °C (36 °F) Off: 24 °C (75 °F) |
| Fuel pressure regulator assembly opening pressure | 448 - 517 kPa (65-75 psi) |
| Fuel strainer | 150 micron |
| High-pressure oil manifold, range | 5 - 28 MPa (725 - 4,075 psi) |

Special Torque

Table 47 Fuel System Special Torques

| | |
|--------------------------------------------------------|--------------------------------|
| Boit, M8 x 20 | 29 N·m (21 lbf·ft) |
| Drain valve | 0.5 - 1 N·m (5 - 10 lbf·in) |
| Elbow jam nut | 88 N·m (65 lbf·in) |
| End plug assembly (AWA) or attenuator | 204 N·m (150 lbf·ft) |
| Fitting assembly, 3/8 tube | 27 N·m (20 lbf·ft) |
| Fuel bowl | 39 N·m (29 lbf·ft) |
| Fuel drain plug | 24 N·m (18 lbf·ft) |
| Fuel fitting | 27 N·m (20 lbf·ft) |
| Fuel filter header mounting bolts, M8 x 100 | 27 N·m (20 lbf·ft) |
| Fuel filter housing cover | 25 N·m (18 lbf·ft) |
| Fuel pressure regulator | 1 - 1.7 N·m (10 - 15 lbf·in) |
| Fuel valve assembly (air bleed and pressure test port) | 15 N·m (132 lbf·in) |
| High-pressure oil hose fitting, M18 (at head) | 54 N·m (40 lbf·ft) |
| High-pressure oil hose (swivel nuts) | 46 N·m (34 lbf·ft) |
| High-pressure oil manifold bolts, M8 x 90 | 27 N·m (20 lbf·ft) |
| High-pressure oil pump assembly bolts | 30 N·m (22 lbf·ft) |
| High-pressure oil pump assembly (gear) | 231-279 N·m (170 - 205 lbf·ft) |
| Injector hold down clamp assembly | 41 N·m (30 lbf·ft) |
| IPR valve assembly | 50 N·m (37 lbf·ft) |
| Low-pressure fuel pump bolts, M6 x 16 | 15 - 18 N·m (132 - 160 lbf·in) |
| Low-pressure fuel pump tube coupling nuts | 18 N·m (155 lbf·in) |
| Plug assembly, M12 (intake manifold fuel rail) | 24 N·m (18 lbf·ft) |
| Post | 8 N·m (72 lbf·in) |
| Self tapping screw | 5 N·m (41 lbf·in) |
| Water In Fuel (WIF) sensor | 1.7 N·m (15 lbf·in) |

EGES-265-2

Read all safety instructions in the "Safety Information" section of this manual before doing any procedures.

Follow all warnings, cautions, and notes.

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Countries: AUSTRALIA, BRAZIL, CANADA, UNITED STATES, MEXICO, SOUTH AFRICA
Document ID: IK1200296
Availability: ISIS, FleetISIS
Revision: 4
Major System: ENGINES
Created: 8/13/2008
Current Language: English
Last Modified: 9/18/2008
Other Languages: [Français](#), [Español](#),
Author: Carl Marquez
Viewed: 1909

[Less Info](#)

Hide Details

Coding Information

| | | | | | | | |
|----------------------|-------------------------------|----------------------------------------------------------|-----------------------------|------------------|-----------------------------|---------------------------|-------------------------------|
| Copy Link | Copy Relative Link | Bookmark View My Bookmarks | Add to Favorites | Print | Provide Feedback | Helpful 666 | Not Helpful 436 |
|----------------------|-------------------------------|----------------------------------------------------------|-----------------------------|------------------|-----------------------------|---------------------------|-------------------------------|

Title: 70 and 90 Degree High Pressure Oil Fitting O-ring Replacement Procedure

Applies To: International I-6 engine with a build date of July 2008 and later.

DESCRIPTION

A new guideline has been set for o-ring replacement for the high pressure oil fitting at the cylinder head and at the high pressure pump.

