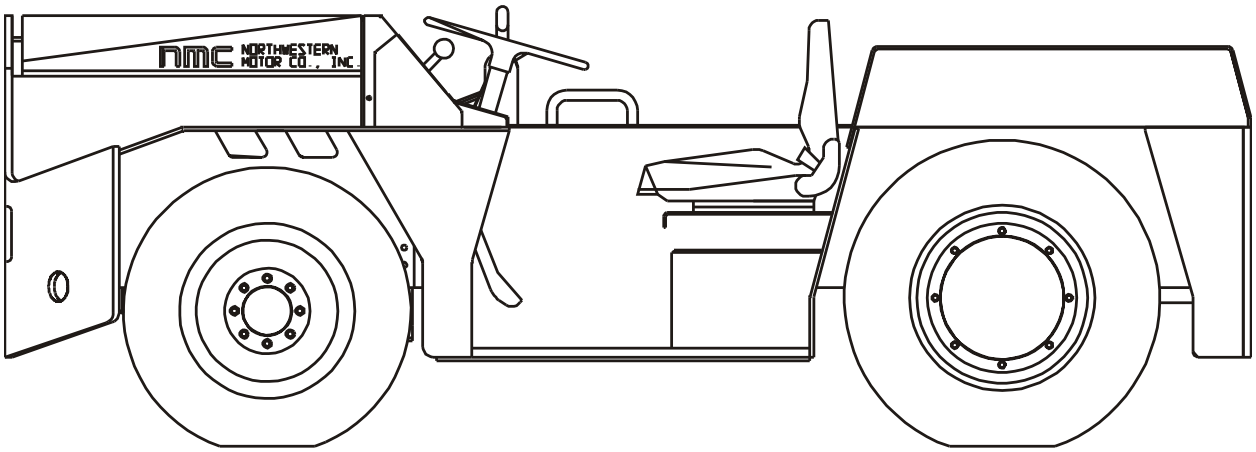
AIRCRAFT/INDUSTRIAL TOW TRACTOR MODEL 140

OPERATION, MAINTENANCE AND PARTS MANUAL



NMC-WOLLARD, Inc.
2021 Truax Blvd.
Eau Claire, WI 54702
715-835-3151
Fax 715-835-6625
Web Site: nmc-wollard.com
General Email: nmc-wollard@nmc-wollard.com

INTRODUCTION

Congratulations on the purchase of your new Tow Tractor from NMC-Wollard, Inc. With its optional equipment this is the simplest, most flexible system on the market today. With proper operation and preventative maintenance it will last for years.

⚠ This SAFETY ALERT SYMBOL indicates important safety messages in the manual. When you see this symbol, be alert to the possibility of PERSONAL INJURY and carefully read the message that follows.

⚠WARNING Never operate without all covers, shields and guards in place. Body, hair or clothing can become entangled in exposed, moving parts and can cause serious injury or death.
Some covers and guards have been removed for illustrative/photographic purposes only in this manual.

The Warranty appears in the front of this book. The order number and serial number are recorded on the cover. These numbers should be recorded on the Registration and Inspection Certificate for your reference and for proper identification of your machine by NMC-Wollard, Inc.

For information on ordering repair parts, refer to the Repair Parts chapter at the back of this book.

You are urged to study this manual and follow the instructions carefully. Your efforts will be repaid in better operation and service as well as a savings in time and repair expense. Failure to read and understand the machine or the system could lead to serious injury. If you do not understand the instructions in this manual contact the manufacturer.

This supercedes all previous published instructions.

When reading this manual, if a figure or paragraph *outside* the current section is referred to, it will be identified by Chapter-Section-Figure Number or Chapter-Section-Paragraph.
Example:
Figure 2-2-4.....Chapter 2-Section 2-Figure 4
2-2-1.4.....Chapter 2-Section 2-Paragraph 1.4

If figures or paragraphs from the current section are referred, the chapter and section may not be referenced.

This manual is available in pdf format on CD-ROM, P/N 46054CD.0.1

Keep a copy of your NMC-Wollard, Inc. manuals on your computer or CD-ROM! You will be able to view and print pages and search for words or numbers. CD-ROM manuals include a linked table of contents. Mouse click on a table of contents entry to display the page containing that item.

For availability and pricing, contact NMC-Wollard, Inc. customer service at:
Phone (715) 835-3151
Fax (715) 835-6625
Email custserv@nmc-wollard.com

©COPYRIGHT NMC-Wollard 2008

1 YEAR LIMITED WARRANTY

NMC-Wollard, Inc

NMC-Wollard, Inc. warrants to the original owner that all components of the equipment are free from defects in material and workmanship under normal use and service for 12 months or 1,000 hours, whichever comes first, from the date of shipment.

This warranty provides for NMC-Wollard, Inc. equipment components that fail because of defects in material or workmanship during the warranty period, without charge to the owner for parts or labor. The owner must provide prompt notice of the defect and allow a reasonable time for replacement or repair.

This warranty applies only to parts manufactured by NMC-Wollard, Inc. Components installed on NMC-Wollard, Inc. equipment but not manufactured by NMC-Wollard, Inc. shall be covered under the original manufacturer's warranty. NMC-Wollard, Inc. will assist in administering all such warranties, with the exception of tires, battery, and other expendable parts, for which the owner will be required to deal directly with the original manufacturer for warranty service. Neither tune-ups, normal maintenance and repair or replacement of expendable parts (such as oil, lubricants, belts, filters, tires, battery, etc.) are covered by this warranty.

This warranty does not cover damage resulting from carelessness or neglect; accidents, fire, or other casualties; improper repair, operation, transportation, or storage; or failure to provide necessary or appropriate maintenance. This warranty does not cover deterioration or failure caused by chemicals, falling objects, dirt and sand, or excessive heat or moisture. The NMC-Wollard, Inc. equipment must be maintained according to the instructions provided with it or this warranty may be considered void. Warranted components must be replaced with parts manufactured or approved by NMC-Wollard, Inc. Warranty determination will be made after NMC-Wollard, Inc. inspects the failed part.

NMC-Wollard, Inc. is not liable for damage or injury resulting from improper installation, use, abuse, inability to use or misapplication of NMC-Wollard, Inc. equipment, nor is NMC-Wollard, Inc. liable for damage resulting from equipment repaired or modified by persons not authorized by NMC-Wollard, Inc. NMC-Wollard, Inc. does not warrant any part or product to meet local, municipal, state, provincial, or national laws or regulations.

This Limited Warranty is in lieu of all other warranties, whether express, implied, or statutory. No other express warranty is given or authorized by NMC-Wollard, Inc. NMC-Wollard, Inc. expressly disclaims any implied warranty of merchantability or fitness for a particular purpose or otherwise. NMC-Wollard, Inc. shall not be liable for loss of use of equipment, loss of time, loss of business, or for any other incidental, or consequential damages. No authorized NMC-Wollard, Inc. representative has the right to change or modify this warranty in any respect.

This warranty is non-transferable.

TO OBTAIN WARRANTY SERVICE

Warranty can be obtained by contacting NMC-Wollard, Inc., 2021 Truax Blvd., Eau Claire, WI. 54703, (Phone 715 835-3151) (Fax 715 835-6625)

What should you do when you receive a new unit?

Check that you have received all the equipment ordered. Check inside the product manual for engine warranties. Some OEM manufacturers supply a registration card that must be filled out and returned immediately to initiate the warranty. If a survey card or delivery checklist is enclosed from NMC-Wollard, Inc. please return it.

What should you do when you discover a possible warranty problem?

Call NMC-Wollard, Inc. (715-835-3151). We will require the serial number, number of hours on the unit, and a description of the problem. You will be given a warranty authorization number and assistance in troubleshooting.

IMPORTANT!
Clear and immediate communication with the factory is the key to obtaining a satisfactory and timely resolution of your warranty problem.

Every warranty situation is different and so there are no hard rules. We will work with your maintenance personnel and service managers to equitably resolve all claims.

What should you do after warranty problem has been resolved?

Complete and return the warranty claim form within 10 days. Place the assigned warranty authorization number we gave you when you first called us with the problem on your claim.

Return defective parts immediately. Your claim cannot be processed until all defective parts have been returned to NMC-Wollard, Inc. Identify returned parts with the assigned warranty authorization number.

What should you use for labor rate and labor time?

Labor rate are reviewed annually, if you do not have an established rate, call NMC-Wollard, Inc. We do not publish a rate book; instead, we have accumulated average times for repairs. We will authorize repair time once we have approved the repair. If unforeseen circumstances cause a significantly greater repair time than originally approved, please contact us before submitting your claim.

INTRODUCTION INTRO-2
1 YEAR LIMITED WARRANTY WARR-4
REVISION RECORD REV-7
REVISION HIGHLIGHTS REVHI-8
PAGE EFFECTIVITY EFF-13
CONFIGURATION CONFI-19
EFFECTIVITY CODE EFFCOD-21

REVISION RECORD

Rev No.	Issue Date	Date Inserted	Initial
0	01/31/08	1/31/08	NMC-Wollard
1	08/31/08	08/31/08	NMC-Wollard
2	01/31/09	01/31/09	NMC-Wollard
3	03/10/14	03/10/14	NMC-Wollard
4	08/31/14	08/31/14	NMC-Wollard
5	01/15/15	01/15/15	NMC-Wollard
6	05/31/15	05/31/15	NMC-Wollard
7	07/15/15	07/15/15	NMC-Wollard
8	10/01/15	10/01/15	NMC-Wollard
9	02/22/16	02/22/16	NMC-Wollard

REVISION HIGHLIGHTS

TO: HOLDERS OF NMC-Wollard, Inc. OPERATION AND MAINTENANCE MANUAL Number 46054

Pages that have been revised are outlined below, together with highlights of the revision. Please delete the affected pages and enter Revision No.and date to the Revision Record page 19.

REVISION NO. 0 DATED 01/31/08

Chapter/Section And Page No.	Description of Changes	Effectivity
All	Complete new manual issued containing current information for this date forward	SN 07-C-3085+ w/Cummins

REVISION NO. 1 DATED 08/31/08

Chapter/Section And Page No.	Description of Changes	Effectivity
Intro/all pages	ANSI Z535.6 Safety formatting updated.	All
1/all pages	ANSI Z535.6 Safety formatting updated.	All
2/all pages	ANSI Z535.6 Safety formatting updated.	All
3/all pages	ANSI Z535.6 Safety formatting updated.	All

REVISION NO. 2 DATED 01/31/09

Chapter/Section And Page No.	Description of Changes	Effectivity
Intro/18-19,21-25,28	Add rev 2, update pg eff. Add Eff A,B,C,D,E	All
4/TOC/1-2	Update TOC	All
4/3/1-8	Update numerical index	All
4/4/17	39557K,38556K added	All
4/4/111	Chng 41588 to 37357. +48079,48080	All
4/4/125	+8797.105,3.1317	A,B
4/4/131-152	Add 46550 engine pak	C
4/4/153-172	Add B3.3Turbo, T3 Eng Pak	E

REVISION NO. 3 DATED 03-10-14

Chapter/Section And Page No.	Description of Changes	Effectivity
Intro/18,20	Rev 3 added, Revision Highlights add Rev 3	all
Intro/Page Eff./22-24	Changed dates	all

Intro/Config/ 27	Added 48685 Option	all
Intro/Eff Code/28	Added F	F
2/1/24	Added to Neutral Switch adjustment section	all
4/4/3	Add 47484,41640-5	all
4/4/39	Add 46341	all
4/4/57	Add 46841 was 38393, 46539 was 46676	all
4/4/59	Add 37604 was 38542, 46541 was 38309	all
4/4/67	NW34619.4 was NW022755-2	all
4/4/73	Add 48985	all
4/4/75	39984 was 39989	all
4/4/139,169	SB489 was NW035944	all
4/4/157	45832 was 37537, add 41052,45831	all
4/4/163	Removed 91926, NW034365	all

REVISION NO. 4 DATED 08-31-14

Chapter/Section And Page No.	**Description of Changes**	**Effectivity**
Intro/TOC/15,16,17	Chapter 4 TOC Changed	all
Intro/Rev Record/19	Added Rev 4	all
Intro/Rev Highlights/20	Added Rev 4	all
Intro/Eff Code/31	Added G	G
1/3/1, 2	Changed engine oil statement, added Perkins engines	G
2/1/4	Add initial 8 hours lug nut check	all
2/2/15,16	Added schematic 1104	G
4/4/19,27	Added 48559,48560,51225-10	all
4/4/30-33	Add NW035226,NW036731, 52487,NW035385, NW035388, NW035378, 43961, 43958, 43963	all
4/4/44-43,50	Add 46648, 52487,43970,51224	all
4/4/61,79	Add 46857, 46538,51443,51444	all
4/4/101, 131	Add 50696, 51228-8	all
4/4/140,141	Changed description of 46572	all
4/4/165	Add 51225-7,50938	all
4/4/176-193	Add Perkins 1104D-44T/C6,T3 engine pack	G
4/4/194-197	Add 51311 wiring harness	all
4/4/198-204	Add Perkins 1104C-44/C6 engine pack	G

REVISION NO. 5 DATED 01/15/15		
Chapter/Section And Page No.	**Description of Changes**	**Effectivity**
Intro/19,22-24	TOC Rev. 5, updated Rev. highlights, page eff	all
2/TOC/1-4	Updated TOC	all
2/2/16-20	Add 51701 schematic	all

REVISION NO. 6 DATED 05/31/15		
Chapter/Section And Page No.	**Description of Changes**	**Effectivity**
Intro/6,7,10,13-17,21	Updated TOC, Rev 6 added, page eff. updated, added H eff. code, removed chapter TOC's	H
1/1/1,2,8	TOC updated, add instrument panel	H
1/2/7	Addded eff H to fig. 1	H
1/3/1,2	Updated specs. for Cummins and Newage axle	H
2/TOC/1-3	Updated TOC	H
2/1/16	Add Newage illustration	H
2/2/20	Illustration added	H
4/TOC/1-3	Updated TOC	H
4/2/2	Added PMR Newage to vendor list	H
4/3/1-9	Updated part number list	H
4/4/6,7	Added 52599,52598	H
4/4/28,29	Added, 50279, 50113, 30500-7,47862	H
4/4/39	Added 50355, 50356, 50354, 50359	H
4/4/43	Added 51464	H
4/4/61	Added 52675-1, 46743, 46676	H
4/4/72,73	Added 52695	H
4/4/159	Added 50030-1, 46950	H
4/4/161	Added 50030-1	H
4/4/162,163	Added52722	H
4/4/166	Added 50030-1	H
4/4/168,169	Added 50030-5	H
4/4/171	Added 50030-9	H
4/4/204	Added 47310-8	H
4/4/205,206	Added Instrument panel parts	H

REVISION NO. 7 DATED 07/15/15		
Chapter/Section And Page No.	**Description of Changes**	**Effectivity**
Intro/ Rev Rec/ 7	Added rev 7	all
Intro/ Rev High/ 11	Added rev 7 highlights	all
Intro/ Page Eff/ 13,14	Updated pages	all
Intro/Config/20	Add 47268,48500,52993	I
Intro/Eff/21	Added I	I
1/1/2	Added 40518, 53005, 204604, 43314	all
2/4/6	Added see tractor decal, removed torque	all
2/2/20,21	Added 52992 schematic, page 22 added	H
4/TOC/1-3	Updated TOC	all
4/3/1-9	Updated parts index	all
4/4/23	Added 52998 and related parts	I
4/4/28,29	Added 52987 and related parts	I
4/4/30	Added 53003	I
4/4/33	Added 52948	I
4/4/43	Added 52999 and related parts	I
4/4/50	Added 52993	I
4/4/53	added 48500	I
4/4/61	Added 52998	I
4/4/103	Added 47268	I
4/4/121	Added 53000-2 and related parts	I
4/4/125	Added 46555-4 and 4687	I
4/4/130,131	Added 53000-1 and related parts	I
4/4/205	Added 53002 and related parts	I

REVISION NO. 8 DATED 10/01/15		
Chapter/Section And Page No.	**Description of Changes**	**Effectivity**
Intro/Rev 7	Added Rev 8	all
Intro/Revhi12	Added Rev 8	all
Intro/Page Eff/13-18	Updated	all
1/1/7,8	Updated instrument panel inserts	all
1/3/1,3	Added see chapt. 5 for Alison Trans	all
4/TOC/1-3	Updated	all
4/3/3-10	Updated part number location	all
4/4/7	Added lower level parts to 52599	H
4/4/22,23	Added 53107,53104,53106,52884,3.2792, 3.0397	I
4/4/42,43	Updated 40518, 53005 was 42159	all
4/4/49	Add missing BOM	all
4/4/61	Add 52988 frame	I
4/4/155	Add 53158	I
4/4/171	Add 48473	I
4/4/205-208	Add air conditioning parts	I
5/87-177	Add CAN display fault information & Allison 2500 transmission information	I

REVISION NO. 9 DATED 02/22/16		
Chapter/Section And Page No.	**Description of Changes**	**Effectivity**
Intro/Rev 7	Added Rev 9	all
Intro/Revhi12	Added Rev 9	all
Intro/Page Eff/13,14,15	Updated	all
4/4/4-61	38547 replaced with 53338	all
2/1/1-7	Added tire pressures for different tire sizes	all

This Page Intentionally Blank

This Page Intentionally Blank

PAGE EFFECTIVITY

INTRODUCTION

CONTENTS
INTRO-2.....AUGUST 31, 2008
INTRO-3.....AUGUST 31, 2008
WARR-4.....AUGUST 31, 2008
WARR-5.....AUGUST 31, 2008
TOC-6 .....MAY 31, 2015
REV-7.....FEBRUARY 22, 2016
REVHI-8.....JANUARY 31, 2009
REVHI-9.....AUGUST 31, 2014
REVHI-10.....MAY 31, 2015
REVHI-11 ..... JULY 15, 2015
REVHI-12.....FEBRUARY 22, 2016
REVHI-13.....FEBRUARY 22, 2016
REVHI-14.....FEBRUARY 22, 2016
EFF-13 .....FEBRUARY 22, 2016
EFF-14 .....FEBRUARY 22, 2016
EFF-15 .....FEBRUARY 22, 2016
EFF-16 .....OCTOBER 01, 2015
EFF-17 .....OCTOBER 01, 2015
EFF-18 .....OCTOBER 01, 2015
CONFI-19.....AUGUST 31, 2008
CONFI-20..... JULY 15, 2015
EFFCOD-21..... JUNE 15, 2015
EFFCOD-22.....AUGUST 15, 2014

CHAPTER 1

TOC-1 .....MAY 31, 2015
TOC-2 .....MAY 31, 2015
1-1 .....MAY 31, 2015
1-2 ..... JUNE15, 2015
1-3 .....AUGUST 31, 2008
1-4 .....AUGUST 31, 2008
1-5 .....AUGUST 31, 2008
1-6 .....AUGUST 31, 2008
1-7 .....OCTOBER 01, 2015
1-8 .....OCTOBER 01, 2015
1-9 .....AUGUST 31, 2008
1-10 .....AUGUST 31, 2008
2-1 .....AUGUST 31, 2008
2-2 .....AUGUST 31, 2008
2-3 .....AUGUST 31, 2008
2-4 .....AUGUST 31, 2008
2-6 .....AUGUST 31, 2008
2-7 .....MAY 31, 2015
2-8 .....AUGUST 31, 2008
2-9 .....AUGUST 31, 2008
2-10 .....AUGUST 31, 2008
3-1 .....OCTOBER 01, 2015
3-2 .....MAY 31, 2015
3-3 .....OCTOBER 01, 2015
3-4 .....AUGUST 31, 2008
3-5 .....AUGUST 31, 2008
3-6 .....AUGUST 31, 2008
4-1 .....AUGUST 31, 2008
4-2 .....AUGUST 31, 2008
5-1 .....AUGUST 31, 2008
5-2 .....AUGUST 31, 2008

CHAPTER 2

TOC-1 .....MAY 31, 2015
TOC-2 .....MAY 31, 2015
TOC-3 .....MAY 31, 2015
TOC-4 .....JANUARY 15, 2015
1-1 .....AUGUST 31, 2008
1-2 .....AUGUST 31, 2008
1-3 .....AUGUST 31, 2008
1-4 .....AUGUST 31, 2014
1-5 .....AUGUST 31, 2008
1-6 .....AUGUST 31, 2008
1-7 .....FEBRUARY 22, 2016
1-8 .....AUGUST 31, 2008
1-9 .....AUGUST 31, 2008
1-10 .....AUGUST 31, 2008
1-11.....AUGUST 31, 2008
1-12 .....AUGUST 31, 2008
1-13 .....AUGUST 31, 2008
1-14 .....AUGUST 31, 2008
1-15 .....AUGUST 31, 2008
1-16 .....MAY 31, 2015
1-17 .....AUGUST 31, 2008
1-18 .....AUGUST 31, 2008
1-19 .....AUGUST 31, 2008
1-20 .....AUGUST 31, 2008
1-21 .....AUGUST 31, 2008
1-22 .....AUGUST 31, 2008
1-23 .....AUGUST 31, 2008
1-24 .....AUGUST 31, 2008
1-25 .....AUGUST 31, 2008
1-26 .....MARCH 10, 2014
1-27 .....AUGUST 31, 2008
1-28 .....AUGUST 31, 2008
1-29 .....AUGUST 31, 2008
1-30 .....AUGUST 31, 2008
1-31 .....AUGUST 31, 2008
1-32 .....AUGUST 31, 2008
1-33 .....AUGUST 31, 2008
1-34 .....AUGUST 31, 2008
1-35 .....AUGUST 31, 2008
1-36 .....AUGUST 31, 2008
1-37 .....AUGUST 31, 2008
1-38 .....AUGUST 31, 2008
1-39 .....AUGUST 31, 2008
1-40 .....AUGUST 31, 2008
1-41 .....AUGUST 31, 2008
1-42 .....AUGUST 31, 2008
1-43 .....AUGUST 31, 2008
1-44 .....AUGUST 31, 2008
1-45 .....AUGUST 31, 2008

1-46 .....AUGUST 31, 2008
2-1 .....AUGUST 31, 2008
2-2 .....AUGUST 31, 2008
2-3 .....AUGUST 31, 2008
2-4 .....AUGUST 31, 2008
2-5 .....AUGUST 31, 2008
2-6 .....AUGUST 31, 2008
2-7 .....AUGUST 31, 2008
2-8 .....AUGUST 31, 2008
2-9 .....AUGUST 31, 2008
2-10 .....AUGUST 31, 2008
2-11.....AUGUST 31, 2008
2-12 .....AUGUST 31, 2008
2-13 .....AUGUST 31, 2008
2-14 .....AUGUST 31, 2008
2-15 .....AUGUST 31, 2014
2-16 .....JANUARY 15, 2015
2-17 .....FEBRUARY 22, 2016
2-18 .....JANUARY 15, 2015
2-19 .....JANUARY 15, 2015
2-20 ..... JUNE 15, 2015
2-21 ..... JUNE 15, 2015
2-22 ..... JUNE 15, 2015
3-1 .....AUGUST 31, 2008
3-2 .....AUGUST 31, 2008
3-3 .....AUGUST 31, 2008
3-4 .....AUGUST 31, 2008
3-5 .....AUGUST 31, 2008
3-6 .....AUGUST 31, 2008
3-7 .....AUGUST 31, 2008
3-8 .....AUGUST 31, 2008
3-9 .....AUGUST 31, 2008
3-10 .....AUGUST 31, 2008
3-11.....AUGUST 31, 2008
3-12 .....AUGUST 31, 2008
3-13 .....AUGUST 31, 2008
3-14 .....AUGUST 31, 2008
3-16 .....AUGUST 31, 2008
3-17 .....AUGUST 31, 2008
3-18 .....AUGUST 31, 2008
3-19 .....AUGUST 31, 2008
3-20 .....AUGUST 31, 2008
3-21 .....AUGUST 31, 2008
3-22 .....AUGUST 31, 2008
3-23 .....AUGUST 31, 2008
3-24 .....AUGUST 31, 2008
3-25 .....AUGUST 31, 2008
3-26 .....AUGUST 31, 2008
4-1 .....AUGUST 31, 2008
4-2 .....AUGUST 31, 2008
4-3 .....AUGUST 31, 2008
4-4 .....AUGUST 31, 2008
4-5 .....AUGUST 31, 2008
4-6 ..... JUNE15, 2015
4-7 .....AUGUST 31, 2008
4-8 .....AUGUST 31, 2008
4-9 .....AUGUST 31, 2008
4-10 .....AUGUST 31, 2008

CHAPTER 3

TOC-1 .....AUGUST 31, 2008
TOC-2 .....AUGUST 31, 2008
1-1 .....AUGUST 31, 2008
1-2 .....AUGUST 31, 2008
1-3 .....AUGUST 31, 2008
1-4 .....AUGUST 31, 2008
1-5 .....AUGUST 31, 2008
1-6 .....AUGUST 31, 2008
1-7 .....AUGUST 31, 2008
1-8 .....AUGUST 31, 2008
1-9 .....AUGUST 31, 2008
1-10 .....AUGUST 31, 2008
1-11.....AUGUST 31, 2008
1-12 .....AUGUST 31, 2008
1-13 .....AUGUST 31, 2008
1-14 .....AUGUST 31, 2008
1-15 .....AUGUST 31, 2008
1-16 .....AUGUST 31, 2008

CHAPTER 4

TOC-1 .....OCTOBER 01, 2015
TOC-2 .....OCTOBER 01, 2015
TOC-3 .....OCTOBER 01, 2015
TOC-4 .....AUGUST 31, 2014
1-1 .....JANUARY 31, 2008
1-2 .....JANUARY 31, 2008
2-1 ..... JUNE 31, 2007
2-2 .....MAY 31, 2015
3-1 .....OCTOBER 01, 2015
3-2 .....OCTOBER 01, 2015
3-3 .....OCTOBER 01, 2015
3-4 .....OCTOBER 01, 2015
3-5 .....OCTOBER 01, 2015
3-6 .....OCTOBER 01, 2015
3-7 .....OCTOBER 01, 2015
3-8 .....OCTOBER 01, 2015
3-9 .....OCTOBER 01, 2015
3-10 .....OCTOBER 01, 2015
4-1 .....JANUARY 31, 2008
4-2 .....JANUARY 31, 2008
4-3 .....MARCH 10, 2014
4-4 .....JANUARY 31, 2008
4-5 .....JANUARY 31, 2008
4-6 .....MAY 31, 2015
4-7 .....OCTOBER 01, 2015
4-8 .....JANUARY 31, 2008
4-9 .....JANUARY 31, 2008
4-10 .....JANUARY 31, 2007
4-11.....JANUARY 31, 2008
4-12 .....JANUARY 31, 2008
4-13 .....JANUARY 31, 2008

4-14 .....JANUARY 31, 2008
4-15 .....JANUARY 31, 2008
4-16 .....JANUARY 31, 2008
4-17 .....JANUARY 31, 2009
4-18 .....JANUARY 31, 2008
4-19 .....AUGUST 31, 2014
4-20 .....JANUARY 31, 2008
4-21 .....JANUARY 31, 2008
4-22 .....OCTOBER 01, 2015
4-23 .....OCTOBER 01, 2015
4-24 .....JANUARY 31, 2008
4-25 .....JANUARY 31, 2008
4-26 .....JANUARY 31, 2008
4-27 .....AUGUST 31, 2014
4-28 ..... JUNE 15, 2015
4-29 ..... JUNE 15, 2015
4-30 ..... JULY 15, 2015
4-31 .....AUGUST 31, 2014
4-32 .....AUGUST 31, 2014
4-33 ..... JUNE 15, 2015
4-34 .....JANUARY 31, 2008
4-35 .....JANUARY 31, 2008
4-36 .....JANUARY 31, 2008
4-37 .....MAY 31, 20015
4-38 .....JANUARY 31, 2008
4-39 .....MAY 31, 2015
4-40 .....AUGUST 31, 2014
4-41 .....AUGUST 31, 2014
4-42 .....OCTOBER 01, 2015
4-43 .....OCTOBER 01, 2015
4-44 .....JANUARY 31, 2008
4-45 .....JANUARY 31, 2008
4-46 .....JANUARY 31, 2008
4-47 .....JANUARY 31, 2008
4-48 .....JANUARY 31, 2008
4-49 .....OCTOBER 01, 2015
4-50 ..... JULY 15, 2015
4-51 .....AUGUST 31, 2014
4-52 .....JANUARY 31, 2008
4-53 ..... JULY 15, 2015
4-54 .....JANUARY 31, 2008
4-55 .....JANUARY 31, 2008
4-56 .....JANUARY 31, 2008
4-57 .....JANUARY 31, 2008
4-58 .....JANUARY 31, 2008
4-59 .....JANUARY 31, 2008
4-60 .....AUGUST 31, 2014
4-61 .....FEBRUARY 22, 2016
4-62 .....JANUARY 31, 2008
4-63 .....MARCH 10, 2014
4-64 .....JANUARY 31, 2008
4-65 .....JANUARY 31, 2008
4-66 .....JANUARY 31, 2008
4-67 .....JANUARY 31, 2008
4-68 .....JANUARY 31, 2008
4-69 .....JANUARY 31, 2008
4-70 .....JANUARY 31, 2008
4-71 .....MARCH 10, 2014
4-72 .....MAY 31, 2015
4-73 .....MAY 31, 2015
4-74 .....JANUARY 31, 2008
4-75 .....JANUARY 31, 2008
4-76 .....JANUARY 31, 2008
4-77 .....MARCH 10, 2014
4-78 .....JANUARY 31, 2008
4-79 .....AUGUST 31, 2014
4-80 .....JANUARY 31, 2008
4-81 .....JANUARY 31, 2008
4-82 .....JANUARY 31, 2008
4-83 .....JANUARY 31, 2008
4-84 .....JANUARY 31, 2008
4-85 .....JANUARY 31, 2008
4-86 .....JANUARY 31, 2008
4-87 .....JANUARY 31, 2008
4-88 .....JANUARY 31, 2008
4-89 .....JANUARY 31, 2008
4-90 .....JANUARY 31, 2008
4-91 .....JANUARY 31, 2008
4-92 .....JANUARY 31, 2008
4-93 .....JANUARY 31, 2008
4-94 .....JANUARY 31, 2008
4-95 .....JANUARY 31, 2008
4-96 .....JANUARY 31, 2008
4-97 .....JANUARY 31, 2008
4-98 .....JANUARY 31, 2008
4-99 .....JANUARY 31, 2008
4-100 .....JANUARY 31, 2008
4-101 .....AUGUST 31, 2014
4-102 .....JANUARY 31, 2008
4-103 ..... JUNE 15, 2015
4-104 .....JANUARY 31, 2008
4-105 .....JANUARY 31, 2008
4-106 .....JANUARY 31, 2008
4-107 .....JANUARY 31, 2008
4-108 .....JANUARY 31, 2008
4-109 .....JANUARY 31, 2008
4-110.....JANUARY 31, 2008
4-111..... JANUARY 31, 2008
4-112.....JANUARY 31, 2008
4-113..... JANUARY 31, 2008
4-114.....JANUARY 31, 2008
4-115.....JANUARY 31, 2009
4-116.....JANUARY 31, 2008
4-117.....JANUARY 31, 2008
4-118.....JANUARY 31, 2008
4-119..... JUNE 31, 2007
4-120 .....JANUARY 31, 2008
4-121 ..... JUNE 15, 2015
4-122 .....JANUARY 31, 2008
4-123 ..... JUNE 31, 2007
4-124 .....JANUARY 31, 2008
4-125 ..... JUNE 15, 2015

4-126 .....JANUARY 31, 2008
4-127 .....JANUARY 31, 2008
4-128 .....JANUARY 31, 2008
4-129 .....JANUARY 31, 2009
4-130 ..... JUNE 15, 2015
4-131 ..... JUNE 15, 2015
4-132 .....JANUARY 31, 2008
4-133 .....JANUARY 31, 2008
4-134 .....JANUARY 31, 2008
4-135 .....JANUARY 31, 2009
4-136 .....JANUARY 31, 2009
4-137 .....JANUARY 31, 2008
4-138 .....JANUARY 31, 2009
4-139 .....JANUARY 31, 2009
4-140 .....AUGUST 31, 2014
4-141 .....AUGUST 31, 2014
4-142 .....JANUARY 31, 2009
4-143 .....MARCH 10, 2014
4-144 .....JANUARY 31, 2009
4-145 .....JANUARY 31, 2009
4-146 .....JANUARY 31, 2009
4-147 .....JANUARY 31, 2009
4-148 .....JANUARY 31, 2009
4-149 .....JANUARY 31, 2009
4-150 .....JANUARY 31, 2009
4-151 .....JANUARY 31, 2009
4-152 .....JANUARY 31, 2009
4-153 .....JANUARY 31, 2009
4-154 .....JANUARY 31, 2009
4-155 .....OCTOBER 01, 2015
4-156 .....JANUARY 31, 2009
4-157 .....JANUARY 31, 2009
4-158 .....JANUARY 31, 2009
4-159 .....MAY 31, 2015
4-160 .....JANUARY 31, 2009
4-161 .....MAY 31, 2015
4-162 .....MAY 31, 2015
4-163 .....MAY 31, 2015
4-164 .....JANUARY 31, 2009
4-165 .....AUGUST 31, 2014
4-167 .....MARCH 10, 2014
4-168 .....MAY 31, 2015
4-169 .....MAY 31, 2015
4-170 ..... APRIL 31, 2009
4-171 .....OCTOBER 01, 2015
4-172 .....JANUARY 31, 2009
4-173 .....MARCH 10, 2014
4-174 .....JANUARY 31, 2009
4-175 .....JANUARY 31, 2009
4-176 .....AUGUST 31, 2014
4-177 .....AUGUST 31, 2014
4-178 .....AUGUST 31, 2014
4-179 .....AUGUST 31, 2014
4-180 .....AUGUST 31, 2014
4-181 .....AUGUST 31, 2014
4-182 .....AUGUST 31, 2014
4-183 .....AUGUST 31, 2014
4-184 .....AUGUST 31, 2014
4-185 .....AUGUST 31, 2014
4-186 .....AUGUST 31, 2014
4-187 .....AUGUST 31, 2014
4-188 .....AUGUST 31, 2014
4-189 .....AUGUST 31, 2014
4-190 .....AUGUST 31, 2014
4-191 .....AUGUST 31, 2014
4-192 .....AUGUST 31, 2014
4-193 .....AUGUST 31, 2014
4-194 .....AUGUST 31, 2014
4-195 .....AUGUST 31, 2014
4-196 .....AUGUST 31, 2014
4-197 .....AUGUST 31, 2014
4-198 .....AUGUST 31, 2014
4-199 .....AUGUST 31, 2014
4-200 .....AUGUST 31, 2014
4-201 .....AUGUST 31, 2014
4-202 .....AUGUST 31, 2014
4-203 .....AUGUST 31, 2014
4-204 .....MAY 31, 2015
4-205 .....OCTOBER 01, 2015
4-206 .....OCTOBER 01, 2015
4-207 .....OCTOBER 01, 2015
4-208 .....OCTOBER 01, 2015

CHAPTER 5

5-1 .....MAY 31, 2015
5-2 .....JANUARY 31, 2008
5-3 .....JANUARY 31, 2008
5-4 .....JANUARY 31, 2008
5-5 .....JANUARY 31, 2008
5-6 .....JANUARY 31, 2008
5-7 .....JANUARY 31, 2008
5-8 .....JANUARY 31, 2008
5-9 .....JANUARY 31, 2008
5-10 .....JANUARY 31, 2008
5-11.....JANUARY 31, 2008
5-12 .....JANUARY 31, 2008
5-13 .....JANUARY 31, 2008
5-14 .....JANUARY 31, 2008
5-15 .....JANUARY 31, 2008
5-16 .....JANUARY 31, 2008
5-17 .....JANUARY 31, 2008
5-18 .....JANUARY 31, 2008
5-19 .....JANUARY 31, 2008
5-20 .....JANUARY 31, 2008
5-21 .....JANUARY 31, 2008
5-22 .....JANUARY 31, 2008
5-23 .....JANUARY 31, 2008
5-24 .....JANUARY 31, 2008
5-25 .....JANUARY 31, 2008
5-26 .....JANUARY 31, 2008
5-27 .....JANUARY 31, 2008
5-28 .....JANUARY 31, 2008

5-29 .....JANUARY 31, 2008
5-30 .....JANUARY 31, 2008
5-31 .....JANUARY 31, 2008
5-32 .....JANUARY 31, 2008
5-33 .....JANUARY 31, 2008
5-34 .....JANUARY 31, 2008
5-35 .....JANUARY 31, 2008
5-36 .....JANUARY 31, 2008
5-37 .....JANUARY 31, 2008
5-38 .....JANUARY 31, 2008
5-39 .....JANUARY 31, 2008
5-40 .....JANUARY 31, 2008
5-41 .....JANUARY 31, 2008
5-42 .....JANUARY 31, 2008
5-43 .....JANUARY 31, 2008
5-44 .....JANUARY 31, 2008
5-45 .....JANUARY 31, 2008
5-46 .....JANUARY 31, 2008
5-47 .....JANUARY 31, 2008
5-48 .....JANUARY 31, 2008
5-49 .....JANUARY 31, 2008
5-50 .....JANUARY 31, 2008
5-51 .....JANUARY 31, 2008
5-52 .....JANUARY 31, 2008
5-53 .....JANUARY 31, 2008
5-54 .....JANUARY 31, 2008
5-55 .....JANUARY 31, 2008
5-56 .....JANUARY 31, 2008
5-57 .....JANUARY 31, 2008
5-58 .....JANUARY 31, 2008
5-59 .....JANUARY 31, 2008
5-60 .....JANUARY 31, 2008
5-61 .....JANUARY 31, 2008
5-62 .....JANUARY 31, 2008
5-63 .....JANUARY 31, 2008
5-64 .....JANUARY 31, 2008
5-65 .....JANUARY 31, 2008
5-66 .....JANUARY 31, 2008
5-68 .....JANUARY 31, 2008
5-69 .....JANUARY 31, 2008
5-70 .....JANUARY 31, 2008
5-71 .....JANUARY 31, 2008
5-72 .....JANUARY 31, 2008
5-73 .....JANUARY 31, 2008
5-74 .....JANUARY 31, 2008
5-75 .....JANUARY 31, 2008
5-76 .....JANUARY 31, 2008
5-77 .....JANUARY 31, 2008
5-78 .....JANUARY 31, 2008
5-79 .....JANUARY 31, 2008
5-80 .....JANUARY 31, 2008
5-81 .....JANUARY 31, 2008
5-82 .....JANUARY 31, 2008
5-84 .....JANUARY 31, 2008
5-85 .....MAY 31, 2015
5-86 .....MAY 31, 2015
5-87 .....OCTOBER 01, 2015
5-88 .....OCTOBER 01, 2015
5-89 .....OCTOBER 01, 2015
5-90 .....OCTOBER 01, 2015
5-91 .....OCTOBER 01, 2015
5-92 .....OCTOBER 01, 2015
5-93 .....OCTOBER 01, 2015
5-94 .....OCTOBER 01, 2015
5-95 .....OCTOBER 01, 2015
5-96 .....OCTOBER 01, 2015
5-97 .....OCTOBER 01, 2015
5-98 .....OCTOBER 01, 2015
5-99 .....OCTOBER 01, 2015
5-100 .....OCTOBER 01, 2015
5-101 .....OCTOBER 01, 2015
5-102 .....OCTOBER 01, 2015
5-103 .....OCTOBER 01, 2015
5-104 .....OCTOBER 01, 2015
5-105 .....OCTOBER 01, 2015
5-106 .....OCTOBER 01, 2015
5-107 .....OCTOBER 01, 2015
5-108 .....OCTOBER 01, 2015
5-109 .....OCTOBER 01, 2015
5-110.....OCTOBER 01, 2015
5-111.....OCTOBER 01, 2015
5-112.....OCTOBER 01, 2015
5-113.....OCTOBER 01, 2015
5-114.....OCTOBER 01, 2015
5-115.....OCTOBER 01, 2015
5-116.....OCTOBER 01, 2015
5-117.....OCTOBER 01, 2015
5-118.....OCTOBER 01, 2015
5-119.....OCTOBER 01, 2015
5-120 .....OCTOBER 01, 2015
5-121 .....OCTOBER 01, 2015
5-122 .....OCTOBER 01, 2015
5-123 .....OCTOBER 01, 2015
5-124 .....OCTOBER 01, 2015
5-125 .....OCTOBER 01, 2015
5-126 .....OCTOBER 01, 2015
5-127 .....OCTOBER 01, 2015
5-128 .....OCTOBER 01, 2015
5-129 .....OCTOBER 01, 2015
5-130 .....OCTOBER 01, 2015
5-131 .....OCTOBER 01, 2015
5-132 .....OCTOBER 01, 2015
5-133 .....OCTOBER 01, 2015
5-135 .....OCTOBER 01, 2015
5-136 .....OCTOBER 01, 2015
5-137 .....OCTOBER 01, 2015
5-138 .....OCTOBER 01, 2015
5-139 .....OCTOBER 01, 2015
5-140 .....OCTOBER 01, 2015
5-141 .....OCTOBER 01, 2015
5-142 .....OCTOBER 01, 2015
5-143 .....OCTOBER 01, 2015

5-144 .....OCTOBER 01, 2015
5-145 .....OCTOBER 01, 2015
5-146 .....OCTOBER 01, 2015
5-147 .....OCTOBER 01, 2015
5-148 .....OCTOBER 01, 2015
5-149 .....OCTOBER 01, 2015
5-150 .....OCTOBER 01, 2015
5-151 .....OCTOBER 01, 2015
5-152 .....OCTOBER 01, 2015
5-153 .....OCTOBER 01, 2015
5-154 .....OCTOBER 01, 2015
5-155 .....OCTOBER 01, 2015
5-156 .....OCTOBER 01, 2015
5-157 .....OCTOBER 01, 2015
5-158 .....OCTOBER 01, 2015
5-159 .....OCTOBER 01, 2015
5-160 .....OCTOBER 01, 2015
5-161 .....OCTOBER 01, 2015
5-162 .....OCTOBER 01, 2015
5-163 .....OCTOBER 01, 2015
5-164 .....OCTOBER 01, 2015
5-165 .....OCTOBER 01, 2015
5-166 .....OCTOBER 01, 2015
5-167 .....OCTOBER 01, 2015
5-168 .....OCTOBER 01, 2015
5-169 .....OCTOBER 01, 2015
5-170 .....OCTOBER 01, 2015
5-171 .....OCTOBER 01, 2015
5-172 .....OCTOBER 01, 2015
5-173 .....OCTOBER 01, 2015
5-174 .....OCTOBER 01, 2015
5-175 .....OCTOBER 01, 2015
5-176 .....OCTOBER 01, 2015
5-177 .....OCTOBER 01, 2015

CONFIGURATION

The NMC-Wollard, Inc. sales order number for this unit is _____

The serial number placard for this unit is located on the inside firewall. For your convenience, record the serial number (or range of numbers for multiple orders) below.

Serial Number(s)

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Both the sales order and serial numbers are required for proper identification by NMC-Wollard, Inc. whenever you call for service parts or other technical support.

The unit shipped with this operator's manual was equipped with the items indicated on the following available options listing.

☐	37844	Keyed Ignition
☐	38072	Pin & Eye Coupler
☐	38834	12,000 lb. Drawbar Pull
☐	39138	Coupler
☐	40040	Holland Coupler w/Release
☐	40041	14,000 lb. Counterweight Package
☐	41005	Amber Rotating Light w/Separate Switch
☐	41040	Shift Inhibitor
☐	41128	Shifter, Morse, Optional
☐	42314	Rear Body w/ Cargo Rail
☐		Cummins Engine
☐	42874	Tires, Rear Radial, Snow, Yokahama
☐	43565	Counterweights 1414, 37" Rear Height, Option
☐	43567	Frame Weldment, 37" Rear

☐	47268	Back-Up Alarm, Sealed Conn.
☐	48500	Option, Lt, Turn Signal, Sealed
☐	48685	Sound Suppression Pads
☐	52993	Option, Beacon, 140 W/Cab
☐	F101920	Mirror for Front Hitch
☐	NW24101E	Spotlight, Option without Cab
☐	NW24103E	Back-up Alarm
☐	NW24110E	Coupler, Hitch, Pintle Hook, Optional
☐	NW24626E	Coupler, Kit
☐	NW26290E	Light, Amber, Rotating without Pole
☐	NW26573E	Safety Shutdown
☐	NW26697E	Passenger Seat
☐	NW27323E	Pin and Eye Coupler Option
☐	NW33236	Fire Extinguisher

Parts breakdown for these items can be found by first looking up in numerical index.

EFFECTIVITY CODE

This manual is effective on units having the following serial numbers:

Effectivity Code	Serial Numbers
None	
A	3098-3106
B	3107+
C	07-C-3085
D	08-C-3098
E	09-C-3184
F	09-C-3202-SN+
G	12-C-3938+
H	15-C-4043
I	15-C-4044+

This Page Intentionally Blank

CHAPTER 1 GENERAL INFORMATION AND OPERATING INSTRUCTIONS

1. DESCRIPTION....1-1
1.1 PRODUCT SAFETY....1-1
1.2 SAFETY DECALS....1-2
1.3 GENERAL SAFETY PRECATIONS....1-3
1.4 EQUIPMENT DESCRIPTION....1-5
1.4.1 Intended Use....1-5
1.4.2 Description Of The Tractor....1-5
1.4.3 Frame....1-5
1.4.4 Engine....1-5
1.4.5 Cooling Sytem....1-5
1.4.6 Transmission....1-5
1.4.7 Torque Converter....1-6
1.4.8 Lubrication System....1-6
1.4.9 Fuel System....1-6
1.4.10 Governor....1-6
1.4.11 Air Cleaner....1-6
1.4.12 Exhaust System....1-6
1.4.13 Electrical System....1-7
1.4.14 Battery....1-7
1.4.15 Alternator....1-7
1.4.16 Current Regulator....1-7
1.4.17 Starter....1-7
1.4.18 Lights and Accessories....1-7
1.4.19 Instrument Panel....1-7
1.4.20 Rear Axle....1-9
1.4.21 Brake System....1-9
1.4.22 Steering System....1-10
2. OPERATION....2-1
2.1 PRE-OPERATION CHECK....2-1
2.2 UNDERSTAND THE CONTROLS AND INSTRUMENTS....2-1
2.2.1 Operator's Controls....2-1
2.2.2 Instruments....2-2
2.3 OPERATING THE ENGINE....2-2
2.3.1 Starting the Engine....2-2
2.3.2 Hard Starting....2-3
2.3.3 Charging the Battery....2-3
2.3.4 Slow Charging....2-4
2.3.5 Fast Charging....2-5
2.3.6 Jump Starting the Tractor....2-5
2.3.7 Engine Performance....2-6
2.3.8 Break-In....2-6
2.3.9 Adjusing Engine Speed....2-6
2.3.10 Altitude (diesel)....2-6

2.3.11 Engine Protection System....2-7
2.3.12 Engine Diagnostic Code Retrieval And Explanations....2-8
2.4 DRIVING THE TRACTOR....2-8
2.5 SHUTTING DOWN THE TRACTOR....2-9
2.6 EMERGENCY STOPPING....2-10
2.7 TOWING THE TRACTOR....2-10
3. SPECIFICATIONS AND CAPABILITIES....3-1
3.1 REAR-WHEEL DRIVE, TWO-WHEEL STEER, TOWING TRACTOR....3-1
3.2 ENGINE....3-2
3.3 TRANSMISSION, C-6....3-2
3.4 TRANSMISSION, ALLISON....3-3
3.5 BRAKES....3-3
3.6 ELECTRICAL....3-3
3.7 INSTRUMENTATION & CONTROLS....3-3
3.8 CORROSION PROOFING....3-3
3.9 STANDARD EQUIPMENT....3-3
3.10 OPTIONAL EQUIPMENT....3-4
3.11 DIMENSIONAL DATA....3-5
4. SHIPPING....4-1
4.1 TOWING THE TRACTOR....4-1
5. STORAGE....5-1
5.1 30 - 90 DAY STORAGE....5-1
5.2 STORAGE FOR 90 DAYS OR LONGER....5-1
5.3 REMOVING THE MACHINE FROM STORAGE....5-2

1. DESCRIPTION

1.1 PRODUCT SAFETY

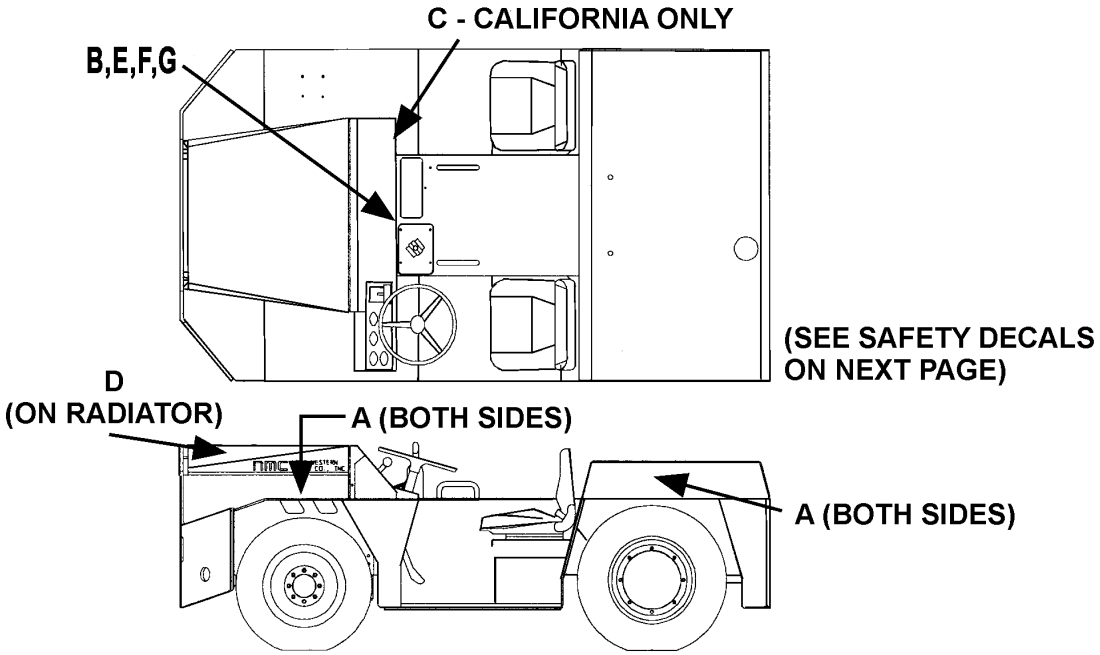
A brief description of signal words that may be used in this manual:

⚠ DANGER Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠WARNING Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠CAUTION Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE! Used to address practices not related to personal injury.



NOTE: Your tow tractor may have additional specific decals. See Decals/Placards in the Parts chapter.

⚠CAUTION For your protection, read all safety decals on the machine and in this manual. Replace any missing or illegible decals by ordering the part numbers shown on the safety decals page.

1.2 SAFETY DECALS

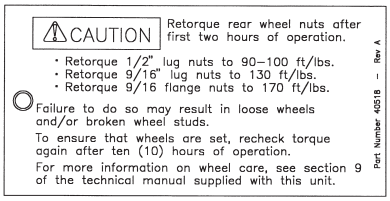
Safety Sign Care

- Keep Safety Signs Clean And Legible At All Times.
- Replace Safety Signs That Are Missing Or Have Become Illegible.
- Replaced Parts That Displayed A Safety Sign Should Also Display The Current Sign.
- Safety Signs Are Available From Your Dealer.