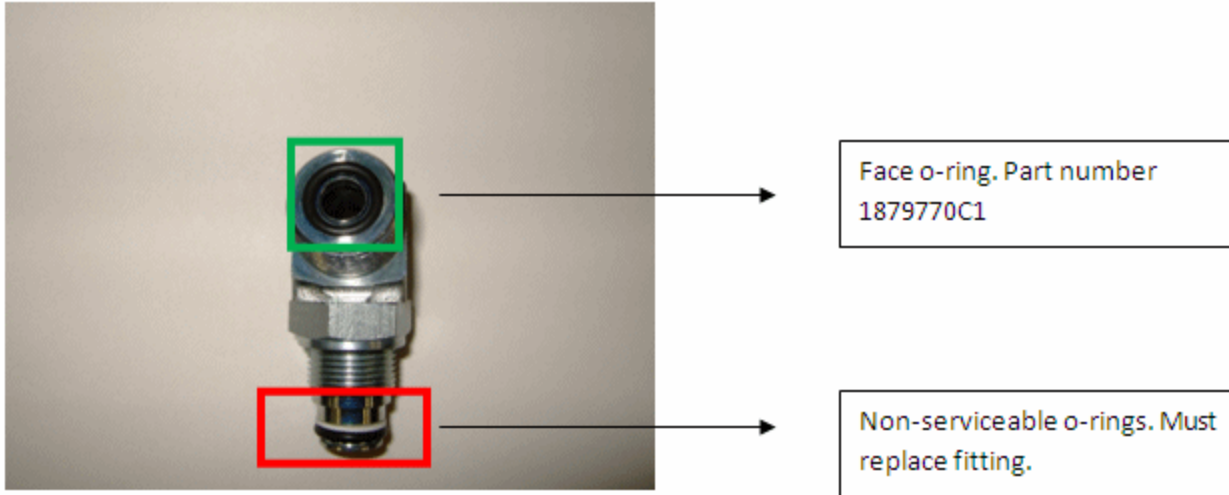
PARTS INFORMATION

| Part # | Description |
|------------|---------------------------------------------------------------------------------------------------------------------------|
| 1879757C91 | 70 degree at cylinder head |
| 1879753C91 | 90 degree at high pressure pump |
| 1884829C91 | High pressure hose kit <ul style="list-style-type: none"> • Contains 1879761C91 hose and instruction sheet |

PROCEDURE

The procedure requires replacement of the fitting assembly if o-ring damage is found at the threaded end that is installed into the cylinder head or high pressure pump. These o-rings are not serviceable by themselves. The "face" o-ring is the only serviceable o-ring. Use the following information for the proper part numbers.

Pictures of 70 degree fitting



Hide Details

Feedback Information

Viewed: 1908
 Helpful: 666
 Not Helpful: 436

| Staff ID | Client ID | Comments | Created Date |
|----------|-----------|----------------------------------------------------------------------|----------------------|
| | DYYDXMP | The face o-ring isn't available anymore. Fitting must be replaced... | 12/1/2009 2:14:56 PM |

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Countries: CANADA, UNITED STATES, MEXICO Document ID: IK1200483
 Availability: ISIS, FleetSIS Revision: 1
 Major System: ENGINES Created: 4/13/2010
 Current Language: English Last Modified: 6/13/2010
 Other Languages: [Français](#), [Español](#), Author: David Kistner
 Viewed: 2427

[Less Info](#)

| | | | | | | | |
|--------------|--------------------|-----------------------------------|------------------|-------|------------------|---------|-------------|
| Hide Details | | Coding Information | | | | | |
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| | | View My Bookmarks | | | | 572 | 796 |

Title: I-6 High Pressure Oil System Design Change

Applies To: Engine Family: International® MaxxForce™ DT, 9, and 10 Diesel Engines, 2007-2009 Model Years

DESCRIPTION:

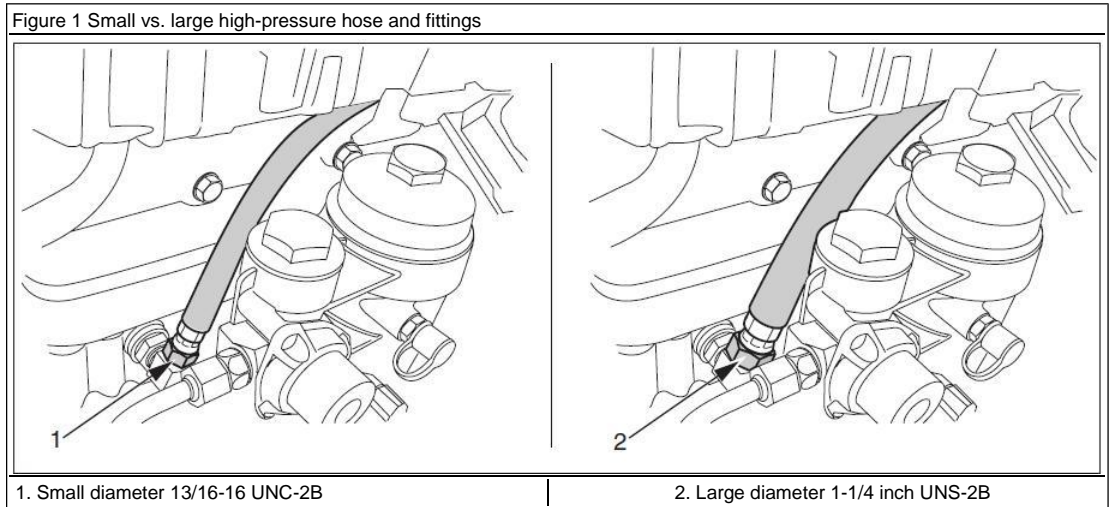
The high-pressure oil hose assembly, elbow fitting assemblies, and mating part assemblies have been redesigned with larger diameter O-ring seals, hose, and threaded fittings. The high-pressure oil hose fitting thread size has changed from 13/16-16 UNC-2B to 1-1/4 UNS-2B. The diameter of the O-ring seal on the hose elbow fittings has changed from 0.070 in. (1.78 mm) to 0.103 in. (2.61 mm). The new larger diameter high-pressure oil hose assembly requires mating part assemblies (high-pressure oil pump and cylinder head) which have larger threaded fittings to accept the new high-pressure oil hose assembly.

SERVICE:

Determine if you have a larger or small diameter high-pressure hose (see Figure 1 on page 2).

1. Order parts for engines with the larger hose from Table 1
2. Order parts for engines with the smaller hose from Table 2
3. New service kits are available for both high-pressure oil hose configurations and all related parts.

NOTE:
 Do not modify any parts to adapt either old-to-new or new-to-old part assemblies.
 High-pressure pump kits include low-pressure fuel pump, 90° elbow fitting, and an IPR valve. Low-pressure fuel pump, 90° elbow fitting, and IPR valve may also be ordered separately



PARTS INFORMATION

Table 1 Large Diameter High-pressure Oil Hose and Associated Components

| Kit or Part Description | Engine Model | Part Number |
|-----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|-------------|
| High-pressure Pump Kit (12 cc) Includes: Low-pressure fuel pump, 1-1/4 in. 90° elbow fitting adapter and IPR valve | International® MaxxForce™ DT (below 285 hp) | 1882258C91 |
| High-pressure Pump Kit (16 cc) Includes: Low-pressure fuel pump, 1-1/4 in. 90° | International® MaxxForce™ DT (285 hp and up) and all International® | 1882259C91 |

| | | |
|-------------------------------------|--------------------------------------------------------|------------|
| elbow fitting adapter and IPR valve | MaxxForce™ 9 and 10 | |
| Low-pressure Fuel Pump Kit | All | 1876108C92 |
| High-pressure Oil Hose Assembly Kit | All | 1884829C91 |
| 70° Elbow Fitting Adapter Assembly | All | 1879757C91 |
| 90° Elbow Fitting Adapter Assembly | All | 1879753C91 |
| IPR Valve and Connector Seal Kit | All | 1878629C92 |
| IPR O-Ring Kit | All | 1842615C92 |
| Cylinder Head Assembly | International® MaxxForce™ DT (245 hp and lower) | 1882594C92 |
| Cylinder Head Assembly | International® MaxxForce™ DT (above 245 hp), 9, and 10 | 1882593 |

Table 2 Small Diameter High-pressure Oil Hose and Associated Components

| Kit or Part Description | Engine Model | Part Number |
|-------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------------|
| High-pressure Pump Kit (12 cc) Includes: Low-pressure fuel pump, 13/16-16 90° elbow fitting adapter and IPR valve | International® MaxxForce™ DT (below 285 hp) | 1876105C93 |
| High-pressure Pump Kit (16 cc) Includes: Low-pressure fuel pump, 13/16-16 90° elbow fitting adapter and IPR valve | International® MaxxForce™ DT (285 hp and up) and all International® MaxxForce™ 9 and 10 | 1876106C93 |
| Low-pressure Fuel Pump Kit | All | 1876108C92 |
| High-pressure Oil Hose Assembly Kit | All | 1883605C91 |
| 70° Elbow Fitting Adapter Assembly | All | 1873463C92 |
| 90° Elbow Fitting Adapter Assembly | All | 1873460C92 |
| IPR Valve and Connector Seal Kit | All | 1878629C92 |
| IPR O-Ring Kit | All | 1842615C92 |
| Cylinder Head Assembly | International® MaxxForce™ DT (245 hp and lower) | 1847673C92 |
| Cylinder Head Assembly | International® MaxxForce™ DT (above 245 hp), 9, and 10 | 1854648C92 |