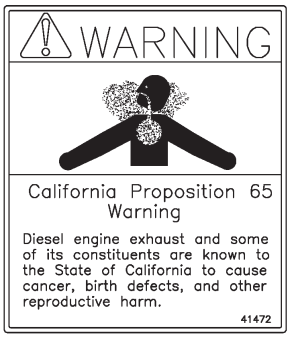
How To Install Safety Signs

- Be Sure That The Installation Area Is Clean And Dry.
- Remove The Smallest Portion Of The Split Backing Paper.
- Align The Decal Over The Specified Area And Carefully Press The Small Portion With The Exposed Adhesive Backing In Place.
- Remove Second Backing And Press Remaining Decal In Place

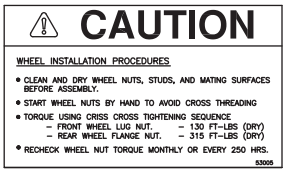
Decal A 42159



Decal A 40518

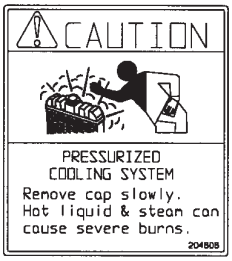


Decal C. 41472



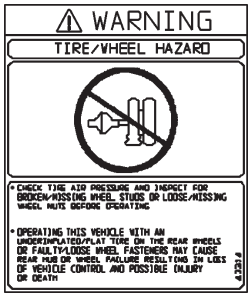
Decal A. 53005

Decal D. 1018145



Decal D. 204606

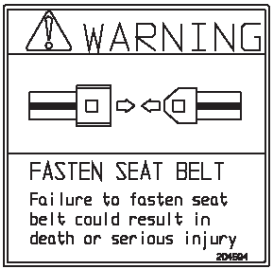
Decal B. NW017237



Decal B. 43314

DECAL G. NW035561

Decal B. 305732



Decal E. 204594

1.3 GENERAL SAFETY PRECATIONS

All personnel who will handle, install, use or service this machine are required to read and understand the recommended practices and safety precautions in this manual. If there is a question that can not be answered satisfactorily by a supervisor, contact the Customer Service Department at NMC-Wollard, Inc.

There are inherent hazards associated with the operation and servicing of this machine. For your protection please read and understand the following precautions before operating or servicing this machine.

⚠ DANGER

- Never approach overhead power lines or cables with any part of your machine. Contact with or getting close to any power lines or cables can result in electrocution.
- Fuel vapors create fire and explosion hazards. Do not allow any open flame, smoking materials or other potential ignition sources near fuel or the fuel system.

⚠WARNING

- Never operate without all covers, shields and guards in place. Body, hair or clothing can become entangled in exposed, moving parts and can cause serious injury or death.
- Keep hands, loose clothing, long hair and loose jewelry away from moving parts. You may become entangled in moving parts that can cause serious injury or death.
- Perform lockout/tagout procedures before adjusting, lubricating, cleaning or otherwise servicing. Failure to do so could result in unexpected startup and could cause serious injury or death.
- Use seat belts, approved headgear, eye protection and other protective equipment as required by federal, state, local or employer regulations.
- Do not operate or service this machine while under the influence of any drugs or alcohol.
- Do not indulge in stunt driving or other reckless operation.
- Limit travel speed. Ground conditions, congestion, slope, location of personnel and other factors increase risk of collision or injury to personnel.
- Operator must be present while this machine is in use.
- California Proposition 65 Warning: Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.
- To minimize risk of serious injury or death, follow these hydraulic servicing precautions:
    - Follow all necessary lockout/tagout procedures.

- Hydraulic systems have residual, stored pressure. Relieve all pressure from the hydraulic system before servicing.
- Allow fluid to cool before working on system.
- Hydraulic fluid escaping under pressure can have sufficient force to enter eyes and penetrate skin. If fluid gets in eyes or skin, flush with large quantities of water and seek medical attention.
- Wear eye protection when servicing hydraulic components or systems.
- Keep all hoses and connections in good serviceable condition. Check before start-up and periodically during operation.
- Do not investigate for leaks with hands. Use a large piece of cardboard.

• To minimize risk of fire or explosion, follow these battery servicing safety precautions:

- Sulfuric battery acid is poisonous. Avoid breathing battery fumes.
- Battery acid is strong enough to burn skin and cause blindness if splashed into the eyes. Protect eyes and skin from contact. In the event of contact with battery acid, immediately rinse in large amounts of water. Obtain medical care if the eyes are burned.
- Battery gas can explode. Keep sparks and flame away from battery.
- Never check battery charge by placing a metal object across the batteryposts. A spark will occur and cause possible explosion. Use a voltmeter or hydrometer.

- To avoid falls and injury, stand only on areas constructed with “gripstrut” or another skid resistant surface. Keep these surfaces in serviceable condition.
- Never make any alterations or modifications to this equipment including disabling safety devices or interlocks.

⚠CAUTION

- Before starting repairs which do not require battery power, always turn off the key switch, then disconnect the battery connector from the battery to prevent accidental short circuit.
- Be certain area is clear of people and other equipment before starting operation.
- Keep machine clear of foreign objects and clean of grease/oil and other lubricants.

Failure to heed could result in serious personal injury or death.

In addition to these general safety precautions you will find specific safety messages embedded in the Operating and Maintenance Chapters of this manual. Please review them for your protection.

1.4 EQUIPMENT DESCRIPTION

1.4.1 Intended Use

It is not to be used on public roads. Do not perform high speed maneuvers. The tractor is designed for towing aircraft but may also be used for towing other loads. Towing couplers may be attached to the front and/or rear of the tractor. Its drawbar pull capacity is 8,000 to 14,000 lbs.

1.4.2 Description Of The Tractor

The tractor operates like most any automotive vehicle powered by an internal combustion engine. The major difference between this tractor and an automobile having a similar size engine is the higher gear ratio in the rear axle. The higher gear ratio allows great pulling (towing) ability. Maximum forward speed is between 12 and 23 MPH, depending on axle gear ratio.

1.4.3 Frame

The frame is a welded-steel one-piece unit, cross-braced to prevent misalignment. Ballast weight is on the frame over the rear axle. An adjustable driver's seat is on the left side of the tractor. A seat may also be provided on the passenger side.

1.4.4 Engine

A diesel or gas engine powers the rear wheels through a transmission, drive shaft, and rear axle assembly. The engine is a valve-in-head, four-cycle, liquid-cooled, pressure-lubricated, with crankcase ventilation.

1.4.5 Cooling Sytem

The water pump on the front of the engine circulates coolant through the cylinder block, head, radiator, and oil cooler. A belt-driven cooling fan creates air flow through the radiator to lower the temperature of the coolant as it passes through the radiator. To allow higher water temperatures without boil-over, the system is pressurized. If system pressure exceeds 14 PSI (due to excessive heat), a valve in the radiator fill cap will open to release the pressure.

To maintain proper engine operating temperature, a thermostat regulates water flow from the engine to the radiator. When coolant reaches 182ºF, the thermostat begins to open, and is fully open at 192ºF.

1.4.6 Transmission

The automatic transmission and torque converter housing are together in an aluminum casting. Gear selection is done by using a conveniently located manual shift lever. On most tractors, the lever has five detent positions; R (reverse), N (neutral), D (drive), 2 (second), and 1 (low).

There is no P (Park) position. The Allison transmission has an additional forward gear.

The gear shift control is linked to the transmission by a cable. The transmission is cooled by hydraulic fluid circulated through a heat exchanger attached to the engine radiator.

1.4.7 Torque Converter

The torque converter is attached to the crankshaft with a flexible plate in between. Cooling is by circulating transmission fluid through the transmission heat exchanger.

1.4.8 Lubrication System

An oil pump draws oil through a strainer in the oil pan and circulates the oil through the engine. Before entering the engine, all the oil from the pump passes through the oil filter. Surplus oil drains back into the pan. Engine oil pressure is maintained by a spring-loaded pressure-relief valve in the oil pump.

The screw-on oil filter is mounted on the oil pump (or auxiliary cooler where provided). If the element becomes clogged, a relief valve in the filter permits oil to bypass the filter.

Engine oil flows through the oil cooler cavity to be cooled by coolant which flows through plates inside the oil cooler.

1.4.9 Fuel System

The fuel riser pump brings fuel from the fuel tank and delivers it to the injection pump.

1.4.10 Governor

A variable-speed governor limits fuel flow. The governor is preset by the manufacturer.

1.4.11 Air Cleaner

The air cleaner is a dry element type and is located on the right front fender. It prevents dirt and other foreign materials from entering the engine.

1.4.12 Exhaust System

The exhaust system consists of an exhaust manifold, exhaust pipe, muffler and tail pipe. The exhaust manifold has large radius curves which permit exhaust gasses to leave the cylinders with a minimum of back pressure and power loss. All parts of the exhaust system are well supported with clamps and hangers.

1.4.13 Electrical System

The tractor uses a conventional 12-volt electrical system to supply power for the lights, horn, starter motor, ignition, and instruments. A standard battery and alternator is used. Some tractors are built with an optional 24-volt system.

1.4.14 Battery

The battery is a conventional 12-volt type with a positive cable and a negative ground cable. The cables have protective boots at the battery end.

1.4.15 Alternator

Electrical power is supplied by a belt-driven alternator mounted on the right front of the engine. It produces three-phase alternating current and voltage, rectified to DC by a full-wave rectifier bridge using six diodes. The alternator does not require a cutout relay.

1.4.16 Current Regulator

The current regulator is part of the alternator assembly. It determines output current according to load, such as headlights, rear lights, etc.

1.4.17 Starter

The starter motor is a gear-reduction type mounted on the automatic transmission housing at the rear of the engine. The starter motor is used to turn the engine fast enough to start the engine.

1.4.18 Lights and Accessories

Two head lights are on the front of the tractor. The stop/tail lights and rear backup lights are in the rear body. The backup lights can also be used as work lights (there is a separate switch for this purpose, see figure 1).

1.4.19 Instrument Panel

All driver instruments are located on the instrument panel (see Figure 1):

1. Voltmeter	2. Engine coolant temperature gauge
3. Oil pressure gauge	4. Transmission oil temperature gauge
5. Fuel gauge	6. Ignition switch
7. Hour meter	8. Switch frame (non functional)
9. Blank (non functional)	10. Rear work light switch.
11. Head and tail light switch	12. Panel Plate (non functional)
13. Tachometer (optional)	14. Glow plug indicator
15. Engine warning indicator	16. Engine stop indicator
17. Blank (non functional)	18. Brake failure indicator

19. Transmission maintenance required indicator

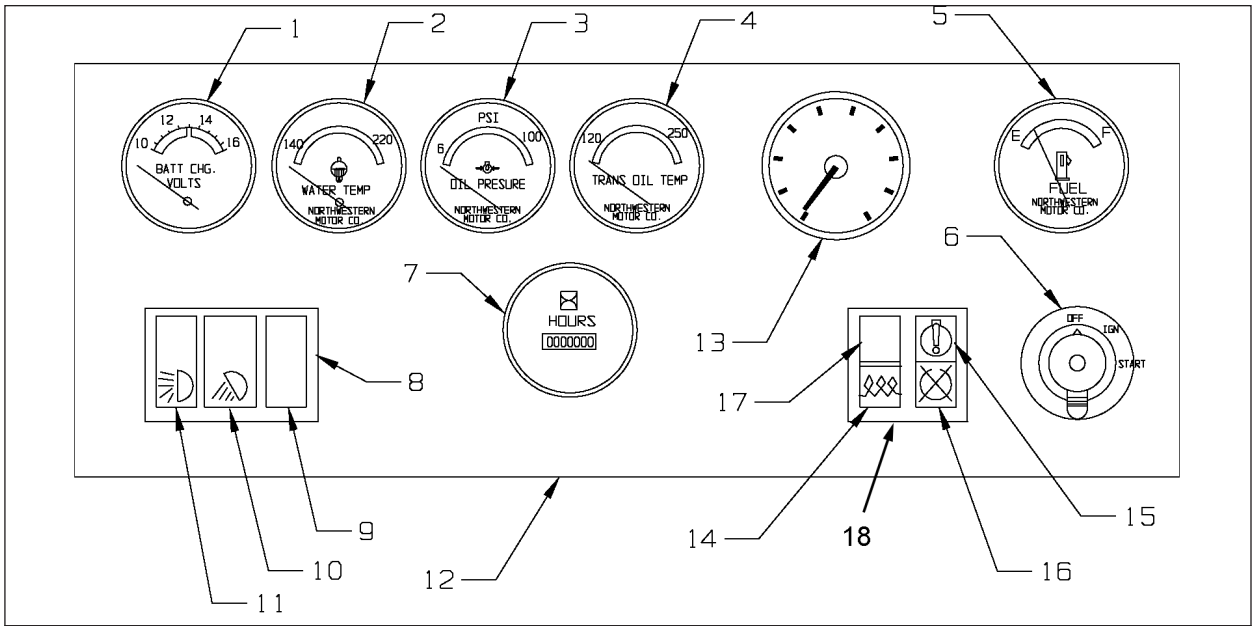


FIGURE 1. INSTRUMENT PANEL

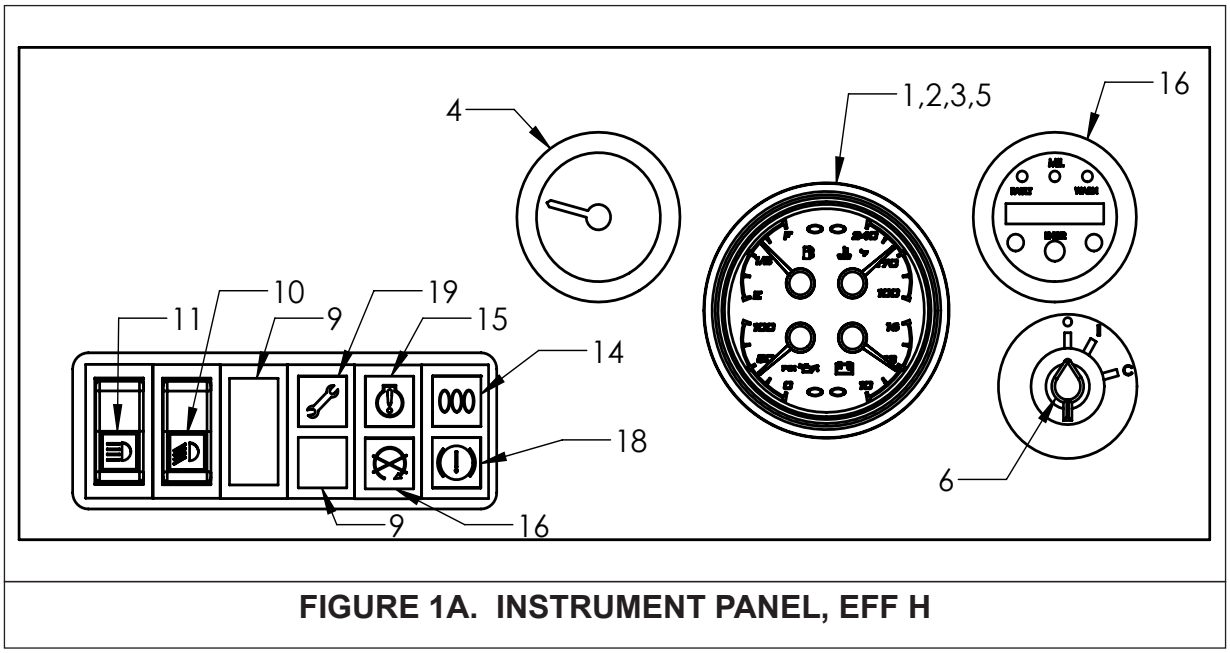


FIGURE 1A. INSTRUMENT PANEL, EFF H

1.4.20 Rear Axle

The rear axle assembly consists of the rear driving axle, differential, and a planetary hub (Rockwell) at each rear wheel. The rear axle assembly is coupled to the transmission by a drive shaft and two universal joints.

1.4.21 Brake System

Service Brake

Disc brakes are on the front and drum brakes on the rear.

The brake system consists of individual hydraulically actuated brake units on the front and rear wheels, a hydraulically assisted master cylinder, a power booster unit with accumulator, an equalizing valve, a check valve, and the necessary coated steel tubing and spiral-wrapped flex hoses.

The **front brakes** are non-adjustable, sliding caliper-type disc brakes.

The **rear brakes** are self-adjusting, expanding, shoe-type brakes. Adjustment occurs when the brake pedal is pushed.

The **master cylinder** has a brake fluid reservoir and a mechanically actuated piston that pressurizes the system when the brake pedal is applied.

The **power booster** unit provides a power assist to operate the dual master cylinder system.

The **equalizing valve** proportions the brake fluid between the front and rear wheel cylinders to provide braking force at each wheel.

The **check valve** in the rear brake circuit slows down the shoe (drum brakes) return, thus preventing the rear wheel cylinders form collapsing and introducing air into the system when the brakes are released.

Parking Brake

The parking brake lever is on the operator’s right. When pulled, the lever pulls a cable which applies pressure to brake bands which press against the parking brake drum or disk (attached to the transmission output shaft). The parking brake is completely mechanical.

1.4.22 Steering System

The steering gear is powered by a gimbal-mounted, double-acting hydraulic cylinder mounted on the front axle. The control unit is actuated directly by the steering wheel to control flow of hydraulic power to the steering cylinder.

Turning the steering wheel actuates the rotary valve in the power steering unit. As the valve opens, hydraulic oil travels into a metering motor within the power steering unit, then out from the motor, through the valve, and out to the retract side of the steering cylinder. Return oil from the extend side flows through the valve to the reservoir. Oil flowing through the metering motor causes it to turn, and as it turns, it moves a feedback linkage that returns the rotary valve to center and locks the steering cylinder in position. The metering motor therefore ensures that the steering cylinder is precisely controlled by the command received from the steering wheel.

In the event of a power failure, steering can be done manually by spinning the steering wheel. In this case, steering wheel movement turns the metering motor directly through the feedback linkage. The motor is then used as a pump to force oil into the cylinder, while drawing oil into the suction side (through check valve) from the return line.

2. OPERATION

⚠WARNING Read and understand the Owner's Manual before operating this machine. Failure to follow the safety instructions could result in serious injury or death.

⚠WARNING To prevent serious injury, all riders must ride in a passenger seat with the safety belt fastened.

2.1 PRE-OPERATION CHECK

Inspect the tractor for shipping damage. A thorough visual examination will usually reveal any damage that may have occurred in transit. Report damage to the proper authorities so that repairs and claims may be made.

The tractor is shipped with all fluids except fuel. As a precaution, however, check all fluid levels, brakes, electrical system, engine, steering, axles, and transmission as described in Chapter 2 and perform the prescribed lubrication.

2.2 UNDERSTAND THE CONTROLS AND INSTRUMENTS

Before driving the tractor, become familiar with all operating controls and instruments as described below. Then drive the tractor without a tow load until you can handle the vehicle properly.

2.2.1 Operator's Controls

1. The **ignition switch** is a rotary type and may be keyed or keyless. Dependent on engine model, it is typically marked OFF, IGN , and START. Depending on engine model, some switches may have an additional position for PREHEAT.
2. The **head and tail light** toggle switch controls the two sealed beam headlights and the tail lights.
3. The **rear work light** toggle switch controls the rear work lights.
4. The **gear shift lever** is to the right of the driver. It permits selection of forward or reverse gears and a neutral position.
5. The electronic **accelerator pedal** is to the right of the brake pedal and sends signals to the electronic control module (ECM) which controls the fuel injection pump.
6. The **park brake lever** is to the right of the driver. It must be pushed forward to disengage the park brake. Tension on the brake cable is changed by loosening or tightening the knob on top of the brake lever.
7. The **service brake pedal** is to the left of the accelerator pedal.

2.2.2 Instruments

1. The **engine hour meter** registers how many hours the engine has operated. It is sealed and can record 99999.9 hours before it returns to zero.
2. The **fuel gauge** shows the amount of fuel in the fuel tank. A sending unit in the tank is connected to the gauge. The gauge is marked E and F to indicate the relative quantity of fuel in the tank.
3. The **oil pressure gauge** indicates oil pressure only (not oil level). It is marked 6 to 100 with intermediate index marks.
4. The **voltmeter** registers voltage across the battery terminals. The needle should be above 12V. Stop the tractor and inspect the battery, cables, and alternator connections is below 12V.
5. The **coolant temperature gauge** shows the coolant temperature in the engine's water jacket. The gauge needle should rise when the engine is started, then level out at between 150 and 200 as the engine warms up.
6. The **transmission oil temperature gauge** shows the temperature of the transmission fluid. Normal operating temperature is in the 120F to 280F range.
7. **Fuses** for all electrical circuits (except the optional cab) are located under the instrument panel in fuse blocks.

2.3 OPERATING THE ENGINE

2.3.1 Starting the Engine

Several things affect engine start, such as battery power, starter motor performance, and oil viscosity.

1. Perform the daily service checks as detailed in Chapter 2.
2. Apply the parking brake.
3. Place the gear shift lever in N (neutral) position.
4. Turn ignition switch to IGN (on). For Cummins 2 engine indicator lights will cycle and then the glow plug indicator will light. See figure 1. Wait for the glow plug indicator to go off. Other engine models may have a separate ignition switch position for PREHEAT. Turn the switch to this position until the glow plug indicator goes off. Then crank the engine (START).
5. Crank starter for no more than 15 seconds.

6. If engine does not start after 15 seconds of cranking starter, turn the switch back to “IGN” for 10 seconds and again crank starter for no more than 15 seconds.

NOTICE! If the tractor still will not start, allow the starter motor to cool before repeating the procedure. This will prevent battery drain and starter motor overheating.

7. Allow engine to warm up for 2 minutes.
8. Observe instruments to be sure each is working. Do not operate engine if oil pressure fails to rise or if voltmeter does not show any charge.

2.3.2 Hard Starting

⚠WARNING DO NOT use ether as a starting aid. The engine is equipped with glow plugs or with an automatic preheater. Highly flammable ether and similar starting aids exposed to these devices can cause a fire or an explosion.
If the tractor fails to start in the normal way, the engine probably needs service.

NOTE: Because it has an automatic transmission, the tractor cannot be started by towing or pushing.

NOTICE! When using a battery booster, observe proper polarity or you may damage the electrical system and battery.

A worn out or badly sulfated battery will produce numerous problems that cannot be corrected until the battery is replaced.
Always check battery condition and connections before condemning other tractor systems.

2.3.3 Charging the Battery

⚠WARNING To minimize risk of fire or explosion when charging a battery:

- Keep sparks and flame away from battery to avoid battery gas explosion.
- If charging the battery while installed in the vehicle, disconnect the negative(black) battery cable and then the positive (red) cable before connecting the charger.
- With the charger unplugged and the switch OFF, connect the positive (red) charger cable to the positive (+) battery terminal and then the negative (black) charger cable to the negative (-) battery terminal.

- Set the charger for the correct voltage and charging rate. Then plug the charger in and turn the switch ON.
- When charging is completed, turn the charger OFF, unplug it and then disconnect negative and then positive cables. Reconnect the positive and then the negative battery cables.

2.3.4 Slow Charging

Slow charging passes a relatively small amount (5-7 amps) of current through a battery for a long period (14-16 hours or longer).

Slow charging is preferred to fast charging if time is available, but a sound battery will not be damaged by proper fast charging. Older batteries respond better to slow charging.

Before charging, clean and fill the battery to recommended level. If battery is to remain in the loader, remove cables to prevent damage to machine electronics.

NOTICE! Watch battery temperature during charging. If it exceeds 125°F, lower the charge rate. Temperatures in excess of 125°F will cause serious battery damage.

Remove battery from charger when charged because overcharging is harmful.

When installing the battery, be sure you connect the ground strap to the negative battery post.

2.3.5 Fast Charging

Fast charging sends a relatively heavy initial current (50-60 amps) through the battery. This will impart a fairly good charge in one to two hours.

As battery begins to take on a charge, charger current will automatically decrease.

A fast charger will not bring a battery up to full charge. When the battery is about 3/4 charged, use a slow rate to bring battery up to full charge.

If battery does not respond to a fast charge, try the slow charge method.

2.3.6 Jump Starting the Tractor

Cold weather reduces battery efficiency. For example, at 32F, battery capacity is reduced to 65%, and at 0F, capacity is reduced to 40%.

A 12-volt booster battery can be connected in parallel with battery on the tractor to aid in cold weather starting. Heavy duty jumper cables will supply significantly more current than light duty cables.

⚠WARNING To minimize risk of fire or explosion when jump starting a vehicle:

- Keep sparks and flame away from battery to avoid battery gas explosion.
- Do not allow the booster and dead vehicles to touch. Set park brakes and turn both vehicle ignitions OFF.
- Connect one end of the positive (red) booster cable to the positive (+) terminal on the dead battery and then the other end of this red cable to the positive (+) terminal of the booster vehicle battery.
- Connect the end of the negative (black) booster cable to the negative (-) terminal of the booster vehicle battery and the other end of this black cable to a unpainted bolt or bracket on the dead vehicle (good ground) located as far as possible from the dead battery to minimize the possibility of igniting any hydrogen gas.
- Start the booster vehicle and let it idle for several minutes, then start the dead vehicle. If the vehicle fails to start in a normal manner, discontinue jump starting and service the vehicle for other problems.
- Once the dead vehicle is running, disconnect the booster cables in the reverse order they were installed.
- Never allow booster cable ends to touch while connected to a battery.

2.3.7 Engine Performance

To get the best performance and the longest life from your engine, you must ensure that maintenance operations are done as indicated in Chapter 2. If the engine works in a very dusty environment or other adverse conditions, maintenance will have to be done more frequently. Replace filter elements and lubricating oil regularly to remove corrosive materials and compounds.

Ensure that adjustments and repairs are done by persons who have had the correct training.

The left and right sides of the engine are as when seated in the operator's seat.

Read the "Safety Precautions" in section 1 of this chapter.

2.3.8 Break-In

Gradual new-engine break-in is not recommended because prolonged operation at light loads during the early life of the engine can cause excessive carbon build-up.

As soon as the engine is put into service and coolant temperature has reached at least 140F, you can apply maximum load to the engine.

Do not operate the engine at high speeds without a load and do not overload the engine.

2.3.9 Adjusing Engine Speed

Do not change the idle or maximum speed settings because this can damage the engine or transmission. Adjust speed only to the manufacturer's specifications. Engine warranty can be affected if the seals on the fuel injection pump (diesel) are broken during the warranty period by a person not approved by Northwestern Motor Co.

2.3.10 Altitude (diesel)

If the engine is to run at an altitude above 2,000 ft., fuel delivery can be adjusted to reduce fuel consumption and smoke. NMC-Wollard, Inc. can advise as to fuel reduction necessary if details of engine application and ambient conditions are given. Changes to settings of the fuel injection pump must be made by authorized personnel.

2.3.11 Engine Protection System

1. The engine is equipped with an engine protection system. The system monitors critical engine temperatures and pressures and will log diagnostic faults when an over or under normal operation condition occurs.
2. If an out-of-range condition exists, the operator will be alerted by the in-cab yellow WARNING lamp. See figure 1. It is not necessary to stop operation if the warning comes on, but it is a warning to change operation, such as reducing the load to correct the situation or to get the tractor to the shop for maintenance if the cause of the warning is not determinable. Check the instrument panel gauges for a possible indication of the problem.
3. If the fault continues to worsen, the warning lamp will begin to blink. If the fault becomes critical, the red STOP lamp is illuminated, see figure 1 and the driver must pull to the side of the work area when it is safe to do so, and shut down to reduce the possibility of engine damage . If not shut down by the driver, the engine will automatically shut down in 30 seconds. NOTE: Engine power and speed will be gradually reduced depending on the level of severity of the observed condition.
4. Engine Protection Shutdown Override: In the event of an engine protection shutdown, the driver can over ride it by turning the ignition off, shifting to neutral and applying the parking brake. Then the engine can be restarted for an additional 30 seconds of operation.
5. Electronic Control Module (ECM) features and engine protection devices are also described in Section 1 of the Cummins manual.
6. If you encounter engine operation problems or malfunctions, see Section TS-Trouble Shooting of that manual.

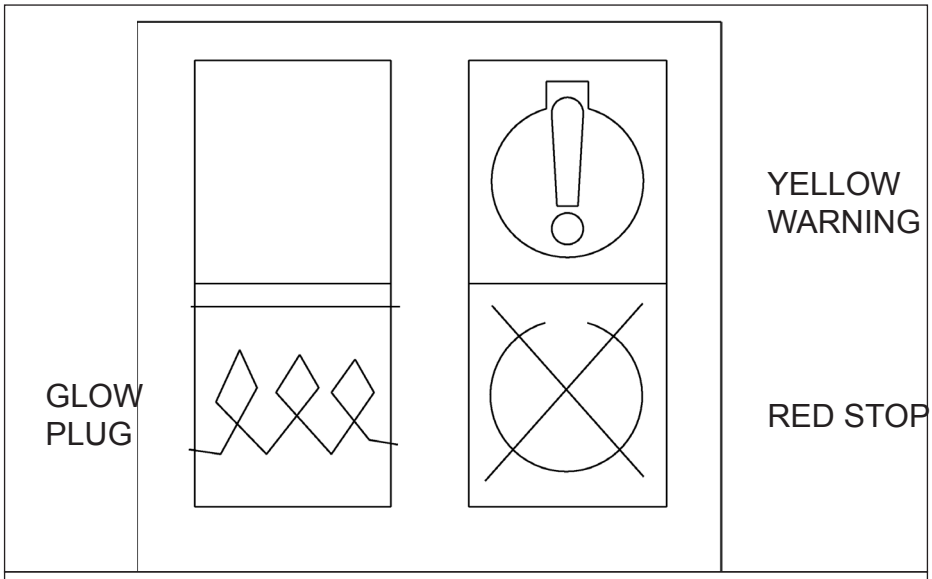


FIGURE 1. ENGINE INDICATOR LIGHTS, CUMMINS (NOT USED FOR EFF. H)

2.3.12 Engine Diagnostic Code Retrieval And Explanations

Turn the ignition switch to the ON position but do not start the engine. At any time, cycle to accelerator pedal to full throttle and back to the idle position, three times within 5 seconds.

If no active fault codes are recorded, both Engine WARNING (yellow) and Engine STOP (red) lights will come on and stay on.
If active fault codes are recorded, the fault code will flash in the following sequence:

1. The WARNING (yellow) lamp will come on for 2 seconds and then go off
2. There will be a 2 second pause, then each digit of the 3 or 4-digit recorded fault code will flash in the STOP (red) lamp. There will be a 2 second pause between each digit and also at the end of the STOP (red) lamp sequence. Count the number of flashes in each digit to determine the number of the fault code
3. The WARNING (yellow) lamp will come on again for 2 seconds and then go off
4. The 3 or 4-digit fault code will repeat on the STOP (red) lamp

The lights flash each fault code out two times before advancing to the next fault code. If only one active fault code is recorded, the control system will continuously display the same fault code. To advance to the next fault code, you can also cycle the accelerator pedal instead of waiting.

The explanation and correction of the fault codes can be found in “Cummins Diagnostic Codes,” Chapter 5.

2.4 DRIVING THE TRACTOR

When the engine is warmed up, the tractor is ready for work. Use lights as required.
1. Release parking brake and apply foot brake.
2. Place gear shift lever in proper speed range:

STANDARD	OPTIONAL MORSE
D – No load or light load	F - Forward
2 – Medium load	N - Neutral
1 – Heavy load or inclines	R - Reverse
R – Reverse	

3. Release the foot brake and depress the accelerator pedal slowly and evenly. As the tractor starts to move and increase speed, the transmission will up shift automatically, unless you are in “1” or ”R”.

NOTICE! Do not shift from a forward gear (D, 2, or 1) to reverse (R) or from reverse to a forward gear unless the tractor is at a complete stop. Failure to do this will damage the transmission and void the warranty.

4. When towing, allow tractor to decelerate by releasing accelerator pedal before applying foot brake. The transmission will downshift automatically.

⚠WARNING Secure all hitch pins and pintle hitches with a safety retainer pin to prevent accidental unhooking, which can result in a run away load.

5. When driving or towing, avoid the tendency to oversteer and turn too sharply. Allow enough clearance for the towed load.

⚠WARNING Limit travel speed. Ground conditions, congestion, slope, location of personnel and other factors increase risk of collision or injury to personnel

⚠CAUTION Always approach turns slowly and carefully. When approaching blind corners or steering around obstructions, reduce speed and proceed cautiously.

⚠CAUTION Be extremely alert during hazardous operating conditions. Operating conditions can change as work progresses and as weather changes.

2.5 SHUTTING DOWN THE TRACTOR

1. Bring tractor to a safe and complete stop and set parking brake.
2. Place gear shift lever in neutral (N).

⚠WARNING Be sure that the shift control lever is secure in the neutral detent and the parking brake is applied to prevent unintended movement that could result in serious injury or death.

3. Turn off all lights.
4. Turn off ignition switch.

⚠WARNING Always set the parking brake when parking the machine. The transmission does not have an internal parking lock and failure to apply the parking brake could allow unexpected movement resulting in crushing injury or death.

2.6 EMERGENCY STOPPING

If the brakes fail, follow this procedure:

1. Downshift to next lower gear, unless already in “1.”
2. Use parking brake to stop tractor by pulling on parking brake lever.

2.7 TOWING THE TRACTOR

NOTICE! Tow the tractor with the rear end picked up or with the drive shaft disconnected. Failure to do so will damage the transmission.

IN AN EMERGENCY, the tractor may be towed without lifting the wheels or disconnecting the drive shaft IF:

- Engine is running AND transmission is in neutral.
- Towing distance must be LESS THAN 1 MILE and travel speed LESS THAN 5 M.P.H.

NOTICE: Failure to follow these instructions will cause transmission damage and will void the warranty.

3. SPECIFICATIONS AND CAPABILITIES

3.1 REAR-WHEEL DRIVE, TWO-WHEEL STEER, TOWING TRACTOR

The following specifications describe the standard configuration. Various options may alter these specifications.

Drawbar Pull (Measured 12") ..... 8,000 lbs./3,630 kg.
*Est. Gross Weight ..... 10,000 lbs./4,450 kg.
Drawbar Pull (Measured 12") ..... 10,000 lbs./4,450 kg.
*Est. Gross Weight ..... 12,000 lbs./5,450 kg.
Drawbar Pull (Measured 12") ..... 12,000 lbs./5,450 kg.
*Est. Gross Weight ..... 14,000 lbs./6,360 kg.
Drawbar Pull (Measured 12") ..... 14,000 lbs./6,360 kg.
*Est. Gross Weight ..... 16,360 lbs./7,420 kg.
Ground Clearance .....5.5"
Turning Radius .....190"
Fuel Tank:
Capacity.....20 Gallons
Material: .....18 Gauge Steel
Cooling System:
Capacity.....24 qts.
Pressure 14psi
Rear Axle:
Make.....Rockwell or Newage
Model.....Rockwell TA268, Newage 612
Lubricant .....APIGL-5 lubricant SAE 80W-90 or 85W-140
Capacity Rockwell ..... 4 Pints wheel end, 9.5 Pints housing bowl
Capacity Newage .....24.3 Pints
Tires:
Front: ..... 8.00 R 16.5
Rear: ..... 8.00 R 17.5 or 215/75R17.5
Alternator .....66 amps
Battery ..... 530 CCA (625CCA diesel)
Fluids:
Engine Oil .....15W-40 CD/SF
Trans. Fluid.....ATFDexron III, See chapter 5 for Allison 2500
Power Steering .....ATFDexron III
Coolant .....50-50 Water/Ethylene Glycol-Base, 18 qts.
Brake Fluid DOT-3
Fuel (for diesel models) ..... JP5-DF1-DF2, 20.7 gal. (78.3L)

NOTE: * Gross vehicle weight may vary by ±5% and is dependent on optional equipment installed.

3.2 ENGINE

MODEL.....Cummins QSB4.5
Displacement.....4.5 Liters
Number of Cylinders.....4
Cycle ..... 4 Stroke
Horsepower .....See engine dataplate
Dry Weight..... 825 lbs.
Aspiration .....turbo charge

MODEL.....Cummins QSB3.3
Displacemant.....3.3 Liters
Number of Cylinders.....4
Cycle ..... 4 Stroke
Horspower .....See engine dataplate
Dry Weight..... 585 lbs.
Aspiration .....turbo charged

MODEL..... Perkins 1104 C&D
Displacement.....4.4 Liters
Number of Cylinders.....4
Cycle ..... 4 Stroke
Combustion System ..... Direct Injection
Horsepower .....See engine dataplate
Dry Weight..... 627 lbs.
Aspiration .....turbo charge

3.3 TRANSMISSION, C-6

Make/Model..... Ford C6
Type.....Automatic w/Torque Converter
Oil Capacity .....11.75 Qts.
Oil Type .....ATF Dexron III
Gear Ratio:
1-Low.....2.46:1
2-Second 1.46:1
D-Drive 1.00:1
R-Reverse 2.18:1
N-Neutral .....

3.4 TRANSMISSION, ALLISON

Make/Model.....AT545
Make/Model.....2500
For AT545 see below, for 2500 see chapter 5
Type.....Automatic w/Torque Converter
Oil Capacity (for service).....9.0 Qts.
Oil Capacity (for rebuild).....15.0 Qts.
Oil Type .....ATF Dexron III
Gear Ratio:
1-Low.....3.45:1
2-Second 2.25:1
D-Drive 1.41:1
R-Reverse 5.02:1
N-Neutral .....

3.5 BRAKES

Dual master cylinder serves front and rear wheels independently. Front and rear brake systems balanced to give maximum control under varied load conditions. Rear - shoe type; Front - 13” vented disc with automotive caliper.

3.6 ELECTRICAL

550/680 amp hour battery and 66 amp alternator with internal regulator. Has starter lock out switch (prevents starter and ring gear damage when engine is running). Tractor starts only in neutral.

3.7 INSTRUMENTATION & CONTROLS

Gauges include: voltmeter, coolant temperature, engine oil pressure, fuel level, transmission oil temperature, engine hour meter. Lighted rocker switches for dual headlights, dual tail lights and rear work lights. Back-up lights operate when transmission is in reverse. Cable operated shift control lever has 1st, 2nd, Drive, Neutral and Reverse positions. Optional morse shifter has reverse, neutral and forward. Operator adjustable Orscheln-type parking brake lever. Shift control and parking brake lever mounted for easy right hand operation. Foot pedals for accelerator and service brakes. Vinyl seat is adjustable 4” forward/backward.

3.8 CORROSION PROOFING

All frame and body surfaces are shot blasted, double primed and painted with weather resistant paint. Standard bolts are SAE grade 5, zinc-phosphate coated to resist corrosion.

3.9 STANDARD EQUIPMENT

Automatic transmission
Gauges: full instrumentation

Lights: 2 head, tail and stop
Paint: white or safety yellow
Power-assisted 4-wheel brakes
Power steering
Seat belts
Spark arresting muffler
Dual wheels

3.10 OPTIONAL EQUIPMENT

Air conditioner
Back-up alarm
Cab assembly - all weather
CNG fuel - consult factory
Econocab
Heater/defroster
Hi-low beam headlights
Hydrostatic steering
Keyed ignition
Mirror kit
Morse R-N-F shifter
Overhead guard
Passenger seat
Rear coupler
Rear spring suspension
Rotating beacon, amber
Safety shutdown
Single rear wheels
Snowplow
Speedometer - mph & km/h
Spot light
Suspension seat
Turn signals
U.L. Rating - consult factory

3.11 DIMENSIONAL DATA

Lifts and jacks may be used on any point on the bottom edge of frame at the front and rear of tractor as illustrated.

⚠ DANGER Never work beneath a machine that is not raised and set securely on blocks or jack stands, front and back, having capacity for the weight of the machine. If the machine falls on you, serious injury or death will occur.

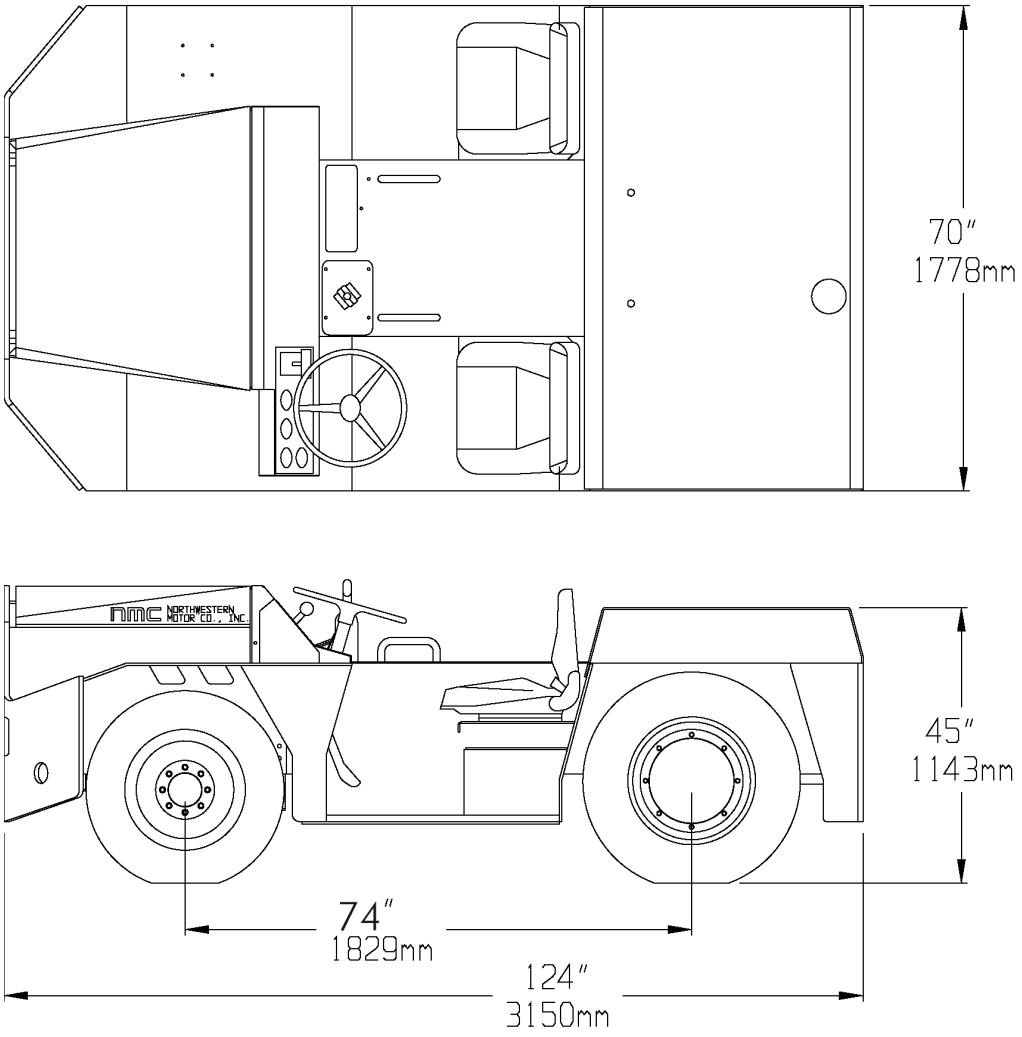


FIGURE 1. TRACTOR DIMENSIONS, APPROXIMATE

This Page Intentionally Blank

4. SHIPPING

4.1 TOWING THE TRACTOR

For tie down locations see Figure 1.

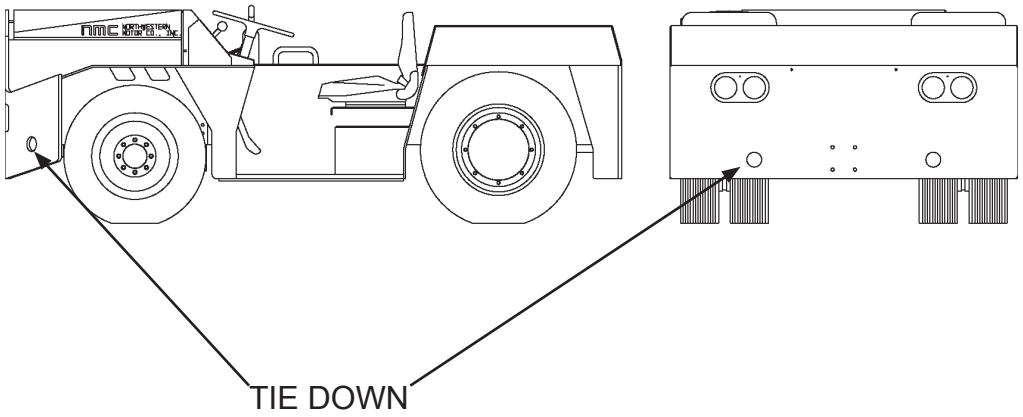


FIGURE 1. TIE DOWN LOCATIONS

This Page Intentionally Blank

5. STORAGE

If you need to keep your machine idle for more than 30 days, or you are putting it into indefinite storage, first prepare it according to the following procedures:

NOTICE! The following steps will help minimize corrosion and deterioration while your machine is in storage

5.1 30 - 90 DAY STORAGE

1. Perform any necessary repairs.
2. Clean machine carefully. Wash off mud and dirt. Wipe off excess oil and grease. Remove debris from radiator cooling fins.
3. Select a dry and protected storage location. Position machine so as to permit access to all components.
4. Start engine and run it until it reaches operating temperature. Shut off engine. Drain crankcase, change oil filter, and refill crankcase with recommended oil.
5. Disconnect battery. Put battery into safe storage in a fully charged condition. Protect battery terminals against corrosion using a spray on external engine preservative or petroleum jelly.
6. Seal all engine openings.
7. Apply a thin coat of grease to exposed metal surfaces.
8. Refinish any scratched or scuffed paint surfaces.
9. If the machine must be stored outdoors, cover with a heavy canvas or waterproof material. Secure cover with a strong waterproof tape so it will not blow away.

5.2 STORAGE FOR 90 DAYS OR LONGER

The recommendations below are designed to prevent damage to the engine when it is withdrawn from service for a prolonged period. Perform in addition to 30-90 day procedure.

1. Clean engine breather pipe and seal end of pipe.
2. Drain fuel system and fill with clean fuel. The fuel must be drained and filters discarded at end of storage period. If you add a fuel preservative to the fuel, the fuel and filters may not need to be discarded at the end of the storage period.
3. Operate engine until it is warm. Stop engine and fix any fuel, oil, or air leaks.
4. Drain the cooling system. In order to protect the cooling system against corrosion, fill with a coolant that has a corrosion inhibitor. If protection against frost is necessary, use an antifreeze mixture.
5. Operate engine for a short period in order to circulate lubricating oil and coolant in engine.

6. Remove injectors and spray an internal engine preservative into each cylinder bore. If this is not available, clean engine oil will offer some protection. Two to three ounces of oil should be placed in each cylinder.
7. Slowly turn crankshaft one revolution and then fit injectors with new seat washers and new dust seals.
8. Remove pipes installed between air filter and intake manifold. Spray preservative into intake manifold. Seal manifold with waterproof tape.
9. Remove exhaust pipe. Spray preservative into exhaust manifold. Seal manifold with waterproof tape.
10. Remove oil filler cap. Spray preservative into oil filler hole to protect rocker shaft assembly. Install filler cap.
11. Seal vent pipe of fuel tank or filler cap with waterproof tape.
12. Remove drive belts and put into storage.
13. Spray engine with external engine preservative to prevent corrosion. Do not spray area inside alternator cooling fan.

If engine protection is done correctly, corrosion damage normally will not occur. NMC-WOLLARD, Inc. is not responsible for corrosion damage which may occur when a vehicle is in storage after a period in service.

Follow instructions in your engine manual.

5.3 REMOVING THE MACHINE FROM STORAGE

1. Remove protective cover and unseal engine openings.
2. Install battery and connect cables. (Negative terminal grounded.)
3. Wipe excess grease from machine surfaces.
4. Inspect hydraulic seals at cylinders for leaks.

NOTICE! If the unit has been stored for more than 120 days, you can expect some deterioration of the hydraulic seals. Replace defective seals before operating machine

5. Install all parts that were removed when vehicle was being prepared for storage.
6. Perform “Daily” checks as described in Maintenance, Chapter 2.
7. After the hydraulic system has warmed up to operating temperature, remove hydraulic tank fill cap and check appearance of hydraulic fluid. A milky appearance indicates that there is water in the system and that the system should be drained and re-filled with fresh oil.

CHAPTER 2 MAINTENANCE

1. SERVICING....1-1
1.1 CHAPTER CONTENTS....1-1
1.2 PERIODIC MAINTENANCE AND INSPECTION....1-3
1.2.1 Preventative Maintenance Schedule....1-4
1.3 DAILY SERVICE....1-6
1.3.1 Coolant Level....1-6
1.3.2 Coolant Leaks....1-6
1.3.3 Engine Oil Level....1-6
1.3.4 Empty Air Cleaner Dust Cup (If Conditions are Extremely Dusty)....1-6
1.3.5 Inspect for Transmission Oil Leaks....1-7
1.3.6 Lights....1-7
1.3.7 Fuel Leaks....1-7
1.3.8 Brake Pedal Free Play....1-7
1.3.9 Tire Condition and Pressure....1-7
1.3.10 Rear Axle Oil Leaks....1-8
1.3.11 Water Separator....1-8
1.3.12 Cummins Diesels - Specific Procedures....1-8
1.4 EVERY 250 OPERATING HOURS OR 3 MONTHS....1-8
1.4.1 Transmission Oil....1-8
1.4.2 Lubricate Grease Fittings....1-9
1.4.3 Inspect Drive Shaft, Steering, Suspension, and Front Axle Components....1-9
1.4.4 Inspect Brakes....1-10
1.4.5 Inspect Muffler, Exhaust, and Tail Pipe....1-10
1.4.6 Instructions For Cleaning Spark Arrester/Exhaust System....1-11
1.4.7 Batteries....1-11
1.4.8 A Sound Battery Is A Must....1-13
1.4.9 Voltmeter....1-13
1.4.10 Alternator....1-14
1.4.11 Change Engine Oil and Oil Filter - Diesel....1-14
1.4.12 Check Air Cleaner Restriction....1-14
1.4.13 Change Fuel Filter....1-14
1.4.14 Replace Air Cleaner Element....1-15
1.5 EVERY 500 OPERATING HOURS OR 6 MONTHS....1-15
1.5.1 Belt Tension And Condition....1-15
1.5.2 Installing or Adjusting Belts....1-15
1.5.3 Rear Axle Oil Level Check....1-15
1.5.4 Inspect Linings, Pads, Calipers, Wheel Cylinders, etc....1-17
1.5.5 Inspect Wiring, Battery, and Cables....1-19
1.6 EVERY 1000 HOURS OR 1 YEAR....1-20
1.6.1 Toe-In Adjustment....1-20

1.6.2 Wheel Bearings 1-20
1.6.3 Transmission - C-6....1-22
1.6.4 Transmission - Allison 1-30
1.7 SHIFT INHIBITOR ADJUSTMENT 1-40
1.8 EVERY 2500 OPERATING HOURS OR 2 YEARS....1-41
1.8.1 Adjust Valves 1-41
1.8.2 Inspect Injectors - Diesels....1-41
1.8.3 Change Coolant....1-41
1.9 CHANGING AXLE OIL....1-41
1.10 BLEEDING THE BRAKES....1-42
1.11 BLEEDING THE POWER STEERING SYSTEM 1-44
1.12 BRAKE PEDAL ADJUSTMENT 1-44
1.13 THROTTLE PEDAL RECALIBRATION REQ. FOR CUMMINS ENG.....1-45
2. TROUBLE SHOOTING....2-1
2.1 STEERING SYSTEM OVERVIEW - USED WITH AT545 TRANSMISSION.2-1
2.2 SYSTEM PRESSURE TEST....2-2
2.3 DIAGNOSTICS, STEERING AND BRAKES 2-3
2.3.1 Power System Test 2-3
2.3.2 Hydraulic Leak Test 2-3
2.4 BRAKE SYSTEM TROUBLE SHOOTING CHART 2-5
2.4.1 Equalizer Valve 2-11
2.4.2 Check Valve....2-11
2.4.3 Stoplight Switch 2-11
2.4.4 Brake Lines And Fittings....2-12
2.5 ELECTRICAL AND HYDRAULIC SCHEMATICS AND DIAGRAMS 2-13
3. REMOVAL AND INSTALLATION 3-1
3.1 AXLE 3-1
3.1.1 Disassembly of Rockwell Differential and Drive Pinion 3-1
3.1.2 Disassembly of Wheel End....3-2
3.1.3 Cleaning and Inspection 3-3
3.1.4 Repair 3-4
3.1.5 Reassembly of Wheel End 3-4
3.1.6 Reassembly of Drive Pinion....3-5
3.1.7 Reassembly of Differential....3-6
3.1.8 Installation of Rear Axle Without Springs....3-6
3.2 DRIVE SHAFT....3-7
3.2.1 Removal....3-7
3.2.2 Installation....3-7
3.3 REAR SUSPENSION 3-8
3.3.1 Removal....3-8
3.3.2 Installation....3-8
3.4 RADIATOR 3-8
3.4.1 Removal....3-8
3.4.2 Installation....3-8
3.5 ENGINE/TRANSMISSION REMOVAL 3-9
3.6 TRANSMISSION AND TORQUE CONVERTER REMOVAL 3-10

3.7 TRANSMISSION AND TORQUE CONVERTER INSTALLATION....3-13
3.8 FUEL TANK....3-15
3.8.1 Removal and Disassembly....3-15
3.8.2 Cleaning and Inspection....3-15
3.8.3 Repair or Replacement....3-15
3.8.4 Reassembly....3-16
3.8.5 Installation....3-16
3.9 STEERING GEAR ASSEMBLY....3-16
3.9.1 Removal....3-16
3.9.2 Installation....3-17
3.10 POWER STEERING PUMP....3-17
3.10.1 Removal....3-17
3.10.2 Installation....3-18
3.11 STEERING COLUMN ASSEMBLY....3-18
3.11.1 Removal....3-18
3.11.2 Installation....3-18
3.12 FRONT SUSPENSION....3-19
3.12.1 Removing the Leaf Springs....3-19
3.12.2 Cleaning and Inspection....3-19
3.12.3 Installation....3-19
3.13 FRONT AXLE ASSEMBLY....3-20
3.13.1 Removal....3-20
3.13.2 Disassembly....3-20
3.13.3 Assembly....3-21
3.13.4 Installation....3-22
3.13.5 Setting Stops On New Axle....3-23
3.13.6 Setting Pitman Arm Stops....3-24
3.14 DRAG LINK....3-24
3.14.1 Removal....3-24
3.14.2 Installation....3-24
3.15 ALTERNATOR....3-24
4. REPAIRS....4-1
4.1 UNIVERSAL JOINT REPAIR....4-1
4.2 WHEELS AND TIRES....4-2
4.2.1 Removal....4-3
4.2.2 Disassembly....4-3
4.2.3 Inspection and Cleaning....4-4
4.2.4 Repair....4-4
4.2.5 Assembly....4-4
4.2.6 Installation....4-5
4.3 REAR SUSPENSION....4-7
4.3.1 Removal....4-7
4.3.2 Installation....4-7
4.4 ROCKWELL REAR AXLE WHEEL HUB SEAL REPLACEMENT....4-7

This Page Intentionally Blank

1. SERVICING

⚠WARNING Perform lockout/tagout procedures before adjusting, lubricating, cleaning or otherwise servicing. Failure to do so could result in unexpected startup and could result in injury or death.

⚠CAUTION Keep maintenance area clean and dry. Oily and wet spots are slippery, greasy rags are a fire hazard, and wet spots are dangerous around electrical equipment.

1.1 CHAPTER CONTENTS

This chapter provides a preventive maintenance schedule with the necessary procedures. Tools required are those normally available in any organizational tool shop.

NOTE: Consult the Manufacturers Information in Chapter 5 in this manual.

Also, guidelines for repairing the tractor are located in Chapter 3.

Before attempting to repair the tractor, be familiar with the information on these pages.

BOLT TIGHTENING DATA

The following data is excerpted from SAE Report J1701, March, 1999. The complete report is available from SAE at www.sae.org. It contains detailed information about variables for torquemanagement to achieve correct fastener joint tightening. This is an advisory guide and responsibility for its application lies with the user. Individual application discretion is recommended.

INCH TIGHTENING TORQUE, FT-LB						
Bolt Size	Grade 2 Dry	Grade2 Lubed	Grade 5 Dry	Grade 5 Lubed	Grade 8 Dry	Grade 8 Lubed
0.250-28	7	5	10	8	14	11
0.250-20	6	5	9	7	12	9
0.3125-24	13	10	20	15	28	21
0.3125-18	12	9	18	14	25	19
0.375-24	23	17	35	27	50	38
0.375-16	20	15	31	24	44	33
0.4375-20	36	27	56	42	78	59
0.4375-14	32	24	50	38	70	53
0.500-20	55	42	85	64	120	90
0.500-13	49	37	76	32	107	80
0.5625-18	78	59	121	91	171	128
0.5625-12	70	53	109	82	154	115
0.625-18	110	82	170	127	240	180
0.625-11	97	73	150	113	212	159
0.750-16	192	144	297	223	420	315
0.750-10	172	129	269	201	376	282
1.000-12	--	--	704	528	995	746
1.000-8	--	--	644	483	909	681

METRIC TIGHTENING TORQUE N-m						
Bolt Size	Class 8.8 Dry	Class 8.8 Lubed	Class 9.8 Dry	Class9.8 Lubed	Class 10.9 Dry	Class 10.9 Lubed
8.0 x 1.25	26.40	19.80	28.50	21.40	36.50	27.30
10.0 x 1.50	52.20	39.20	56.60	42.40	72.20	54.20
12.0 x 1.75	91.00	68.00	99.00	74.00	126.00	94.00
14.0 x 2.00	145.00	109.00	157.00	118.00	200.00	150.00
16.0 x 2.00	226.00	170.00	245.00	184.00	313.00	235.00
20.0 x 2.50	441.00	331.00	478.00	358.00	610.00	458.00
24.0 x 3.00	762.00	572.00	826.00	620.00	1055.00	791.00
30.0 x 3.50	1515.00	1136.00	1641.00	1231.00	2095.00	1572.00
36.0 x 4.00	2647.00	1985.00	2868.00	2151.00	3662.00	2746.00

37° TUBE FITTINGS & PIPE FITTINGS						
Dash #	37° Swivel Nut	37° JIC Flats from Finger Tight	O-Ring Lock Nut Ft-Lbs.	Pipe Dia. Inch)	NPT Ft. Lbs.	NPT Turns from Finger Tight
-04	10	2	8	1/4	25	2 1/2
-06	20	1 1/4	13	3/8	40	2 1/2
-08	40	1	21	1/2	54	2 1/2
-10	60	1	33	--	--	2 1/2
-12	80	1	48	3/4	78	2 1/2
-16	110	1	63	1	112	2 1/2
-20	130	1	--	1 1/4	154	2 1/2
-24	160	1	--	1 1/2	211	2 1/2
-32	250	1	--	2	300	2 1/2

Torque Conversion: Ft-Lbs = 0.7376xN-m N-m = 1.356xFt-Lbs

NOTE: Do not use these values if a different torque value is given for a specific procedure.

These values are for clean, dry, PLATED (or lubricated) threads. Increase torque 20% for lubricated or threads.

If the fastened part is aluminum, reduce torque 25%.

Fasteners should be replaced with the same or higher grade. If higher grade fasteners are used, they should be tightened to the strength of the original fastener.

Locknuts: Tighten plastic-insert or crimped-steel-type lock nuts to approx. 50% of the dry torque shown (applied to the nut, not the screw head).

1.2 PERIODIC MAINTENANCE AND INSPECTION

Use the engine hour meter to keep track of when preventive maintenance is required.

Use Table below to schedule your maintenance.

NOTICE! Recommended service intervals are for normal operating conditions. Service MORE OFTEN if machine is operating under sandy, dusty, or wet conditions.

⚠WARNING Follow the recommended maintenance program to prevent unsafe operation or accidents.

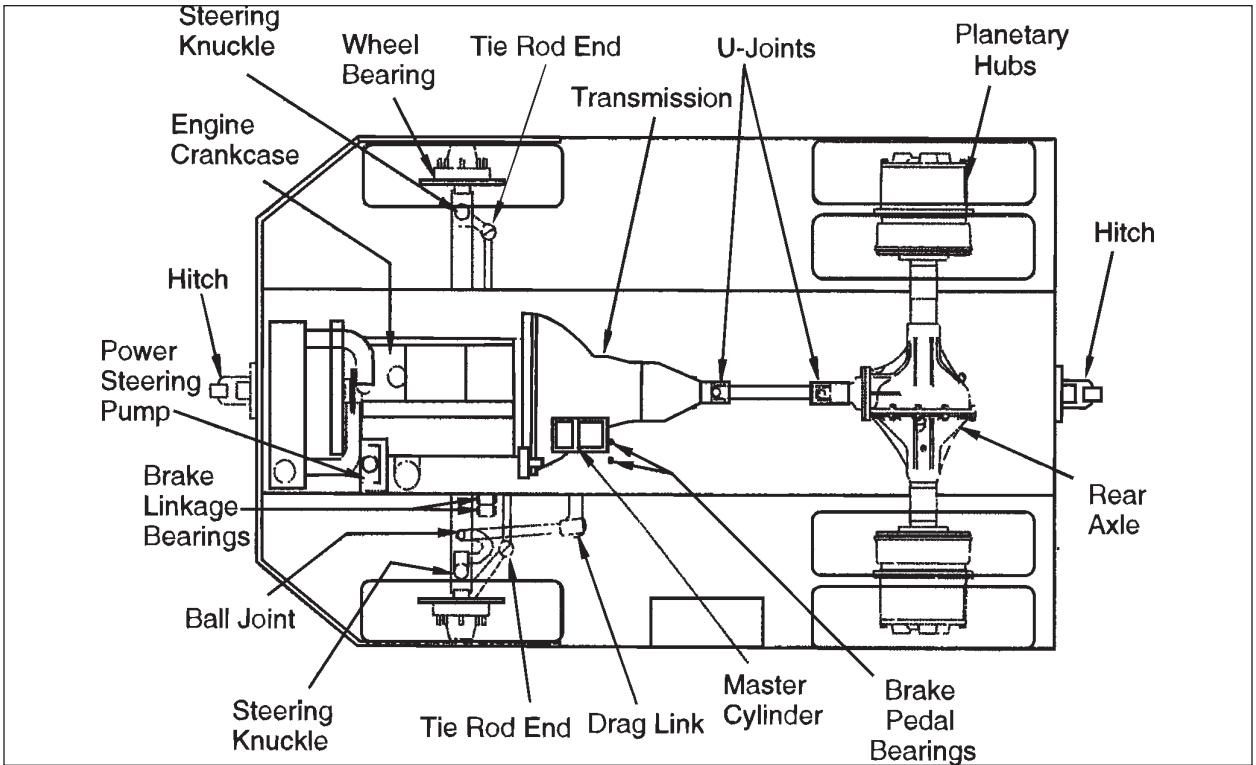


FIGURE 1. LUBRICATION/SERVICING LOCATIONS (TYPICAL)

1.2.1 Preventative Maintenance Schedule

COMPONENT	SERVICE REQUESTED	REF
DAILY (PRE-START UP)		
Engine Cooling System	Check coolant level. Check for coolant leaks.	1.3.1 1.3.2
Engine Oil	Check level.	1.3.3.
Engine Air Filter(if conditions are extremely dusty)	Inspect element and empty dust cap.	1.3.4.
Transmission	Check for leaks.	1.3.5
Electrical System	Check lights.	1.3.6
Fuel System	Check for fuel leaks. Check water separator.	1.3.7 1.3.11
Brakes	Check brake pedal free play.	1.3.8
Wheels and Tires	Inspect condition and check pressure	1.3.9
Rear Axle	Check for leaks.	1.3.10
Lugnuts	Initial Check	2-4 - 4.2.6
Spring U-Bolt Torque	Initial Check	2-3.13.4
AFTER FIRST 8 OPERATING HOURS		
Lugnuts	Check Lugnut Torque	2-4-4.2.6
EVERY 250 OPERATING HOURS		
Accelerator Linkage	Oil 2 bearings on firewall	Use motor oil
Engine Oil and Filter	Change.	1.4.11
Transmission	Check Oil	1.4.1
Fuel Filter (Diesel)	Change.	1.4.12
Grease Fittings	Lubricate	1.4.2+engine manuals
Drive shaft,steering, susp., and front axle	Inspect and lubricate.	1.4.3
Brakes	Inspect parking brake.Inspect lines. Check master cylinder fluid level.	1.4.4
Exhaust System/Spark Arrester	Inspect.	1.6.5 &1.6.6
Engine Air Cleaner	Change element - check for restrictions	1.4.14, 1.4.12
Lugnuts	Check	2-4 - 4.2.6
Spring U-Bolts	Check	2–3.13.4

EVERY 500 OPERATING HOURS OR YEARLY		
Perform 250 hour service		
Air Filter	Replace elements	1.4.14
Belts	Check tension and condition. Install or adjust.	1.5.1 1.5.2, 1.3.12
Rear Axle	Check oil level.	1.5.3
Brakes	Inspect	1.5.4
Electrical System	Clean and inspect wiring, battery, and cables	1.5.5
Coolant	Check concentration	
EVERY 1000 OPERATING HOURS		
Perform 500 hour service		
Transmission	Change oil and filter. Tighten mounting bolts. Adjust bands	1.5
Axle	Change oil. Repack front wheel bearings.	1.6.3 and 1.6.4
Wheel Alignment	Adjust toe-in.	1.6.1
Cummins Engine	Adjust Valve Lash	Engine Manual
EVERY 2500 OPERATING HOURS		
Perform 500-hour service		
Engine	Adjust valves. Inspect injectors(Diesel).	1.8.1 1.8.2
Engine Cooling System	Change Coolant	1.8.3
Vibration Damper (Cummins Diesel	Inspect	Engine Manual
Coolant and Antifreeze (Cummins Diesel	Change	Engine Manual

1.3 DAILY SERVICE

1.3.1 Coolant Level

Raise engine hood and visually check level of coolant in coolant reservoir. If low, fill to FULL mark a 50/50 mixture of clean, soft water and an ethylene glycol-base engine coolant (Fed. Spec. A-A-870).

For Cummins engines, see the OEM Operation and Maintenance Manual supplied for the engine and included with this manual.

1.3.2 Coolant Leaks

After tractor has been parked overnight, check ground under engine for leaked coolant (green-colored). If found, try to locate exact source of the leak. If source is a loose hose, tighten hose clamp or replace hose if necessary. If radiator or water pump is leaking, report condition to a supervisor.

1.3.3 Engine Oil Level

With engine off and tractor parked on a flat surface, remove dipstick and read oil level. If low, add engine oil as required. Use correct viscosity grade for the temperature range in which the tractor will be operating.

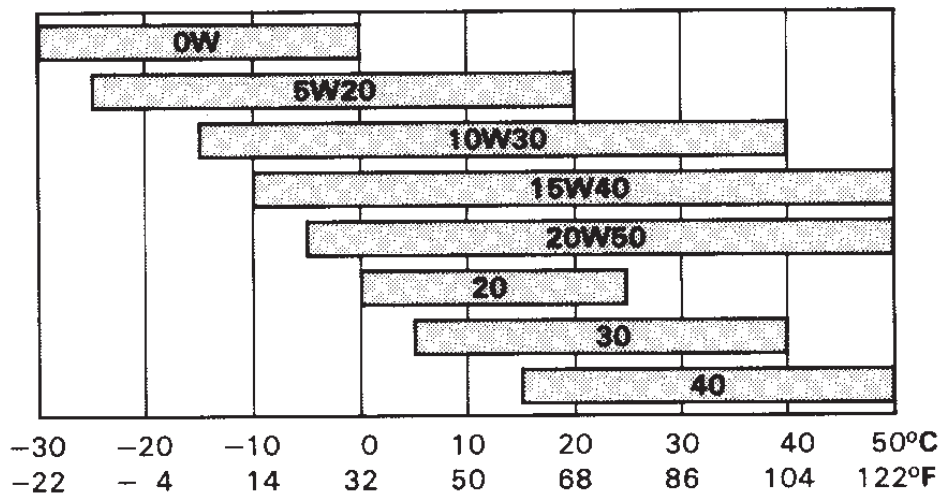


FIGURE 2. RECOMMENDED ENGINE OIL VISCOSITY GRADES

1.3.4 Empty Air Cleaner Dust Cup (If Conditions are Extremely Dusty)

Remove retaining strap securing dust cup to canister. Remove dust cup. Remove wing nut securing filter element to canister. Remove and inspect element. Clean out dust from canister and dust cup with a damp, lint-free cloth. Install element and dust cup. Replace element if necessary.

NOTICE! Replace filter element immediately if sealing edges are damaged.

1.3.5 Inspect for Transmission Oil Leaks

After tractor has been parked overnight, check ground under tractor for evidence of oil leakage (red-colored fluid). Try to find exact source of any leak and report condition to your supervisor.

1.3.6 Lights

Check operation of all tractor lights. Replace any burned-out lights.

1.3.7 Fuel Leaks

Raise engine cover and inspect fuel line connections for leaks. Be sure fuel lines are securely fastened by retaining clips.

1.3.8 Brake Pedal Free Play

Check brake pedal free play. There should be ample travel remaining when brakes are fully applied. The pedal should be firm with no spongy feeling. If free travel is excessive, but braking improves after “pumping” the pedal several times, there may be air in the brake lines. Report condition to your supervisor. Also see 1.12. Excessive free travel may also be caused by worn brake linings, pads, or both.

1.3.9 Tire Condition and Pressure

⚠WARNING Regularly check tires and wheels for proper tire inflation or loose wheel studs/nuts. Dual wheel sets must have equal inflation in both tires to prevent tire overloading. Wheel or tire failure could result in loss of vehicle control.

1. Inspect tire for cuts, nails, stones in the tread or deterioration. Remove stones and other foreign material imbedded in the tires. If damaged, report condition to supervisor. Schedule machine for maintenance. Also see 2-4 - 4.2.3
2. Inspect wheels for loose or missing stud nuts. If found, do not operate. Schedule machine for maintenance and see instructions following in Section 4 for wheel installation.
3. Maintain identical air pressure in both tires of a dual set for equal load distribution. Pressure should be:
   8.00x17.5----------65PSI
   LT215/75R17.5--------120 PSI

4. If a tire goes flat on a dual set, immediately drive to the maintenance shop for repair. A flat tire will transfer all the load to the remaining wheel and over stress the studs.

1.3.10 Rear Axle Oil Leaks

After engine has been parked overnight, check ground under rear axle for spots of oil. Try to find the exact source of any leak and report condition to your supervisor.

1.3.11 Water Separator

The water separator is located behind the right front wheel well. Visually check for water in the water separator sight glass. Drain any water into a container by turning the drain valve. Avoid getting fuel on your hands. Close valve when water has drained and fuel appears. For Cummins engines, see the OEM Operation and Maintenance Manual supplied for the engine and included with this manual.

1.3.12 Cummins Diesels - Specific Procedures

Inspect Drive Belt

See the Cummins “Operation and Maintenance Manual” included with this manual.

Inspect Cooling Fan

See page 3-6 of the Cummins “Operation and Maintenance Manual B Series Engines” manual included with this manual.

1.4 EVERY 250 OPERATING HOURS OR 3 MONTHS

1.4.1 Transmission Oil

1. Bring transmission to normal operating temperature (about 180ºF). Five minutes of driving, including frequent stops and starts, will usually produce normal fluid temperature.
2. Set gear selector to neutral (N) and withdraw transmission dipstick (located in engine compartment on driver’s right) to check oil level.

NOTICE! Always check fluid level with tractor on a level surface and with fluid at normal operating temperature for hot check. Do not overfill transmission. Overfilling can result in transmission damage. To avoid overfilling, add fluid in small amounts and recheck level frequently.

3. Examine fluid for discoloration and a foul (burned) smell. This would indicate damaged bands or clutches. If oil has a milky look, water has entered the transmission. Air bubbles mean there is an air leak in the suction lines. Report any of these conditions to your supervisor.

4. Check level indicated on dipstick. Add fluid as needed to maintain level between “FULL” and “ADD” marks on the dipstick. See Section 1.3 for fluid specifications

1.4.2 Lubricate Grease Fittings

At each oil change, apply a high-quality grease to all grease fittings. See Figure 1 for locations.

1. Wipe grease and dirt from fitting with a clean rag.
2. Using a grease gun, apply grease until clean grease oozes from between the mating parts.
3. Wipe off all excess grease.

1.4.3 Inspect Drive Shaft, Steering, Suspension, and Front Axle Components

1. Inspect drive shaft by trying to move shaft sideways and up and down. If there is any movement in the U-joint, replace the U-joint. An indication of a worn U-joint is a regular squeak when the tractor is moving.
2. Using an appropriate torque wrench, check drive shaft bolt torque. Torque should be to 70 ft/lbs.
3. Inspect steering gear assembly, steering column assembly, drag link, pitman arm, and column support bracket for looseness; cracked, broken, or bent parts; and seal leaks. Replace all damaged parts.
4. Check front axle for worn, bent, cracked, or otherwise damaged parts. Replace all damaged parts.
5. Make sure pivoting members turn freely through complete turning radius.
6. Check knuckle bushings for wear.
   a. Raise tractor until wheels are off ground. Support with safety stands.
   b. Grab top of tire with both hands and move tire towards and away from the tractor. Grab bottom of tire and do the same. Any movement should be almost unnoticeable (no more than 0.010-inch). If movement is excessive, replace all knuckle bushings. Lower tractor to ground.
7. Check tie rods for wear. Grab and try to move the tie rod tube in any direction. If any movement or looseness is felt, replace the ball joint assemblies.
8. Check tires for uneven wear patterns which might suggest axle misalignment or damage.
9. Check fastener torque according to values in Section 1.
10. Inspect hoses for softness, swelling, cracking, abrasion, etc. Inspect fittings for cracking or looseness.
11. Replace hoses and components that show signs of damage or deterioration.

12. Wipe off hoses and steering parts with a clean cloth to remove dirt and foreign materials.
13. Inspect steering pump oil level.
    a. Clean steering pump filler cap, remove cap, and read oil level on dipstick.
    b. Add oil if necessary (automatic transmission fluid type , Dexron III.
    c. Replace filler cap.

1.4.4 Inspect Brakes

Inspect Brake Lines

Access to brake lines can be obtained from the underside of the tractor. Check brake lines and hoses for leaks, deterioration, swelling, cuts, kinks and other damage. Report abnormal conditions to your supervisor.

Inspect Parking Brake and Clean Disc

Inspect all parts of the parking brake assembly for wear and damage, particularly brake pads. To change pads, refer to Chapter 3.

The parking brake may be adjusted by turning handle knob clockwise to tighten. Do not allow pads to “drag” on brake disk while brake is released.

Wipe off any dirt or oil from the parking brake disc using a cloth dampened with approved brake cleaner.

Check Fluid Level in Brake Master Cylinder Reservoir

To access the master cylinder reservoir, remove access cover or open engine hood. Clean dirt from master cylinder cover and remove cap by raising the cap holders and snapping them over the ends of the cylinder.

If necessary, replenish with brake fluid. See Section 1.3, Fluids And Capacities. If fluid level is often low, check all brake components for leaks. Report any abnormal condition to your supervisor.

Replace cap on top of cylinder and snap holders back into place.

1.4.5 Inspect Muffler, Exhaust, and Tail Pipe

With engine off and cool, check for loose mounting straps and fasteners. Check for damage such as rusted-through areas and report condition to supervisor.

⚠CAUTION Do not touch any part of an exhaust system, until it has had sufficient time to cool to prevent serious burn.

1.4.6 Instructions For Cleaning Spark Arrester/Exhaust System

1. Disposal of accumulated particles may be accomplished by following the steps listed below.
2. IN A SAFE AREA take precautions to collect and properly dispose of residue falling from the spark arrester trap.

⚠WARNING Keep head and face away from possible hot or toxic muffler drainage. Exposure to this drainage can result in serious injury.

1. Remove the plug (pipe plug) on the bottom half or side of the spark arrester (muffler). Some particles may begin to drain out at this time. Soot mixed with condensation or other oily liquids may also empty out.
2. Without causing deformation (or any type of damage to the spark arrester) repeatedly tap on the arrester near the plug. This may be enough to begin drainage of the spark trap.
3. An industrial vacuum cleaners can do a complete job at this point. IN A SAFE AREA, start the engine. Idle in a neutral gear. Then alternate between low idle and high idle for two to three minutes. You can also operate the engine while doing two to three minutes of work.
4. If the engine was started, TURN OFF THE ENGINE AND LET THE ARRESTER COOL AGAIN, as stated above.
5. Replace the cleanout plug.
6. Dispose of the accumulated particles.

NOTICE! This maintenance is recommended after every 250 hours of use. If any breaks in the metal or are discovered, the spark arrester must be replaced.

1.4.7 Batteries

⚠WARNING To minimize risk of fire or explosion, follow these battery servicing safety precautions:

- Sulfuric battery acid is poisonous. Avoid breathing battery fumes.
- Battery acid is strong enough to burn skin and cause blindness if splashed into the eyes. Protect eyes and skin from contact. In the event of contact with battery acid, immediately rinse in large amounts of water. Obtain medical care if the eyes are burned.
- Battery gas can explode. Keep sparks and flame away from battery.

- Never check battery charge by placing a metal object across the battery posts.A spark will occur and cause possible explosion. Use a voltmeter or hydrometer.

Maintenance

The 12-volt battery supplied with your loader will provide long service if given proper care. Clean and inspect your battery every 3-4 months.

- The battery requires little maintenance.
- If the electric system has a defect, i.e., regulator damage, compensate for increased water consumption of battery.
- Unscrew the sealing caps and replenish distilled water until battery acid level is 3/8” above the lead plates. Screw on caps hand-tight.

⚠WARNING Disconnect battery before performing service to prevent accidental startup.

Cleaning and Inspecting

A dirty battery top may become conductive and allow a small flow of current from one post to the other. Such a condition will cause the battery to slowly discharge.

Minute amounts of hydrogen and oxygen are continuously vented from a charging battery. These gasses can attack the terminals and cause high resistance to voltage.

1. Keep battery clean by wiping it with a damp cloth. Keep all connections clean and tight. Remove any corrosion, and wash terminals with a solution of 1 part baking soda and 4 parts water.
2. Coat battery terminals and connectors with petroleum jelly or nonmetallic grease to prevent corrosion.
3. Keep battery fully charged, especially during cold weather.
4. Check for signs of cracking or leaking.
5. Check electrolyte level in each cell. Pry off caps and check that electrolyte is 3/8” above plates.
6. Do not over-tighten hold-downs or battery case may crack.
7. If level is low, carefully add distilled water to bring up level. DO NOT OVERFILL.
8. If battery uses an excessive amount of water, check system for overcharging. Prolonged overcharging will reduce battery life.

Checking Battery Charge

1. Checking the specific gravity of the electrolyte in the battery is a good method for determining approximate state of charge and condition.
2. To test specific gravity, use a good-quality hydrometer.
3. If the electrolyte level is too low to draw a sufficient amount into the hydrometer, add water and either charge battery or run engine for 30 minutes or so to thoroughly mix electrolyte.
4. If the battery was just charged, crank the engine for several seconds to reduce the “surface charge.”
5. Draw electrolyte into hydrometer, then squirt it back out several times to bring float to electrolyte temperature.
6. Draw in enough to suspend float, and allow bubbles to rise to surface before taking your reading. Hold hydrometer at eye level and take reading.
7. Correct reading by subtracting .004 for each 10F BELOW 80F, and add .004 for each 10F ABOVE 80F
8. A typical fully-charged battery should have a specific gravity (SG) of 1.280-1.260. A 50% charge is indicated by a SG of 1.180-1.170. A typical discharged battery will have a SG of 1.080-1.070.
9. A difference of more than .025 between cells means the battery is starting to fail due to internal shorts, or normal deterioration.
10. If charging does not bring SG to a satisfactory level, replace the battery (original factory-installed battery is rated 470 cold-crank amps).
11. If a good battery repeatedly becomes discharged during normal operation, there may be a problem with the regulator or alternator.

1.4.8 A Sound Battery Is A Must

A worn out or badly sulphated battery will produce numerous problems that cannot be corrected until the battery is replaced.

Always check battery condition and connections before condemning other parts of the system. A fully charged battery is a must for conducting accurate systems tests.

1.4.9 Voltmeter

The voltmeter indicates voltage across the battery terminals. When the ignition and lights are off, the voltmeter needle should be at the 12V mark. When the engine is running, the voltmeter needle should show 14V.

If the voltmeter does not jump to 14V after starting the engine, this indicates that the battery is not being charged by the alternator.

1.4.10 Alternator

The alternator used is a 60-amp type.

The alternator requires no special care except to keep the drive belt properly tensioned. It is not a user-repairable item.

If you suspect a problem with the alternator, most alternator problems can be traced to one of the following causes:

- Battery or battery connection fault.
- Loose, dirty, or corroded alternator connections.
- Broken wires to alternator.
- Slipping drive belt.

⚠CAUTION Before repairing the electrical system, disconnect the positive cable from the battery to prevent possible injury due to electrical shock.

NOTICE! Before welding on the machine, disconnect the battery to prevent damage to the alternator.

The operating voltage of the electrical system is 12V.

- Do not disconnect the battery when the diesel engine is running.
- Do not start the diesel engine using a battery charger when the battery has been removed.
- For electrical welding work, disconnect the battery. The positive terminal of the welder shall be connected directly to the part to be welded.

1.4.11 Change Engine Oil and Oil Filter - Diesel

For Cummins engines, see the OEM Operation and Maintenance Manual supplied for the engine and included with this manual.

1.4.12 Check Air Cleaner Restriction

Inspect all air system hoses and els.
For Cummins engines, see the OEM Operation and Maintenance Manual supplied for the engine and included with this manual.

1.4.13 Change Fuel Filter

See page 5-3 of the Cummins “Operation and Maintenance Manual B Series Engines” manual included with this manual.

1.4.14 Replace Air Cleaner Element.

A dirty filter can restrict the air intake and reduce engine efficiency.

1. Remove retaining strap securing dust cup to canister and remove dust cup.
2. Every 250 hours, remove the wing nut securing the primary filter element to canister and remove element. Do not remove or clean the secondary filter element.
3. Direct compressed air, DO NOT EXCEED 30 PSI, from the inside to the outside of the primary element by inserting air nozzle inside element. Blow loose particles by holding nozzle at least 6” from element.
4. Clean inside of canister with a damp, lint-free cloth. Also clean dust cap and baffle.
5. Remove air cleaner inlet cap. Wash cap with water and wipe dry with a clean cloth.
6. Install element in canister and secure with wing nut. Install baffle in dust cap. Secure dust cap to canister by tightening retaining strap.
7. Install air cleaner inlet cap.
8. Check and tighten all air induction connections before resuming operations.
9. Every 500 Hours replace both the primary and secondary filter elements

1.5 EVERY 500 OPERATING HOURS OR 6 MONTHS

1.5.1 Belt Tension And Condition

1. To check deflection, press belt down with your thumb at center of longest free length. With moderate thumb pressure, deflection should be 3/8 inch.
2. If deflection is excessive and belt is in good condition, tighten belt by pivoting alternator or power steering pump. Replace belt if worn, cracked, or frayed.

1.5.2 Installing or Adjusting Belts

1. Adjust or install a belt by pivoting the alternator or power steering pump on its mounting brackets:
2. Loosen fasteners holding pump or alternator to their mounting brackets.
3. Change position of alternator or pump to give correct tension. Tighten fasteners.
4. Recheck belt tension.
5. If you installed a new belt, recheck belt tension after 25 hours of operation.

1.5.3 Rear Axle Oil Level Check

1. The Rockwell rear axle has three fill plugs: one on the outside of each wheel end and one on the axle housing.

2. Park tractor on a level surface. Shut off engine and set parking brake.
3. Using a rag and wire brush, thoroughly clean dirt and rust from around the fill plug on the differential bowl. The axle bowl fill plug is the upper plug.
4. Check oil level in wheel ends, turn wheel so wheel end plug is horizontal to axle shaft.
5. Remove each fill plug and check oil level with a finger. Level should be to height of fill plug hole. Add oil, 80W-85-140 as required.

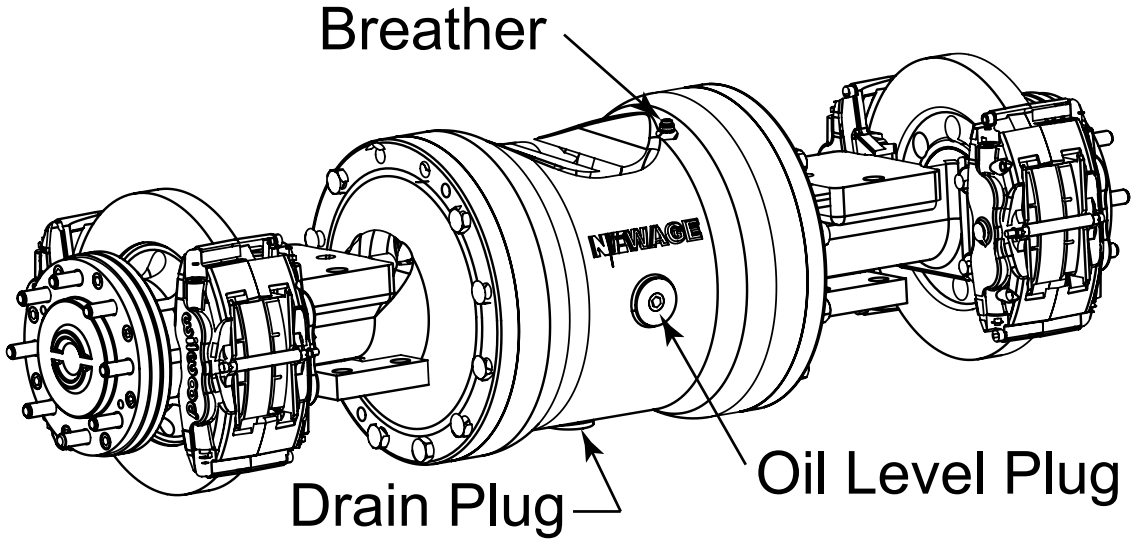


FIGURE 3. NEWAGE AXLE OIL LEVEL PLUG LOCATION

1.5.4 Inspect Linings, Pads, Calipers, Wheel Cylinders, etc.

⚠WARNING To minimize risk of brake system failure and possible accident, when servicing brakes or brake system:

- Do not over tighten brake tube fittings. Over tightening may crack the fitting or damage the seat in the cylinder fitting.
- Compressed air used to service brake components must be oil-free or rubber parts may be damaged.
- Always replace brake lines that are questionable.
- Never allow brake system rubber parts to come in contact with gasoline, diesel fuel, or any type of cleaner other than an approved brake cleaner. Wash hands before handling brake components.
- Brake linings that contact oil or grease can become contaminated, lose braking friction and then must be discarded.

⚠WARNING Any brake service, other than periodic inspection or bleeding, should be performed only by personnel specially trained in brake service. Improper and poor quality service procedures can result in brake system failure, loss of vehicle control, and personal injury.

IMPORTANT! Clean brake system rubber parts in clean, denatured (isopropyl) alcohol, approved brake cleaning solution, or brake fluid.

⚠WARNING Keep alcohol and other flammable solvents away from open flame or lit cigarettes to prevent explosion or fire.

Periodic brake inspections are a must for safe and efficient brake operation. Your inspection should be thorough.

⚠CAUTION Using non-original replacement parts is not recommended. Their use may cause unit failure and/or affect vehicle safety.

Front Disc and Pads

1. Set parking brake. Using a jack, raise tractor high enough off floor to provide adequate working space underneath the frame. Support tractor with safety stands. Be sure that positioning of safety stands does not interfere with work task.
2. Remove front wheels.
3. Check friction pad wear.

NOTE: There are four pads in each caliper.

4. Pads should be replaced if any pad has 1/8 inch or less friction material remaining.
5. Inspect brake disc for rust, scoring, ridges, and distortion. Light rust is not harmful. Disc should be free of excessive or heavy scoring, but some scoring is natural. If scoring is deeper than .080-in., replace both discs. Any cracks require disc replacement.
6. Clean up minor roughness with an emery cloth. Discs can be repaired by honing to a minimum thickness of 0.85”.
7. If brake disc has heavy scoring, ridges, or blue heat spots, machining the disc may eliminate these problems.
8. Maximum friction surface lateral (side-to-side wobble) allowed is 0.030" total.
9. Replace disc if wear or distortion exceeds these values.

Wheel Cylinders and Brake Shoe/Drum Assemblies

1. Pull the rear wheel and drum assemblies. Refer to 2-4 - 4.2.
2. Use a dry bristle brush or a clean lint-free cloth to remove lining dust from shoes, backing plate, springs, drum, and wheel cylinder.
3. Inspect wheel cylinders according to Chapter 3. Repair or replace wheel cylinder as needed according to Chapter 3.
4. Inspect brake drums for scoring, heat checking, pitting, out-of-round condition, or concave, convex, or condition. Drum must be free of grease, oil, scoring, cracking, or uneven wear.
5. Replace drum if inside surface is rough or ragged or if depth of scoring exceeds 0.010” (0.3 mm). If heat cracks are visible or can be felt with a finger nail, replace drum, see Chapter 3.
6. Inspect lining thickness. If less than 1/8 inch, replace shoe and lining assemblies and turn drums. Refer to Chapter 3.

7. Inspect retracting springs, shoe hold-downs, automatic adjusting device, and shoe contact pads on backing plate. Backing plate and shoe anchors must be tight.
8. Inspect rear brake backing plate and replace if damaged. Damage might include cracks, warping, or loose rivets. Refer to Chapter 3.

⚠WARNING Do not allow linings to drag on drum or they will heat up and lock. The linings will be charred and rendered useless, resulting in brake failure.

Stoplight Switch
Check switch operation according to 2-2 - 2.5.3.
Power Booster/Master Cylinder
Check for hydraulic fluid leaks and service if necessary. Check accumulator reserve charge retention as described in Chapter 3.

⚠ DANGER Do not carry brake booster by accumulator, allow brake booster to fall on accumulator or expose brake booster to heat or flame. It contains high pressure gas and can leak under pressure and explode if heated.

Road Test
After performing the above checks and any necessary repairs, drive the tractor to test brake action. The tractor should stop quickly and smoothly with no tendency to dive or pull to one side.

1.5.5 Inspect Wiring, Battery, and Cables

1. Inspect all wiring and cable harnesses for loose connections, evidence of shorting (burned insulation or terminals) and frayed wires.
2. Check that retaining clips are secure.
3. Remove exterior dirt and grease by wiping with a cloth dampened with a general-purpose cleaner.
4. Allow parts to air dry after cleaning.
5. Remove cables from battery posts.
6. Inspect battery for evidence of electrolyte loss. Inspect case for cracks and leaks.
7. Check that posts are secure. If loose, replace battery. (Send battery to overhaul personnel for salvage.)
8. If corrosion or dirt is present, clean top of battery with a solution of clean warm water and baking soda. Scrub areas with a stiff bristle brush, being careful not to scatter corrosion residue. Wipe clean with a cloth moistened with baking soda in water.

9. Using a common wire-brush type battery tool, brush battery posts and inside of cable ends.
10. Reattach positive cable, then negative cable, to correct battery post.

1.6 EVERY 1000 HOURS OR 1 YEAR

1.6.1 Toe-In Adjustment

Toe-in is a condition in which the front of the tires are closer together than the back. This is used to compensate for the natural tendency of road-to-tire friction to force the wheels apart. If the wheels were set parallel (no toe-in), steering linkage wear would allow the wheels to actually toe-out. By setting a certain amount of toe-in, the wheels will be nearly parallel in actual use.

An improper toe-in can grind off tire tread in a short period of driving. Toe-in should be checked using a toe gauge or trammel.

1. Jack up each front wheel and chalk a band near center of tire while spinning the wheel.
2. Use a sharp-nosed scriber to form a thin line near the center of the chalk band while spinning the wheel. Keep the line THIN.
3. Lower wheels to floor. Roll tractor forward until wheels have made one complete turn. Wheels should point straight ahead. This will impart a rearward thrust to the wheels and will provide an accurate toe-in reading.
4. Move toe-in gauge to behind wheels. Set pointers exactly on scribed lines. Top of pointers should be as near the center of the spindle height as possible.
5. Carefully remove gauge without altering pointer setting. Align one pointer with scribe mark on the front of one of the tires. Check distance between the other pointer and scribe mark on other tire. The distance will indicate amount of toe-in or toe-out present.
6. Loosen tie rod jam nuts and rotate tube to obtain 0.15 .030 (5/32 1/32) toe-in./
7. Tighten jam nuts to secure adjustment.

1.6.2 Wheel Bearings

1. To provide adequate working space under tractor, raise front of tractor with jack and support tractor with appropriate jack stands. Position jack so it does not interfere with work.
2. Remove front wheel and tire assemblies, see 2-4 - 4.2.
3. Remove center cap from hub.

4. Remove cotter pin, spindle nut, and washer from spindle.
5. Remove hub. Outer wheel bearing cone will slide out of hub. Inspect outer bearing cone and cup. Remove bearing cone and cup if they appear damaged in any way. (Always replace cup and cone as a set.)

NOTE: Always replace grease seals.

6. Remove grease seal. Inspect inner bearing cone and cup. Remove bearing cone and cup if they appear damaged in any way. (Always replace cup and cone as a set.)
7. Using a clean rag, wipe old grease from spindle, hub, and bearings.
8. Install new outer bearing cup, if removed.
9. Install new inner bearing cup, if removed.
10. Install new grease seal, if removed, using a plug to place pressure evenly around seal. If you bend or otherwise damage seal, discard and use a new one.

NOTICE! Do not overfill with grease because too much grease can cause seal to fail or grease cap to pop loose after assembly.

11. Spread grease inside hub cavity.
12. Use grease to lubricate the seal lip.
13. Install hub. Rotate hub while installing to spindle so seal doesn't roll under. As spindle goes into inner cone, try to feel that all parts are straight and properly seated on spindle bearing journal.
14. Grease outer cone and place over spindle and into cup.
15. Assemble washer and nut to spindle. Tighten nut to 10-15 ft-lbs torque. Rotate hub while tightening nut.
16. Back off nut until it just becomes loose.
17. While rotating hub, nut to finger tight. Line up cotter pin hole in spindle with slot in nut. Check hub for excessive end play. Excessive end play indicates that nut is too loose. Hub should rotate freely, but if hub binds or if you can feel the bearings, it means that the nut is too tight. Readjust nut if needed.
18. Insert cotter pin and bend to lock it on nut. Fill grease cap with grease and snap into place.
19. Check seal for a turned-under lip. Check hub for any indication of roughness which might indicate misalignment. If roughness is noted, disassemble hub and check inner cup for any small nick. If a nick is found, the hub must be replaced.
20. Lube all grease fittings with MIL-G-10924D grease, if not already done.

21. Install front wheels and tighten mounting nuts to 90 ft-lbs torque.
22. Remove jack stands and jack.

⚠ CAUTION After initially mounting wheel and tire assembly, recheck lug nut torque after the first hour of operation and after the first 8 hours of operation. After this, check monthly or every 250 hours, whichever comes first. Do not lube wheel studs as it will result in inaccurate tightening torque. Failure to follow these procedures could result in wheel mounting failure and loss of vehicle control.

1.6.3 Transmission - C-6

(For Allison Transmission Service, See 1.8.4)

Fluid Level and Condition

1. Bring transmission to normal operating temperature (about 180º F). Five minutes of driving, including frequent stops and starts, will usually produce normal fluid temperature.
2. Set gear selector to neutral (N) and withdraw transmission dipstick (located in engine compartment on driver's right) to check oil level.

NOTICE! Always check fluid level with tractor on a level surface and with fluid at normal operating temperature for hot check. Do not overfill transmission. Overfilling can result in transmission damage. To avoid overfilling, add fluid in small amounts and recheck level frequently.

3. Withdraw dipstick and examine fluid for discoloration and a foul (burned) smell. This would indicate damaged bands or clutches. If oil has a milky look, water has entered the transmission. Air bubbles mean there is an air leak in the suction lines. Report any of these conditions to your supervisor.
4. Check level indicated on dipstick. Add fluid as needed to maintain level between "FULL" and "ADD 1 PINT" marks on the dipstick. See 1.3, Fluids And Capacities.

Transmission Service - C6

The Ford C6 transmission combines a torque converter with a two-speed or three-speed, fully automatic unit for transmitting engine torque to the drive axle via a drive shaft. Maintenance is limited to changing the fluid and filter at the recommended service intervals and adjusting the linkage, intermediate band and the neutral start switch.

Removal and installation procedures are included in the event the transmission must be replaced or sent to a specialized repair facility.

Malfunctions
Automatic transmission malfunctions may be caused by poor engine performance or improper transmission adjustments.

You should always begin by checking engine performance, then fluid level and condition, and gearshift cable adjustment.

If the problem exists after these checks and adjustments are completed, remove tractor from service and refer the transmission to a transmission repair facility.

NOTICE! If you ever notice unusual noises such as gear noise or grinding, a buzz or whine, knocks, scraping, clicking, etc., remove the tractor from service and refer it to a transmission repair facility.

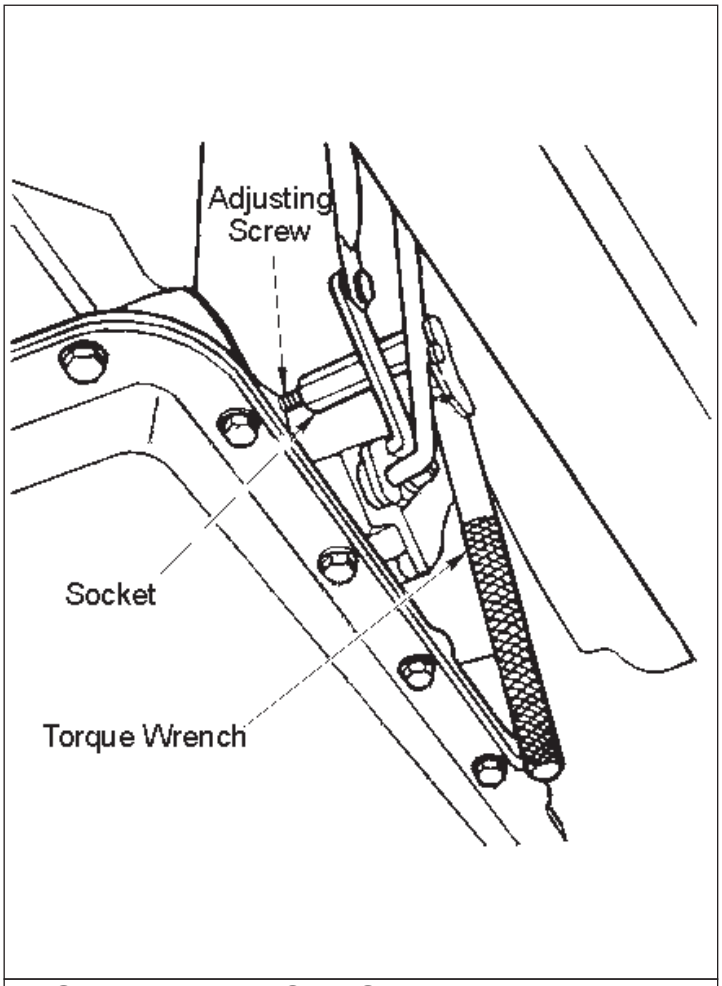


FIGURE 4. ADJUSTING THE INTERMEDIATE BAND - C6

Transmission Adjustments for C6
Most repair facilities can perform intermediate band and neutral start switch adjustments.

NOTICE! When making band adjustments, FOLLOW SPECIFICATIONS EXACTLY. Failure to do so may cause serious damage to the transmission.

The intermediate band may need to be occasionally adjusted to compensate for normal wear. Adjust band at every transmission oil change.

Gearshift Cable

⚠WARNING Failure to follow the shift cable precautions following can result in serious injury or equipment damage.

1. Disconnect the shift cable from the shift control on the transmission. (Driver's side of transmission).
2. Place gearshift lever on dash in N (neutral).
3. Move the control lever on transmission to the rearmost position detent. Move the control lever on transmission ahead 2 detents. This is neutral.
4. Adjust cable length by turning clevis in or out until clevis will slide through clevis and shift lever without movement of shift lever or control lever.
5. Move control lever through the entire shift range one position at a time, checking shift lever detent at each position.
6. Tighten the clevis lock nut. Install the clevis and a new self-locking nut. Tighten the nut firmly.

Intermediate Band Adjustment

See Figure 4

1. Raise tractor on jack stands or a hoist.
2. Clean dirt from band adjusting screw. Remove and discard locknut.
3. Install a new locknut and tighten adjusting screw to 10 ft-lbs torque.
4. Back off adjusting screw exactly 1-1/2 turns.
5. Hold adjusting screw from turning and tighten locknut to 35-40 ft-lbs
6. Lower the tractor.

Neutral Start Switch

The neutral start switch is a safety device that prevents the engine from starting if the transmission is in any shift position other than NEUTRAL.

Adjusting the Neutral Start Switch

NOTE: The neutral start switch may also be checked by attempting to start the engine with the gear shift lever in each shift position.

This switch is a combination unit located on the automatic transmission shifter shaft in the engine package.

1. Park machine, shift to neutral and apply parking brake. “Tagout” the machine.
2. Remove engine/transmission cover to gain access to the transmisssion linkage.
3. Unhook the shifter cable clevis from the transmission shift lever.

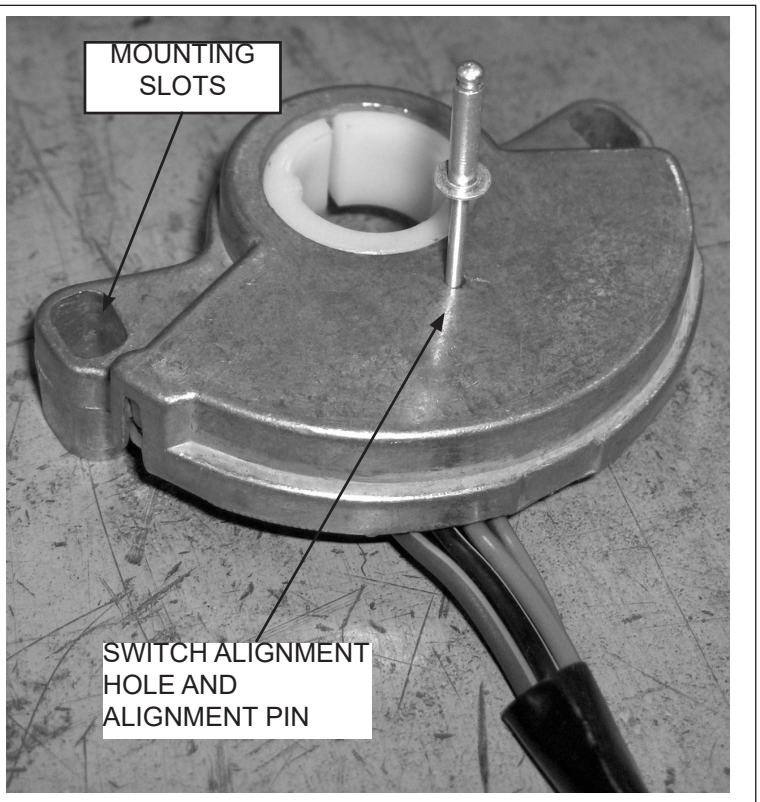


FIGURE 5. SWITCH ALIGNMENT

4. Loosen the two 1/4-20 Gr. 5 HHCS attaching the switch to the transmission.
5. Check that the shifter lever is rotated as far CW as it will go. This is the transmission part position. Then rotate it CCW through the first detent which is the reverse position, and to the second detent whick is the neutral position.
6. Insert a 1/16 diameter nail, or rivet or other pin into the switch alignment hole. See figure 5. Slightly rotate the switch on the two 1/4” mounting slots until the pin fully engages the switch which is secured onto the shifter shaft. Snug the two mounting bolts and remove the alignment pin. This procedure should result in a successful check test which follows. Remove the alignment pin.
7. With the shift lever in the neutral position, place a continuity tester across the prongs of the neutral harness plug. It should indicate continuity, neutral switch

closed. Move the shift lever one detent in both the CW and CCW directions. At these positions the continuity tester should indicate open-circuit netural switch open.