OTHER RESOURCES

TSI 081222

<https://evalue.internationaldelivers.com/service/tsipdf/081222.PDF>

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Feedback Information

Viewed: 2426
 Helpful: 572
 Not Helpful: 796

No Feedback Found

PE12-011

NAVISTAR

8-31-2012

ITEM #8 TESTING,

Fatigue Study Rev1

Fatigue study of interaction between the FC835 socket and nipple during bending

Background

The motivation for this study is to determine if the growth in the thickness of the socket shoulder during crimping affects the fatigue life of the nipple when subjected to a bending and pressure loading.

Introduction

When engineering metals are subjected to plastic deformation they generally behave as incompressible bodies. Thus the initial volume is equal to the final volume. This means that when a socket is crimped to a smaller diameter, other dimensions must increase to maintain the constant volume. In this case the thickness of the socket shoulder increases during the crimping operation.

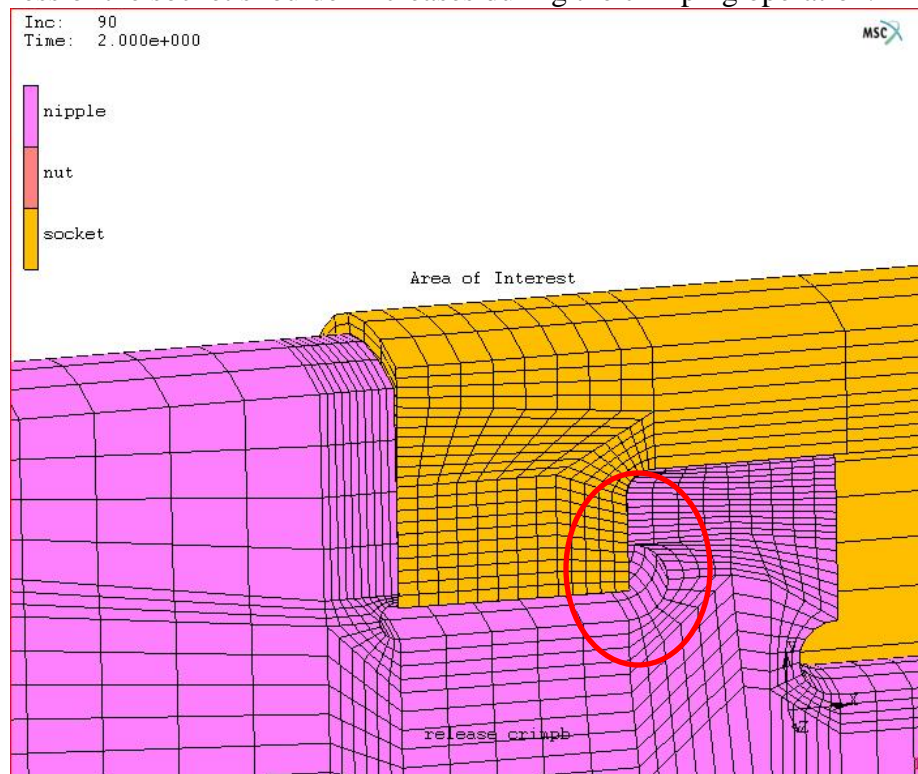


Figure 1 Location of Interest on the nipple

If the gap on the nipple is within specification but below the nominal value of .120 inches the socket could interfere with the nipple. This interference means that a positive stress will occur on the undercut. In terms of the fatigue, this stress is a residual mean stress, which will affect the expected fatigue life at this location. If the residual stress is compressive, it will help the fatigue life and if it is tensile it will diminish the fatigue life.

This is the second residual mean stress at this location, the first being due to the bending loading.

This analysis has three main portions; the first is the crimping and release of the socket, the second is the application of the bending load and the third is the application of the pressure. The mean stresses from the crimping operation and the bending are added to the mean stress of the impulse pressure load. This mean stress along with the calculated alternating stress will then be used along with the Goodman methodology to determine the fatigue life of the nipple at this location.

A careful examination of the mean residual stresses left in the part post crimping will show that the worst case is at the location shown in Figure 1.