8. If the test fails (unlikely), loosen the two switch mounting bolts and slightly rotate the switch on the trnasmission until contact opens for the same throw of the shift lever either side of netural. When the test is successful, tighten the mounting bolts to 7 ft-lbs.
9. For reference, the second harness plug is for the reverse switch and will be closed when in the reverse detent, open in all other positions.
10. Hook the shifter cable clevis to the shifter lever with both the transmission shift lever and gearshift in netural. The clevis pin should insert without any tension. If necessary, adjust clevis on the cable or the cable in its mounting until it does.
11. Replace engine/transmission cover. Verify that the starter will not crank in any selected gear except netural. Verify the backup lights come on in reverse

Replacing the Neutral Start Switch

1. Remove neutral start switch from transmission case. Catch fluid in a clean container.
2. Move control lever to NEUTRAL position. Check to see that the switch operating lever finger is centered in switch opening in transmission case.
3. Install switch and tighten to 24 ft-lbs torque. Readjust switch.

NOTE: Be sure the switch packing is properly installed to prevent oil leakage.

4. Add fluid to transmission if needed.

C-6 Transmission Set-Up Procedure for <u>Diesel Engines</u>

1. Remove vacuum diaphragm from transmission. See figure .

NOTE: If the transmission vacuum modulator pin comes out the pin must be reinstalled into the transmission for the mechanical modulator to function. See figure 7.

NOTICE! Unit is factory adjusted and disassembly of the modulator lid should not be required. Disassembly could result in unequal of screws causing gasket leakage and/or loss of the internal parts.

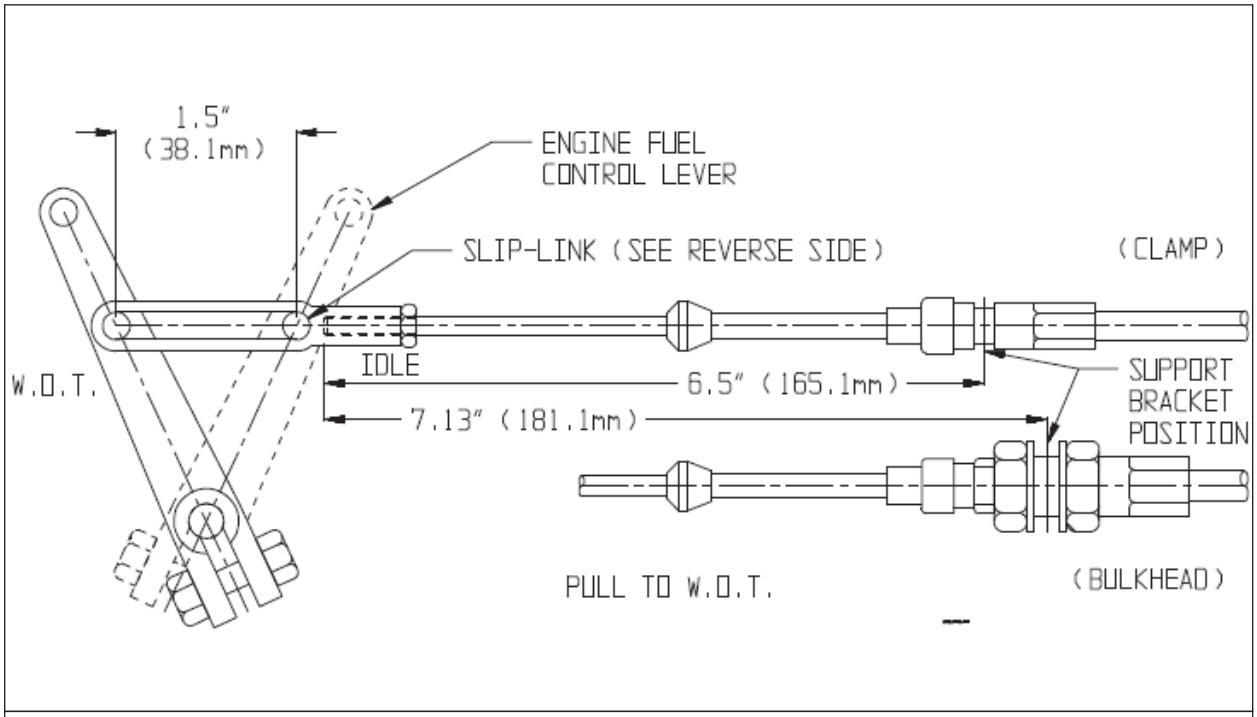


FIGURE 6. PULL TO W.O.T.

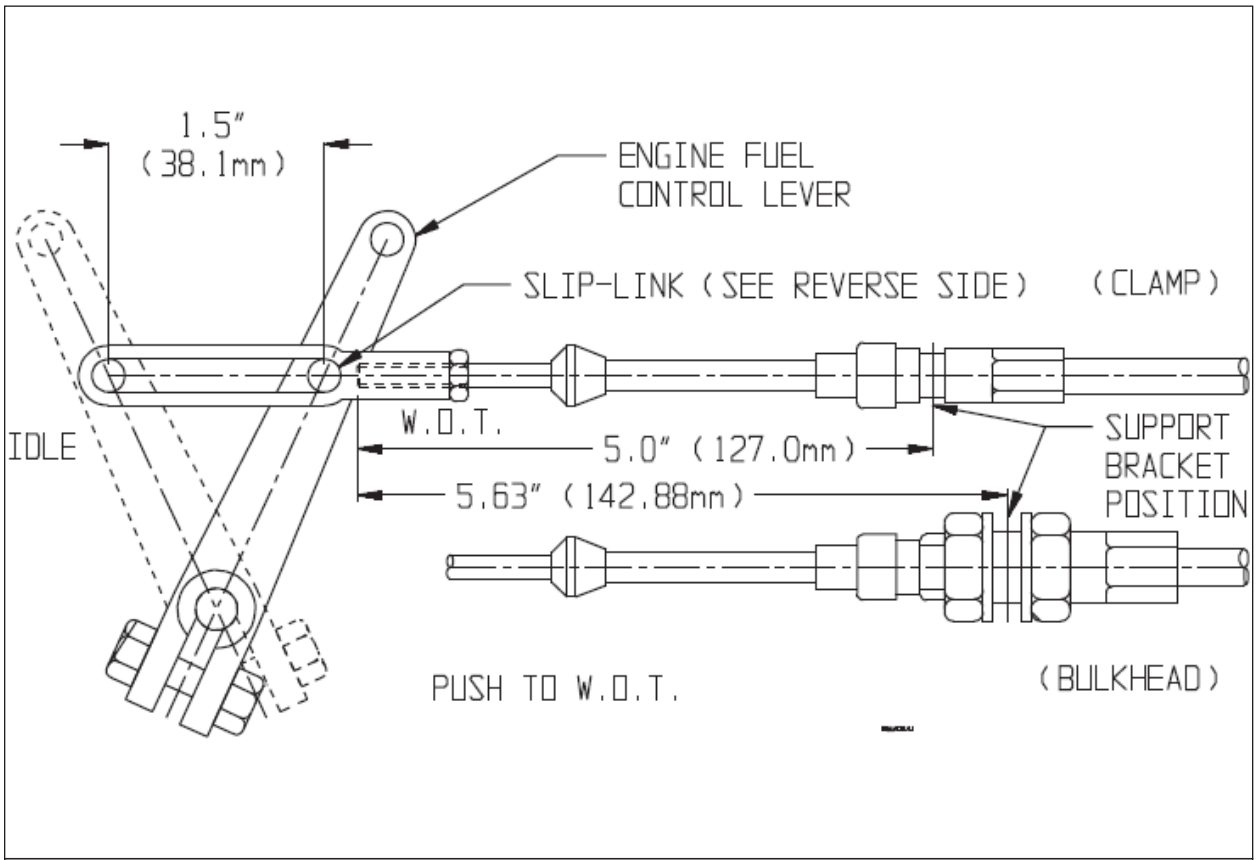


FIGURE 7. PUSH TO W.O.T.

a. Remove plastic plug from transmission base and protective cap form modulator body. Make sure that the modulator valve actuating rod is in place inside transmission case. (On some models, the rod is retained within the transmission.) Lubricate the “O” ring with transmission fluid and fit it on the neck of the modulator. Insert neck into transmission opening.
b. The necessary clip and fastener are provided with the transmission. Fit the retaining clip to the groove in the neck of the modulator as shown in (Figure 6). Fit fastener and tighten to 180 - 240 lb. ins. (20.3 - 27.1 Nm).
c. Route cable and secure cable hub to mounting bracket at fuel control lever. Make sure that the cable bend radius is not less than 4 ins. (101.6 mm) and that the cable is clear of exhaust system and other engine hot spots. Support cable if necessary but do not crush conduit.

2. Attach a hydraulic pressure gauge 0 to 300 PSI (0 - 2068.4 Kpa) to the transmission line pressure port. See figure 9.

3. Check and if necessary set engine speeds (RPM)per engine specifications.
4. Engine idle transmission line pressure check. Lock emergency brake, apply foot brake and block non-drive wheels. Adjust cable on modulator to obtain the following line pressures:

Transmission in neutral or drive 45 - 90 PSI (310.3 - 620.5).
Transmission in reverse 55 - 140 PSI (379.2 - 965.3 Kpa).

Some cable adjusting may be required to obtain full travel of the modulator cable, as follows:

a. Move fuel control lever to wide open throttle (W.O.T.) position. Pull (figure 7) or Push (figure 8) threaded cable rod end until it bottoms on its internal stop. Adjust cable terminal to provide a free pin condition to the fuel lever as shown in figure 6 or 7.

NOTICE! The Felsted Modulator is designed with positive stop at both ends of 1.5 ins. (38.1 mm) travel. Therefore, cable terminal (slip-link) must allow lever to return to idle regardless of cable position.

b. Check for proper return to idle and ease of movement.

5. Engine full throttle transmission line pressure check. With brakes engaged and non drive wheels blocked gradually accelerate engine to full throttle. Pressure should increase to the following at full throttle.

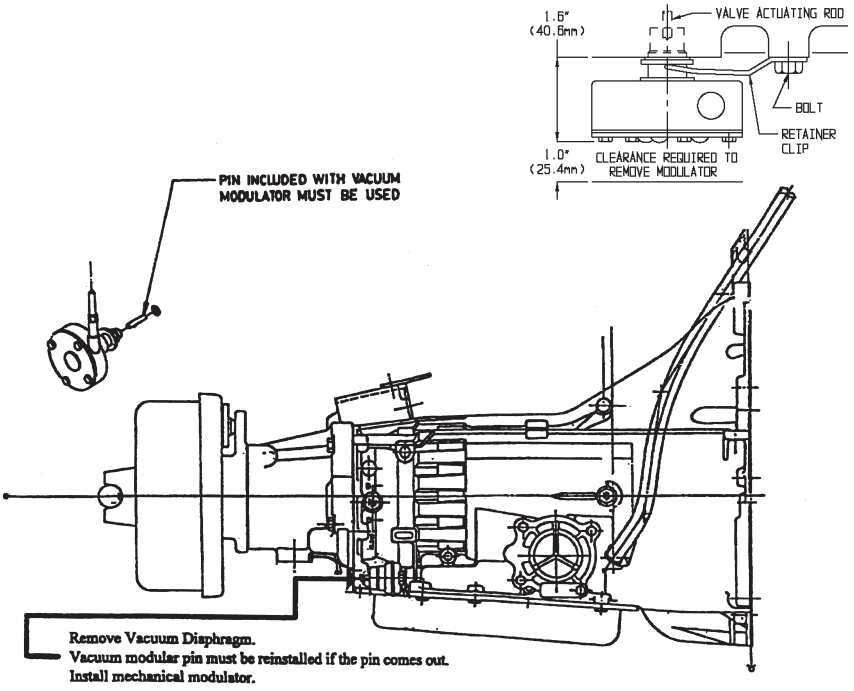


FIGURE 8. INSTALL MECHANICAL MODULATOR

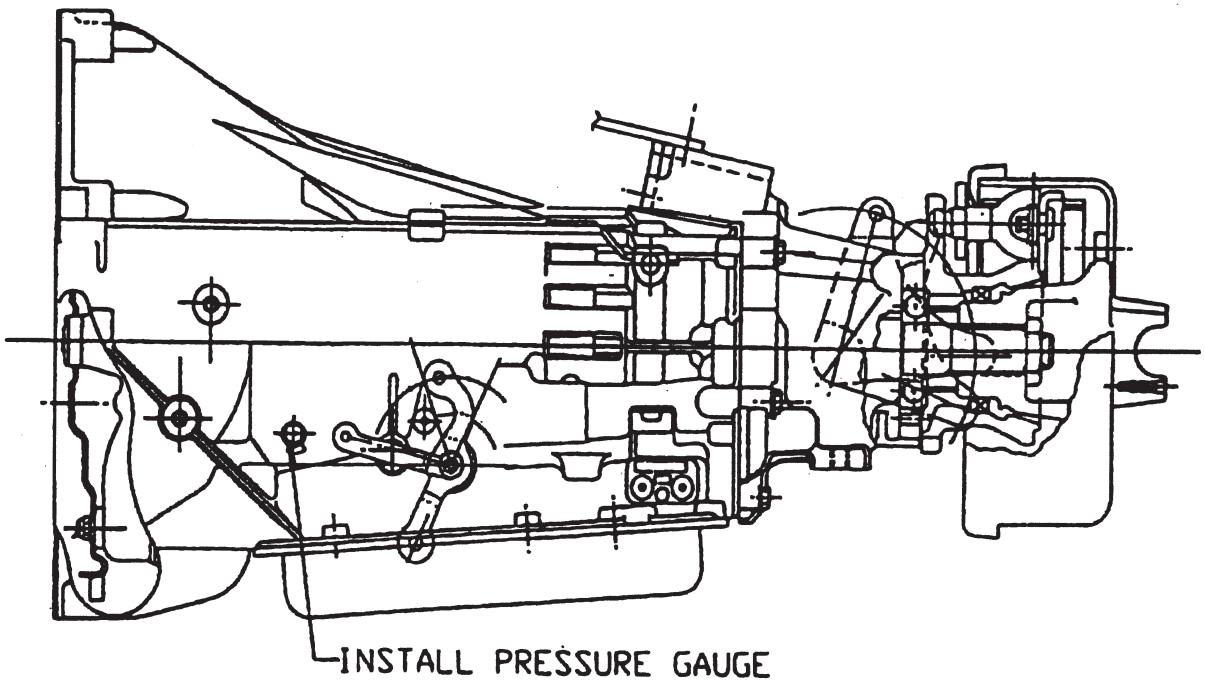


FIGURE 9. PRESSURE READING

NOTICE! Do not stall transmission and run engine at wide open throttle for more than ten seconds at a time. Extended operation in a transmission stall mode at full or partial throttle will cause overheating and transmission failure. After each full throttle check, move the selector to neutral and run the engine at fast idle for about fifteen seconds to cool the converter before continuing to the next check.

Transmission in drive ..... 110- 188PSI (758.4 - 1296.2 Kpa)
or
Transmission in reverse.....175- 300PSI (1206.6 - 2068.4 Kpa)

If the line pressure obtained is too low repeat step five adjusting the line pressure closer to the higher pressure of the specification. If the pressure obtained is too high repeat step five adjusting the pressure closer to the lower pressure of the specification. The specified minimum pressure settings will only provide clutch/band capacity for engines up to 251 ft-lbs engine output torque.

NOTICE! Pressure below 110 PSI for drive and 175 PSI for reverse may cause band and clutch slippage and damage the transmission.

6. Remove wheel blocks and up shift test the vehicle with brakes not engaged. From a stop “floor board” the accelerator and hold down the accelerator until automatic up shift which will be a harsh change. If the up shift does not occur repeat step five setting line pressure lower but not below the minimum specified line pressure.
7. Remove hydraulic pressure gauge and reinstall pipe plug. Test vehicle under normal driving conditions.

1.6.4 Transmission - Allison

Figure 10

Fluid Level and Condition

All AT545 transmissions are equipped with a dipstick marked COLD RUN and HOT RUN. The only purpose of the “Cold Check” below is to determine if the transmission has enough oil to be safely operated until a “Hot Check”, following, can be made.

NOTICE! Always check fluid level with tractor on a level surface and with fluid at normal operating temperature for hot check. Do not overfill transmission. Overfilling can result in transmission damage. To avoid overfilling, add fluid in small amounts and recheck level frequently.

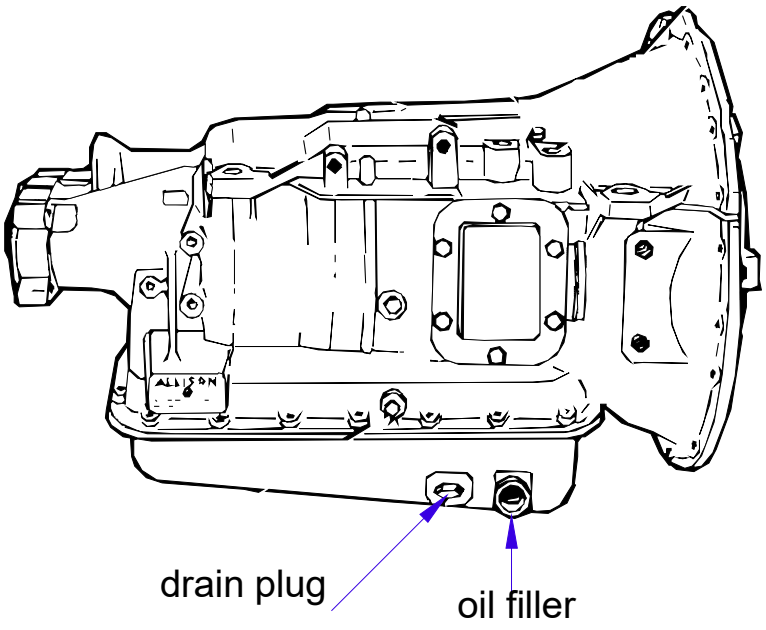


FIGURE 10. PLUG AND FILLER TUBE LOCATIONS

Approved Fluid Types:
III (down to -10º F)
Allison Type C-3 10W (down to 10º F)
*Allison Type C-3 30 (down to 32º F)
*Use 30 when ambient temperatures are consistently above 86º F.

Cold Check Procedure
1. Park the tractor on a level surface and apply parking brake.
2. Run the engine for at least one minute. Shift to first and then to reverse to clear the hydraulic circuits of air. Shift to neutral and allow the engine to idle between 1000-1500 rpms.

NOTICE! Clean around the transmission filler tube before removing the dipstick to insure that no dirt or debris enters the system.

3. After wiping the dipstick clean, check the oil level. If the oil on the dipstick is within the COLD RUN band, it is safe to operate the transmission until the oil is hot enough to perform a HOT CHECK.
4. If the oil level is not within the COLD RUN band, add or drain fluid as needed. Use type A fluid, III.
5. Perform a HOT CHECK as soon as possible.

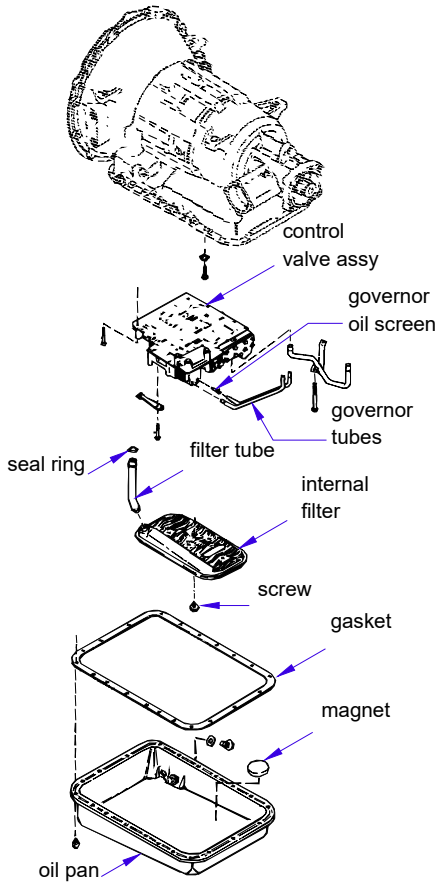


FIGURE 11. INTERNAL OIL FILTER

Hot Check Procedure

1. Operate transmission in drive range until normal operating temperature is reached:
   160-200º F (71-93º C.) sump
   180-220º F (82-104º C.) convert.-out
2. Park the tractor on a level surface, apply parking brake, and allow engine to idle.

NOTICE! Clean around the transmission filler tube before removing the dipstick to insure that no dirt or debris enters the system.

3. After wiping the dipstick clean, check the oil level. The safe operating level is anywhere within the HOT RUN band.
4. If the oil level is not within the HOT RUN band, add or drain fluid as needed. Use type A fluid, III.

Fluid and Filter Change

Figure 11

At each oil change, examine the oil that is drained for evidence of dirt, metal particles, or engine coolant contamination. If there is evidence of contamination, tag out machine and inform your supervisor.

NOTICE! If excessive metal contamination occurred, replace the oil cooler and bearings in the transmission. If coolant contamination is evident, disassemble, clean, and inspect or serious damage may occur.

1. To assist draining, operate transmission to warm it up to operating temperature.
2. Park the tractor on a level surface, shift to neutral, apply parking brake, and chock wheels.

⚠WARNING Always set the parking brake when parking the machine. The transmission does not have an internal parking lock and failure to apply the parking brake could allow unexpected movement resulting in crushing injury or death.

3. Remove the transmission drain plug and disconnect the oil filler tube from the oil pan. See figure 10 for locations.
4. Remove 21 washer-head screws retaining the oil pan to the transmission housing. Discard the pan gasket and clean the pan with mineral spirits.
5. Remove the screw and washer that retain the internal oil filter. Remove the oil filter and oil filter tube. Remove and discard the seal ring (See figure 10 for this and all remaining steps).
6. Clean or replace the governor oil screen by removing the governor feed tube. This tube and the remaining two tubes are held in place by the control valve body.
7. Install a new seal ring onto the top end of the filter tube. Lubricate the seal ring with transmission fluid.
8. Insert the filter tube and seal ring into the hole in the bottom of the transmission. Install the new oil filter assembly (including gasket) onto the filter tube.
9. Attach oil filter assembly with one 5/16-18 x 5/ 8” washer-head screw. Tighten the screw to 10-15 lb ft.
10 . Submerge gasket in transmission fluid for five minutes. Place gasket onto oil pan lip. Do not seal gasket with any substance other than transmission fluid.

11 . Carefully attach oil pan to transmission by hand with four 5/16-18 washer-head screws. Thread one screw into each corner. Do not allow dirt or debris to enter transmission.
12 . Install the remaining 17 screws by hand, carefully threading them through the gasket and into the transmission. Bottom all screws before tightening.
13 . Tighten all 21 washer-head screws evenly to 10-15 lb ft. Monitor gasket fit while tightening.

NOTE: The oil pan bolts must maintain a minimum of 5 lb ft of torque after the oil pan gasket has taken a set.

14 . Install filler tube at the side of the pan. Tighten the tube fitting to 90-100 lb ft. Install the drain plug and o-ring. Tighten the plug to 15-20 lb ft.
15 . Replace spin-on type external auxiliary oil filter. The filter is mounted on the driver's side inside frame plate near the back of the transmission.
16 . Refill transmission with the proper amount of fluid:
Servicing 9.00 Qts.
Rebuild 15.00 Qts
17 . Check oil level.

Transmission Adjustment For Allison
(For C6, see 1.6.3)

The Allison AT 545 transmission combines a torque converter with a four-speed, fully automatic unit for transmitting engine torque to the drive axle via a drive shaft. Maintenance is limited to changing the fluid and filter at the recommended service intervals and adjusting the linkage.

Most repair facilities can perform the following adjustments: gearshift linkage, and the neutral starting switch.

Malfunctions
Automatic transmission malfunctions may be caused by poor engine performance or improper transmission adjustments.

You should always begin by checking engine performance, then fluid level and condition, and gear-shift linkage adjustment.

If the problem exists after these checks and adjustments are completed, remove tractor from service and refer the transmission to a transmission repair facility.

NOTICE! If you ever notice unusual noises such as gear noise or grinding, a buzz or whine, knocks, scraping, clicking, etc., remove the tractor from service and refer it to a transmission repair facility.

Gearshift Linkage

The shift linkage adjustment is done to make sure that when the gearshift control lever is in a certain drive range, the operator's shift lever is actually in that exact position.

The original setting can be altered by wear, loosening of locknuts, and deterioration of engine mounts. If the engine mounts are damaged, replace the mounts before attempting any other maintenance.

1. Inspect all shift linkage components and replace any that are worn or damaged. Clean any grease, dirt, or rust from linkage to ensure smooth movement.
2. Disconnect shift cable from shift lever on transmission.
3. Place operator's shift lever in REVERSE position.
4. Move shift control lever (on transmission) to rearmost position (R) detent.
5. Adjust cable length by turning clevis in or out until clevis will slide through clevis and shift lever without movement of shift lever or control lever.
6. Move control lever through entire shift range one position at a time, checking shift lever detent at each position.
7. Tighten clevis lock nut. Install clevis and a new self-locking nut. Tighten nut firmly.

Neutral Starting Switch

The neutral starting switch is a safety device which prevents the engine from starting if the transmission is in any shift position other than NEUTRAL.

Testing the Neutral Start Switch

1. Disconnect electrical lead at neutral starting switch.
2. Connect one lead of a test lamp to switch terminal and other lead to battery positive terminal.
3. Move control lever (on transmission) through shift positions while watching test lamp. Lamp should light only when control lever is in NEUTRAL position.

NOTE: The neutral starting switch may also be checked by attempting to start the engine with the gear shift lever in each shift position.

4. If test lamp does not light, switch is faulty or shift cable is out of adjustment. Adjust shift cable as described previously in this section.

5. If lamp still does not light, replace switch.

Replacing the Neutral Start Switch

1. Remove neutral start switch from transmission case. Catch fluid in a clean container.
2. Move control lever to NEUTRAL position. Check to see that the switch operating lever finger is centered in switch opening in transmission case.
3. Install switch and tighten to 24 ft-lbs torque. Retest switch as described previously. If switch still does not light, replace it.

NOTICE! **Be sure the switch packing is properly installed to prevent oil leakage.**

4. Add fluid to transmission if needed.

Shift Cable For Allison

⚠WARNING Failure to follow the shift cable precautions following can result in serious injury or equipment damage.

- Do not adjust shift cable with the engine running.
- If a shift cable gets moisture inside or becomes frozen, replace the cable. Do not apply heat to thaw or dry the cable.
- The shift cable is lubricated for the life of the cable. Do not remove seals or lubricate the control cable.
- The shift cable is non-repairable. Do not attempt to repair the shift cable.

Allison Modulator Installation and Adjustment

As engine power demand increases (i.e. from idle to full throttle), the speeds at which transmission upshifts and downshifts occur are increased accordingly. To optimize vehicle performance at full throttle (as on an accelerating vehicle) upshifts normally occur near engine governed speed. Closed and part throttle shifts are at lower speeds, providing quieter operation and fuel economy benefits.

The shift modulator is a significant element of the controls system, since it changes (modulates) the transmission shift points as a function of vehicle speed and the operator's demand for engine power. Correct design, installation, and maintenance of the shift speed modulation control are therefore extremely important for proper transmission operation.

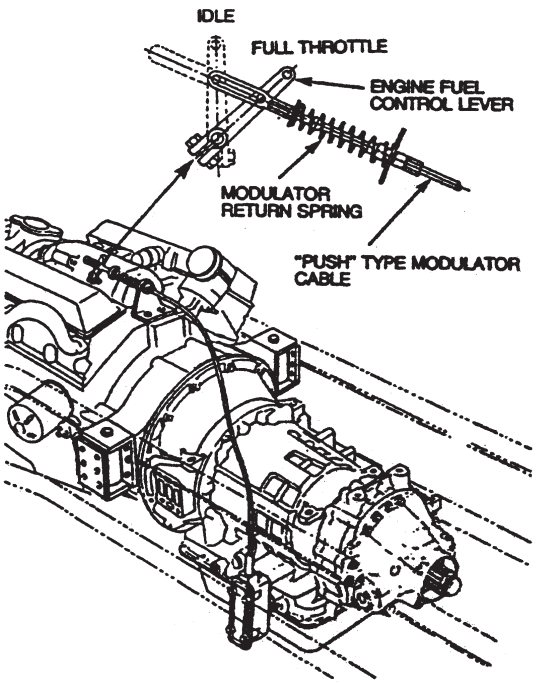


FIGURE 12. MECHANICAL MODULATOR INSTALLATION

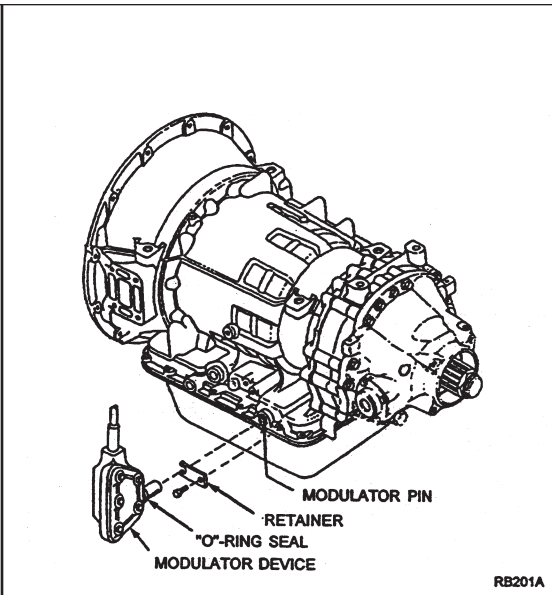


FIGURE 13. MECHANICAL MODULATOR COMPONENTS

Design requirements for a mechanical modulator are shown on separate Shift Modulator Installation Drawings for each transmission series. The mounting location of the modulator is shown on both the Shift Modulator and Basic Installation Drawing for each transmission.

The system design should provide for ease of installation and adjustment. Adjust at full throttle position to insure maximum speed upshifts at full throttle. The modulator must provide a force against the transmission modulator pin, in proportion to cable travel, as described on the appropriate Shift Modulator Installation Drawing. Different modulator designs are available for either “push” or “pull” cable motion when the fuel lever moves from closed to full throttle position.

Figure 12 illustrates a recommended type of connection of the end of a “push type” modulator cable to the engine fuel lever. This type of arrangement will allow the fuel lever to return to idle even if the actuator binds somewhere in its travel between idle and full throttle positions. With this system, a return spring is required on the actuator linkage to insure that the actuator follows the movement of the fuel lever (throttle). The spring should be designed for the particular installation and have a low spring rate to keep the additional accelerator pedal force as low as possible. For suppliers of the mechanical modulator, refer to the Support Equipment section of the appropriate Transmission Installation Manual.

Installation of Modulator

When installing the mechanical actuator, the following procedures should be used. Refer to figure 11,12

- Remove the bolt and modulator to case retainer (spring clip) from the transmission. Remove the plastic shipping plug form the modulator valve opening in the transmission.
- Verify that the modulator pin remains centered in its bore inside the modulator valve opening (see Installation Drawing).
- Lightly lubricate the modulator “O”-ring seal with ®-III or oil soluble grease.
- Insert the modulator into the transmission, making certain that the “O”-ring seals properly with the modulator valve bore, and the modulator contacts the modulator pin in the transmission.
- Install the modulator retainer which is provided with the transmission. The bent tabs on the retainer should be placed in the groove on the neck of the modulator so they bend towards the transmission.
- Secure the retainer with the bolt provided and torque to the specification on Shift Modulator Installation Drawing.

Design of the Mechanical Modulator

When the mechanical linkage, cable and modulator are used to connect engine and transmission, the following design guidelines should be used:

- All levers, pins, and clevises should be case hardened to prevent wear.
- The cable length should be selected to keep bends as gradual as possible. Bend radius should be 203 mm (8 inches) minimum.
- Select adequate size cable or linkage to transmit load.
- The cable assembly should be sealed sufficiently to exclude dirt, water, and solvents.
- The cable housing must be mounted securely at the transmission at the engine. Support clips may be used to secure the cable and prevent backlash. Mount completely on the power package and not on the chassis.
- For engines with yield able throttle levers, the modulator should be connected to the non-yielding position.
- Cable routing should avoid proximity with hot exhaust manifold, mufflers, tail pipes, etc.

Normal modulator cables will withstand continuous temperatures of 121°C (250°F). Insulation, heat shields, or mechanical linkage actuation may be necessary if continuos temperatures at 121°C (250°F) are exceeded. Special cables are also available for applications that operate at high temperatures.

All transmission control linkages must be reviewed by Allison Engineering.

When adjusting the mechanical actuator, the procedure noted below should be followed:

- With engine off, rotate fuel lever to full throttle position. If lever is a type, make sure lever is in the non-yielded position.
- Pull (or push) modulator cable until it is internally “bottomed”.
- Adjust clevis or trunnion on end of cable to permit “free pin” with fuel control lever. With lever still at full throttle position, install and secure pin.
- Check linkage for proper return to idle position. Refer to the modulator manufacturer specifications for correct amount of modulator stroke.

1.7 SHIFT INHIBITOR ADJUSTMENT

1. Place the shift selector in neutral, wheel, transmission is in neutral.
2. Remove the four mounting bolts on the floor mounted shifter and move it aside. Do not unhook the cable connection.
3. Remove the deck plate to gain access to the transmission area.
4. Check that the solenoid engages the locking slot on the locking swing arm freely, without binding, when in neutral. Loosen the solenoid mounting slight and move the solenoid as required if adjustment is needed. Retighten the mounting. The locking swing arm is located on the transmission selector shaft.
5. When adjusting the inhibitor the objective is to set the pressure contact point within the switch (located in the brake line) so the green light never lights when pressing on the brake pedal until the vehicle is completely stopped. If the vehicle is almost stopped when the green light comes on, even as slow as1-2mph, the light will indicate that the inhibitor is unlocked. Transmission damage may occur if the operator shifts the transmission through neutral to change vehicle direction while the tractor is still moving.
6. The following procedure is recommended for correctly adjusting the switch, best done by two people:
    a. Without moving the vehicle but with the engine running, press down on the brake pedal to the point at which you think that effort would be enough to stop the vehicle aggressively.
    b. Unscrew the phillips screw holding the white nylon cap and remove the cap and screw. Turn the exposed allen head screw clockwise to increase the required brake pressure and counter clockwise to decrease the pressure (1/4 turn equals approximately 50 psi).
    c. Stop adjusting when the green light comes on.
    d. Drive the vehicle and make several aggressive stops, similar to an operator driving too fast. If the green light lights before the vehicle comes to a complete stop, the switch is adjusted too low. Repeat the adjustment until the green light comes on only when firmly pressing on the brake pedal after the vehicle has come to a complete stop.
    e. Replace the nylon cap
7. Replace the deck plate and the floor mounted shifter.

1.8 EVERY 2500 OPERATING HOURS OR 2 YEARS

1.8.1 Adjust Valves
Refer to Engine Manufacturer's manual supplied with this manual.

1.8.2 Inspect Injectors - Diesels
Refer this service to a specially trained technician.

1.8.3 Change Coolant
To prevent internal corrosion in the radiator, oil cooler, and engine, the cooling system should be flushed out and filled with fresh coolant.

⚠ DANGER Do not open radiator cap while engine is hot and system is under pressure. Escaping hot coolant can scald and cause serious skin burn.

1. Remove radiator fill cap. Place suitable catch pans under the radiator and engine drain plugs.
2. Drain radiator by opening tap at bottom of radiator.
3. Remove the drain plug from side of cylinder block to drain engine. Make sure drain hole is not plugged.
4. Dispose of old coolant in an approved manner.
5. Flush system with clean water.
6. Install drain plugs and close radiator tap.
7. Remove one of the plugs from the thermostat housing to allow air to escape the engine. Fill radiator with clean engine coolant. Fill coolant reservoir to the recommended level. See 1.3, Fluids And Capacities.
8. Start engine. When engine reaches normal operating temperature, check coolant level in reservoir and fill as required.

1.9 CHANGING AXLE OIL
The rear axle has three drain plugs: one on the outside of each wheel end and one on the axle housing. The wheel end drain plugs are also the fill plugs.

1. Remove rear wheels according to 4.2.1.
2. Using a rag and wire brush, thoroughly clean dirt and rust from around the three drain plugs, axle housing fill plug, and axle breather.
3. Remove, clean, and reinstall drive axle breather. Replace if corroded.
4. Place a catch pan under wheel end and differential drain plugs.

5. Rotate wheel end until plug hole is at its lowest position.
6. Remove drain plugs. Inspect and remove metal particles from plugs. Normally, these particles are very fine. If they appear to be irregular or of a large size, there may be damage inside the axle. Notify your supervisor of this condition.
7. When oil has drained, apply a non-hardening sealing compound (like #51 or equivalent) to differential drain plug and install and tighten plug.
8. Turn wheel ends so plug holes are above level of the axle shaft. If necessary, install plugs temporarily to prevent new oil from leaking out.
9. Remove differential fill plug (upper plug) and fill with oil (SAE 80W-90 or 85W-140) to level of plug hole.
10. To properly fill wheel ends, turn wheels so wheel end plugs are horizontal to axle shaft. Fill wheel ends with oil (80W-90 or 85W-140) to level of plug hole.
11. Apply a non-hardening sealing compound (like #51 or equivalent) to plugs and install and tighten plugs.
12. Install wheels according to 2-4 - 4.2.

1.10 BLEEDING THE BRAKES

Figure 14

Bleeding the brakes means removing air from the brake system. Air in the system causes a springy or spongy feel when braking. Bleeding consists of pumping fresh fluid throughout the system. This forces air out through the wheel cylinder or caliper bleeder valves.

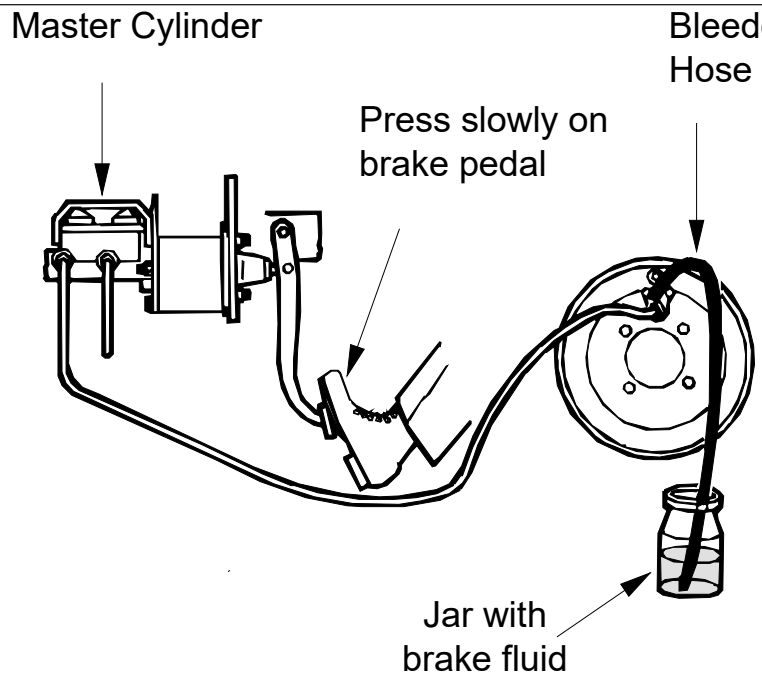


FIGURE 14. TYPICAL SETUP FOR BLEEDING AIR FROM THE BRAKE SYSTEM

1. Clean master cylinder filler cover and remove cover. Fill master cylinder reservoir to within 1/ 4” (6 mm) from top of reservoir. Replace cover.
2. Clean all wheel cylinder and caliper bleeder screws.
3. If using a pressure bleeding system, connect the bleeding system pressure hose with the special fitting to the master cylinder.
4. If the bleeder screw is not at the top of the caliper, remove screws holding caliper to front axle weldment and rotate caliper to top of rotor. This will allow trapped air to escape.
5. Open bleeder screw and allow fluid and air to flow into jar. When air bubbles can no longer be seen and fluid runs clear, close the bleeder screw. Repeat this procedure on the left rear, right front, and left front wheel cylinders, in that order. Remove the pressure bleeding system hose. The procedure is complete.

NOTE: If you are not using a pressure bleeding system, use the standard method as follows in steps 6 and 7:

NOTE: Bleeding the brakes without pressure bleeding equipment requires two persons, one to observe the fluid being bled, and one to depress the brake pedal.

6. With a bleeder hose set up as in step 4, loosen bleeder screw and depress brake pedal several times until air bubbles can no longer be seen and fluid runs clear. Close bleeder screw. Repeat this procedure on the left rear, right front, and left front wheel cylinders, in that order. (Remember to check fluid level in master cylinder frequently.)
7. Replace caliper to original position.
8. After all four brakes have been bled, fill reservoir and install cover on master cylinder.

IMPORTANT! Do not let reservoir run empty. If you let the reservoir run empty, air will enter the system and you will have to begin the procedure all over again.

⚠WARNING To minimize risk of brake system failure and possible accident, when servicing brakes or brake system:

- Do not over tighten brake tube fittings. Over tightening may crack the fitting or damage the seat in the cylinder fitting.
- Compressed air used to service brake components must be oil-free or rubber parts may be damaged.
- Always replace brake lines that are questionable.

- Never allow brake system rubber parts to come in contact with gasoline, diesel fuel, or any type of cleaner other than an approved brake cleaner. Wash hands before handling brake components.
- Brake linings that contact oil or grease can become contaminated, lose braking friction and then must be discarded.

⚠WARNING Any brake service, other than periodic inspection or bleeding, should be performed only by personnel specially trained in brake service. Improper and poor quality service procedures can result in brake system failure, loss of vehicle control, and personal injury

1.11 BLEEDING THE POWER STEERING SYSTEM

Any time a hose, pump, or steering gear unit is removed, replaced, or opened, air in the system will have to be eliminated.

1. Fill power steering pump to proper level and let fluid stand for at least two minutes.
2. Start engine and run momentarily. Add power steering fluid if necessary.
3. Repeat above procedure until fluid level remains constant after running engine.
4. Raise front of vehicle so that wheels are off ground. Turn steering wheel back and forth, lightly contacting wheel stops. Add fluid if necessary.
5. Lower vehicle and turn wheels back and forth on ground. Check fluid level and refill as required.
6. If fluid is foamy, allow vehicle to stand for a few minutes with engine off. Repeat steps 1-6 as necessary.
7. Trapped air in system will cause fluid level in pump to rise when engine is off. Repeat steps above until this condition no longer occurs.

Any brake service other than periodic inspection or bleeding should be performed only by personnel specially trained in brake service.

IMPORTANT!: Clean brake system rubber parts in clean, denatured (isopropyl) alcohol, approved brake cleaning solution, or brake fluid.

⚠WARNING Keep alcohol and other flammable solvents away from open flame or lit cigarettes to prevent explosion or fire.

1.12 BRAKE PEDAL ADJUSTMENT

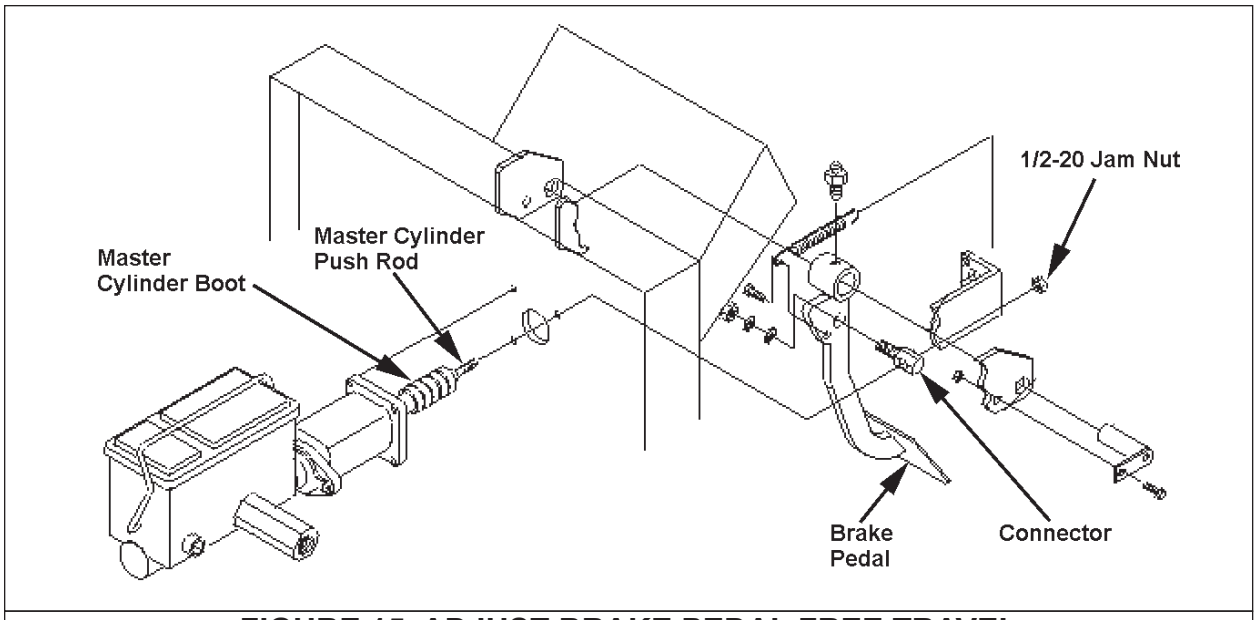


FIGURE 15. ADJUST BRAKE PEDAL FREE TRAVEL

The brake pedal should have about 3/8" free travel before resistance is felt (linkage begins to push booster piston).

1. Remove cover plate.
2. Disconnect upper end of turnbuckle and turn in or out to decrease or increase pedal travel.
3. Reconnect turnbuckle and check pedal free travel. Repeat step 2 if necessary.
4. Reinstall cover plate.

1.13 THROTTLE PEDAL RECALIBRATION REQ. FOR CUMMINS ENG.

The throttle pedal must always be calibrated when it's replaced on a Cummins engine using the following procedure.

1. Start the procedure with the engine and ignition key OFF & the throttle pedal in the idle position.
2. Turn the ignition start key ON (engine is still OFF).
3. Wait 5 seconds.
4. Depress the pedal to FULL throttle position and hold for 3 seconds.
5. Release the pedal tot he IDLE position.
6. Wait 3 seconds.
7. Depress the pedal to FULL throttle position again and hold for 3 seconds.
8. Release the pedal to the idle position again.
9. Wait for 3 seconds.
10. Turn ignition start key to OFF.
11. Wait 5 seconds.
12. The throttle pedal is now calibrated; turn the ignition start key ON and start the engine.

This Page Intentionally Blank

2. TROUBLE SHOOTING

⚠WARNING Perform lockout/tagout procedures before adjusting, lubricating, cleaning or otherwise servicing. Failure to do so could result in unexpected startup and could cause serious injury or death.

⚠WARNING To minimize risk of serious injury or death, follow these hydraulic servicing precautions:

- Follow all necessary lockout/tagout procedures.
- Hydraulic systems have residual, stored pressure. Relieve all pressure from the hydraulic system before servicing.
- Allow fluid to cool before working on system.
- Hydraulic fluid escaping under pressure can have sufficient force to enter eyes and penetrate skin. If fluid gets in eyes or skin, flush with large quantities of water and seek medical attention.
- Wear eye protection when servicing hydraulic components or systems.
- Keep all hoses and connections in good serviceable condition. Check before start-up and periodically during operation.
- Do not investigate for leaks with hands. Use a large piece of cardboard.
-

2.1 STEERING SYSTEM OVERVIEW - USED WITH AT545 TRANSMISSION

The steering gear is powered by a gimbal-mounted, double-acting hydraulic cylinder mounted on the front axle. The control unit is actuated directly by the steering wheel to control flow of hydraulic power to the steering cylinder.

Turning the steering wheel actuates the rotary valve in the power steering unit. As the valve opens, hydraulic oil travels into a metering motor within the power steering unit, then out from the motor, through the valve, and out to the retract side of the steering cylinder. Return oil from the extend side flows through the valve to the reservoir. Oil flowing through the metering motor causes it to turn, and as it turns, it moves a feedback linkage that returns the rotary valve to center and locks the steering cylinder in position. The metering motor therefore ensures that the steering cylinder is precisely controlled by the command received from the steering wheel.

In the event of a power failure, steering can be done manually by spinning the steering wheel. In this case, steering wheel movement turns the metering motor directly through the feedback linkage. The motor is then used as a pump to force oil into the cylinder, while drawing oil into the suction side (through check valve) from the return line.

2.2 SYSTEM PRESSURE TEST

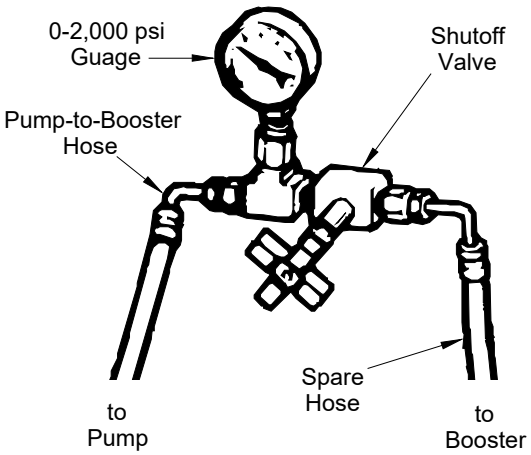


FIGURE 1. TEST GAUGE

A reduction in steering responsiveness may be caused by a faulty pump, relief valve, or internal leakage in the steering gear or power booster.
The relief valve is the least expensive and easiest power system component to replace or repair. The relief valve is located in the lower port on the steering pump. The relief valve may only require cleaning to work properly.

1. Check for proper belt tension and fluid level, and repair any power system fluid leaks.
2. Raise and set front of tractor onto jack stands so that front wheels are off the ground.
3. Disconnect pump-to-booster pressure hose at the power booster. Use rags to catch any fluid leakage.
4. Install a 0-2,000 PSI pressure gauge, shutoff valve, and extra hose between the pump pressure hose and the booster as shown in the figure 1. Gauge must be between shutoff valve and pump.
5. Open the shutoff valve.
6. Start engine and bleed system by turning wheels stop-to-stop. Check fluid level and refill as required. Allow system to reach operating temperature.
7. Without steering, pressure should read below 150 psi. If above 150 psi, check for hose restrictions. When corrected, proceed with this procedure.
8. Turn the steering wheel all the way to one of the stops, then the other. If pressure rises to 1100-1200 PSI each time, the steering pump is OK. If pressure exceeds 1200 PSI, replace the relief valve and re-test. If pressure is below 1100 PSI, continue with step 9.
9. Slowly close the shut-off valve, then immediately open. If pressure is 1100-1200 PSI or greater, the pump is OK. The cause of the low pressure measured in step 8 may be a faulty steering gear or power booster. If the pressure exceeds 1200 PSI, replace the relief valve and re-test. If pressure during this step is below 1100 PSI, either the relief valve or pump is faulty.

NOTICE! Do not leave the shut-off valve closed for more than 5 seconds. Excessive heat may build up, damaging the power system components.

10. Turn engine off, remove test gauge, valve, and extra hose. Reconnect pressure hose to the booster, make necessary repairs, and check fluid level.

2.3 DIAGNOSTICS, STEERING AND BRAKES

Use Table 2.4 for assistance in diagnosing brake problems.

2.3.1 Power System Test

To determine if the pump and booster are operating properly, perform the following test:

1. With engine off, depress and release brake pedal four times to deplete all hydraulic pressure in booster.
2. Depress pedal and hold with light pressure, then start engine.
3. If power section is operating properly, the pedal will fall slightly and then hold. Less pressure will be needed to hold pedal down to this position. You may now wish to perform the leak test.
4. If the power system is not operating properly, check pump fluid level. If OK, check drive belt tension and condition and repair as necessary. If OK, check pump flow and relief pressure and replace pump if necessary. If all tests and checks are OK, replace the booster.

2.3.2 Hydraulic Leak Test

1. First perform the Power System Test.
2. Thoroughly clean all hydraulic system (steering and braking) components.
3. With hydraulic system at normal operating temperature and engine at medium idle speed, apply heavy brake pedal force (100 lbs. maximum) for no more 5 seconds at a time.
4. Check booster, master cylinder, pump, steering gear, and all hose fittings for leaks. Perform repairs as required.

5. If no leaks are found, depress and release brake pedal several times, then hold with medium pressure (25 to 35 lbs.)
   - If pedal does not fall away, hydraulic brake system is not leaking.
   - If pedal falls away, the hydraulic brake system is leaking. Check for external
   - leakage at wheel cylinders, calipers, and brake lines and hoses.
   - If there is no external leak, there may be an internal leak, such as in the master cylinder.

2.4 BRAKE SYSTEM TROUBLE SHOOTING CHART

PROBLEM	POSSIBLE CAUSE	CORRECTION
No Pedal No Brakes	Air in system.	Repair source of air entry and bleed system
	Lining and/or pads worn.	Replace lining and/or pads.
	Master cylinder leaking internally.	Replace master cylinder.
	Low fluid level in master cylinder.	Fill reservoir and bleed system.
	Brake linkage disconnected.	Re-connect.
	Rear brakes not adjusted.	Repair or replace adjusters and adjust
	Caliper seal or piston damage	Repair or replace caliper.
Spongy Pedal	Air in system.	Repair source of air entry and bleed system
	Shoes not centered on drum.	Adjust anchors to center shoes.
	Drums worn or turned too thin.	Replace drums.
	Soft hose.	Replace hose.
	Shoe lining wrong thickness.	Install correct lining.
	Cracked brake drum.	Replace drum.
	Brake shoes distorted.	Replace shoes.
	Insufficient brake fluid.	Bleed system and fill with fluid.
Brakes Fade	Poor lining and/or pads.	Use proper lining and/or pads.
	Excessive use of brakes.	Reduce speed or use lower gear.
	Poor brake fluid.	Flush system and install heavy-duty fluid.
	Improper drum-to-lining contact.	Adjust shoes or grind to correct radius.
	Thin brake drums.	Install new drums.
	Dragging brakes.	Adjust or repair cause of dragging.
	Riding the brake pedal.	Keep foot off brake pedal unless needed
	Excessively thin rotors.	Replace rotors.

BRAKE SYSTEM TROUBLESHOOTING (CONTINUED)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Hard Pedal (Excessive Foot Pressure Required)	Incorrect rear brake lining.	Install proper lining
	Lining contaminated with grease or brake fluid.	Replace or reline shoes. Repair source of fluid.
	Shoes not centered.	Center shoes.
	Primary and secondary shoes reversed	Install shoes in correct location.
	Brake linkage binding	Free linkage and lubricate.
	Master or wheel cylinder pistons frozen	Rebuild or replace cylinder.
	Seized caliper pistons.	Repair or replace.
	Linings hard and glazed.	Sand lining with medium grit sandpaper.
	Lining ground to wrong radius.	Grind to correct radius.
	Heat checked or blued rotor.	Recondition or replace rotor.
	Brake line or hose clogged or kinked	Replace line or hose.
	Power booster unit defective	Replace power booster.
	Power steering pump belt defective or slipping.	Replace belt or tighten
	No hydraulic fluid in power steering pump reservoir.	Add hydraulic fluid.
Brakes Pull Tractor to One Side	One wheel grabbing.	See “Brakes Grab”
	Shoes not centered or adjusted properly	Center and adjust lining-to-drum clearance.
	Different lining on one side or shoes reversed on one side.	Replace lining or install shoes in proper position.
	Sagged, weak, or broken suspension.	Repair or replace axle.
	Uneven tire pressure.	Use same pressure on both sides.
	Front axle damaged.	Repair or replace axle.
	Plugged line or hose.	Clean or replace.
	Caliper or backing plate loose.	Tighten fasteners to proper torque specs

BRAKE SYSTEM TROUBLESHOOTING (CONTINUED)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Brakes Drag	Parking brake adjust. too tight.	Adjust properly.
	Clogged hose or line.	Clean or replace.
	Master cylinder reservoir cap vent clogged.	Open vent in cap.
	Brake pedal not fully releasing.	Adjust pedal release.
	Insufficient pedal free travel.	Adjust pedal free travel.
	Brakes adjusted too tight.	Adjust correctly.
	Brakes not centered on drum.	Center shoes.
	Master cylinder or wheel cylinder cups soft and sticky.	Repair or replace cylinders. Flush system. Adjust bearings.
	Loose wheel bearing.	Adjust, 3-1-1.5.5.
	Parking brake fails to release.	Clean and lubricate parking brake linkage.
	Shoe retracting springs weak or broken.	Replace springs.
	Out-of-round drum.	Turn drums.
	Defective power booster.	Repair or replace booster.
	Seized caliper piston(s).	Repair or replace caliper.
	Thin rotor.	Replace rotor.
	Loose caliper bolts.	Tighten to proper torque specs
Brakes Chatter	Weak or broken shoe retracting springs.	Replace springs.
	Loose backing plate.	Tighten fasteners.
	Loose or damaged wheel bearings.	Adjust or replace bearings
	Drums tapered or barrel-shaped.	Turn drum in pairs, or replace.
	Bent shoes.	Replace.
	Dust on lining or lining glazed.	Sand with medium grit sandpaper and clean.
	Drum damper spring missing.	Install damper spring.
	Grease or fluid on linings.	Replace shoe and lining assembly.
	Shoes not adjusted properly.	Center and adjust shoes.
	Incorrect pads.	Install correct pads.
	Damaged pads.	Replace pads.

BRAKE SYSTEM TROUBLESHOOTING (CONTINUED)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Brakes Squeal	Glazed or charged lining and/ or pads	Sand or replace linings and/or pads
	Dust or metal particles imbedded in lining.	Sand lining with medium grit sandpaper and clean.
	Lining rivets loose.	Replace shoes
	Wrong lining.	Replace with correct shoe and lining assemblies.
	Shoe hold-downs weak or broken.	Replace hold-downs.
	Drum damper spring missing.	Install damper spring.
	Pads worn or glazed.	Replace pads.
	Shoes improperly adjusted.	Adjust shoes.
	Shoes bent.	Replace shoes.
	Bent backing plate.	Replace backing plate.
	Shoe retracting springs weak or broken.	Replace springs.
	Drum too thin.	Replace drum.
	Lining saturated with grease or brake fluid	Replace shoe and lining assemblies
“Nervous Pedal (Pedal Moves Rapidly Up and Down When Applying Brakes)	Excessive disc distortion.	Machine or replace disc.
	Brake drums out-of-	Turn or replace drums.
	Loose wheel bearings.	Adjust to remove play.
	Drums loose.	Tighten wheel lugs.
	Rear axle bent.	Replace axle.

BRAKE SYSTEM TROUBLESHOOTING (CONTINUED)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Brakes Grab (One or More Wheels)	Grease or brake fluid on lining and/or pads.	Replace lining and/or pads.
	Lining charred.	If mild, sand. If severe, replace.
	Lining loose on shoe.	Replace.
	Loose wheel bearings.	Adjust bearings.
	Defective wheel bearing.	Replace bearings.
	Loose brake backing plate.	Torque fasteners.
	Defective drum.	Turn both drums.
	Sand or dirt in brake shoe assembly.	Disassemble and clean. Repair as required.
	Wrong lining type or size.	Install correct lining.
	Primary and secondary linings or shoes reversed.	Install correctly.
	Loose caliper.	Torque fasteners.
	Defective power booster.	Repair or replace.

This Page Intentionally Blank

2.4.1 Equalizer Valve

The equalizer valve reduces the hydraulic pressure to the front disk brakes and maintains high pressure to the rear drum brakes.

Check the equalizer valve for leakage whenever the brakes are serviced. If there is evidence of leakage, replace the equalizer valve.

2.4.2 Check Valve

The check valve maintains a slight pressure in the rear brake system to prevent the entry of air into the system past the wheel cylinder cups when the pedal is released and fluid returns to the master cylinder from the wheel cylinder.

The check valve is non-repairable. If air is frequently being drawn into the brake system, as evidenced by spongy brakes, replace the check valve.

2.4.3 Stoplight Switch

The stoplight switch is actuated by hydraulic pressure. It is located next to the brake fluid reservoir.

Check switch operation by inspecting brake lights while brake is being applied. Lights should come on with very mild pressure on the brake pedal.

If one light does not come on, check for a burned-out bulb or a poor electrical connection. If both lights do not come on, check the fuses.

If bulbs, fuses, and connections are good, check the stop light switch: Unplug the two wires from the switch and test for 12VDC. Voltage should be present. If not, the problem is in the wiring. If voltage is present, the switch is not working and should be replaced.

If care is taken, a new switch may be installed without allowing air into the brake system. To replace the switch, unscrew the switch from the hydraulic fitting. Apply a very small amount of pressure on the brake pedal, just enough to cause brake fluid to fill the opening in the hydraulic fitting, then install the new switch. Plug in the wires and re-check the brake light operation.

If brakes feel spongy after replacing the stoplight switch, bleed the brakes according to paragraph 2-1 - 1.10.

2.4.4 Brake Lines And Fittings

Check the brake metallic lines and hoses for leaks whenever servicing the brakes. Check the lines for signs of deterioration, cuts, kinks and other damage. Replace any line that is questionable.

Brake fittings are either the inverted flare or pipe type.

The **pipe fitting** (Figure 2) uses a tapered thread that produces leakproof joints. Pipe threads will leak if or over-torqued.

Use a good pipe dope such as teflon tape on pipe threads. Do not put dope on the first two threads from the end. Always put dope on the male thread, never on the female thread.

After firm hand tightening, give the fitting 2-1/2 to 3 additional turns. This will lock the threads. Tightening beyond this point will be of no value and could even split the fitting.

Flare fittings (Figure 3) are designed especially for high-pressure application.

To properly tighten an inverted flare fitting:
a. Align the tubing with the fitting.
b. Shove the flare against the fitting seat and run up the nut finger-tight.
c. Using a flare wrench, bring the nut up solidly. You will feel a firm metal-to-metal contact. At this point, give the nut an additional 1/6 turn.

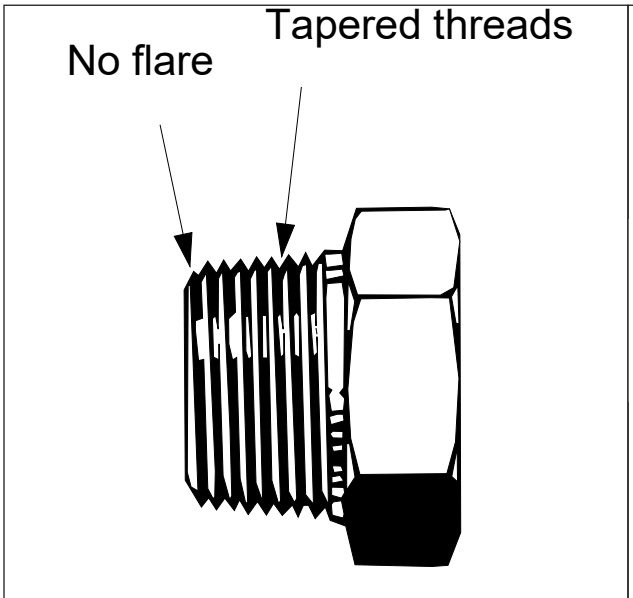


FIGURE 2. PIPE FITTING (TYPICAL)

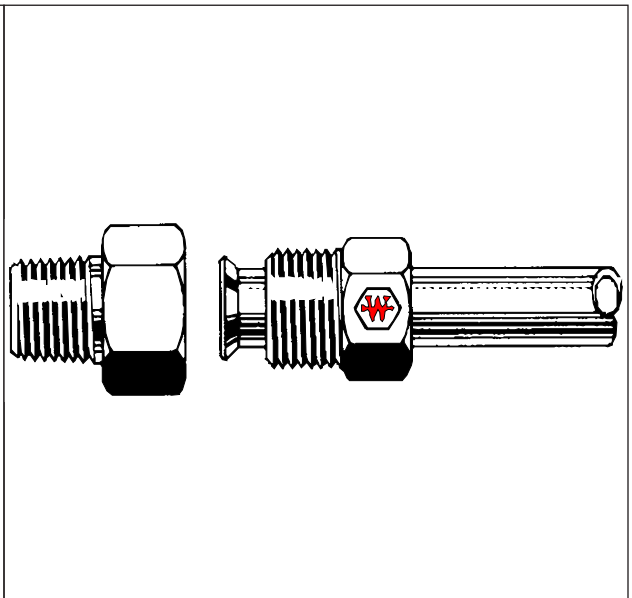


FIGURE 3. INVERTED FLARE FITTING

2.5 ELECTRICAL AND HYDRAULIC SCHEMATICS AND DIAGRAMS

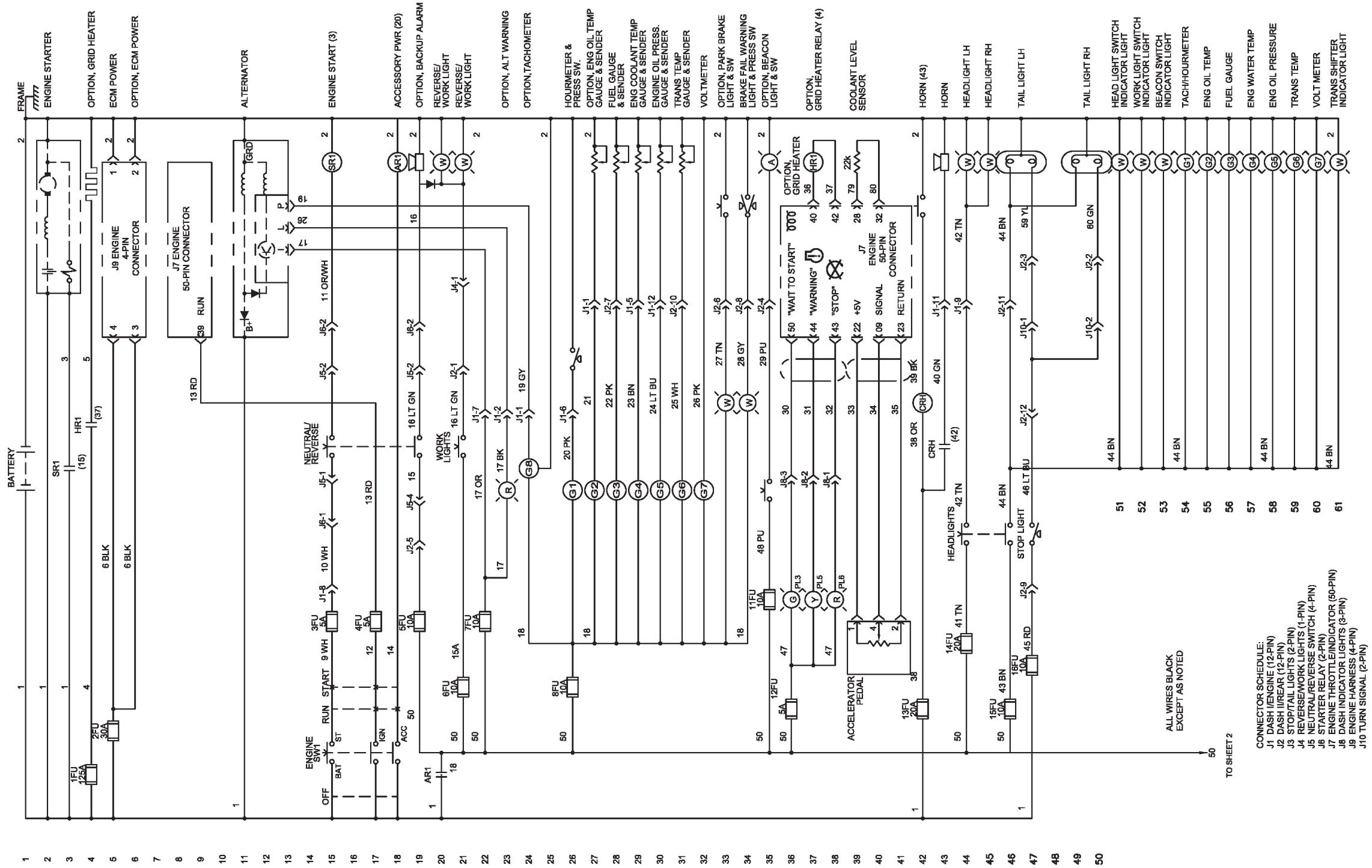


FIGURE 4. CUMMINS QSB4.5/AT SCHEMATIC

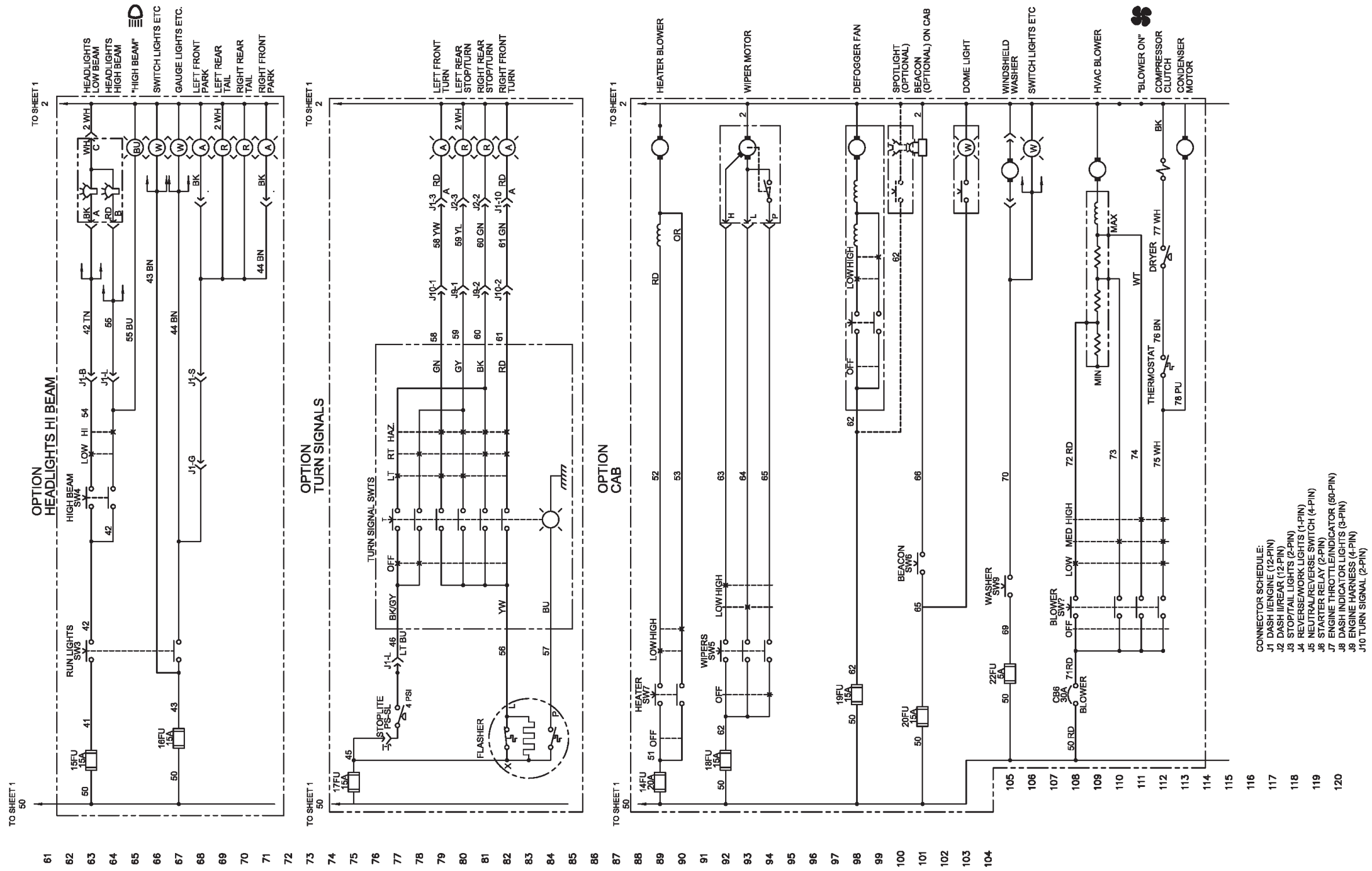


FIGURE 5. CUMMINS QSB4.5/AT SCHEMATIC

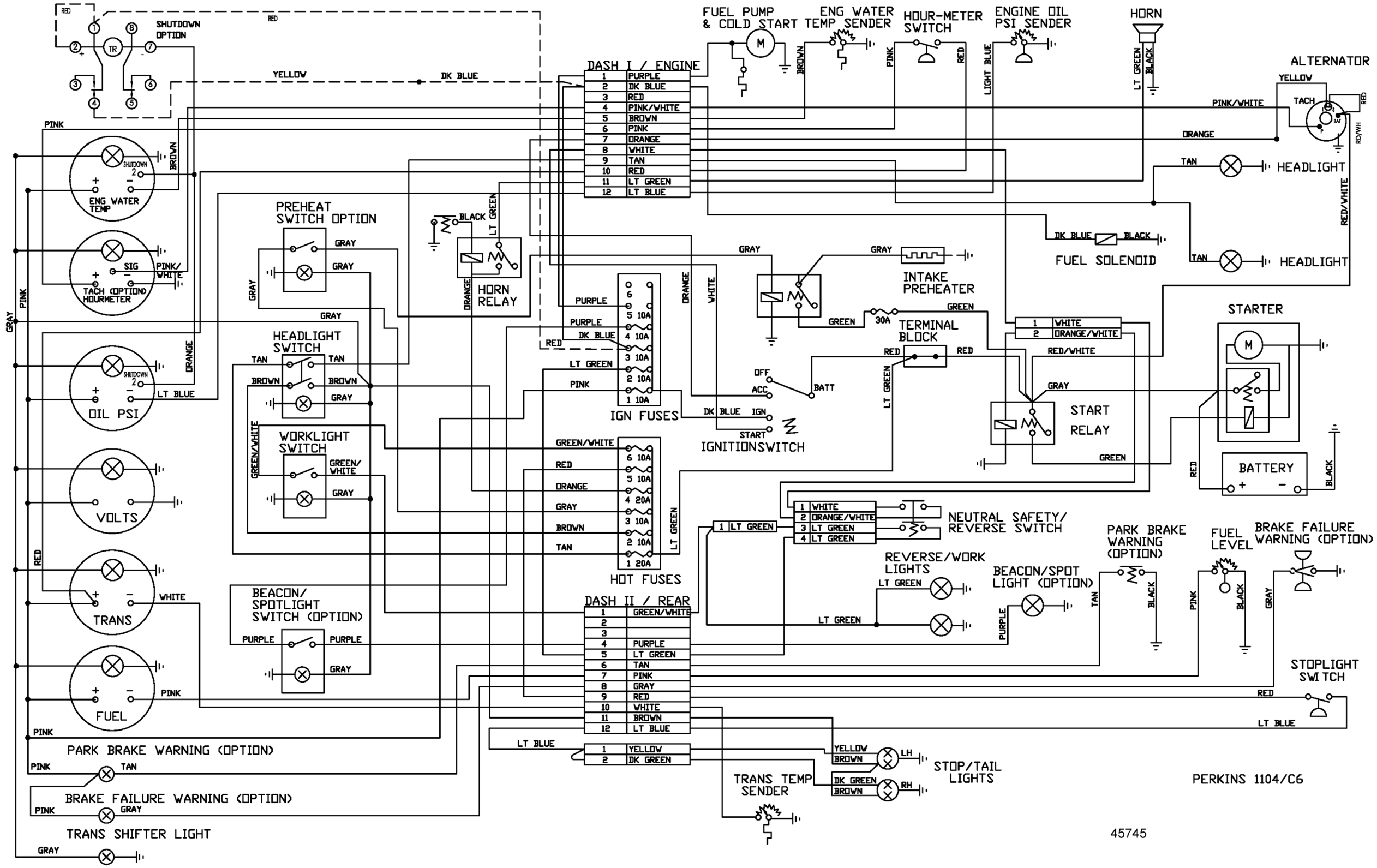


FIGURE 6. PERKINS 1104/C6 SCHEMATIC

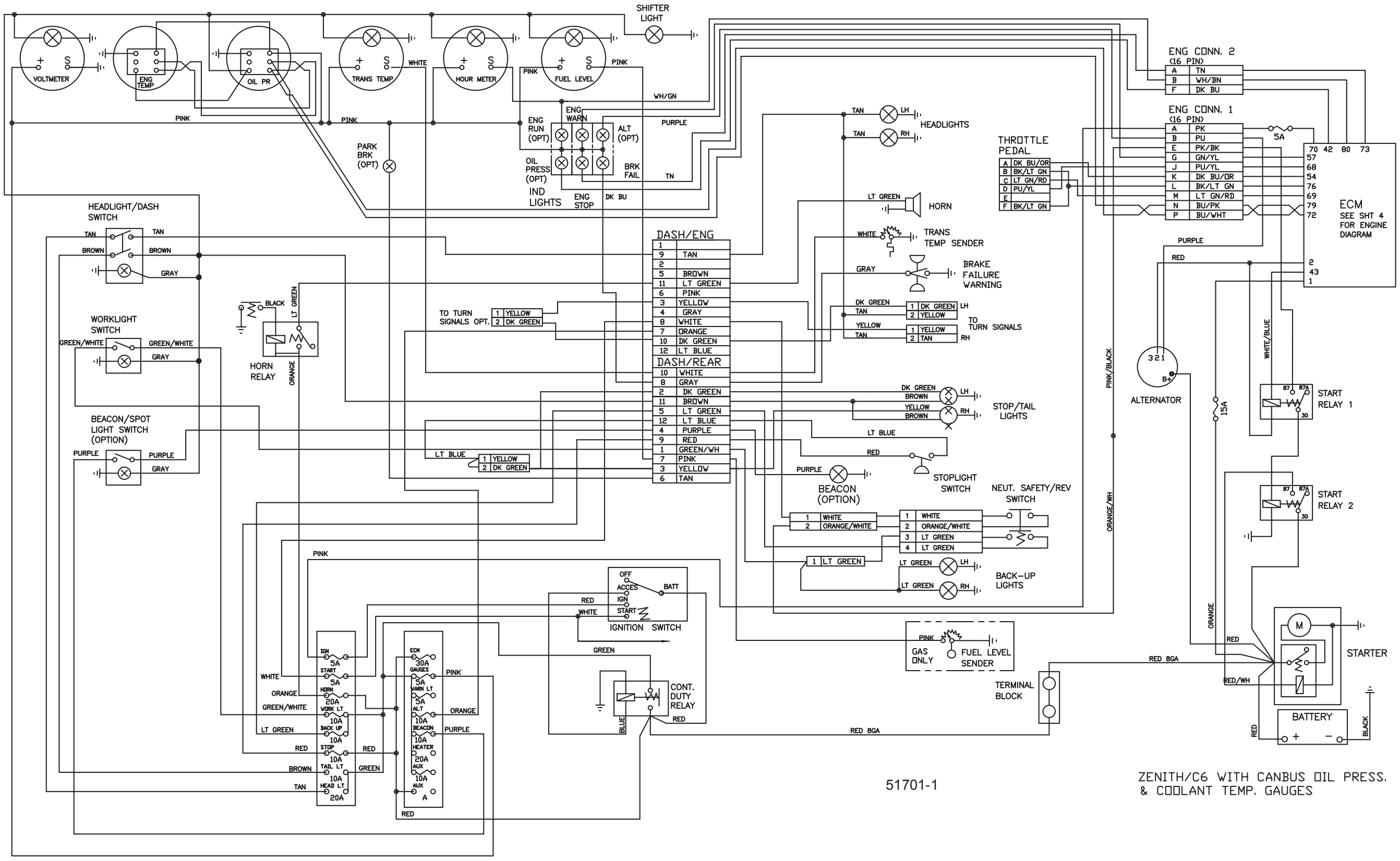
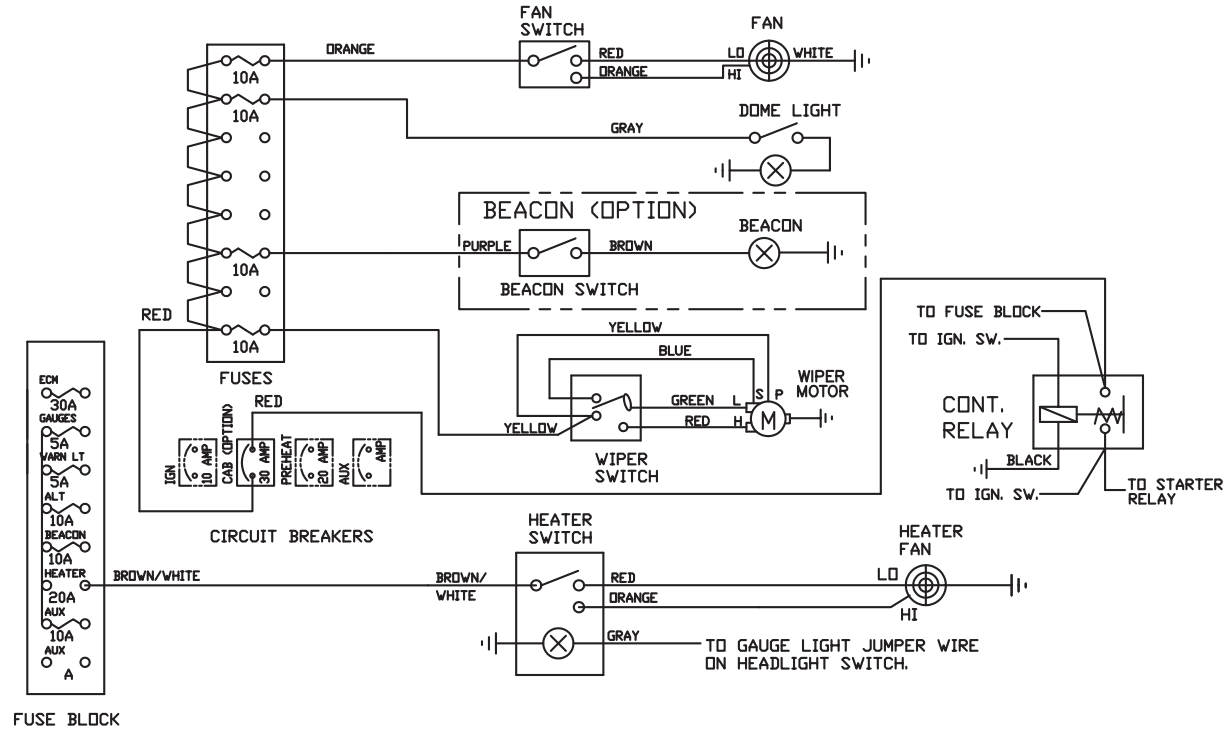
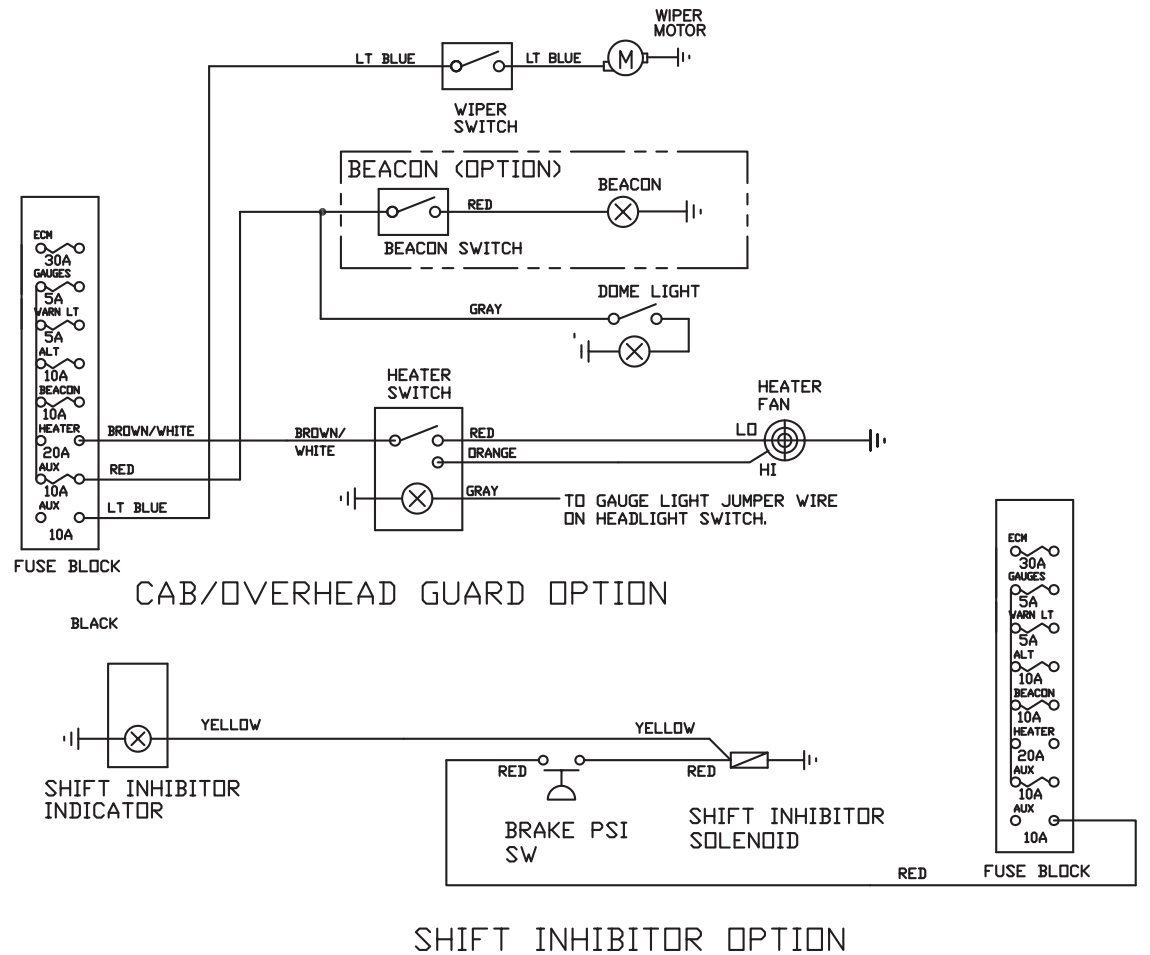


FIGURE 7. ZENITH/C6 SCHEMATIC (1 OF 4)

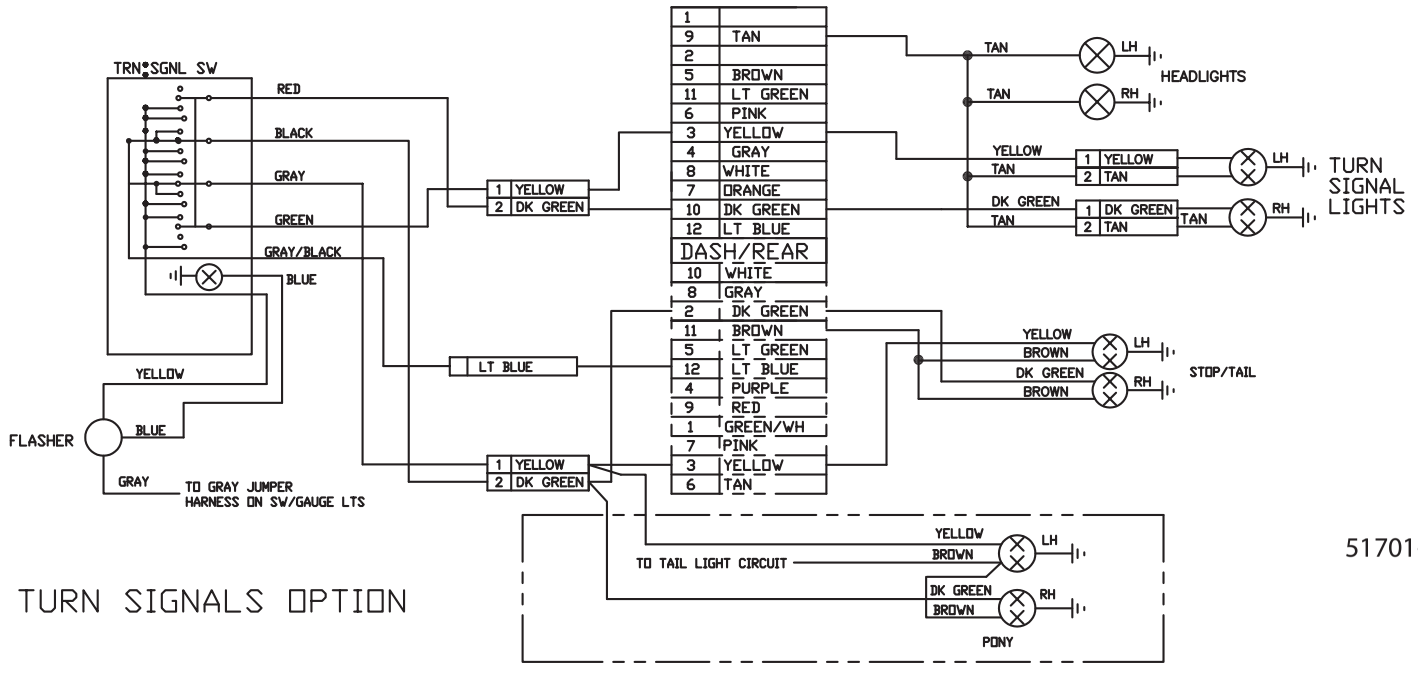


CAB OPTION



CAB/OVERHEAD GUARD OPTION

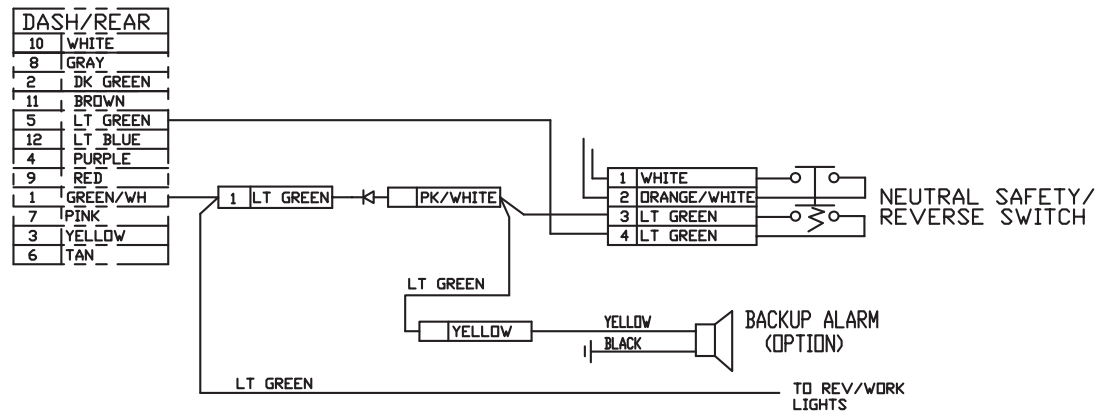
SHIFT INHIBITOR OPTION



TURN SIGNALS OPTION

51701-2

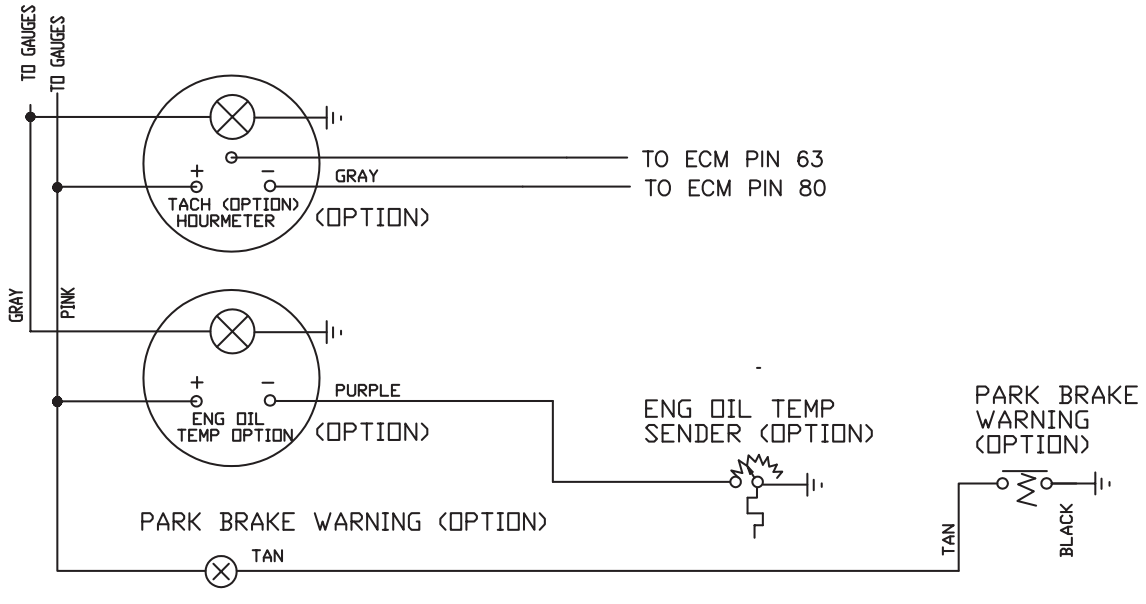
PONY LIGHT OPTION



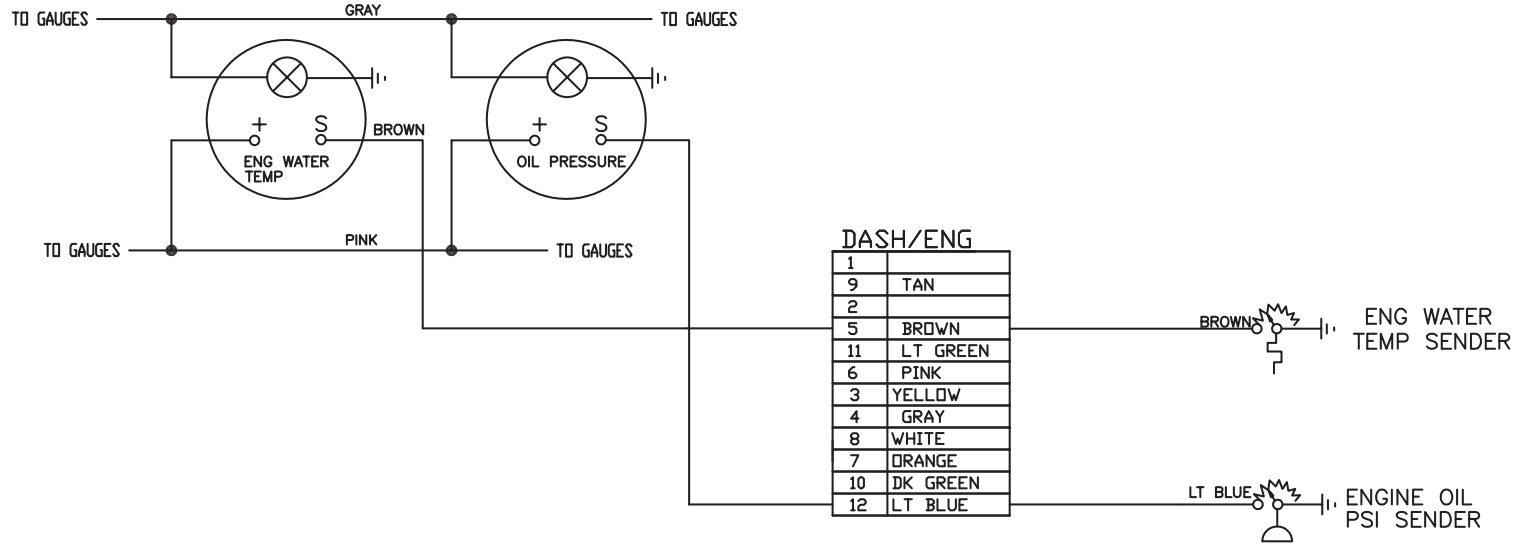
BACKUP ALARM OPTION

ZENITH/C6

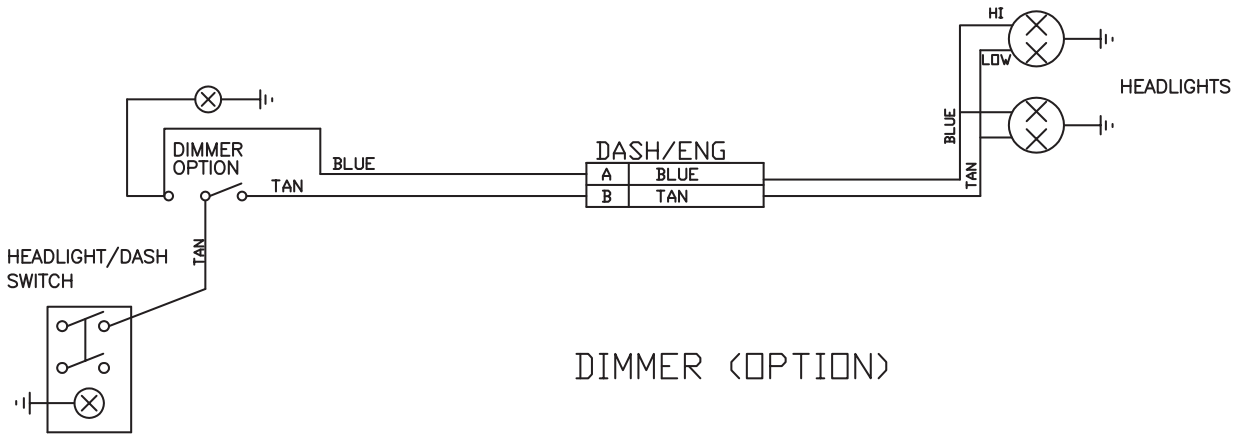
FIGURE 7. ZENITH/C6 SCHEMATIC (2 OF 4)



GAUGE & INDICATOR OPTIONS

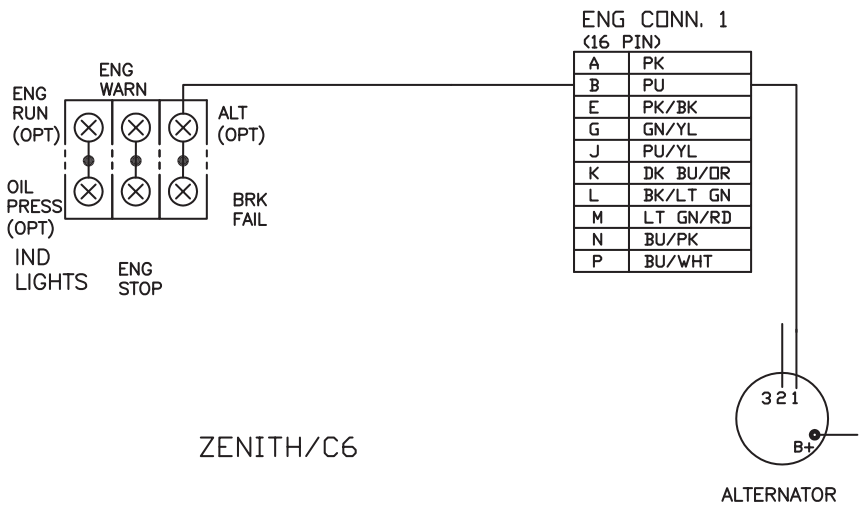


ELECTRICAL OIL & TEMP GAUGE OPTION



DIMMER (OPTION)

51701-3



ZENITH/C6

ALTERNATE CHARGE IND. WIRING

FIGURE 7. ZENITH/C6 SCHEMATIC (3 OF 4)