Results

The results in Table 1 show the results from the models analyzed. The socket shoulder thickness was shown to grow by .016 inches. In the first model there is no side-to-side contact between the nipple and the socket. The second model has .002 inches interference; the third .001 inches interference and the last has line-to-line contact.

The mean stress reported is a sum of the mean stress of the crimping, the bending operation and the pressure impulse. The pressure impulse is given in Table 2.

Table 1

| Model | Goodman | Mean | Alternating |
|-------------------------|---------|--------|-------------|
| No side to side contact | 0.0477 | 3205 | 3354 |
| .114 gap, .100 socket | 0.9339 | 102625 | 2801 |
| .115 gap, .100 socket | 0.4448 | 44925 | 2332 |
| .116 gap, .100 socket | 0.2253 | 24137 | 936 |

Table 2

| | |
|----------------|-----|
| Pressure | Bar |
| Normal Impulse | 450 |
| Peak | 515 |

The stress safety factors are given in Table 3. The safety factors refer to the 20,000,000 cycle life of the nipple. This life curve is based on an endurance limit equal to 50% of the ultimate tensile strength of 1137 steel.

A graphical representation of the safety factor is shown in Figure 2. The line from the origin to the mean and alternating stress condition is extended to the Goodman line. The difference between the stress point and the point of interference with the Goodman line is the safety factor. It should be noted that the

Goodman line represents a probability of 50% of failure, so that the closer the stress condition is to the Goodman line the more likely fatigue failure is to occur.

Table 3

| Model | Stress Safety Factor |
|-------------------------|----------------------|
| No side to side contact | 10.48804 |
| .114 gap, .100 socket | 1.070805 |
| .115 gap, .100 socket | 2.318982 |
| .116 gap, .100 socket | 4.439017 |

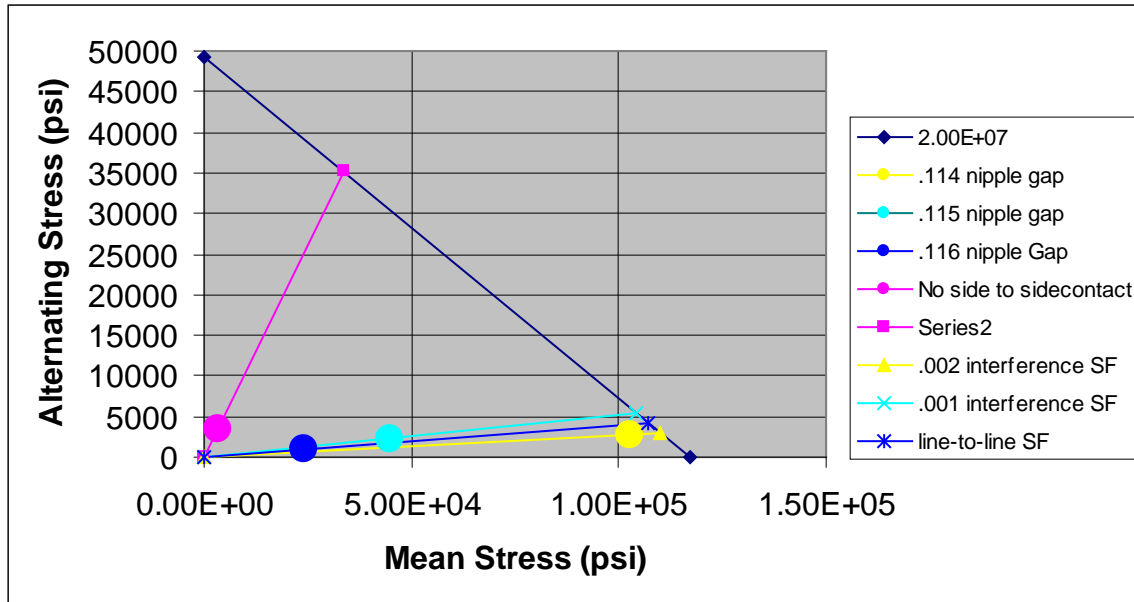


Figure 2 Haigh Diagram of Various Fatigue Conditions

Conclusion

The shoulder thickness of the socket grows approximately .016 inches when the socket is crimped to .830 inches. Depending on the width of the nipple, the socket can interfere with the nipple groove. This interference causes residual mean stresses in the nipple. These mean stresses can potentially significantly reduce the fatigue life of the part with fracture occurring at the undercut shown in Figure 1.

To achieve the maximum possible fatigue life of the nipple, the socket should be redesigned so that no side-to-side interference is experienced during crimping.