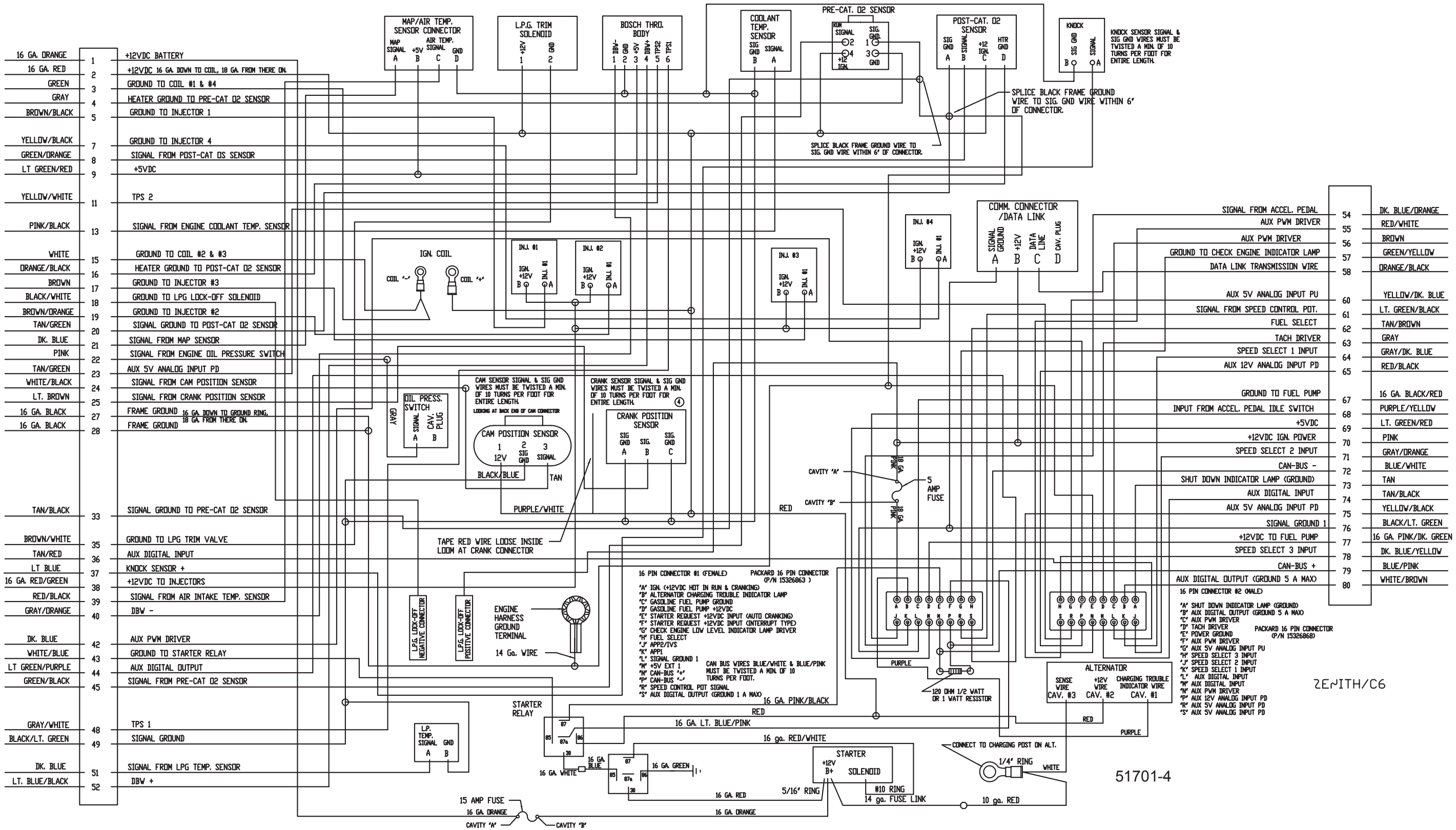
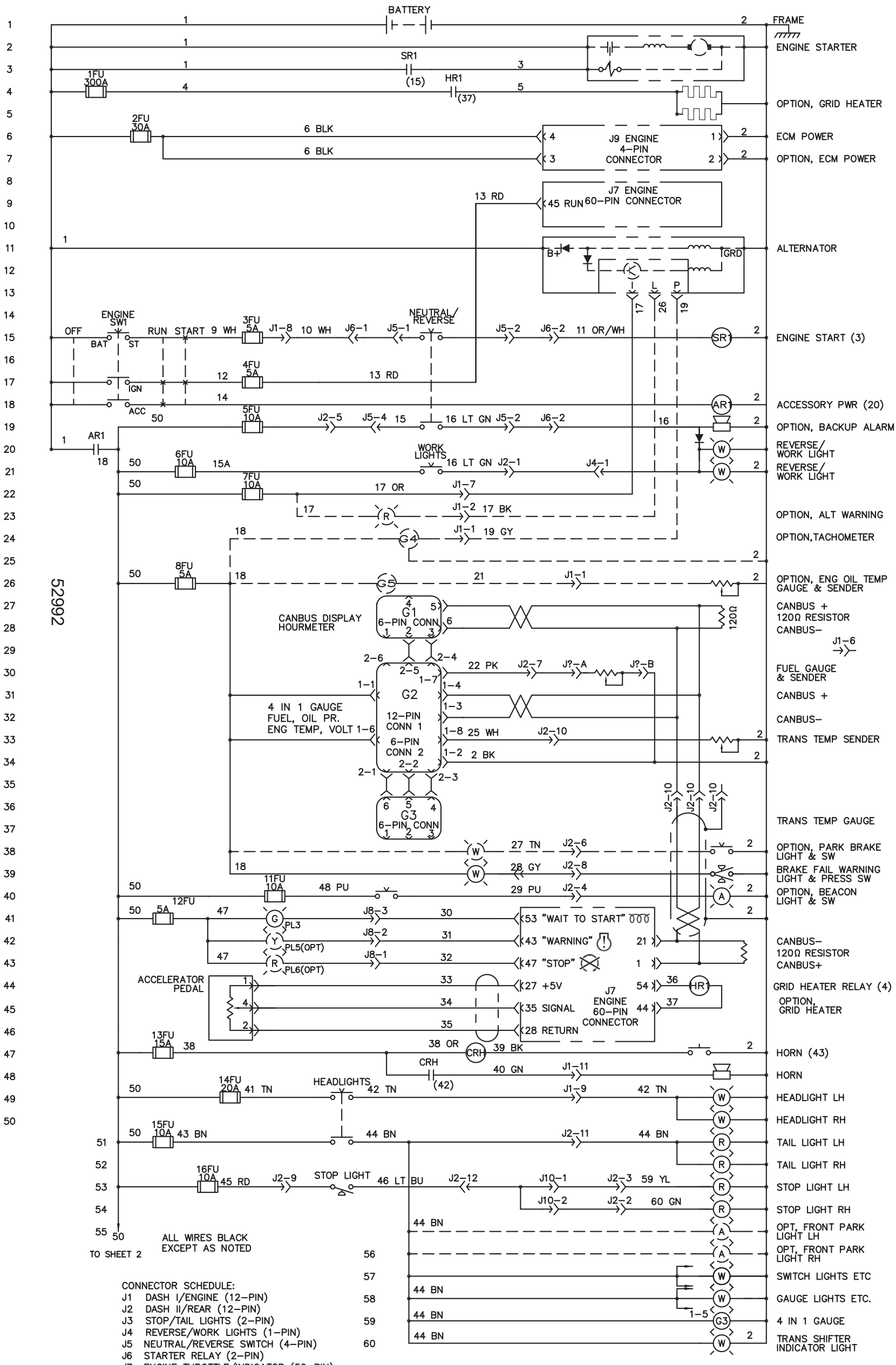


FIGURE 7. ZENITH/C6 SCHEMATIC (4 OF 4)

FIGURE 8. CUMMINS QSB3.3/C6 SCHEMATIC (1 of 2)



CONNECTOR SCHEDULE:
J1 DASH I/ENGINE (12–PIN)
J2 DASH II/REAR (12–PIN)
J3 STOP/TAIL LIGHTS (2–PIN)
J4 REVERSE/WORK LIGHTS (1–PIN)
J5 NEUTRAL/REVERSE SWITCH (4–PIN)
J6 STARTER RELAY (2–PIN)
J7 ENGINE THROTTLE/INDICATOR (50–PIN)
J8 DASH INDICATOR LIGHTS (3–PIN)
J9 ENGINE HARNESS (4–PIN)
J10 TURN SIGNAL (2–PIN)

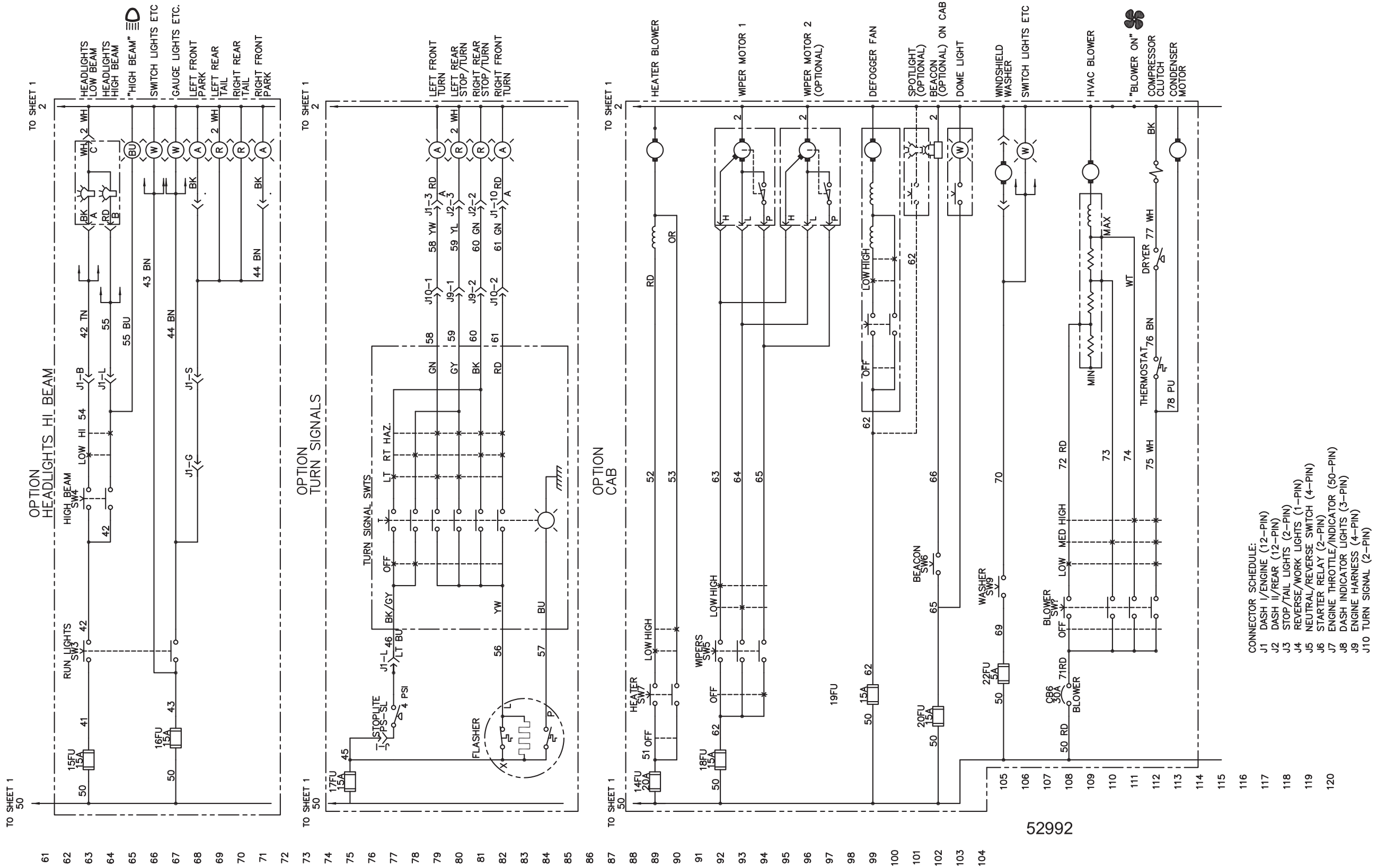


FIGURE 8. CUMMINS QSB3.3/C6 SCHEMATIC (2 of 2)

This Page Intentionally Blank

3. REMOVAL AND INSTALLATION

⚠WARNING Perform lockout/tagout procedures before adjusting, lubricating, cleaning or otherwise servicing. Failure to do so could result in unexpected startup and could cause serious injury or death.

3.1 AXLE

If you need to disassemble or replace the axle, first remove axle from tractor.

1. Remove rear wheels.
2. Drain axle lubricant according to steps 3-7.
3. Remove pipe clamps holding exhaust pipe and tail pipe to frame. Disconnect exhaust pipe at exhaust manifold and remove exhaust system.
4. Remove U-bolts securing rear universal joint to input yoke of differential and swing drive shaft out of the way. Tape bearing to universal joint spider to prevent losing bearings.
5. Disconnect brake lines from wheel cylinders and remove hardware securing tee to differential housing. Plug lines to prevent system contamination. Move brake lines and secure to frame to prevent damage to lines.
6. Drain lubricant from wheel ends and differential housing.
7. Position an axle jack or other mobile lifting device under axle and raise it enough to relieve tension. Remove capscrews to free axle unit from tractor and lower axle.
8. Raise tractor until rear axle unit can be moved from under tractor.
9. Move axle unit from beneath tractor. If sufficient clearance cannot be obtained at the rear, slide unit outside of tractor.

NOTICE! Do not attempt to clean assembled units using steam or by dipping in solvent. These methods will result in premature axle failure. Complete disassembly is necessary for thorough cleaning.

3.1.1 Disassembly of Rockwell Differential and Drive Pinion

If you want to remove only the drive pinion assembly and not the differential, perform steps 4-12 only.

1. Remove axle according to 3.1.
2. Remove bolts or and separate differential carrier halves.
3. Remove differential and gear assembly.
4. Turn axle so cover side is up.
5. Remove the six (6) from pinion cage assembly.

6. Remove oil seal.
7. Use a soft hammer and tap housing gently, exerting pressure on drive pinion to remove pinion and cage assembly from axle housing.
8. Bend back the soft metal lock on outer nut.
9. Remove outer nut and metal lock.
10 . Remove inner nut and thrust washer.
11 . Support pinion cage on flange face and press out drive pinion.
12 . Remove and replace bearings if necessary. If original identification marks are not clear, match mark differential case halves with a punch or chisel.
13 . Cut lock wire, remove , and separate case halves.
14 . Remove spider, differential pinions, side gears and thrust washers.
15 . Separate bevel gear from case (if required) by removing , washers, and nuts.
16 . Remove differential bearings with a bearing puller, if replacement is necessary.

3.1.2 Disassembly of Wheel End

See exploded parts illustration in chapter 4.

1. Remove axle according to 3.1.
2. Remove fill/drain plug and drain lubricant from wheel end.
3. Remove the 16 from planetary spider assembly cover.
4. Using puller holes, remove planetary spider assembly.
5. Remove the three (3) planetary gears.
6. Inspect bronze planetary shafts for wear. If wear is excessive, replace shafts. This can be done by removing setscrews and pressing out shafts.
7. Remove axle shaft and sun gear (note integral part).
8. Remove planetary ring gear.
9. Remove hub bearing adjusting nut.
10. Remove hub and drum assembly.
11.Remove, clean, and reinstall drive axle breathers. Replace if corroded.

NOTE: When removing hub and drum assembly, always replace hub oil seal.

3.1.3 Cleaning and Inspection

Thorough cleaning and visual inspection of parts for indications of wear or stress is necessary to eliminate costly and avoidable axle failures.

Clean parts in a suitable solvent such as P-D-680 or equivalent. Parts should be thoroughly dried immediately after cleaning. Use soft, absorbent paper towels or wiping rags free of dirt, lapping compound, metal filings, or contaminated oil.

Immediately after cleaning, coat parts with a light film of oil to protect from corrosion and then reassemble. If parts are to be stored for any length of time, they should be treated with a good rust preventive and wrapped in special paper or other material designed to prevent corrosion.

NOTE: Do not clean bearings in gasoline. Never place ground and polished surfaces in a hot cleaning solution tank.

1. Inspect all bearing cups and cones, including those not removed from parts of the carrier. Replace if pitted or damaged in any way.
2. Remove parts needing replacement with a suitable puller. Avoid use of hammers and drifts as they can easily mutilate or distort axle parts.
3. Inspect gears for wear or damage. Gears that are pitted, galled, worn, or broken through the case hardening should be replaced.

NOTE: When necessary to replace either the bevel pinion or gear, replace the gears as a set. These gears are matched to assure quietness and satisfactory service.

4. Inspect differential assembly for:

    a. Pitted, scored or worn thrust washers, spiders, differential gears or wear surfaces.

    NOTE: Replace thrust washers in sets because using old and new washers together can result in premature failure.

    b. Wear or damage to differential gear teeth.
    c. Spider trunnions for looseness in differential case bores.

5. Check bevel pinion end for indications of brinelling caused by worn splines. Replace parts if pinion or shaft splines are worn, permitting the pinion to move on the shaft.
6. Inspect axle shafts for indications of torsional fractures and runout. Total runout should not exceed .005”.

3.1.4 Repair

Replace all worn or damaged parts. Replace hex nuts with rounded corners, all lock washers, oil seals, and gaskets.

3.1.5 Reassembly of Wheel End

1. Install inner and outer wheel bearing cups into hub using an appropriate driver. Apply light machine oil to inner bearing cone and install bearing cone.

Installation of new oil seal.

2. Apply a thin coat of #51 sealer to O.D. of oil seal.
3. Using an appropriate driver install the seal until it bottoms in the hub bore.

NOTE: Be sure lip is towards the bearing cone.

4. Apply a light coat of grease or oil to seal lip and spindle seal journal.
5. If hub and drum were separated, assemble drum and hub using capscrews and tighten to 85-115 ft-lbs torque.
6. Install hub and drum assembly onto axle spindle, being careful not to damage oil seal.
7. Apply light machine oil to outer bearing cone and install bearing cone.
8. Install wheel bearing adjusting nut and tighten to obtain 5-8 in/lbs rolling torque.
9. Install planetary ring gear (NOTE: Wheel bearing adjusting nut roll pin must line up with hole in planetary ring gear).

If differential pinion was removed, go to 3.1.8. If pinion was not removed, perform steps below:

⚠WARNING To minimize risk of serious eye injury always wear industrial safety glasses when working with snap rings and spring loaded retainers as they can be ejected with great force. Use extreme caution and keep your body and face out of the way.

10. Install axle shaft. Place sun gear on shaft end and secure with snap ring.
11. Assemble planetary spider (pinion shafts, setscrews, pinion gears thrust washers, and snap rings).
12. Install planetary spider assembly to hub using capscrews and washers. Secure with 85 to 115 ft/lbs. Use RTV-732 sealant when reinstalling the planetary spider assembly.

13 . Remove differential fill plug (upper plug) and fill with oil (SAE 80W-90 or 85W-140) to level of plug hole. Apply a non-hardening sealing compound (like Permatex #51 or equivalent) to plug threads and install and tighten plug.
14 . Turn each wheel so wheel end plug is horizontal to axle shaft. Fill wheel ends with oil (SAE 80W-90 or 85W-140) to level of plug hole. Apply a non-hardening sealing compound (like Permatex #51 or equivalent) to plug threads and install and tighten plugs.
15 . Install axle according to 3.1.8.

3.1.6 Reassembly of Drive Pinion

1. If removed, install new bearing cone to drive pinion shaft.
2. If removed, press new bearing assembly firmly against drive pinion shoulders using a suitable sleeve.
3. Install bearing assembly snap ring and squeeze ring into pinion shaft groove with pliers.
4. If a new cone was installed onto pinion shaft, press a new inner cup into the pinion bearing cage firmly against cage shoulder.
5. If a new outer cone is to be installed onto pinion shaft, press a outer new cup into the pinion bearing cage firmly against cage shoulder.
6. Install new dowel into bearing cage, if removed
7. Place bearing cage assembly over drive pinion and bearing cone assembly.
8. Press outer front bearing cone onto shaft.
9. Rotate cage several revolutions to assure normal bearing contact.
10 . Install thrust washer.
11 . Install and secure inner nut to 300 ft/lbs.
12 . Install lock plate and bend tab flat over inner nut.
13 . Install outer nut and tighten to 300 ft/lbs.
14 . Bend lock plate tab flat over outer nut.
15 . Install assembly into differential carrier.
16 . Place gasket into groove in face of pinion cage and apply #51 sealing compound or equivalent.
17 . Install new oil seal.
18 . Install cover and secure with the washers and six (6) capscrews (five long and one short) to 130-165 ft-lbs torque.

If differential was disassembled, continue to 3.1.7.

3.1.7 Reassembly of Differential

1. If disassembled, attach bevel gear to case half using capscrews, washers and nuts. Tighten to 60-75 ft/lbs. torque.
2. Lubricate differential case inner walls and all internal parts with clean axle oil.
3. Install thrust washers, side gears, differential pinions, and spider in bevel gear-case assembly.
4. Align match marks and position differential case plain half onto flange half. Draw together using four washers and capscrews, equally spaced.
5. Check for free rotation of differential gears and correct if necessary.
6. Install remaining washers and capscrews and tighten to 85-115 ft/lbs. If lock wire was not used, apply Loctite No. 277 or equivalent to threads prior to assembly.
7. If bearings are to be replaced, press new cones squarely and firmly on differential case halves. Press new cups into carrier halves.
8. If removed, install thrust block and pin into carrier plain half.
9. Coat carrier flanges with a non-hardening sealing compound (like #51 or equivalent).
10. Using a new gasket, assemble carrier halves together. Make sure mounting pads are in the same position and level with each other. Secure halves with lock capscrews, washers and nuts. Tighten to 65-85 ft/lbs.

NOTICE! There is no shim pack or shims necessary for adjusting bevel gears or differential bearing pre-load because housing and gears are machined within limits that impose the correct pre-load and gear lash when unit is assembled.

3.1.8 Installation of Rear Axle Without Springs

1. Position rear axle under tractor and raise axle into position.
2. Install and secure axle to frame using original fasteners if undamaged.
3. Secure tee to differential housing.
4. Install brake lines. Bleed brakes as described in 2-1 - 1.10.
5. Connect rear universal joint to differential. Tighten U-bolt style nuts to 20-24 ft-lbs or strap design bolts to 30-35 ft-lbs.
6. Install exhaust system.
7. Remove differential fill plug (upper plug) and fill with oil to level of plug hole. Apply a non-hardening sealing compound (like #51 or equivalent) to plug threads and install and tighten plug.

8. Turn each wheel so wheel end plug is horizontal to axle shaft. Fill wheel ends with API GL-5 oil (SAE 80W-90 or 85W-140) to level of plug hole. Apply a non-hardening sealing compound (like Permatex #51 or equivalent) to plug threads and install and tighten plugs.
9. Install wheels according to 2-4- 4.2.6.

⚠WARNING After initially mounting u-bolts over springs and axle, recheck u-bolt nut torque after the first hour of operation and after the first 8 hours of operation. After this, check monthly or every 250 hours, whichever comes first. Failure to do so may result in axle mounting failure and loss of vehicle control.

3.2 DRIVE SHAFT

The drive shaft transmits torque from the transmission to the rear axle assembly. Universal joints at each end of the drive shaft compensate for any angular misalignment between the transmission and the rear axle.

Repair of the drive shaft assembly is limited to replacing universal joints, the slip joint components, or the complete drive shaft.

3.2.1 Removal

1. Remove four capscrews securing front yoke to transmission.
2. Remove nuts and lock washers from “U” bolts securing rear spider to yoke on differential.
3. Remove “U” bolts and carefully strike the yoke to push the drive shaft slip joint together. Remove drive shaft assembly from tractor. Be careful not to allow bearing caps to fall off spider.

3.2.2 Installation

1. Install drive shaft assembly on transmission and secure with capscrews and lock washers. Tighten U-bolt style nuts to 20-24 ft-lbs or strap design bolts to 30-35 ft-lbs.
2. Position slip yoke on differential gear case yoke and loosely install “U” bolts. Remove tape securing bearings to yoke and tighten “U” bolt nuts to 70 ft./lbs.
3. Grease universal joints with a high-quality grease.

3.3 REAR SUSPENSION

3.3.1 Removal

1. Move tractor to a level surface. Shut off engine and set parking brake.
2. Place axle jack under axle. Raise slightly.
3. Remove nut and washers from axle plate.
4. Lower axle.
5. Remove front spring bolts.
6. Remove top shackle bolts.
7. Tip front of spring forward, down, and out.

3.3.2 Installation

Install in reverse of removal sequence. Refer to Section 1 and 3.1.11 for torque specifications.

3.4 RADIATOR

If a tractor radiator leaks, do not attempt to repair it by pouring any substance into the radiator. This will only be a temporary fix at best, and may damage the engine and water pump.

The recommended way to fix a radiator is to either replace it with a new one or take it to a qualified radiator repair facility.

3.4.1 Removal

1. When engine is cool, remove transmission oil cooler from radiator.
2. Drain cooling system.
3. Disconnect upper and lower hoses. Replace if bulged, cracked, or leaky.
4. Remove radiator mounting fasteners and remove radiator.

3.4.2 Installation

1. Install radiator and secure with fasteners.
2. Connect hoses. Use new clamps if old clamps are corroded or faulty.
3. Fill cooling system.
4. Install transmission oil cooler assembly.
5. Start engine and check for leaks and proper operating temperature.

3.5 ENGINE/TRANSMISSION REMOVAL

The following is a general guide for removing the engine (or the engine and transmission together). The numerous available options make it necessary for the individual technician to determine the best course for removing the tow tractor engine.

1. Block rear wheels in both directions to prevent tractor from rolling when drive shaft is disconnected. Do not apply parking brake.
2. Remove engine hood, side panels, and access plates.
3. Raise front of tractor with suitable stands.
4. Shift transmission into neutral. Drain engine crankcase, cooling system and transmission.
5. Remove air cleaner and hose assemblies.
6. Disconnect battery cables.
7. Remove radiator, see 3.4.
8. Remove fan blade.
9. Tag and disconnect all wire harnesses to engine and transmission components.
10. Disconnect and cap fuel lines at required engine locations.
11. Disconnect accelerator linkage.
12. Disconnect exhaust pipe at the exhaust manifold. Tape over opening to prevent debris from entering engine.
13. Disconnect drive shaft from parking brake disc and tie out of the way.
14. Disconnect shift cable from transmission.
15. Disconnect and cap transmission fluid cooler lines.
16. Remove master cylinder/power booster.
17. Remove screws from hood support and slide back to allow clearance for removing engine/transmission assembly.
18. Loosen cable tension and disconnect parking brake cable from caliper and bracket.

⚠WARNING The engine and transmission assembly is large and heavy. To prevent it from falling on you, use proper slings and hoists for removal and installation

19. Attach a suitable hoisting bracket to transmission and/or engine assembly for support and lifting.
20. Steps 20-25 apply if it is possible to remove the engine without the transmission.

21. Remove converter drain plug access cover from lower end of converter housing. Matchmark torque converter with drive plate (for easier installation).
22. Remove converter-to-flywheel attaching nuts.
23. Remove converter housing-to-engine attaching bolts.
24. Lower tractor for easier engine removal, if necessary.
25. Remove engine mount capscrews.

NOTICE! The transmission and torque converter must be removed and installed as an assembly to prevent damage to the front bushing or front oil seal.

26. Move engine away from transmission.
27. Steps 28-33 apply if removing the transmission with the engine.

NOTICE! The drive plate (flywheel) will not support a load. Transmission should not rest on the drive plate during removal or installation. Before removing transmission support, use a jack to support the transmission.

28. Remove capscrews securing transmission rubber mounts to rear cross member. Remove capscrews mounting rear cross member to frame. Remove cross member.
29. Remove ground strap.
30. Remove two engine rubber mount capscrews.
31. Lower tractor for easier engine removal, if necessary.
32. Lift engine and transmission assembly upward slowly from tractor frame. It may be necessary to tilt front of engine upward so transmission clears fire wall.
33. Lower engine and transmission assembly onto a suitable support or repair stand.
34. To install engine assembly, reverse this procedure. Make sure plugs are secure and hoses are tight. Refill engine crankcase, cooling system, and transmission with recommended fluids and check for leaks.

3.6 TRANSMISSION AND TORQUE CONVERTER REMOVAL

NOTICE! The transmission and torque converter must be removed and installed as an assembly to prevent damage to the front bushing or front oil seal.

1. Put tractor on hoist, but do not raise at this time. Disconnect neutral switch wire at plug connector.
2. Raise tractor on hoist or stands.

3. Place drain pan under transmission fluid pan. Starting at rear of pan and working toward front, loosen attaching bolts and allow fluid to drain. Finally remove all of pan attaching bolts except two at front to allow fluid to further drain. With fluid drained, install two bolts on rear side of pan to temporarily hold it in place.
4. Remove converter drain plug access cover from lower end of converter housing. torque converter with drive plate (for easier installation).
5. Remove converter-to-flywheel attaching nuts. Place a wrench on crankshaft pulley attaching bolt to turn converter to gain access to bump switch.
6. With wrench on crankshaft pulley attaching bolt, turn converter to gain access to converter drain plug. Place a drain pan under converter to catch fluid and remove plug. After fluid has been drained, re-install plug.
7. Disconnect park brake cable. Disconnect from transmission park brake disk and slide shaft rearward from transmission. Install a seal installation tool in extension housing to prevent fluid leakage.
8. Disconnect downshift and manual linkage rods or cable controls from levers at transmission.
9. Disconnect oil cooler lines from transmission. Disconnect temperature sender wire.
10. Remove vacuum hose from vacuum diaphragm unit. Remove vacuum line from retaining clip.
11. Disconnect cable from terminal on starter motor. Remove the three attaching bolts and remove starter motor.
12. Remove transmission rear support and insulator assembly attaching bolts at bottom rear of transmission.
13. Raise transmission with transmission jack to take pressure off rear.
14. Remove bolts securing transmission to frame and remove cross member.
15. Secure transmission to jack with safety chain.
16. Remove converter housing-to-engine attaching bolts.
17. Move transmission away from engine.

NOTICE! The drive plate (flywheel) will not support a load. None of the weight of the transmission must be allowed to rest on the drive plate during removal or installation.

18. Lower transmission jack and move transmission and converter assembly from under vehicle.

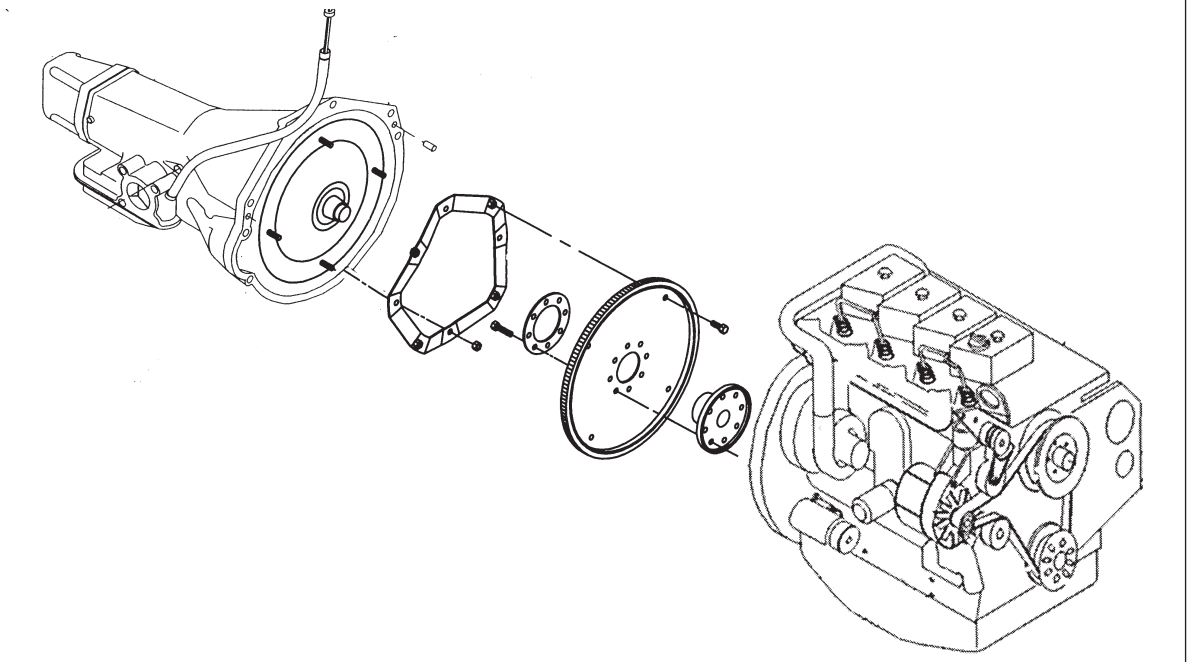


FIGURE 1. ENGINE/C6 TRANSMISSION ASSEMBLY CUMMINS ILLUSTRATED

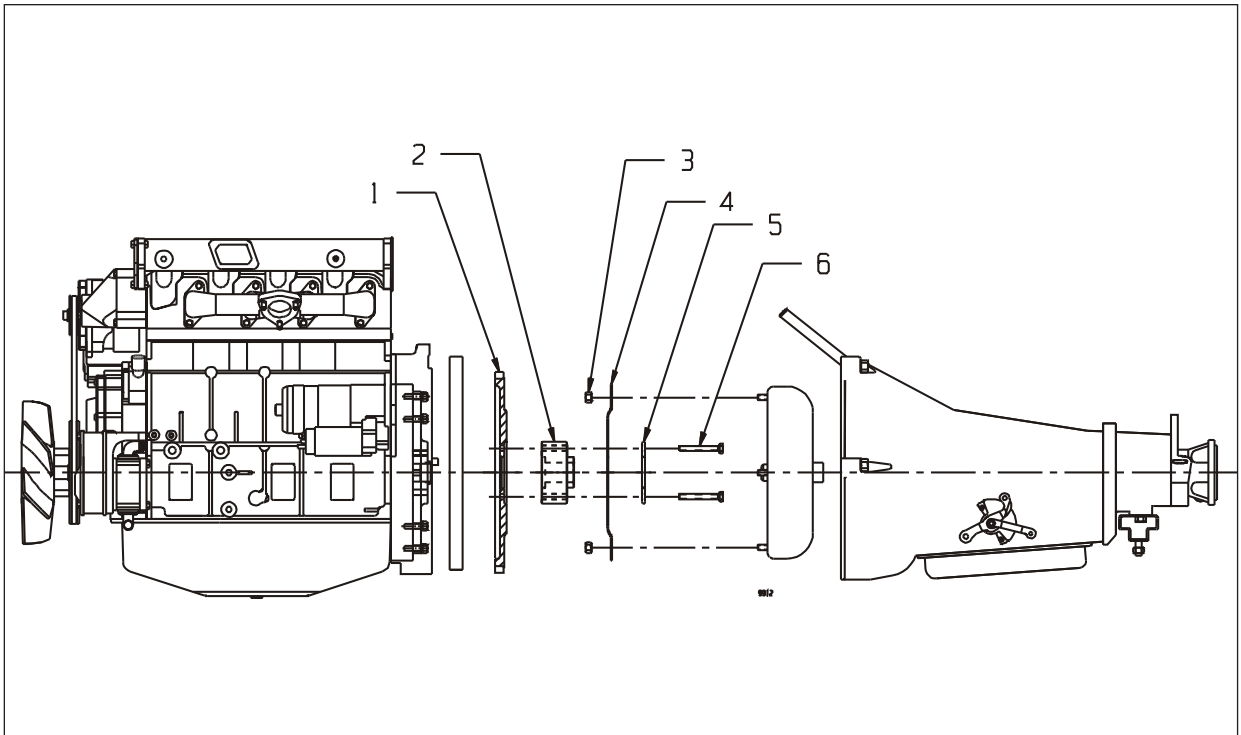


FIGURE 2. ENGINE/AT545 INSTALLATION

3.7 TRANSMISSION AND TORQUE CONVERTER INSTALLATION

1. Tighten converter drain plug to 18-28 ft-lbs.
2. Position converter on transmission, making sure converter drive flats are fully engaged in pump gear.
3. With converter properly installed, place transmission on jack. Secure transmission to jack with chain and place under tractor.
4. Raise transmission to align with engine.
5. Rotate converter until studs, drain plug and are in alignment with flywheel.

NOTE: Steps 6-10 for C6 transmission. For AT545, skip to step 11. See figure 3.

6. Install the crankshaft adapter (1) to the engine crankshaft.
7. Bolt the (2) to the crankshaft adapter.
8. Bolt the torque converter adapter (4) to the transmission.
9. Assemble the transmission housing to the engine housing flange being sure to align the two housings properly by use of the locating dowel pins. Tighten bolts.

NOTICE! The engine and transmission must be assembled to each other before bolting the engine to the torque converter adapter.

10. Working through the access opening in the engine bell housing, bolt the (2) to the torque converter adapter (4) using four flange head hex screws (6). Use blue loctite and torque to 101-105 ft-lbs
11. Bolt the hub (2), (4) and washer plate (5) to the engine flywheel (1) as illustrated. Apply blue loctite to M10 x 1 x 85-12g bolt threads (6) and torque to 30 NM + 60° + 90°.
12. Align the studs of the torque converter through holes in the and assemble the transmission housing to the engine housing flange being sure to align the two housings properly by use of the locating dowel pins. Tighten bolts.
13. Working through the access opening in the engine bell housing, Bolt the (2) to the torque converter adapter (4) using four flange head hex screws (6). Use blue loctite and torque to 101-105 ft-lbs.
14. Remove transmission jack safety chain from around transmission.
15. Position transmission support cross member to frame side rails and tighten attaching bolts to torque specified in Section 1.

16. Position transmission rear support and insulator assembly above cross member and lower transmission into place. Install mounting bolts and tighten to torque specified in Section 1.
17. Remove jack.
18. Connect vacuum line to vacuum diaphragm making sure that line is in retaining clip.
19. Connect oil cooler lines to transmission.
20. Connect downshift and manual linkage rods or cable controls to their respective levers on the transmission. Refer to parts illustrations in Chapter 4.
21. Secure starter motor in place with attaching bolts. Connect cable to terminal on starter.
22. Install a new O-ring on lower end of transmission filler tube and insert tube in case.
23. Secure converter-to-flywheel attaching nuts and tighten them to 20-30 ft-lbs.
24. Install converter housing access cover and secure it with attaching bolts.
25. Slide forward and connect it to transmission park brake drum. Connect park brake cable to park brake lever.
26. Adjust shift cable as required. Refer to 2-1 - 1.9.3.
27. Install new filter and pan gasket, and fill transmission with oil according to procedures in 2-1 - 1.9.3. Check for leaks.
28. Connect neutral switch wire to plug connector.
29. Connect temperature sender wire.
30. Connect the battery negative cable.
31. Lower tractor. Start engine and again check for leaks.

3.8 FUEL TANK

⚠ DANGER Fuel vapors create fire and explosion hazards. Do not allow any open flame, smoking materials or other potential ignition sources near fuel or the fuel system.

⚠WARNING Have a multi-purpose ABC type fire extinguisher (preferably dry powder) available and in good working condition.

If excessive amounts of water appear in the filter/separator, the tank may be contaminated and will require removal and cleaning or replacement.

3.8.1 Removal and Disassembly

⚠WARNING Disconnect the negative battery cable before servicing the fuel tank or fuel system. An electrical arc at the fuel tank sending unit can act as an igniter creating a fire and explosion hazard.

1. Raise tractor on suitable jacks or hoist and block with jack stands.
2. Place a suitable container beneath drain opening at bottom rear of tank.
3. Remove drain plug from fuel tank and drain tank.
4. Remove filler cap and cover filler hole to keep out debris. Support fuel tank and remove tank straps from tank supports.
5. Remove tank supports and lower tank to ground. Disconnect fuel sending wire and fuel hoses. Tank can now be removed from area for cleaning and inspection.

NOTICE! Use care when handling the sending unit to prevent damaging it.

3.8.2 Cleaning and Inspection

1. Install drain plug on bottom of tank.
2. Pour a detergent and water solution into tank.
3. Agitate mixture by rotating tank. Make sure solution contacts entire interior surfaces of tank.
4. Drain cleaning solution from tank. Rinse and repeat steps 1-4.
5. Flush interior of tank with clean water and allow to air dry.
6. Inspect filler cap and sending unit for corrosion and damage.
7. Inspect tank protectors for deterioration.
8. Inspect fuel tank for damage. Repair or replace tank as needed.
9. Check tank mounting straps for rust and corrosion.
10. Inspect elbows for damage.

3.8.3 Repair or Replacement

⚠ DANGER To minimize risk of serious injury or death from fire or explosion, before servicing a fuel tank: Clean the tank thoroughly before soldering or brazing. Fill tank with an inert gas such as carbon dioxide or nitrogen, or completely fill with water.

1. Repair tank by soldering or brazing if needed. Re-prime and paint any repaired areas of tank.
2. Test any repair with wet soap lather. Place an air hose in tank and admit air. By holding a rag around hose where it enters, a mild pressure will be built up. If the repair is sound, no bubbles will appear.
3. Replace corroded or damaged cap or sending unit.
4. Replace protectors if they are damaged or deteriorated.
5. Replace straps if weakened by either of these conditions.
6. Replace damaged parts.
7. If there is any doubt as to the integrity of the tank, replace the tank.

3.8.4 Reassembly

1. Install new gasket on sending unit opening on tank, then carefully lower sending unit into tank. Do not use gasket cement.
2. Secure sending unit with its hardware.
3. Temporarily tape or cover tank filler opening to prevent entry of dirt when installing tank.
4. Apply thread sealer to drain plug threads and install drain plug.

3.8.5 Installation

1. When ready to install tank, place a quart of fuel in the tank, slosh around, and pour out.
2. Install hoses and sending unit wire.
3. Position tank under frame and raise into position.
4. Install tank supports and straps. Tighten mounting hardware to 30 ft-lbs torque.
5. Install battery and connect battery cables.
6. Fill tank with fuel and check for leaks.

3.9 STEERING GEAR ASSEMBLY

Maintenance of the power steering gear should be performed by qualified service personnel. If the steering gear does not operate properly, replace it or take it to a specialized repair shop.

3.9.1 Removal

1. Loosen hose clamp at power steering pump and disconnect hose. Drain fluid into suitable container.

2. Remove steering column cover and pitman arm cover, if applicable.
3. Remove hose clamp and hose from return fitting at steering gear. Remove hose assembly, union and pressure fitting from steering gear.
4. Loosen pinch bolt on coupling on lower end of steering column.
5. Disconnect drag link at steering gear end.
6. Remove pitman arm nut and washer. Remove arm from steering gear.
7. Remove capscrews and washers securing steering gear to frame mounting bracket. Disconnect steering gear from coupling on column and remove from vehicle.

3.9.2 Installation

1. Position steering gear assembly on frame bracket and engage gear shaft with coupling on lower end of steering column. Secure to bracket with capscrews and washers. Tighten capscrews to 45 ft./lbs.
2. Tighten pinch bolt on steering gear coupling.
3. Install hose assembly, union and pressure fitting. Connect hose assembly to power steering pump.
4. Connect hose to return fitting and power steering pump and secure with hose clamps.
5. Install pitman arm on gear shaft. Install hex nut and washer. Tighten hex nut to 188 ft./lbs.
6. Install drag link and grease the link.
7. Bleed the system according to 2-1 - 1.12.
8. Install steering column cover and pitman arm cover, if applicable.

3.10 POWER STEERING PUMP

Repair of the power steering pump is not recommended. If the pump does not function properly or leaks, replace the entire unit.

3.10.1 Removal

1. Disconnect hoses at steering pump and secure in raised position to prevent drainage of fluid. Cap hose ends and pump connections to prevent entry of contaminants.
2. Remove capscrews that allow power steering pump to pivot. (Saginaw belt driven pump) or attach it to the engine (direct engine driven pump) Remove belt (Saginaw) and pump.
3. Remove pulley from pump shaft Saginaw.

NOTICE! Do not hammer pulley off shaft. This will damage the pump.

3.10.2 Installation

1. Installation is the reverse process of removal.
2. Bleed the power steering system per 2-1 - 1.11
3. Install capscrews that allow pump to pivot.
4. Install belt and adjust tension to approx. 3/8" deflection.
5. Uncap hoses and pump connections. Connect hoses to pump. Tighten hose fittings to 30-40 ft./lbs.
6. Bleed system as described in 2-1 - 1.10.
7. Install cap on power steering pump.

3.11 STEERING COLUMN ASSEMBLY

3.11.1 Removal

1. Disconnect external horn wire from under dash panel.
2. Remove rubber horn button from steering wheel by peeling it from plastic horn base.
3. Remove plastic horn base by turning and pulling it. Ease horn base off so spring and seat assembly don’t pop out.
4. Remove nut and flat washer from top of steering column shaft. Hold your hand under steering wheel while removing wheel because two carbon brushes and a spring will fall out.
5. Remove steering wheel assembly. Wheel is keyed to serrations on steering shaft.
6. Remove nuts, washers, and U-bolt attaching steering column to dash assembly. Remove steering column assembly.
7. Remove cover plate.
8. Loosen pinch bolt on coupling at lower end of steering column assembly.
9. Place nut and washer on steering column shaft to prevent loss.

3.11.2 Installation

1. Install cover plate.
2. Position steering column assembly to lower coupling on steering gear assembly.
3. Install U-bolt around steering column and attach to dash assembly with washers and nuts. Hand tighten nuts.

4. Check engagement of coupling and steering gear shaft. Tighten pinch bolt.
5. Tighten nuts on U-bolts to secure steering column.
6. Install steering wheel assembly on steering shaft. Tap into place on shaft serrations with a soft-faced hammer. Install nut and washer to secure steering wheel to column.
7. Insert plunger into counterbored hole in steering wheel. Install horn parts.
8. Connect external horn wire. Test operation of horn.
9. Install cover plate.

3.12 FRONT SUSPENSION

The front suspension is comprised of the leaf springs, hangers, brackets, and hardware needed to secure the springs to the axle and frame.

⚠WARNING After initially mounting u-bolts over springs and axle, recheck u-bolt nut torque after the first hour of operation and after the first 8 hours of operation. After this, check monthly or every 250 hours, whichever comes first. Failure to do so may result in axle mounting failure and loss of vehicle control.

3.12.1 Removing the Leaf Springs

1. Using a jack, raise the front of tractor. Support with appropriate jack stands.
2. Raise tractor far enough to relieve tension on springs. Support axle with jack stands positioned so they will not interfere with spring removal.
3. Remove nuts, lock washers, U-bolts and spring plate.
4. Remove bolt, nut, and lock washer securing front of spring to frame.
5. Lower axle until there is enough clearance to remove spring.
6. Lower front of spring until rear of spring clears seating slot in rear spring hanger.

3.12.2 Cleaning and Inspection

In order to properly inspect the condition of the springs, clean the spring assembly with solvent using a brush or a cloth dampened with solvent. Then inspect the leaves for cracks or breaks. Replace the spring assembly if damaged.

3.12.3 Installation.

1. Work rear of spring into seating slot in the rear spring mounting plate.
2. Align front of spring bushing bore with hole in frame and install spring front mounting hardware. Tighten nut to 135 ft-lbs torque.

3. Install U-bolts over front axle and springs and install mounting plates, washers, and nuts. Torque nuts to 105 ft-lbs.
4. Remove jack stands and jack from beneath axle and frame.

3.13 FRONT AXLE ASSEMBLY

3.13.1 Removal

1. To provide adequate working space under tractor, raise front of tractor with jack so tires clear the ground and support tractor with appropriate jack stands. Position stands so they do not interfere with axle removal.
2. Remove front wheel and tire assemblies. Disconnect hydraulic fittings from calipers and plug caliper and fitting openings to prevent system contamination. Tie brake lines to frame to prevent kinking, bending or other damage.
3. At the drivers side, unhook the front brake hose from the tee that connects it to the line from the equalizer valve and front cross over line.
4. Place a small container under the connections to catch spillage and caps ends of open lines to prevent dirt from getting in.
5. At the passenger side, unhook the front brake hose from the front cross over line.
6. Disconnect steering drag link from the steering arm on the axle. The drag link is a rod that connects the steering gear unit pitman arm to the left-hand front axle knuckle.
7. Position axle jack under front axle.
8. Remove nuts, washers, mounting plates and U-bolts attaching spring and axle assembly to frame.
9. Lower axle jack until front axle clears frame and remove axle.

3.13.2 Disassembly

1. Remove cotter pins and caliper retaining bolts holding caliper to mounting bracket and remove caliper. If necessary, loosen a bleeder to relieve pressure (This will necessitate bleeding the brakes later.). Place a block between the friction pads to secure the pistons.
2. Remove grease cap from hub.
3. Remove cotter pin, nut, and washer from wheel hub and pull off wheel hub and brake disk. Protect bearings from contamination.
4. Remove brake disc from wheel hub, if necessary, by removing socket head capscrews. Do not remove wheel studs unless replacement is necessary.

5. Remove cotter pins and locknuts securing lower steering arms to tie rod end assemblies. Remove tie rod. If tie rod ends need replacing, loosen jam nuts on tie rod and remove end assemblies.
6. Disassemble knuckles and push out the king pins.
7. Remove knuckles from axle weldment. Remove knuckle bushings and/or thrust bearings.
8. If necessary to remove tie rod and/or caliper brackets, remove the socket head capscrews.
9. Remove steering arm, if necessary.
10. Inspect hub bearings. Remove bearing cups, if necessary. Always replace cup and cone as a set.

3.13.3 Assembly

1. Install new thrust bearings, bushings, and king pins into the knuckles and axle weldment.
2. Re-assemble king pins.
3. Install ball stud and secure with nut and cotter pin, if previously disassembled. Place on socket head screw threads and tighten to 85 ft-lbs torque.
4. If inner and outer bearings are to be replaced, install new cups into hub. Make sure cups are seated well.
5. Install wheel studs, if removed.
6. Grease inner cone and cup and install inner cone.
7. Install grease seal using a plug to place pressure evenly around seal. If you bend or otherwise damage seal, discard and use a new one.
8. Install brake disc on wheel hub, if removed. Tighten bolts to 85 ft-lbs torque (axle) or 105 ft/lbs (Brierton Axle)
9. Install tie rod assembly to tie rod arms. Adjust toe-in of front wheels according to 2-1 - 1.6.1. Tighten tie rod lock nuts to 20 ft-lbs torque.

NOTICE! Do not overfill with grease because too much grease can cause seal to fail or grease cap to pop loose after assembly.

NOTE: If the tie rod ball joints were replaced or adjusted in any way, check toe-in and adjust if necessary.

Use MIL-G-10924D grease on the front axle.

10. Pump grease into hub cavity.

11. Use grease to lubricate the seal lip.
12. Install hub. Rotate hub while installing to spindle so seal doesn't roll under. As spindle goes into inner cone, try to feel that all parts are straight and properly seated on spindle bearing journal.
13. Grease outer cone and place over spindle and into cup.
14. Assemble washer and nut to spindle. Tighten nut to 10-15 ft-lbs torque. Rotate hub while tightening nut.
15. Back off nut until it just becomes loose.
16. While rotating hub, nut to finger tight. Line up cotter pin hole in spindle with slot in nut. Check hub for excessive end play. Excessive end play indicates that nut is too loose. Hub should rotate freely, but if hub binds or if you can feel the bearings, it means that the nut is too tight. Readjust nut if needed.
17. Insert cotter pin and bend to lock it on nut. Fill grease cap with grease and snap into place.
18. Check seal for a turned-under lip. Rotate hub and check for any indication of misalignment or roughness. If either is noted, disassemble hub and check inner cups for any small nicks or other damage. If damaged, the hub must be replaced.
19. Using a C-clamp (surface that contacts pad MUST be clean.) on each piston, force pistons into caliper to allow caliper to fit over disc.
20. Reassemble brake caliper to caliper bracket. Insert retaining bolts and reinstall cotter pins. Tighten bolts to 60 ft-lbs torque (axle) or 105 ft-lbs torque (Brierton axle).
21. Lube all grease fittings with MIL-G-10924D grease.

3.13.4 Installation

1. Position new axle under tractor and raise axle using an axle jack. The axle has a hole in the top side to engage with the boss on lower side of spring stack for proper positioning.
2. Install new U-bolts over springs and front axle and install new mounting plates, washers, and nuts. Torque nuts to 105 ft.-lbs.
3. Position drag link so opening in end engages ball on steering arm.
4. Tighten plug until plug is flush with end of tube.
5. Align holes in ends of drag link tube with holes in plugs and install cotter pins to secure.
6. Cut the 30" plastic sleeve in half and slide onto each front brake hose
7. Connect the new front brake hoses to the front calipers with banjo bolt and copper washers. Connect the other ends of the hoses to the front cross over line.

IMPORTANT: There is a RH and LH brake hose. Place a hose block over the port in the brake caliper. If the steel hose ell from the hose block angle upward and back it is for this side. If it does not, this hose is for the opposite side.

8. Bleed the front brakes as instructed in 2-1 -1.10.
9. Install front wheels and tighten mounting nuts to 120 ft-lbs torque.

3.13.5 Setting Stops On New Axle

1. There must be weight on the axle when making this adjustment, so leave the machine on the ground. Alternately, the unit can be raised back up onto the and then use the axle jack to raise up on the axle until the it relieves slack from the springs. This procedure will make it easier to work on the machine to make the remaining adjustments.
2. The axle stops maybe preset by the manufacturer, but need to be checked.
3. The included angle between the axle tube and the brake rotor disk is 60 degrees. The angle must be set equally at both ends. See figure 4.
4. If adjustment is required, turn the hub until you measure a 60 degree angle with an adjustable protractor or template. Move the stop bolt out until it contacts the axle pivot weldment.
5. When adjustment is correct, lock stop bolt with jam nut.

NOTE: If stop bolt supplied with axle is not long enough to make adjustment, replace it with a 1/2-13x2.50 hex bolt.

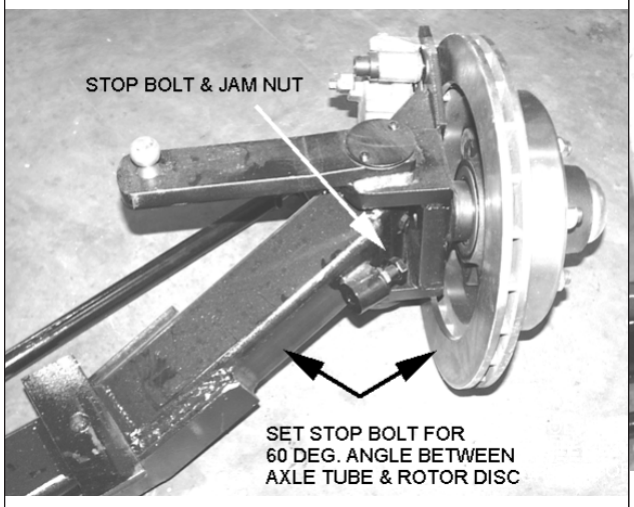


FIGURE 3. SETTING AXLE STOPS

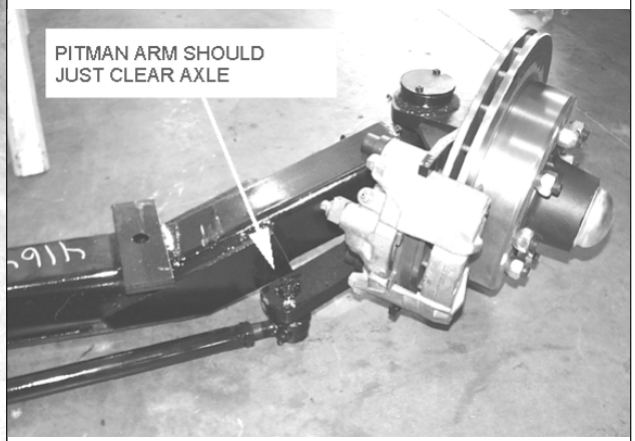


FIGURE 4. STEERING ARM

6. Make adjustment at both ends. If correct, the steering arm will just clear the axle tube when the stop bolts stop the hub from turning. See figure 5.

3.13.6 Setting Pitman Arm Stops

1. Turn the wheels with the steering wheel in one direction until the axle stop bolt just contacts the axle pivot weldment. Do not force.
2. Turn the pitman arm adjuster bolt on the side where the pitman arm contacts, so the travel is limited to this position. Lock stop bolt with jam nut. See figure 6.
3. Turn wheels in opposite direction and make the same adjustment as in step 2. above.

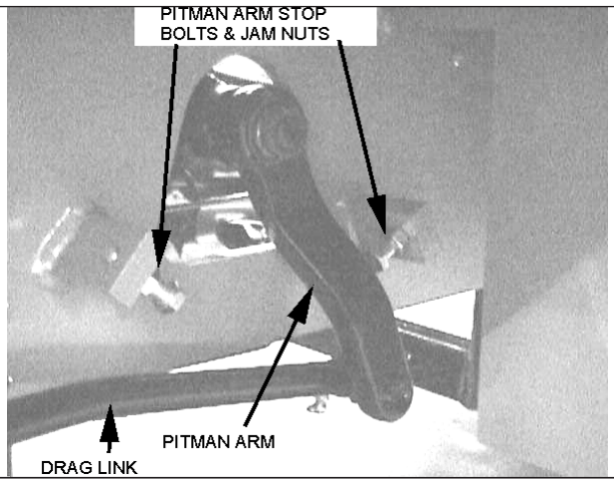


FIGURE 5. PITMAN ARM STOPS

3.14 DRAG LINK

The drag link is a rod that connects the steering gear unit pitman arm to the left-hand front axle knuckle.

3.14.1 Removal

1. Remove cotter pins from ends of drag link.
2. Unscrew drag link plugs enough to free pitman arm and steering arm. Remove drag link.

3.14.2 Installation

1. Position drag link so openings in ends engage balls on pitman arm and steering arm.
2. Tighten plugs until plugs are flush with ends of tube.
3. Align holes in ends of drag link tube with holes in plugs and install cotter pins to secure.

3.15 ALTERNATOR

The alternator requires no special care except to keep the drive belt properly tensioned. It is not a user-repairable item.

If you suspect a problem with the alternator, most alternator problems can be traced to one of the following causes:

- Battery or battery connection fault.
- Loose, dirty, or corroded alternator connections.
- Broken wires to alternator.
- Slipping drive belt.

NOTICE! When welding on the tractor, disconnect the battery to prevent damage to the alternator.

This Page Intentionally Blank

4. REPAIRS

⚠WARNING Perform lockout/tagout procedures before adjusting, lubricating, cleaning or otherwise servicing. Failure to do so could result in unexpected startup and could cause serious injury or death.

4.1 UNIVERSAL JOINT REPAIR

⚠WARNING To minimize risk of serious eye injury always wear industrial safety glasses when working with snap rings and spring loaded retainers as they can be ejected with great force. Use extreme caution and keep your body and face out of the way.

Removal–Flange Yoke End

1. Match mark the flange yoke bearing caps and spider to ensure that bearings are assembled on same spider journals.
2. Remove retaining ring clips securing bearing caps to flange yoke and separate flange yoke from drive shaft.
3. Support drive shaft in a way that will allow bearings to be pressed from yoke without interference.
4. Using a short piece of pipe or a solid rod (about same diameter as bearing cap) and a hydraulic press, press a bearing cap until spider bottoms on yoke.
5. Use a hammer to tap loosened bearing cap from yoke.
6. Turn drive shaft over and repeat steps 4 and 5 to remove remaining bearing cap.

Removal–Slip Yoke End

1. Loosen slip yoke dust cap and remove slip yoke from drive shaft.
2. Remove retaining rings securing bearing caps in slip yoke.
3. Repeat previous steps 3-6 under ‘Flange Yoke End’ to disassemble universal joint.

Assembly–Slip Yoke End

1. Clean and inspect yokes for damage and replace if necessary.
2. Apply automotive grease to new needle bearings to retain them in caps.
3. Start one of the caps into slip yoke bearing bore.

NOTICE! Protect bearings before installation and handle carefully during installation to prevent entry of dirt or other foreign matter into bearings.

4. Pack grease passage in spider with automotive type grease before installation.
5. Install new seals on spider journals.
6. Install spider in yoke and start one journal into bearing cap assembled to yoke. Be careful to not dislodge needle bearings.
7. Start remaining bearing cap into remaining yoke bore and start journal into that bearing. Do not dislodge needle bearings in either bearing.
8. Using either a press or bench vise, carefully push bearing caps into bores and onto bearing journals. If substantial resistance is encountered, a needle bearing may have been dislodged and is impeding progress. Carefully remove bearing caps and make sure bearings are in place. If a bearing is damaged, replace it with a new one.
9. Continue pressing on one side until retaining ring groove is exposed. Install retaining ring. Turn yoke over and press the other bearing into its bore. Install the retaining ring.
10. Install remaining seals and bearings on spider journals. Tape these bearings to yoke to prevent them from falling off spider.
11. Loosely assemble dust cap. Lubricate splines on drive shaft and insert shaft into slip yoke, insuring that front and rear yokes are aligned.
12. Lubricate slip joint through grease fitting before installing drive shaft on tractor.

Assembly–Flange Yoke End

1. Apply automotive grease to needle bearings to retain them in cap.
2. Pack grease passage in spider with automotive-type grease before installation.
3. Slide two bearing assemblies onto spider journals 180 deg. apart. Use match marks to get correct bearing on correct journal.
4. Position spider and bearing assembly on flange yoke and secure bearing assemblies with retaining ring clips.
5. Install remaining two bearing assemblies on spider journals and position flange assembly on drive shaft. Install retaining rings.

4.2 WHEELS AND TIRES

⚠ DANGER To minimize the risk of serious injury or death from exploding tire or wheel, follow these safety precautions:

- All tire service must be performed by a technician properly trained in tire service.
- Use proper tire removal tools to prevent possible damage to the tire bead.
- Do not attempt to use extremely high air pressure to seat a tire bead. If a tire cannot be seated using normal pressure, contact the manufacturer for advice.

- Do not lean or rest your body or repair equipment against the restraining device while the wheel/tire is in the device.
- If a bead breaker slips, it can fly off with enough force to cause serious injury.
- Make sure no one is in the blow-out trajectory area. Always stand to one side when inflating tires.

⚠WARNING To minimize the risk of tire/wheel failure and loss of vehicle control, when servicing tire/wheels:

- Do not use cleaning solvent on tires. Solvents cause deterioration of the rubber.
- Never inflate tires with air from systems using alcohol evaporators.
- Never mix rim parts of different manufacturers or different sizes.
- Do not use damaged parts.

⚠CAUTION After initially mounting wheel and tire assembly, recheck lug nut torque after the first hour of operation and after the first 8 hours of operation. After this, check monthly or every 250 hours, whichever comes first. Do not lube wheel studs as it will result in inaccurate tightening torque. Failure to follow these procedures could result in wheel mounting failure and loss of vehicle control. The front and rear wheels are similar in maintenance, cleaning, and inspection.

4.2.1 Removal

1. Move tractor to a level surface. Shut off engine and set parking brake.
2. Using a jack, overhead crane, or some other suitable lifting device (minimum 5 ton), raise end of tractor. Before tires leave the ground, loosen the lug nuts. Then continue raising the tractor until the tire comes off the ground. See Chapter 1 for jack stand locations.
3. Place jack stands under tractor to support it while wheel is off.
4. Remove lug nuts, valve stem bracket (rear wheels), and tire and wheel assembly.

4.2.2 Disassembly

(See Chapter 3 for Special Tire Changing Tools.)

1. Let air out of tire and remove valve core.
2. Remove tire from wheel using standard safety equipment, tire changing equipment, and safety practices.
3. Remove valve stem, if damaged or defective.

4.2.3 Inspection and Cleaning

1. Inspect for corrosion buildup, cracks in metal, bent or broken components and loose, missing, stripped or damaged wheel studs or nuts. Completely remove rust, dirt and other foreign materials from all mating surfaces. Mating surfaces must be free of paint. Especially important to clean are the areas used for mounting the wheel to the vehicle; hub, wheel nuts, studs, and mating surfaces of wheels. Use hand or electric wire brushes, light sand blasting, or brake cleaner/degreaser. Remove any metal projections or burrs. Wheel must be flat and stud holes must not show any wear. If warped or if hole damage is found, replace wheel.
2. If one wheel stud fails, all the wheel studs on that hub must be replaced because it is very likely that the remaining studs have been over stressed and may even be cracked. If this is not done, continued failure will result.
3. Inspect tire for uneven wear. Replace any badly worn tire.
4. Inspect tire for cuts, nails, stones in tread, or deterioration. If damage is severe, replace tire.
5. Inspect wheels for cracks and other damage. If damaged, replace wheel.

4.2.4 Repair

1. Remove stones and other foreign material imbedded in tires.
2. Repair punctures or cuts if possible.
3. Remove nicks, burrs, and rust from wheels. Clean rim sealing area with coarse steel wool. Repaint wheel if necessary.

4.2.5 Assembly

1. If removed, install a new valve stem in wheel.
2. Mount tire on wheel using standard safety equipment, tire changing equipment, and safety practices. To help get tire on, always use an approved rubber lubricant or use a small amount of soapy water for lubricating tire bead.
3. Install valve core and place entire assembly in restraining device and inflate tire to 60 PSI. Make sure bead has seated all around and on both sides.
4. Inspect tire and wheel components while still in restraining device to make sure they are properly seated. If further adjustment is necessary, first deflate tire and remove valve core. Check for leaks. If none are detected, install valve cap.

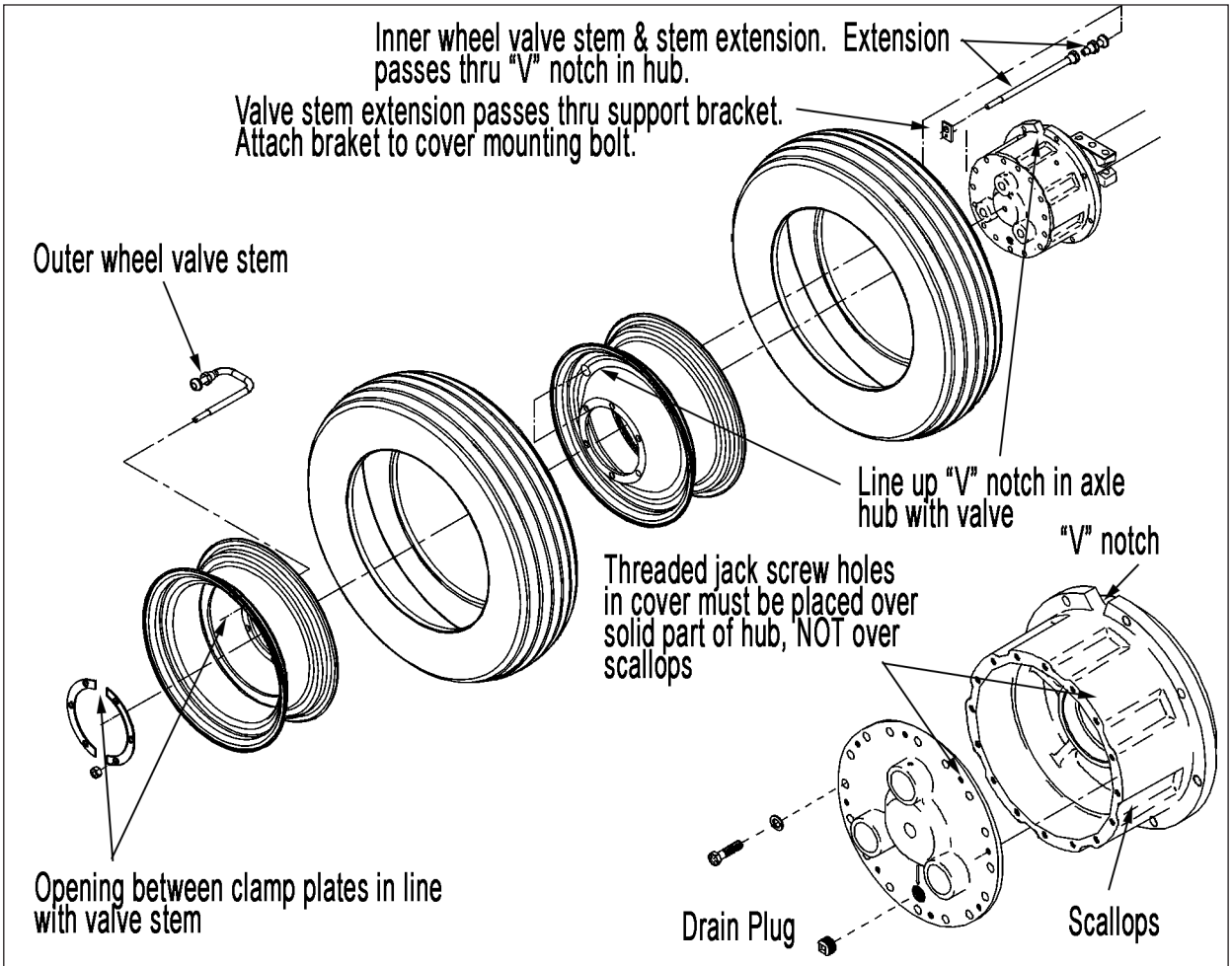


FIGURE 1. PROPER INSTALLATION OF AXLE HUB COVER PLATE AND DUAL WHEELS

4.2.6 Installation

1. Assemble valve stems, if not already done.
2. Tires on dual sets must be replaced together. Unequal tire tread wear will result in uneven weight distribution.
3. Proper installation when wheels are reinstalled. See figure 1:
   a. Clean and dry wheel, studs, and mating surfaces before assembly. See 4.2.3

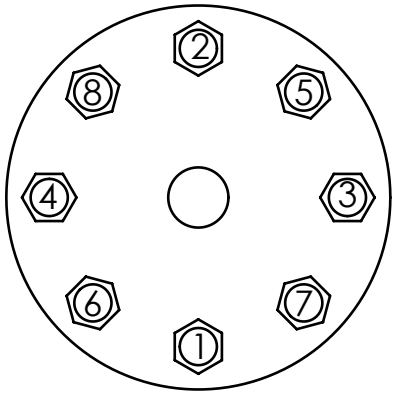


FIGURE 2. NUT TIGHTENING SEQUENCE

b. Install wheel and tire assembly on axle. Rear dual wheels are installed with clamp plates over the studs, see figure 1. Thread the flange nuts on. DO NOT use lock washers under flange nuts. Tighten gradually in an alternating pattern.
c. The axle hub cover is provided with jack screw holes so when you remove the cover bolts, you can thread them into these holes and uniformly torque them to remove the press fitted cover.
d. When reinstalling this cover, it is very important to center the jack screw holes over the solid parts of the hub. **DO NOT** position them over the scallops in the hub. If you do, the next time you use the jack screw holes to remove the cover, the bolts will ride up on the scallops and break the hub.

NOTICE!: When using jackscrews to remove cover be sure all the mounting bolts have been removed or cover breakage will result.

e. When mounting the wheels, position the valve stem hole in line with the “V” notch on the axle hub. The valve stem extension must pass through this notch. If you do not, the valve stem will wear through.
f. Position the wheel clamps so the joint is in line with the valve stem and6 doesn’t cover the passage way for the valve stem extension.
g. Torque using the criss cross tightening sequence shown on figure 2.
h. If air wrenches are used, they must be periodically calibrated for proper torque output. Use a torque wrench to check the air wrench output and adjust the line pressure to give correct torque.
i. Recheck wheel nut torque on new wheel installations after the first hour of operation and after the first 8 hours of operation. Rechecking the torque levels is necessary because settling in the joint causes loss of clamp load. After initial operation, check monthly or every 250 hours, whichever comes first.

Which Wheel	Stud Size	Tightening Torque (dry)
Front	1/2”-20	See decal on tractor
Rear (Rockwell)	9/16”-18	See decal on tractor
Rear (Newage)	M20 x 1.5	See decal on tractor

j. Maintain nut torque shown in table through planned, periodic checks at 250 hour intervals.

4. Remove jack stand and jack from beneath tractor.
5. Run unit and check wheels after one hour and periodically thereafter to be sure wheels are set.

4.3 REAR SUSPENSION

4.3.1 Removal

1. Move tractor to a level surface. Shut off engine and set parking brake.
2. Place axle jack under axle. Raise slightly.
3. Remove nut and washers from axle plate.
4. Lower axle.
5. Remove front spring bolts.
6. Remove top shackle bolts.
7. Tip front of spring forward, down, and out.

4.3.2 Installation

Install in reverse of removal sequence. Refer to Table in Section 1 for torque specifications.

When installing u-bolts over springs and rear axle, torque nuts to 175 ft.-lbs

4.4 ROCKWELL REAR AXLE WHEEL HUB SEAL REPLACEMENT

Figure 3

1. Drain wheel end.
2. Mark planetary and hub for ease of assembly.
3. Remove planetary capscrews.
4. Using planetary capscrews, screw (3) into tapped holes in planetary spider and push spider and hub apart.
5. Remove planetary spider assembly.
6. Remove axle shaft and sun gear.
7. Remove ring gear hub.
8. Remove spindle nut.
9. Use strap to remove hub assembly from spindle.
10. Remove oil seal from hub bore.

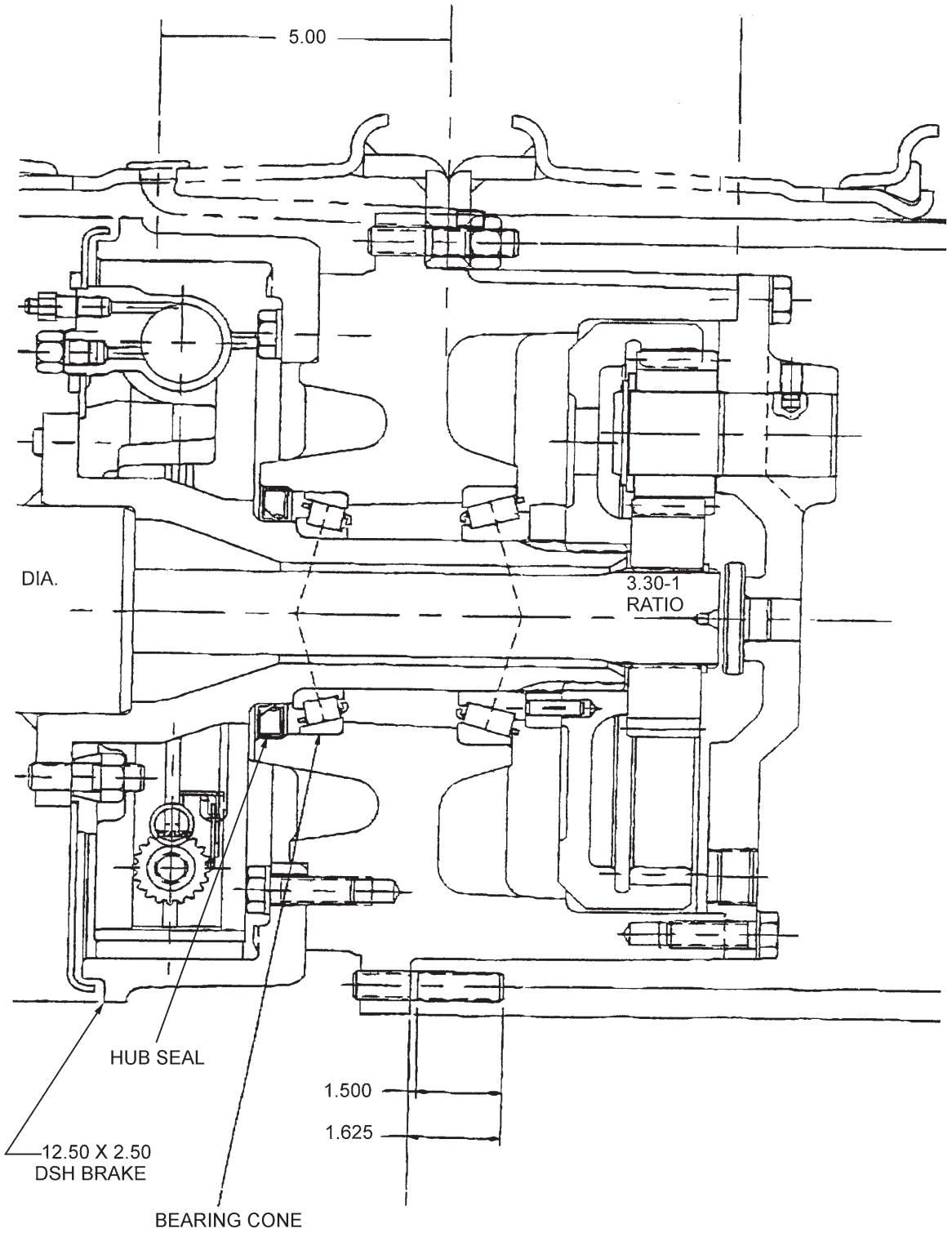


FIGURE 3. ROCKWELL REAR AXLE WHEEL HUB SEAL REPLACEMENT

11. Check bore for scratches or imperfections. Clean bore and chamfer with fine emery cloth to be sure no nicks or burrs are present.
12. Using an appropriate driver install the seal until it bottoms in the hub bore.

IMPORTANT! Seal must be pressed into the hub bore until it bottoms out, even if the original seal was only pressed in flush to the bore.

NOTE: Be sure lip is towards the bearing cone (see sketch)

13. Apply a light coat of grease or oil to seal lip and spindle seal journal.
14. Install hub and bearing on spindle.
15. Install outer bearing cone.
16. Assemble nut and torque to 200 ft-lbs.
17. Rotate hub forward and back several revolutions to seat the bearings.
18. Retorque to 200 ft-lbs.
19. Back nut off slightly to relieve the torque, then to 100 ft-lbs. This is your adjustment.
20. Make a mark on the spindle spline lining up the roll pin in the nut.
21. Mark the ring gear spline to line up with hole in the back face.
22. Assemble the ring gear by aligning the marks so the hole and the roll pin go together. This locks the nut in place.
23. Assemble axle shaft and sun gear.
24. Apply silicone sealer to mounting surface of planetary spider. Assemble planetary, install capscrews and torque to 85-115 ft-lbs.
25. Fill with oil to proper level.

This Page Intentionally Blank

CHAPTER 3 OVERHAUL

TABLE OF CONTENTS

1 General Repair 1
1.1 Guidelines for Repairing the Tractor 1
1.1.1 Special Tools 1
1.1.2 Removal and Disassembly 1
1.1.3 Cleaning 1
1.1.4 Using Compressed Air 2
1.1.5 Frame, Engine, and Transmission 2
1.1.6 Metal Parts 2
1.1.7 Bearings 2
1.1.8 Gears 2
1.1.9 Inspecting Parts 2
1.2 Repair and Replacement 2
1.2.1 Structural Parts 2
1.2.2 Wiring 2
1.2.3 Gaskets and Seals 3
1.2.4 Reassembly and Installation 3
1.3 Engine Repair and Maintenance 3
1.3.1 Ordering Parts 3
1.4 Front Brakes 3
1.4.1 Friction Pad Removal and Installation (Front) 3
1.4.2 Disc Replacement (Front) 4
1.4.3 Caliper Repair (Front) 5
1.5 Rear Brakes 6
1.5.1 Rear Drum Brake Removal 6
1.5.2 Cleaning and Inspection 7
1.5.3 Adjustment 7
1.5.4 Rear Drum Brake Assembly and Installation 8
1.5.5 Rear Wheel End Installation 9
1.6 Wheel Cylinders 10
1.6.1 Removal 10
1.6.2 Disassembly 10
1.6.3 Cleaning and Inspection 10
1.6.4 Assembly 11
1.6.5 Installation 11

1.7 Power Booster/Master Cylinder Assembly 11
1.7.1 Removal 12
1.7.2 Repair 13
1.7.3 Installation 13
1.8 Parking Brake (C-6 Transmission) 14
1.8.1 Removing Brake Shoes and Pads 14
1.8.2 Inspecting and Lubricating Brake Assembly. 14
1.8.3 Repair and Replacement. 14
1.8.4 Reassembly 14
1.9 Special Tools For Tire Changing 15

1 GENERAL REPAIR

⚠WARNING Perform lockout/tagout procedures before adjusting, lubricating, cleaning or otherwise servicing. Failure to do so could result in unexpected startup and could cause serious injury or death.

⚠WARNING To minimize risk of brake system failure and possible accident, when servicing brakes or brake system:

- Do not over tighten brake tube fittings. Over tightening may crack the fitting or damage the seat in the cylinder fitting.
- Compressed air used to service brake components must be oil-free or rubber parts may be damaged.
- Always replace brake lines that are questionable.
- Never allow brake system rubber parts to come in contact with gasoline, diesel fuel, or any type of cleaner other than an approved brake cleaner. Wash hands before handling brake components.
- Brake linings that contact oil or grease can become contaminated, lose braking friction and then must be discarded.

1.1 GUIDELINES FOR REPAIRING THE TRACTOR

The following are general instructions for the removal, disassembly, cleaning, inspection, reassembly, and installation of tractor components within the capabilities of the using organization. Common shop practices are not described. Use the exploded views in parts manual, chapter 4 for reference.

1.1.1 Special Tools

There are no special tools required for this tractor. Common automotive shop tools are all that is required to service the tractor.

1.1.2 Removal and Disassembly

Special instructions are noted in the appropriate text. Disassemble components only to the extent necessary to do repairs.

1.1.3 Cleaning

When cleaning, keep related parts together so reassembly is easier. Valves, pistons, sleeves and other internal parts that have close tolerance fits in mating bores should be cleaned individually to prevent surface scoring and marking. Special cleaning instructions are given where required.

1.1.4 Using Compressed Air

Use low-pressure compressed air to remove debris and dirt as necessary.

1.1.5 Frame, Engine, and Transmission

NOTICE! Be sure all openings are closed or covered adequately before cleaning to prevent the entry of water into internal parts.

Structural parts are best cleaned using soap and water and suitable brushes. Steam cleaning may also be done before disassembly to remove heavy accumulations of grease, oil, and dirt from exterior of engine, transmission and rear axle assembly.

1.1.6 Metal Parts

Wash metal parts in an appropriate cleaning solvent. Allow to air dry. Do not use compressed air to dry parts. The moisture generally present in air systems may cause corrosion. Lubricate metal parts as soon as possible after cleaning.

1.1.7 Bearings

Wash bearings in a bearing washer or immerse in solvent and scrub clean with a soft brush. Remove all grease and oil from bearing recesses. Allow to air dry. Apply a thin film of lubricating oil to bearings and check for free movement between inner and outer race. Worn bearings must be replaced.

1.1.8 Gears

Clean gears using a soft bristle brush and cleaning solvent. Remove foreign matter from the gears.

1.1.9 Inspecting Parts

Inspect all parts visually for cracks, breaks, scratches, dents, bends, punctures, galling, wear, scoring, stripped threads, distortion and deformation. Give special attention to bearing surfaces, mating surfaces, gaskets and seals. Specific dimensional checks and tests are given where required.

1.2 REPAIR AND REPLACEMENT

1.2.1 Structural Parts

Structural parts, enclosing, and supporting members may be repaired by welding, brazing and refinishing. Major repairs should be performed by overhaul facilities. Where repainting is required, the surface should first be suitably prepared and primed.

1.2.2 Wiring

Wiring should be repaired in accordance with standard automotive practices.

1.2.3 Gaskets and Seals

Gaskets, oil seals, preformed packing, and seals should be replaced instead of being cleaned and reused, unless otherwise specified by local directives. Replace any seals and packings that show any deterioration or damage.

Use repair kits when available.

1.2.4 Reassembly and Installation

Unless otherwise specified, reassembly and installation are the reverse of removal and disassembly. Use the illustrations in parts manual chapter for reference.

1.3 ENGINE REPAIR AND MAINTENANCE

Refer to the operator's manual supplied by the engine manufacturer (supplied with this manual) for instructions. More detailed "shop" manuals may be special-ordered from NMC or can be obtained from a local distributor.

1.3.1 Ordering Parts

If you need parts for your engine, you must provide the complete engine number, and tractor description, name, and serial number.

The engine number is stamped on a label fastened to the cylinder block.

1.4 FRONT BRAKES

The brake assemblies must be removed as complete assemblies. They cannot be disassembled while mounted on the front axle.

NOTE: There is no adjustment for caliper-type brakes.

1.4.1 Friction Pad Removal and Installation (Front)

Figure 1

Never mix new and used pads in the brake assembly.

1. Set parking brake. Using a jack, raise tractor high enough off floor to provide adequate working space underneath the frame. Support tractor with jack stands. Be sure that positioning of jack stands does not interfere with work task.
2. Remove wheel.
3. Remove dirt and grease from disc and caliper components by wiping them with a cloth dampened with clean brake fluid or isopropyl alcohol.

4. Remove the retaining bolts holding caliper to axle and remove caliper. If necessary, loosen a bleeder to relieve pressure (This will necessitate bleeding the brakes later.).
5. Knock the tabs holding pads in place back, and remove pads
6. Check pistons for leakage, corrosion, and gumming. If necessary, disassemble and service the caliper, see 1.4.3.
7. Using a C-clamp (surface that contacts pad MUST be clean.) on each piston, force pistons into caliper to allow caliper to fit over disc.
8. Install new pads.

NOTICE! Small metal tabs project through the mounting holes of the outboard brake pads on the outside of the caliper. To keep the pads from floating, peen the tabs over the edge of the hole. This should extend the life of the outer pad and eliminate premature rotor wear. Do this in assembly with the rotor while applying pressure to the caliper to prevent the mounting bolts from bending. To insure that the caliper floats check for adequate grease in the caliper mounting sleeves, we recommend Stalube #3303 synthetic brake caliper grease with added graphite and teflon.

9. Reassemble brake caliper to caliper bracket. Insert caliper pins with blue Loctite. Tighten bolts to 35-40 ft-lbs torque.
10. Check that the caliper and pads are centered over (parallel to) the disc.
11. Install wheel assembly and tighten lug nuts (front) per Chapter 2. Remove safety stands and lower tractor.

⚠CAUTION After initially mounting wheel and tire assembly, recheck lug nut torque after the first hour of operation and after the first 8 hours of operation. After this, check monthly or every 250 hours, whichever comes first. Do not lube wheel studs as it will result in inaccurate tightening torque. Failure to follow these procedures could result in wheel mounting failure and loss of vehicle control.

12. If air was allowed to enter the hydraulic system, bleed brakes according to Chapter 2.
13. Pump brake pedal to force pads against disc. Check fluid reservoir and bring to correct level.
14. Road test the tractor to test brake action. The tractor should stop quickly and smoothly with no tendency to dive or pull to one side.

1.4.2 Disc Replacement (Front)

Refer to 1.4.3

Inspect disc according to Chapter 2.

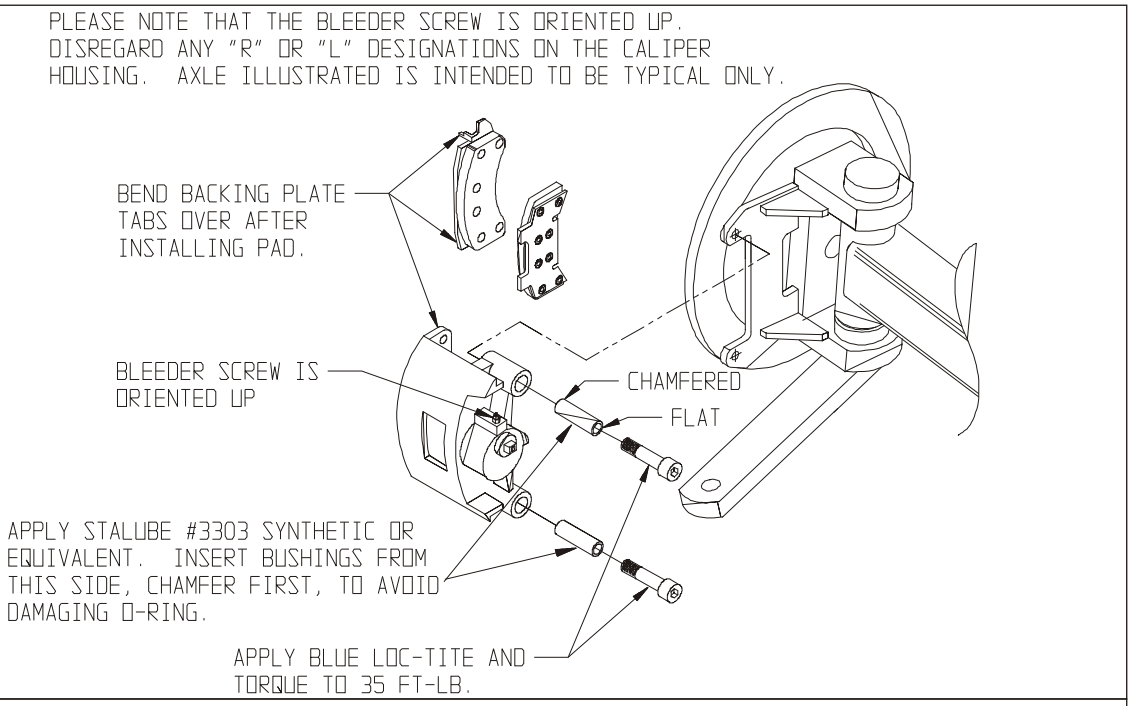


FIGURE 1. CALIPER ASSEMBLY

1.4.3 Caliper Repair (Front)

Figure 1

Removal

1. Using a jack, raise tractor high enough off floor to provide adequate working space underneath the frame. Support tractor with safety stands. Be sure that positioning of safety stands does not interfere with work task.
2. Remove front wheel.
3. Remove brake line from caliper and plug line end to prevent entry of contaminants. Some brake fluid will spill from line when removing.
4. Remove screws holding caliper to axle weldment and remove caliper.
5. Inspect disc and friction pads according to Chapter 2.
6. Inspect caliper housing for evidence of fluid leakage. If present, caliper must be replaced.

Installation

1. Connect brake line to housing assembly.
2. Install caliper in reverse order of disassembly.
3. Bleed brake system as described in Chapter 2.

1.5 REAR BRAKES

The rear brake is a two-shoe type hydraulic brake mounted on a backing plate that serves as a dust shield. The brake assembly can be removed as a complete assembly or partially disassembled while mounted on the axle housing.

Item numbers refer to parts illustration in Chapter 4.

1.5.1 Rear Drum Brake Removal

See parts illustration in Chapter 4.

1. Raise tractor high enough off floor to provide adequate working space underneath the frame. Support tractor with jack stands. Be sure that positioning of jack stands does not interfere with work task.
2. Remove lug nuts and remove rear wheel assembly.
3. Remove fill/drain plug (AXLE-Rear, Wheel End, item 3) and drain lubricant from wheel end.
4. Remove the 16 capscrews (item 1) from planetary spider assembly cover (item 4).
5. Using puller holes, remove planetary spider assembly cover (item 4).
6. Remove axle shaft and sun gear together (item 11, 12, & 13).
7. Remove planetary ring gear (item 14).
8. Remove hub bearing lock nut (item 16).
9. Remove hub and drum assembly (item 19 and 24). If necessary, manually retract the brake shoes by loosening the star wheel adjuster.

IMPORTANT! When removing hub and drum assembly, always replace hub oil seal.

10. Remove automatic adjusting link wires and pivot (see parts illustration in Chapter 4).
11. Remove two upper shoe springs (item 9 and 20).
12. Remove the leading shoe hold-down clip (item 10). Lift and rotate the clip until released from hold-down pin (item 4).

13. Remove bottom shoe spring (item 12) and adjusting bolt assembly (items 13-15).
14. Remove the two trailing shoe hold-down clips (item 10). Lift and rotate the clip until released from hold-down pin.
15. Remove anchor pins (item 8) from holes.
16. If removal of the wheel cylinder or backing plate is necessary, place a clean pan under brake assembly. Disconnect hydraulic line and cap the ends to prevent system contamination.
17. If necessary, remove wheel cylinder attaching capscrews and wheel cylinder.
18. Clean and inspect the brake assembly according to paragraph 1.5.2.

NOTE: Disassembly of the brake is the same whether it is mounted on the vehicle or is on a bench.

1.5.2 Cleaning and Inspection

Refer to Chapter 2.

1.5.3 Adjustment.

The rear brake is self-adjusting. As long as brake components are maintained as directed in paragraph 1.5.2, normal vehicle operation is sufficient to keep the rear brakes properly adjusted.

However, following overhaul or when new linings are installed, the brakes must be manually adjusted to locate the curvature of the lining to the drum and obtain the proper clearance. To adjust the rear brakes manually:

1. If not already done, raise tractor high enough off floor to provide adequate working space underneath the frame. Support tractor with safety stands. Be sure that positioning of safety stands does not interfere with work task.
2. Remove the rubber plug covering the adjustment slot, see parts illustration in Chapter 4, on the backing plate. The slot is located about two inches from the bottom edge of the backing plate. (There are actually two slots. Use the slot that is toward the front of the vehicle).
3. Insert an adjusting tool through the adjustment slot to engage the star wheel on the adjustment bolt, item 14, see parts illustration in Chapter 4. To move the shoes closer to the brake drum, move the tool handle down.

To move the shoes away from the drum, rotate the tool handle up while keeping the adjuster spring pushed away from the star wheel.

⚠WARNING Do not allow linings to drag on drum or they will heat up and lock. The linings will be charred and rendered useless, resulting in brake failure.

4. Adjust the linings until a slight resistance can be felt when the brake drum is rotated. Then adjust in the other direction until the drum can just rotate freely.

1.5.4 Rear Drum Brake Assembly and Installation

See parts illustration in Chapter 4.

1. Before assembly, apply a thin layer of brake lubricant (or No. 2 grease) to the following parts:
   a. Ends of cylinder push rods (item 21).
   b. Adjusting bolt (item 14) threads and on ends (item 13 and 15) where they contact shoes.
   c. All shoe sliding surfaces.
   d. Anchor pins (item 8), anchor pin holes, and anchor pin slots.
2. Position wheel cylinder, install and lock washers, and tighten to 15-20 ft-lbs torque.
3. Install the two anchor pins in the holes in the backing plate.
4. Put the trailing shoe in position into the anchor pin slot and engage it with the wheel cylinder push rod.
5. Install the two trailing shoe hold-down pins through the backing plate.
6. To install the two hold-down clips, engage the clip on the pin and rotate the clip down until it sets flat on the shoe.
7. Install the stamped adjusting spring lever (item 16) on the leading shoe.
8. Position leading shoe in anchor pin slot and position adjusting bolt assembly (items 13, 14, & 15) between shoes. At the same time, install the lower spring.
9. Hold the leading shoe in correct position and install the hold-down pin and clip.
10. Install the two upper springs. Place the green spring on the leading shoe for the right-hand brake and on the trailing shoe for the left-hand brake.
11. Install the short automatic adjustment wire (item 19) to connect the pivot to the pin near the anchor location.
12. Install the long automatic adjustment wire (item 17) to connect the pivot (item 18) to the stamped automatic adjustment spring.
13. Install the automatic adjustment pivot and spacer to the leading shoe on its shoulder bolt fastener. Be careful that the pivot is not pinched under the edge of the shoulder.

14. Rotate the star wheel to make sure it can easily rotate with a “click” in one direction and cannot easily rotate in the other direction.
15. Connect brake line to wheel cylinder. Tighten tube fitting firmly. Do not over tighten.
16. Bleed brake system as described in Chapter 2. Check for leaks when bleeding system.
17. Assemble and install rear wheel end as described in paragraph 1.5.5.

1.5.5 Rear Wheel End Installation

Item numbers refer to AXLE-Rear, see parts illustration in Chapter 4..

1. Apply to inner bearing cone (item 22) and install bearing cone.
2. Press in a new oil seal (item 23).
3. If hub and drum were separated, assemble drum and hub using bolts and washers (item 26 and 25) and tighten to 85-115 ft-lbs torque.
4. Install hub and drum assembly onto axle spindle, being careful not to damage oil seal.
5. Apply to outer bearing cone (item 17) and install bearing cone.
6. Install wheel bearing adjusting nut (item 16) and tighten to obtain 5-8 in/lbs rolling torque.
7. Install planetary ring gear (item 14). Wheel bearing adjusting nut roll pin (item 15) must line up with hole in planetary ring gear.
8. Install axle shaft/sun gear assembly.
9. Apply MIL-S-46163 Type II sealant to mating surface of the planetary spider cover hub.
10. Install planetary spider assembly to hub using and washers (item 1 and 2). Secure with 85 to 115 ft-lbs.
11. Remove differential fill plug (upper plug) and fill with oil (80W-90 or 85W-140) to level of plug hole. Apply a non-hardening sealing compound (like #51 or equivalent) to plug threads and install and tighten plug.
12. Turn each wheel so wheel end plug is horizontal to axle shaft. Fill wheel ends with oil (SAE 80W-90 or 85W-140) to level of plug hole. Apply a non-hardening sealing compound (like Permatex #51 or equivalent) to plug threads and install and tighten plugs.

⚠CAUTION After initially mounting wheel and tire assembly, recheck lug nut torque after the first hour of operation and after the first 8 hours of operation. After this, check monthly or every 250 hours, whichever comes first. Do not lube wheel studs as it will result

in inaccurate tightening torque. Failure to follow these procedures could result in wheel mounting failure and loss of vehicle control.

13. Install wheel and tire assembly. Tighten 9/16 lug nuts (rear) per Chapter 2. Remove safety stand and lower tractor.

1.6 WHEEL CYLINDERS

Wheel cylinders are used to apply hydraulic force to the rear brake shoes. There is one wheel cylinder on each rear axle end.

NOTE: If the wheel cylinder is leaking or has failed, it is better to install a new one rather than repair the old one. The time and cost involved to recondition a cylinder is usually greater than its replacement cost.

1.6.1 Removal

1. Remove brake drum. Refer to paragraph 1.5.1.
2. Back off brake adjusting bolts if necessary to get clearance between drum and brake shoes.
3. Disconnect brake line at cylinder. Plug brake line or secure clean rag around open brake line to keep brake fluid from contaminating brake linings and work area.
4. Remove brake return spring.
5. Remove securing wheel cylinder to brake. Spread brake shoes apart until ends of shoes clear cylinder. Remove cylinder.

1.6.2 Disassembly

1. Remove rubber boots from wheel cylinders.
2. Apply low-pressure compressed air to cylinder inlet (if needed) and force pistons and cups from cylinder bores. Remove spring.
3. If needed, remove bleeder screw from cylinder.

1.6.3 Cleaning and Inspection

1. Clean all parts and dry with compressed air.
2. Inspect boots for tears, holes, and deterioration. Replace if damaged.

NOTE: A hard, crystal-like substance sometimes forms a ring in cylinder bore near where piston stops when brake is released.

3. Inspect pistons, cups, and cylinder bores for scratches, scoring, pitting and corrosion.

4. Use crocus cloth or a hone to remove deposits or minor surface irregularities. If bore does not clean up readily, replace cylinder.
5. Inspect tapped holes of cylinder for thread damage. Use a tap to clean up minor damage. Replace cylinder if threads are damaged due to cross-threading or of or fittings.
6. Check passage in bleeder screw. Use a piece of fine wire to open passage if blocked. Also check threads for damage. Replace bleeder screw if threads cannot be cleaned up.
7. Piston movement should be smooth.

1.6.4 Assembly

1. Lubricate cylinder bore, spring, cups, and pistons with clean brake fluid. Install into cylinder. Open side of cups and flat side of piston must be toward inside of cylinder.
2. Install rubber boots making sure they engage grooves on cylinder.
3. Install bleeder screw into cylinder but do not tighten.

1.6.5 Installation

1. Position wheel cylinder, install and lock washers, and tighten to 15-20 ft-lbs torque.
2. Spread brake shoes apart enough to allow projections of brake shoes to engage cylinder properly.
3. Connect brake line to wheel cylinder. Tighten tube fitting firmly. Do not over tighten.
4. Bleed brake system as described in Chapter 2. Check for leaks when bleeding system.
5. Install brake drum as described in paragraph 1.5.4.

⚠ CAUTION After initially mounting wheel and tire assembly, recheck lug nut torque after the first hour of operation and after the first 8 hours of operation. After this, check monthly or every 250 hours, whichever comes first. Do not lube wheel studs as it will result in inaccurate tightening torque. Failure to follow these procedures could result in wheel mounting failure and loss of vehicle control.

6. Install wheel assembly and tighten 9/16 lug nuts (rear) per Chapter 2. Remove safety stands and lower tractor.

1.7 POWER BOOSTER/MASTER CYLINDER ASSEMBLY

A hydraulically operated unit called a “power booster” supplies the power-assist to the master cylinder, much like the vacuum booster found in most automobiles. The power

steering pump provides the hydraulic pressure. The master cylinder is mounted on the end of the power booster.

An accumulator is filled with brake fluid each time the brakes are applied. If the power steering pump fails for some reason, the accumulator will provide around three power-assisted stops. Brakes can also be operated with no power assist, but will require much firmer pedal pressure.

Check accumulator reserve charge retention as follows:

1. With engine running at medium rpm, holding steering to stop or hold brake with 100 lb. minimum brake pedal force for 5 seconds (maximum) and turn engine off.
2. Several minutes later, depress brake pedal (engine off). You should be able to make two power-assisted applications. If this cannot be done, repair or replace the booster.

Brake Booster Noise

Normal hydro-boost brake units will produce certain noises. The following noises usually occur during high pedal efforts and quick pedal release:

Above-normal pedal pressure may cause the booster to hiss. Loud hissing sounds at or below normal pedal effort indicates a possible problem.

Clunk, chatter, or clicking noises may be heard when the brake pedal is quickly released from hard pedal efforts.

If you notice booster noise (hydraulic system at normal operating temperature) during low brake pedal effort or with no pedal effort at idle, the booster may be faulty.

1.7.1 Removal

1. With engine off, depress brake pedal several times to discharge accumulator.
2. Remove deck plate (located to right of operator's seat).
   a. Disconnect parking brake cable from parking brake lever.
   b. Remove round head screws from both brake access plates and remove access plates.
   c. Remove deck plate fasteners and deck plate.
3. Disconnect brake pedal linkage from power booster by removing linkage locknuts and .

4. Place rags under booster and master cylinder assembly. Disconnect all hoses and pipes from booster and master cylinder.
5. Plug hoses, pipes, and booster ports to prevent entry of dirt, water or other contaminants.
6. Remove hardware securing power booster to bracket and remove booster assembly.

⚠ DANGER Do not carry brake booster by accumulator, allow brake booster to fall on accumulator or expose brake booster to heat or flame. It contains high pressure gas and can leak under pressure and explode if heated.

1.7.2 Repair

Repair of the power booster/master cylinder assembly is not recommended. If faulty, replace entire unit.

1.7.3 Installation

1. Position power booster assembly on bracket and secure booster with its mounting hardware. Tighten to 30 ft-lbs torque.
2. Bleed air from master cylinder.
   a. Fill reservoir with DOT 3 brake fluid.
   b. Using two plastic or rubber tubes, each approx. 5 inches long, place one end of each tube into one of the master cylinder ports and place other end in reservoir.
   c. Move booster piston back and forth until no more bubbles appear.
   d. Remove tubes and connect brake lines to master cylinder.
3. Connect brake lines to master cylinder and tighten.
4. Connect fittings to power booster and tighten.
5. Bleed air from Hydro-boost unit as follows:
   a. Fill pump reservoir.
   b. Crank engine for several seconds with coil wire or fuel pump wire disconnected. DO NOT START ENGINE.
   c. Check fluid level and add if necessary.
   d. Start engine.
   e. Turn wheels, lock-to-lock, twice.
   f. Stop engine.
   g. Discharge accumulator by depressing brake pedal five times.
   h. Repeat steps (a) through (g).

i. foaming occurs, stop engine and wait for 1 hour for foam to dissipate.
j. Repeat steps (a) through (g).

6. Re-connect pedal linkage. Tighten locknuts to 70 ft-lbs torque.
7. Adjust brake pedal. Refer to Chapter 2.
8. Bleed brake system. Refer to Chapter 2.
9. Road test the tractor.

1.8 PARKING BRAKE (C-6 TRANSMISSION)

1.8.1 Removing Brake Shoes and Pads

1. Block wheels, release park brake and loosen park brake cable by turning handle counterclockwise.
2. Raise rear wheels of tractor using a hoist and jack stands to allow enough room under tractor for the work task.
3. Disconnect park brake cable from parking brake lever.
4. Remove drive shaft mounting and slide drive shaft back and away from park brake assembly.
5. Remove from park brake cover and remove cover.
6. Remove springs holding brake shoes in assembly and remove shoes and pads together.

1.8.2 Inspecting and Lubricating Brake Assembly.

Inspect all parts of parking brake assembly for wear and damage, particularly brake pads and linkage. Lubricate all moving parts. Be careful to keep brake shoes and pads clean and free of grease, oil and gasoline.

1.8.3 Repair and Replacement.

Replace all parts which are worn excessively or damaged brake drum for scoring and replace if drum has excessive grooving.

1.8.4 Reassembly

1. Position brake shoes in drum and fasten with springs.
2. Put cover over brake assembly and fasten with attaching screws.
3. Slide drive shaft forward and attach to park brake assembly.
4. Turn knob on park brake handle out as far as possible without removing it.

1.9 SPECIAL TOOLS FOR TIRE CHANGING

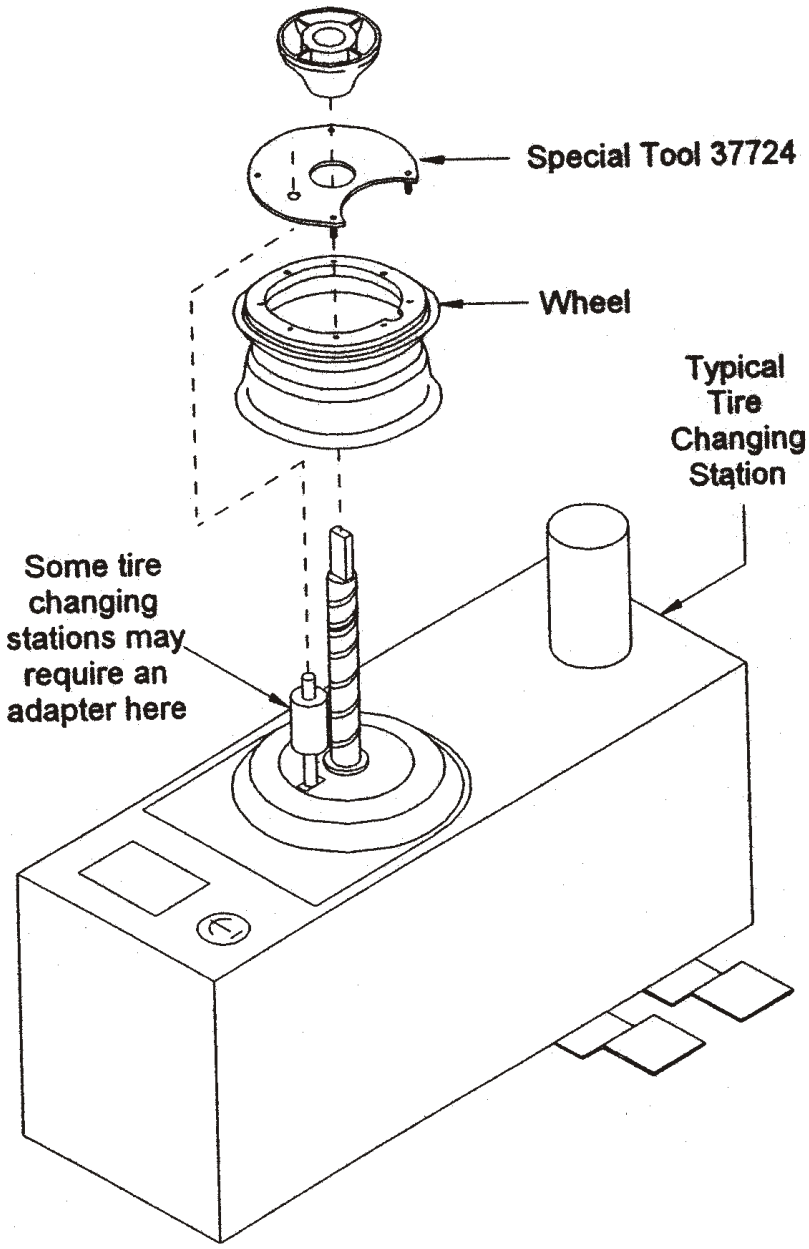


FIGURE 2. SPECIAL TOOLS FOR TIRE CHANGING

This Page Intentionally Blank.

CHAPTER 4 REPAIR PARTS

1. HOW TO USE THE REPAIR PARTS CHAPTER....1-1
2. LIST OF VENDORS....2-1
3. NUMERICAL PART NUMBER LIST....3-1
4. ILLUSTRATED REPAIR PARTS....4-1
- 3RD GEAR LOCK OUT....4-68
- AIR CONDITIONING, M140 CUMMINS QSB3.3....4-206
- AIR HEATER STARTING AID, OPT (CUMMINS)....4-108
- AIR INTAKE SYSTEM, CUMMINS B OR QSB 3.3 TURBO....4-168
- AIR INTAKE SYSTEM, CUMMINS QSB4.5/AT....4-126
- AIR INTAKE SYSTEM, CUMMINS QSB4.5T3/C6....4-148
- AIR INTAKE SYSTEM, M140, 1104D-44....4-192
- AXLE - FRONT, (BRIERTON)....4-2
- AXLE-FRONT SPRING....4-4
- AXLE, REAR....4-6
- AXLE, REAR, REPAIR....4-8
- AXLE, REAR, WHEEL END....4-12
- BACK-UP ALARM, OPTION....4-102
- BATTERY SYSTEM....4-26
- BRAKE - ALLISON TRANSMISSION PARKING....4-20
- BRAKE C6 - PARKING....4-18
- BRAKE, DISC BRAKE, CALIPER....4-14
- BRAKE - PEDAL LINKAGE....4-24
- BRAKE PEDAL & MASTER CYL, HYD TUBES, HOSES & CONNECTIONS....4-22
- BRAKE - REAR, DUAL WHEELS....4-16
- CAB ASSEMBLY GROUP - DOORS, OPT....4-80
- CAB ASSEMBLY GROUP, OPT....4-78
- COOLING SYSTEM, B3.3 TURBO T3....4-166
- COOLING SYSTEM, CUMMINS QSB4.5/AT....4-122
- COOLING SYSTEM, CUMMINS QSB4.5T3/C6....4-144
- COOLING SYSTEM, PERKINS 1104D-44 T/C6, T3....4-190
- COUNTERWEIGHTS....4-82
- COUNTERWEIGHTS....4-84
- DECALS AND PLACARDS....4-42
- DRIVE SHAFT, B3.3 TURBO, T3....4-162
- DRIVESHAFT, CUMMINS QSB4.5/AT....4-118
- DRIVESHAFT, QSB4.5T3 TURBO OR 1104D....4-140
- ELEC. SYS, ENG M140,PERKINS 1104D/C6....4-188
- ELECTRICAL ASSEMBLY, B3.3 TURBO T3....4-174
- ELECTRICAL ASSEMBLY RELAYS....4-28
- ELECTRIC ASSEMBLY, CUMMINS QSB4.5/AT....4-132
- ELECTRIC ASSEMBLY, CUMMINS QSB4.5T3/C6....4-154
- ENGINE REPAIR PARTS, CUMMINS QSB4.5, TIER III....4-116
- ENGINE/TRANS ASSEMBLY, CUMMINS QSB4.5/AT....4-112

ENGINE/TRANSMISSION ASSEMBLY, CUMMINS B3.3 TURBO T3.....4-158
ENGINE/TRANSMISSION ASSEMBLY, CUMMINS B3.3 TURBO, T3.....4-160
ENGINE/TRANSMISSION MOUNTING, CUMMINS QSB4.5/AT.....4-114
ENGINE/ TRANSMISSION MOUNTING, PERKINS 1104-44T/C6.....4-178
ENGINE/TRANSMISSION MOUNTING, PERKINS 1104-44T/C6.....4-180
ENGINE TRANSMISSION MOUNTING, PERKINS 1104C-44/C6.....4-200
ENGINE TRANSMISSION MOUNTING, PERKINS 1104C-44/C6.....4-202
ENGINE/TRANS MOUNTING, CUMMINS QSB4.5T3/C6.....4-136
ENGINE/TRANS MOUNTING, CUMMINS QSB4.5T3/C6.....4-138
EXHAUST SYSTEM, B3.3 TURBO T3 & PERKINS 1104 C&D.....4-164
EXHAUST SYSTEM, CUMMINS QSB4.5/AT.....4-124
EXHAUST SYSTEM, CUMMINS QSB4.5T3/C6.....4-146
FIRE EXTINGUISHER, OPTION.....4-102
FUEL SYS, M140 CUMMINS QSB3.3.....4-204
FUEL SYSTEM.....4-152
FUEL SYSTEM CUMMINS & PERKINS 1104D.....4-130
GRP, M140, ENG, 1104C-44/C6 PERKINS.....4-198
GRP, M140,ENG,PERKINS 1104D-44T/C6.....4-176
GUARD OVERHEAD.....4-74
GUARD OVERHEAD.....4-76
HARNESSES.....4-34
HARNESSES.....4-36
HARNESSES.....4-38
HARNESSES 46648.....4-40
HARNESS WIRING 51311, PERKINS, 1104, M140.....4-194
HARNESS WIRING 51311, PERKINS, 1104, M140.....4-196
HEATER/DEFROST 140 D, OPTION.....4-106
HITCH ASSEMBLY, PIN & EYE.....4-86
HITCH, COUPLER KIT.....4-96
HITCH, COUPLER, PINTLE HOOK, OPTION.....4-90
HITCH, HOLLAND W/RELEASE.....4-98
HITCH, MULTI-LEVEL, REAR, OPTION.....4-94
HITCH, PIN & EYE COUPLER, OPTION.....4-88
HITCH, PIN/EYE, SPRING-LOADED, OPTION.....4-92
HOOD.....4-62
HYDRAULIC SYSTEM, CUMMINS B3.3 TURBO.....4-170
INSTRUMENT PANEL, M140 CUMMINS QSBT3.3, EFF H,I.....4-205
INSTRUMENT PANEL, SPEEDOMETER OPTION, TACHOMETER OPTION4-30
INSTRUMENT PANEL, SPEEDOMETER OPTION, TACHOMETER OPTION4-32
LIGHTS - 4 WAY FLASHERS, OPTION.....4-52
LIGHTS-HEADLIGHT.....4-44
LIGHTS-HEADLIGHT HI-LO BEAM, OPTION.....4-46
LIGHTS - REAR.....4-48
LIGHTS- SPOTLIGHT, OPTION WITHOUT CAB.....4-54
LIGHTS-STROBE AND BEACON.....4-50
LIGHTS- TURN SIGNALS, OPTION.....4-52
LINKAGE SYSTEM, B3.3 TURBO T3.....4-142

LINKAGE SYSTEM, B3.3 TURBO T3....4-172
LINKAGE SYSTEM, CUMMINS QSB4.5/AT....4-120
LINKAGE SYSTEM, PERKINS 1104D-44T/C6....4-184
LINKAGE SYSTEM, PERKINS 1104D-44T/C6....4-186
MIRROR, OPTION....4-100
OEM PARTS, PERKINS 1104 C & D....4-182
SEAT....4-56
SEAT, SUSPENSION, GRAMMAR, OPTION....4-58
SHEET METAL....4-60
SHIFT CONTROL ASSEMBLY - QUADRASTAT....4-64
SHIFT - MORSE, OPTIONAL....4-66
SHUTDOWN, LOW OIL/HIGH TEMPERATURE....4-110
SNOW PLOW, OPTION....4-104
STEER SYS, CUMMINS QSB4.5/AT....4-128
STEER SYSTEM, CUMMINS QSB4.5T3/C6....4-150
WHEELS AND TIRES - FRONT....4-70
WHEELS AND TIRES - REAR....4-72

This Page Intentionally Blank

1. HOW TO USE THE REPAIR PARTS CHAPTER

To ORDER REPAIR PARTS, call NMC-Wollard, Inc. Customer Service at 1-715-835-3151. Be prepared to supply the model number and serial number of your machine. Inform the Customer Service Representative what page and figure number the part you require is on, along with the date that appears in the footer of the parts page. Then order the part number that is listed for the item you require. For your convenience, Visa and MasterCard are accepted for payment.

VENDOR PART NUMBER column lists the original manufacturers' part numbers of items purchased by NMC-Wollard, Inc.. Although these parts may be purchased from NMC-Wollard, Inc. by using the NMC-Wollard, Inc. part number, you may wish to purchase directly from the original manufacturer.

ABBREVIATIONS may be used in this manual as follows:
A/R - As Required
COMM - commercial item readily available from local sources
DPST - Double-Polesingle-Throw
HHCS - Hexhead Capscrew
ID - Inside Diameter
LH - Left-Hand
NS - Not Shown
OA - Over-All
OD - Outside Diameter
RH - Right-Hand
RHMS - Roundhead Machine Screw
SHCS - Socket Head Capscrew
SPDT - Single-Pole Double-Throw

NOMENCLATURE column contains the part description required for identification or procurement. If the part is an item purchased by NMC-Wollard, Inc. and has not been modified by NMC-Wollard, Inc., then following the description will be the vendor's federal supply (CAGE) code. If a vendor does not have a CAGE code, a number will be assigned by NMC-Wollard, Inc. with the prefix letter "V". Example: V1234. Where there is no vendor or CAGE code, NMC-Wollard, Inc. is the manufacturer.

EFF (Effectivity) column identifies by code the model or serial number/s on which a particular part is used. Absence of the code in the "EFF" column indicates that the part or assembly is used on all models with Ser #001 and on.

See the Introduction for Effectivity Code and Serial Numbers

This Page Intentionally Blank

2. LIST OF VENDORS

Cage Code	Vendors
NVC	Sam's Auto Supply (purchase locally)
NVC	North Star Fire Sys/Hannafin
V00544	Fiamm Technologies, Inc., 1550 Leeson Ave., Cadillac, MI 49601
V00548	OE Sales, 239 Old New Brunswick Rd., Piscataway, NJ 08854
V00565	Brennan
00506	D&D Instruments, PO Box 64097. St. Paul, MN 55164-0097
00511	Unlimited Services, Dept. No. 59431, Milwaukee, WI 53259-0431
00513	Certified Power Inc. Co., 95 West Deere Rd., Elkhorn, WI 53121
00523	Genuine Service & Machine, Inc., 2424 Pleasant Street, Eau Claire, WI
00532	Batteries Plus, 3115 E. Hamilton Avenue, Eau Claire, WI 54701
00539	Courtney Industrial Battery, 6522 N 40th St., Milwaukee, WI 53209
00540	Ken Vance Motors, Inc., 5252 Hwy 93, Eau Claire, WI 54701
00542	Maxima Technologies, Inc., PO Box 11579, Boston, MA 02211
00543	Motion Industries, PO Box 1503, Eau Claire, WI 54702
00544	Fiamm Technologies, Inc., 1550 Leeson Ave., Cadillac, MI 49601
00545	Transtar Industries, 34 Offical Rd., Addison, IL 60101
00546	Catco, 2785 Long Lake Rd., St. Paul, MN 55113
00548	OE Sales, 239 Old New Brunswick Rd., Piscataway, NJ 08854
00550	JW Speaker Corp., MB Unit #68-6171, Milwaukee, WI 53268-0489
00551	Grey Products, N6673 State Hwy 25, Durand, WI 54736-4206
00556	Continental Engineering, PO Box 68, Chaska, MN 55318
00779	Tyco Electronics Corp., M/S 38-77, 2800 Fulling Mill Road, PO Box 3608, Harrisburg, PA 17105-3608, Middletown, PA 17057
01276	Aeroquip Corporation, 1225 West Main Street, Van Wert, OH 45891
	Cummins Great Lakes, 5555 S Kilpatrick, Chicago, IL 60629-5348
05WC5	Bosch Automotive Motor Systems, 101 1st Ave, Waltham, MA 02154
0AT39	Brierton Engineering, PO Box 217, Abilene, KS 67410
0BFU2	Tewco Inc., 9701 South 58 Street, Franklin, WI 53132
0J567	Indiana Heat Transfer, 500 W. Harrison St., Plymouth, IN 46563
0NHJ9	Universal Tool and Mold Co., 7522 Frenchton Pl., PO Box 276375, San Antonio, TX 78251-1314
0NYT6	Interdynamics Inc., 80 39th St., Brooklyn, NY 11232
0X0P8	Superior Unlimited, PO Box 3888, Bristol, TN 37625
12662	Peterson Mfg. - Grndvw, PO Box 410032, Kansas City, MO 64141-0032
13445	Cole-Hersee Co., 20 Old Colony Ave., Boston, MA 02127
14894	Allied Automotive, 1094 Bendix Dr., Jackson TN 38301
16476	Datcon Instruments Co., PO Box 128, East Petersburg, PA 17520-0128
1FDW0	Force America, 501 East Cliff Rd. 100, Burnsville, MN 55337
1HS72	Chicago Power Systems Inc., 1533 Lathem St., Batavia, IL 60510
2Y580	Dominion Automotive Ind., 19308 70th Ave S., Kent, WA 98032
24617	General Motors Corp., 3044 W Grand Blvd., Detroit, MI 48202-3091
39569	Northern Power Products, PO Box 21348, Eagan, MN 55121-0348
3E157	Rockwell Standard Axle Co., 500 Commerce Rd, Richmond VA 23224-5414

41469	Titus FD & Son, 13731 E. Proctor Ave., PO Box 2370, La Puente, CA 91746
41625	Incom Intl. Inc., Morse Controls Div., 21 Clinton St., Hudson OH 44236-2802
41640	Morse Mfg. Co. Inc., 727 W Manlius St., East Syracuse, NY 13057-2156
44185	NMC-WOLLARD, Inc., 2021 Truax Blvd., Eau Claire, WI, 54703
52793	Saginaw Products Corp., 68 Willamson St., Saginaw MI 48601-3246
53867	Robert Bosch Corporation, 2800 South 25th Avenue, Broadview, IL 60153-4532
56118	Sparton Corp., 2400 W Ganson, Jackson, MI 49202-3772
56289	Sprague Electric Co., World Hqs., 678 Main St., Sanford ME 04073
58051	Quadrastat Controls Corp., 3860 S Capital Avenue, City of Industry, CA 91748
58961	Waytek Inc., PO Box 690, Chanhassen, MN 55317
62465	Electronic Controls Co., 11080 Executive Dr., PO Box 7246, Boise, ID 83707
63477	Cooper Industries, Inc., Wagner Brake Div., 3700 Forrest Park Blvd., St. Louis, MO 63018
64386	Buckhorn Rubber Co., 5151 Industrial Dr., Hannibal, MO 63401-0998
65439	Advanced Technology Corp., 101 N. Eagle St., Geneva, OH 44041
69633	Meritor HVS LLC, ASP Div., 7975 Dixie Hwy, Florence, KY 41042
6H839	Zenith Spring Co., 3116 W Michigan St., Duluth MN 55806-1744
6K635	Hydraulic Supply Co., 4301 N. W. 36 Street, Miami Springs, FL 33166
6K866	Keystone Cable Corp., 7600 Chrysler Dr., Detroit, MI 48211-1974
6N512	Inland Diesel Inc., PO Box 68-9633, Milwaukee WI 53268-9633
72643	Power Great Lakes, Inc., 655 Wheat Lane, Wood Dale, IL 60191
72447	Dana Corporation, Universal Joint Division, 6201 Trust Drive, Holland, OH 43528
75175	Concord Instruments Corp., KD Lamp Company, 1910 Elm St., Cincinnati, OH 45210-2451
77326	Pollak Joseph Corp., 195 Freeport St., Dorchester, MA 02122-2827
79470	Weatherhead Div., Dana Corp., 6615 Brotherhood Way, Ft. Wayne, IN 46825
79995	Sheller-Globe Corp., 1641 Porter St., Detroit, MI 48202-3091
7A009	Diesel Components, Honolulu, HI 96800
7J925	Endries Fastners & Supply Inc., PO Box 69, Hwy 10W, Brillion, WI 54110
81834	Grote Mfg. Company Inc., PO Box 766, Madison, IN 47250-0766
8S377	Fuel Systems, 12730 Robin Lane, Brookfield, WI 53005
92867	Orschlein Brake Lever Mfg. Co., 1177 North Morley, Moberly, MO 65270-2736
94222	Southco Inc., 210 N Brinton Lake Rd., Concordville, PA 19331
96151	(Char-Lynn) Eaton Corp., Fluid Power Operations, 15151 Hwy. 5 Eden Prairie, MI 55344
K4216	QDS Components Ltd, Victory Rd., Derby DE24, United Kingdom
03718	Cummins Great Lakes, 5555 S Kilpatrick, Chicago, IL 60629-5348
	PRM Newage LTD, Barlow Road, Coventry England, CV 2LD

3. NUMERICAL PART NUMBER LIST

Part No	Page
1.7864	4-129, 4-151, 4-171
1.8125	4-159
1.8498	4-159
1.8732	4-23
1.8786	4-103
1.8808	4-129, 4-151
1.9016	4-159
2.0131	4-29
2.0134	4-31
2.1401	4-29, 4-189
2.2441	4-111
2.3010	4-111
2.3267	4-27
2.3274	4-27, 4-175
2.3277	4-27, 4-175
2.3345	4-189
2.3346	4-189
2.3359	4-27
2.3360	4-27
2.3366	4-197
2.3478	4-45, 4-103, 4-197
2.3913	4-197
3.0143	4-129, 4-151, 4-171
3.0391	4-179, 4-201
3.0397	4-23
3.0556	4-189
3.1317	4-129, 4-151, 4-171
3.1391	4-129, 4-151, 4-171
3.1571	4-191
3.1572	4-129, 4-151, 4-171
3.1820	4-133, 4-155, 4-159, 4-175, 4-179, 4-189, 4-201
3.1917	4-171
3.2143	4-171
3.2519	4-129, 4-151, 4-171
3.2642	4-133
3.2792	4-23
3.2793	4-23
3.2951	4-91
3.3197	4-189
3.3304	4-171
3.3326	4-181, 4-203
3.3329	4-189
9.0027	4-207
9.2066	4-131, 4-145, 4-153, 4-167, 4-191, 4-204
562A279	4-43
7310-10	4-157
8796.108	4-129, 4-151
8796.109	4-171
8797.11	4-171
8797.104	4-129, 4-151
8797.105	4-129, 4-151, 4-171
8946.46	4-171

Part No	Page
12654.36	4-5
33899	4-103
37049	4-197
37188	4-65, 4-139, 4-161, 4-181, 4-203
37206	4-107
37210	4-107
37244	4-43
37249	4-17
37292	4-101
37292S	4-101
37305	4-37
37306	4-35
37307	4-35, 4-37, 4-41, 4-45, 4-53, 4-195
37308	4-35, 4-41, 4-195
37309	4-35, 4-37, 4-41, 4-53, 4-195
37310	4-37, 4-45, 4-195
37333	4-107
37357	4-115, 4-137
37408	4-39, 4-197
37409	4-35, 4-39, 4-197
37433	4-191
37443	4-31
37445	4-31
37446	4-31
37447	4-31
37489	4-127
37535	4-115, 4-137, 4-161, 4-179, 4-201
37537	4-115, 4-137
37540	4-189
37551	4-123, 4-145
37576	4-191
37578	4-45
37604	4-63
37639	4-37, 4-45, 4-53
37640	4-35, 4-37, 4-41, 4-195
37654	4-31
37655	4-191
37667	4-65, 4-143, 4-173, 4-187
37674	4-161
37676	4-191
37681	4-29
37698	4-73
37711	4-77
37718	4-73
37725	4-73
37729	4-35
37733	4-189
37734	4-45, 4-105
37813	4-3
37833	4-131, 4-153

Part No	Page
37844	4-31
37851	4-193
37856	4-17
37897	4-71
37915	4-99
37920	4-139, 4-161, 4-181, 4-203
37934	4-69
38001	4-35
38031	4-195
38040	4-45
38041	4-45
38043	4-63
38072	4-89
38073	4-89
38075	4-89
38077	4-191
38078	4-17
38079	4-17
38118	4-7
38130	4-89
38138	4-57
38154	4-99
38183	4-99
38186	4-99
38189	4-99
38227	4-89
38229	4-89
38296	4-87
38307	4-185
38308	4-61
38311	4-61
38317	4-165
38321	4-179, 4-201
38334	4-179, 4-201
38344	4-191
38378	4-87
38381	4-87
38409	4-83, 4-85
38422	4-121
38446	4-85
38452	4-85
38452.2	4-73
38461	4-25, 4-185
38463	4-83
38466	4-85
38478	4-57
38487	4-61, 4-185
38493	4-51
38494	4-51
38495	4-51
38504	4-25, 4-185
38508	4-61
38511	4-23

PART NO.	PAGE
38513	4-23
38547	4-61
38601	4-29
38605	4-61
38610	4-63
38615	4-61, 4-191
38622	4-85
38634	4-115
38640	4-61
38661	4-85
38662	4-85
38665	4-85
38675	4-61, 4-143, 4-173
38692	4-131, 4-153, 4-204
38695	4-83
38718	4-83, 4-85
38719	4-83
38721	4-61
38733	4-155, 4-159, 4-175, 4-179, 4-189, 4-201
38739	4-63
38743	4-89
38744	4-89
38746	4-89
38757	4-17
38758	4-17
38759	4-17
38760	4-17
38761	4-17
38762	4-17
38763	4-17
38764	4-17
38768	4-207
38825	4-207
38828	4-129, 4-151, 4-171
38834	4-85
38852	4-97
38863	4-51
38867	4-43
38876	4-93
38963	4-43
38969	4-57
39037	4-131, 4-153
39077	4-5
39086	4-105
39127	4-93
39129	4-93
39131	4-93
39138	4-93
39139	4-93
39140	4-93
39141	4-93
39150	4-9
39152	4-9
39153	4-9
39154	4-9
39155	4-9, 4-13
39156	4-9
39157	4-9
39158	4-9
39159	4-9
39160	4-9
39161	4-9
39164	4-9
39165	4-11
39166	4-11
39167	4-11
39168	4-11
39169	4-11
39170	4-11
39171	4-11
39172	4-11
39173	4-11
39174	4-11
39175	4-11
39176	4-11
39177	4-11
39178	4-11
39179	4-11
39180	4-11
39181	4-11
39182	4-11
39183	4-11, 4-13
39184	4-11
39185	4-11, 4-13
39186	4-13
39187	4-13
39188	4-13
39189	4-13
39190	4-13
39191	4-13
39192	4-13
39194	4-13
39195	4-13
39196	4-13
39197	4-13
39198	4-13
39199	4-13
39220	4-143, 4-173, 4-185
39239	4-29, 4-77
39283	4-17
39286	4-17
39287	4-17
39288	4-17
39289	4-17
39290	4-17
39291	4-17
39292	4-17
39293	4-17
39294	4-17
39295	4-17
39296	4-17
39297	4-17
39457	4-143, 4-173, 4-185
39465	4-61
39484	4-191
39487	4-93
39512	4-107
39552	4-17
39553	4-17
39555	4-17
39556K	4-17
39557K	4-17
39580	4-131, 4-153
39924	4-121, 4-143, 4-173, 4-185
39925	4-121, 4-143, 4-173, 4-187
39927	4-99
39962	4-99
39976	4-51
39981	4-179, 4-201
39984	4-79
39986	4-101
39989	4-79
39992	4-79
39992-1	4-79
39992-2	4-79
39992-3	4-79
39992-4	4-79
39992-5	4-79
39992-6	4-79
39992-7	4-79
39992-8	4-79
39992-9	4-79
39992-10	4-79
39992-11	4-81
39992-12	4-81
39992-13	4-81
39992-14	4-81
39992-15	4-81
39992-16	4-81
40016	4-89
40027	4-105
40028	4-105
40029	4-105
40040	4-99
40041	4-85
40043	4-77
40046	4-29
40049	4-77
40053	4-79
40085	4-77
40091	4-77
40093	4-89

PART NO.	PAGE
40095	4-89
40099	4-83, 4-85
40100	4-83, 4-85
40101	4-83, 4-85
40102	4-83, 4-85
40116	4-77
40117	4-77
40122	4-107
40164	4-123, 4-145, 4-191
40181	4-101
40216	4-101
40307	4-95
40308	4-95
40310	4-95
40329	4-43
40340	4-191
40479	4-67
40481	4-67
40518	4-43
40559	4-77
40667	4-165
40694	4-79
40986	4-5
40996	4-49
41005	4-51
41052	4-161
41059	4-13, 4-73
41060	4-13, 4-19
41063	4-13
41068	4-9
41069	4-73
41072	4-137, 4-141, 4-161, 4-163, 4-181, 4-203
41073	4-137, 4-141, 4-161, 4-163, 4-181, 4-203
41124	4-9
41155	4-9
41156	4-9
41168	4-13
41319	4-187
41393	4-29
41400	4-33, 4-111
41401	4-33, 4-111
41434	4-30, 4-31
41437	4-73
41450	4-115, 4-137
41457	4-185
41461	4-27
41472	4-43, 4-204
41482	4-207
41496	4-11
41506	4-59
41520	4-3
41521	4-3
41522	4-3
41523	4-3
41524	4-3
41526	4-3
41533	4-131, 4-153
41640	4-3
41640-4	4-3
41640-5	4-3
41676	4-73
41677	4-73
41705	4-33
41706	4-187
41752	4-115
41780	4-75
41781	4-75
41798	4-51
41811	4-23
41812	4-23
41813	4-23
41814	4-23
41819	4-3
41820	4-3
41821	4-3
41822	4-3, 4-15
41823	4-3, 4-15
41824	4-3
41828	4-3
41829	4-15
41830-1	4-15
41840	4-9
41842	4-7, 4-9
41935	4-11
42031-1	4-183
42031-15	4-183
42031-16	4-183
42031-20	4-179, 4-201
42039	4-111
42047	4-183
42051	4-131, 4-153, 4-204
42057	4-51
42096	4-115
42118	4-204
42120	4-7
42151	4-191
42165	4-111
42176	4-15
42248	4-73
42265	4-179, 4-201
42270	4-185
42271	4-187
42272	4-185
42300	4-187
42301	4-187
42314	4-61
42340-1	4-9
42343	4-57
42381	4-185
42382	4-43
42460	4-121
42536	4-43
42537	4-43
42545	4-71
42546	4-73
42552	4-57
42553	4-43
42581.3	4-119
42602	4-67
42627	4-7
42635	4-83
42637	4-63
42738	4-43
42802	4-119, 4-141
42814	4-43, 4-107
42856	4-137, 4-161, 4-181, 4-203
42908	4-127
42913	4-15
42942	4-27
42943	4-43
42944	4-43
42959	4-165
42962	4-137
42964	4-137
42965	4-137
42980	4-175
42993	4-207
43018	4-81
43023	4-79
43024	4-79
43056	4-47
43096	4-3
43114	4-23, 4-143
43118	4-131, 4-153
43142	4-79
43145	4-109, 4-155, 4-175
43184	4-59
43216	4-91
43217	4-91
43246	4-183
43246-1	4-183
43258	4-179, 4-201
43269	4-181, 4-203
43277	4-115
43294	4-119
43314	4-43
43361	4-181, 4-203
43362	4-181, 4-203
43363	4-181, 4-203
43365	4-137, 4-159, 4-181, 4-203
43413	4-191

PART NO.	PAGE
43424	4-131, 4-153
43443	4-115
43459	4-123, 4-145, 4-167
43468	4-45
43481	4-131, 4-153
43565	4-85
43567	4-61
43575	4-33
43586	4-3
43693	4-181, 4-203
43694	4-181, 4-203
43695	4-181, 4-203
43697	4-131, 4-153
43804	4-85
43805	4-85
43806	4-85
43834	4-129, 4-151
43944	4-83
43945	4-83
43946	4-83, 4-85
43947	4-73
43948	4-71
43949	4-73
43950	4-71
43953	4-65, 4-143, 4-173
43954	4-67
43956	4-65
43957	4-67
43958	4-33
43959	4-45
43960	4-47, 4-49
43961	4-33
43962	4-111
43963	4-33
43964	4-31
43965	4-57
43966	4-57
43968	4-31
43970	4-43
43974	4-113, 4-131, 4-135, 4-153, 4-157
44075	4-139, 4-161, 4-181, 4-203
44152	4-3
44153	4-3
44243	4-175
44293	4-187
44298	4-191
44476	4-29, 4-39
44477	4-29, 4-39
44514	4-179, 4-201
44528	4-197
44544	4-123, 4-145, 4-167, 4-191
44556	4-123, 4-145, 4-167, 4-191
44631	4-201
44667	4-7
44670	4-201
44720	4-31
44726	4-191
44727	4-191
44735	4-31
44738	4-129, 4-151, 4-171
44745	4-17
44746	4-17
44826	4-181
44827	4-183, 4-201
44859	4-179, 4-201
44887	4-79
44888	4-179, 4-201
44940	4-137, 4-159, 4-179, 4-201
44941	4-179, 4-201
44942	4-179, 4-201
45009	4-37
45010	4-37
45011	4-37
45016	4-35, 4-37, 4-41, 4-195
45017	4-35, 4-37, 4-41, 4-195
45018	4-39
45019	4-39
45028	4-37
45036	4-123, 4-145
45051	4-37
45093	4-179, 4-201
45099	4-29
45143	4-31, 4-205
45164	4-31, 4-205
45165	4-205
45201	4-127, 4-149
45234	4-187
45309	4-113, 4-125, 4-147
45357	4-37, 4-121, 4-143, 4-173
45360	4-29
45361	4-29
45363	4-31, 4-33
45366	4-125, 4-147
45367	4-125, 4-147
45368	4-125, 4-147, 4-165
45393	4-39
45394	4-39
45398	4-37
45400	4-35, 4-155, 4-175
45417	4-43
45426	4-111
45537	4-103
45666	4-35, 4-41
45695	4-5
45745	4-189
45811	4-179, 4-201
45812	4-179, 4-201
45820	4-183
45831	4-161
45832	4-161
45982	4-127, 4-149, 4-169, 4-193
45983	4-127, 4-149, 4-169, 4-193
45992	4-175
45996	4-39
45998	4-39
46036	4-27, 4-133, 4-155, 4-175
46065	4-137
46070	4-115
46200-1	4-181
46217	4-165
46229	4-179, 4-201
46240.2	4-129, 4-151
46240.14	4-171
46246	4-171
46247	4-129, 4-151, 4-171
46249	4-33
46261	4-37
46264	4-37
46300	4-37
46325-5	4-149
46341	4-43
46412	4-123, 4-145
46420	4-23, 4-129, 4-151, 4-171
46420.5	4-129, 4-151
46447	4-123, 4-145
46451	4-115, 4-137
46453	4-115, 4-137
46454	4-115, 4-137
46482	4-113, 4-129, 4-135, 4-151
46483	4-37, 4-155
46519	4-3, 4-5
46529	4-23
46530	4-129, 4-151, 4-171
46535	4-139, 4-161
46538	4-61
46539	4-61
46540	4-61
46541	4-63
46544	4-27, 4-113, 4-135
46550	4-135
46550-1	4-135, 4-137, 4-139
46550-2	4-135, 4-143, 4-157, 4-173
46550-3	4-135
46550-4	4-135, 4-147
46550-5	4-113, 4-127, 4-135, 4-149

PART NO.	PAGE
46550-6	4-135, 4-145
46550-9	4-113, 4-129, 4-135, 4-151
46551	4-123, 4-145
46555	4-113
46555-1	4-113, 4-115
46555-2	4-113, 4-121
46555-3	4-113, 4-133, 4-155
46555-4	4-125
46555-6	4-113, 4-123
46572	4-119, 4-141
46573	4-115, 4-119
46575	4-115
46576	4-115
46580	4-133, 4-155, 4-175
46589	4-123, 4-145, 4-167
46591	4-127, 4-149, 4-169
46592	4-127, 4-149, 4-169
46593	4-127, 4-149
46594	4-127, 4-149
46601	4-109, 4-155, 4-175
46604	4-127, 4-149, 4-193
46611	4-127, 4-149
46619	4-149
46620	4-175
46624	4-129, 4-151
46625	4-175
46635	4-23
46636	4-121, 4-143, 4-173
46642	4-129, 4-151, 4-171
46644	4-37, 4-155
46646	4-5
46647	4-61
46648	4-41, 4-175, 4-189
46649	4-29
46650	4-109, 4-155, 4-175
46651	4-61
46656	4-121, 4-143, 4-173
46658	4-129, 4-151, 4-171
46669	4-35
46670	4-39
46671	4-39
46674	4-123, 4-145
46675	4-61
46676	4-61
46677	4-107
46685	4-143, 4-173
46700	4-29
46743	4-113, 4-135, 4-157
46841	4-61
46857	4-61
46863	4-115
46864	4-115
46867	4-43
46890	4-103
46950	4-159
46997	4-39
47032	4-23
47033	4-23
47038	4-155, 4-175
47174	4-187
47231	4-167
47235	4-167
47239	4-163
47240	4-159
47246	4-165
47268	4-103
47307	4-157, 4-171
47310	4-157
47310-1	4-157, 4-159, 4-161
47310-3	4-157, 4-175
47310-4	4-157, 4-165
47310-5	4-157, 4-169
47310-6	4-157, 4-167
47310-8	4-204
47310-9	4-157, 4-171
47310-10	4-27, 4-157
47341	4-161
47484	4-3
47800	4-191
47862	4-29
48079	4-115, 4-137
48080	4-115, 4-137
48144	4-29
48376	4-161
48377	4-161
48387	4-169
48390-1	4-159
48460	4-165
48471	4-169
48472	4-169
48474	4-169
48476	4-187
48486	4-191
48487	4-179, 4-201
48500	4-53
48519	4-167
48522	4-37
48531	4-27
48559	4-19
48560	4-19
48683	4-77
48684	4-77
48685	4-77
48687	4-125
48915	4-29
49085	4-29
49124	4-29
49283	4-195
49657	4-197
49672	4-195
50030-1	4-159
50030-2	4-143
50030-4	4-165
50030-5	4-169
50030-9	4-171
50113	4-29
50151	4-37
50279	4-29
50354	4-39
50355	4-39
50356	4-39
50359	4-39
50394	4-161
50696	4-101
50851	4-131
50938	4-165
51224	4-51
51225	4-131, 4-177
51225-1	4-177, 4-179, 4-181
51225-2	4-177, 4-185, 4-187, 4-199
51225-3	4-177, 4-189, 4-199
51225-4	4-177, 4-191, 4-199
51225-5	4-177, 4-193, 4-199
51225-7	4-165, 4-177
51225-8	4-177, 4-199
51225-10	4-27, 4-177, 4-199
51235	4-179, 4-183
51311	4-189, 4-195, 4-197
51312	4-181, 4-203
51315	4-179, 4-201
51318	4-165
51320	4-179, 4-201
51423	4-177, 4-179, 4-199, 4-201
51424	4-177, 4-199
51428	4-179, 4-201
51437	4-193
51443	4-79
51444	4-79
51449	4-131
51464	4-43
51555-1	4-199
51555-7	4-199
51606	4-121
51826	4-205
52487	4-31, 4-43, 4-205
52555	4-199
52555-1	4-201, 4-203
52555-7	4-165
52598	4-7
52599	4-7
52656	4-30
52675-1	4-61

PART NO.	PAGE
52678	4-7
52693	4-73
52694	4-73
52695	4-73
52722	4-163
52739	4-33
52751	4-205
52752	4-205
52753	4-205
52858	4-29
52859	4-29
52880	4-205
52882	4-131
52884	4-23
52886	4-7
52948	4-33
52983	4-29
52987	4-29
52988	4-61
52993	4-50
52997	4-30
52998	4-23
52999	4-43
53000	4-115
53000-1	4-115
53000-2	4-121
53002	4-205, 4-207
53003	4-30
53004	4-205
53005	4-43
53104	4-23
53106	4-23
53107	4-23
53153	4-207
90474	4-25
90559	4-57
90562	4-121, 4-143, 4-173, 4-185
90652	4-19
91926	4-123, 4-129, 4-145, 4-151, 4-171
91930	4-123
91938	4-171
120917	4-61
122077	4-99, 4-137, 4-159
150526	4-129, 4-151, 4-171
151427	4-95
152864	4-29, 4-191
153768	4-43, 4-204
165412	4-99
200084	4-29, 4-107
200085	4-133, 4-155, 4-175
200223	4-149
202735	4-129, 4-151, 4-171
202736	4-129, 4-151, 4-171
202993	4-129, 4-151, 4-171
203194	4-91
203566	4-123, 4-145, 4-167, 4-191
203999	4-35, 4-41
204594	4-43
204604	4-43
204606	4-43
204614	4-7
204684	4-197
204714	4-179, 4-201
204730	4-181, 4-203
204783	4-179, 4-201
205065-3	4-159
205065-4	4-159
205065-6	4-159
205065-7	4-159
205065-8	4-159
206098	4-37
206099	4-37
206101	4-35, 4-37, 4-39, 4-41, 4-195
206102	4-197
206103	4-197
206117	4-35, 4-37, 4-41, 4-197
206405	4-159
206407	4-159
206408	4-159
206409	4-159
206498	4-159
206500	4-159
206616	4-39
206640	4-207
206725	4-169
207649	4-159
208609	4-159
208945	4-167
208967	4-167
210095	4-207
210307	4-207
220110	4-131, 4-153
302313	4-139, 4-161, 4-181, 4-203
303108	4-99
303831-01	4-183
304610	4-171
304682	4-29, 4-51
305006	4-109, 4-155, 4-175
305007	4-29
305732	4-43
306521	4-43
306522	4-43
307215	4-29
307216	4-29
307217	4-29
307218	4-29
308070	4-37
308743	4-21
308809	4-183
308937	4-183
308938	4-183
400906	4-179, 4-201
404500	4-163
406203	4-121, 4-143, 4-173
421806	4-169
429902	4-121
1000519	4-25
1008837	4-93
1011081	4-129, 4-151, 4-171
1018145	4-43
F001005	4-185
F002691	4-129, 4-151, 4-171
F002958	4-195, 4-197
F006612	4-195
F009535	4-101, 4-103
F009536	4-89, 4-101, 4-103, 4-143, 4-173, 4-187
F009541	4-3, 4-50, 4-51
F009546	4-23, 4-51, 4-57, 4-101, 4-107, 4-137, 4-159, 4-185, 4-191
F009547	4-23, 4-57, 4-99, 4-101, 4-185
F009549	4-23, 4-27, 4-51, 4-57, 4-107, 4-191
F009665	4-27, 4-137, 4-159, 4-179, 4-201
F009666	4-27, 4-61
F009669	4-19, 4-79
F09704	4-89, 4-137, 4-159, 4-181, 4-203
F009791	4-41
F009792	4-41, 4-103, 4-195
F9793	4-195
F009794	4-51, 4-195, 4-197
F009797	4-41, 4-195
F010046	4-50, 4-51, 4-131, 4-153
F010824	4-131, 4-153
F011057	4-145
F011487	4-107
F013412	4-93
F013500	4-99
F013588	4-99, 4-137, 4-159
F014476	4-191
F015973	4-19, 4-91, 4-105, 4-179, 4-181, 4-201, 4-203
F016102	4-181, 4-203
F016241	4-83
F016765	4-189

PART NO.	PAGE
F016818	4-3, 4-19
F016824	4-19, 4-99
F016825	4-19, 4-21, 4-91, 4-105, 4-179, 4-201
F16829	4-89, 4-93, 4-97, 4-99
F017264	4-89
F018486	4-137, 4-159, 4-179, 4-181, 4-201, 4-203
F018701	4-179, 4-201
F018708	4-19
F018937	4-89
F018975	4-103
F100002	4-89
F100003	4-99
F100010	4-50, 4-51
F100030	4-61
F0100061	4-89
F100064	4-179, 4-201
F100196	4-179, 4-201
F100272	4-91
F100304	4-99
F100306	4-185, 4-191
F100308	4-181, 4-203
F100311	4-27, 4-79
F100312	4-61
F100320	4-137, 4-159
F100331	4-99
F100333	4-99
F100340	4-137, 4-159
F100357	4-91
F100358	4-105
F100377	4-99
F100378	4-51, 4-61, 4-89, 4-101
F100398	4-105
F100403	4-19, 4-59, 4-181, 4-203
F100405	4-179, 4-201
F100444	4-137, 4-159, 4-181, 4-203
F100484	4-50, 4-51
F100514	4-195
F100522	4-51, 4-55, 4-103
F100527	4-41
F100622	4-181, 4-203
F 100669	4-167
F100669	4-123, 4-145
F100671	4-131, 4-153
F100728	4-23
F 100780	4-175
F100780	4-133, 4-155, 4-179, 4-201
F100846	4-41, 4-51, 4-103, 4-195
F100851	4-51
F100864	4-51
F100895	4-103
F100898	4-41, 4-195
F100899	4-41, 4-195
F100905	4-47
F100930	4-27
F100931	4-27
F100933	4-41, 4-195
F100937	4-107, 4-167
F100979	4-129, 4-145, 4-151, 4-167, 4-171, 4-191
F101015	4-131, 4-153, 4-204
F101115	4-189
F101127	4-23
F101137	4-23
F101140	4-123, 4-145, 4-191
F 101146	4-175
F101146	4-133, 4-155
F101150	4-131, 4-153, 4-204
F101156	4-107
F101160	4-77
F101190	4-61, 4-79
F101258	4-129, 4-151, 4-171
F 101295	4-145, 4-167
F101331	4-19
F101377	4-19
F101448	4-19
F101526	4-179, 4-189, 4-201
F 101527	4-175
F101527	4-133, 4-155, 4-159, 4-179, 4-189, 4-201
F101529	4-131, 4-153
F101531	4-41
F101548	4-39, 4-103
F101549	4-39, 4-103
F101550	4-39, 4-53
F101551	4-39
F101552	4-53, 4-103
F101553	4-103
F101557	4-39
F101567	4-53
F101573	4-23
F101588	4-131, 4-153, 4-204
F101597	4-35
F101601	4-61
F101603	4-61, 4-191
F101622	4-47
F101630	4-71, 4-73
F101642	4-197
F101647	4-195
F101661	4-77
F101679	4-129, 4-151, 4-171
F101680	4-189
F101685	4-107, 4-207
F101767	4-55
F101772	4-197
F101783	4-41
F101787	4-41
F101793	4-53, 4-197
F101847	4-129, 4-151
F101850	4-195
F101854	4-195
F 101863	4-143, 4-173
F101863	4-67, 4-121, 4-185
F101865	4-99, 4-185
F101878	4-195
F101889	4-97, 4-99
F101890	4-41
F101895	4-41, 4-197
F101896	4-197
F101897	4-195
F101899	4-41
F101920	4-101
F101921	4-23
F101927	4-103
F 102160	4-175
F102160	4-29, 4-155, 4-189
F102162	4-29
F102204	4-195
F102369	4-197
F102526	4-179, 4-201
F102544	4-75
F103213	4-129, 4-151, 4-171
F103924	4-23
F103925	4-181, 4-189, 4-203
F103926	4-179, 4-201
F104049	4-169
F104092	4-195
F104159	4-169
F104281	4-31, 4-33, 4-205
F104341	4-35, 4-41, 4-197
F104348	4-179, 4-201
F 104402	4-145, 4-167
F104402	4-129, 4-151, 4-171, 4-191
F104418	4-171
F104428	4-195, 4-197
F104435	4-25, 4-185
M27507.5	4-29
M257005	4-29, 4-133, 4-155, 4-175
M2848062	4-183
NW03461	4-179, 4-201
NW010370EB	4-23
NW010518FB	4-133, 4-155, 4-175, 4-179, 4-189, 4-201
NW010526C10	4-29, 4-51
NW010526C20	4-29, 4-77
NW014597	4-191
NW 015530	4-143, 4-173

PART NO.	PAGE
NW015530	4-121, 4-187
NW015632	4-23
NW015764	4-13
NW015766	4-13
NW015767	4-13
NW015769	4-13
NW016196	4-107
NW016220	4-105
NW016340	4-63
NW017079	4-125, 4-147
NW017237	4-43
NW017242	4-71
NW017243	4-191
NW017269	4-189
NW018775	4-71
NW019009	4-53
NW020686	4-101
NW20903	4-105
NW20904	4-105
NW20940	4-105
NW021261	4-31
NW021634	4-107
NW 021649	4-175
NW021649	4-133, 4-155, 4-159, 4-179, 4-189, 4-201
NW021810	4-27
NW021911	4-185
NW022072	4-21
NW022755-2	4-71
NW 022767	4-143, 4-173
NW022767	4-121, 4-185
NW022778	4-23
NW022814	4-27, 4-63
NW022821	4-27
NW022828	4-107
NW022834	4-59
NW023065	4-63
NW023066	4-63
NW023102	4-11
NW023112	4-165
NW023205	4-107
NW023360	4-29
NW023700	4-29
NW023706	4-141, 4-163
NW023733	4-57
NW023734	4-57
NW023843	4-57
NW023994	4-179, 4-201
NW024101E	4-55
NW024103E	4-103
NW024110E	4-91
NW024357	4-43
NW024626E	4-97
NW024637	4-103
NW024699	4-31, 4-33
NW024700	4-31, 4-33
NW024701	4-30, 4-31
NW024702	4-31, 4-204
NW24796	4-105
NW026290E	4-51
NW26327	4-131, 4-153, 4-204
NW026601	4-51
NW26697E	4-57
NW026799	4-129, 4-151, 4-171
NW027041	4-59
NW027323E	4-89
NW27824	4-131, 4-153, 4-204
NW27825	4-131, 4-153, 4-204
NW28109R	4-61
NW029020	4-129, 4-151, 4-171
NW029842	4-89
NW029846	4-89
NW029866	4-27
NW029923	4-27
NW029951	4-169
NW029952	4-169
NW030043	4-27
NW030064	4-127, 4-149, 4-169
NW030220	4-53
NW 030236	4-175
NW030236	4-133, 4-155, 4-159, 4-189, 4-191
NW030247	4-31, 4-43
NW030263	4-23
NW030435	4-23
NW030677K	4-53
NW030820	4-53
NW030828	4-103
NW031334	4-50, 4-51
NW031487	4-189
NW031646	4-179, 4-201
NW 031669	4-143, 4-173
NW031669	4-65, 4-67, 4-187
NW031776	4-37, 4-189
NW031820	4-181, 4-203
NW 031849	4-167
NW031849	4-123, 4-145, 4-191
NW031880	4-47
NW31948	4-65
NW032137	4-27, 4-189
NW032310	4-59
NW032329	4-103
NW032342	4-23
NW032343	4-23
NW032352	4-107
NW32439	4-77
NW032841	4-65
NW032842	4-65
NW032893	4-79
NW033056	4-99
NW033068	4-21
NW033073	4-21
NW033074	4-21
NW033101	4-169, 4-193
NW033102	4-127, 4-149, 4-169
NW033103	4-127, 4-149, 4-169, 4-193
NW033159	4-31
NW033179	4-31
NW033180	4-31
NW033223	4-47
NW033236	4-103
NW033314	4-77
NW033318	4-75, 4-77
NW033538	4-35
NW033731	4-119, 4-141, 4-163
NW033761	4-5
NW033813	4-47
NW 033835	4-143, 4-173
NW33835	4-25, 4-185
NW033848	4-23
NW33861	4-25, 4-185
NW033891	4-23
NW033918	4-17
NW033929	4-17
NW034019	4-95
NW034020	4-95
NW034021	4-95
NW034154	4-17
NW34156	4-27
NW034176	4-31, 4-50, 4-51, 4-53, 4-77, 4-205
NW034208	4-3
NW 034238	4-143, 4-173
NW034238	4-65, 4-67, 4-187
NW34244	4-163
NW34265	4-25, 4-185
NW034296	4-187
NW034298R	4-185
NW 034343	4-143, 4-173
NW034343	4-185
NW034352	4-91
NW34364	4-185
NW 034365	4-145
NW034365	4-123
NW034377	4-119, 4-141, 4-163
NW034404	4-121
NW 034441	4-159
NW034441	4-137, 4-159, 4-181, 4-203
NW034448	4-23
NW034459	4-121
NW34461	4-83
NW034469	4-21, 4-121
NW034470	4-21, 4-121

PART NO.	PAGE
NW034519	4-53
NW034532	4-139, 4-161, 4-181, 4-203
NW034536	4-53
NW034546	4-49, 4-101
NW 034551	4-143, 4-173
NW034551	4-67, 4-187
NW34568	4-73
NW034575	4-53
NW034579	4-77, 4-79
NW034591	4-67
NW034592	4-67
NW034658	4-61, 4-63
NW034678	4-181, 4-203
NW 034717	4-143, 4-173
NW034717	4-185
NW 034718	4-143, 4-173
NW034718	4-187
NW034725	4-95
NW034726	4-95
NW034727	4-95
NW034728	4-57, 4-59
NW034729	4-191
NW 034731	4-143, 4-173
NW034731	4-187
NW034733	4-187
NW034736	4-131, 4-153, 4-191, 4-204
NW034742	4-207
NW034758	4-23
NW034801	4-73
NW034835	4-73
NW034853	4-79
NW034879	4-19
NW034880	4-19
NW034881	4-19
NW034882	4-19
NW034883	4-19
NW034884	4-19
NW034885	4-19
NW034886	4-19
NW034887	4-19
NW034888	4-19, 4-121
NW034889	4-19, 4-121
NW034890	4-19
NW034955	4-29
NW034967	4-3
NW034968	4-3, 4-129, 4-151, 4-171
NW034993	4-89
NW035029	4-101
NW035226	4-31
NW35268	4-79
NW035304	4-71
NW035372	4-129, 4-151, 4-171
NW035374	4-33
NW035376	4-31, 4-205
NW035378	4-31, 4-33, 4-205
NW035379	4-31, 4-33, 4-77, 4-205
NW035380	4-31, 4-33, 4-77
NW035381	4-31, 4-33
NW035382	4-31
NW035383	4-31, 4-205
NW035384	4-50, 4-51
NW035385	4-31, 4-33, 4-205
NW035386	4-31, 4-205
NW035388	4-31, 4-205
NW035394	4-79, 4-107
NW035395	4-79, 4-107
NW035412	4-37
NW035413	4-37
NW035561	4-43
NW035606	4-125, 4-147, 4-165, 4-169
NW035615	4-35, 4-41
NW035616	4-35, 4-41
NW035623	4-127, 4-149
NW035628	4-127, 4-149, 4-193
NW035682	4-73
NW035714	4-63
NW35727	4-105
NW35728E	4-105
NW035733	4-127, 4-149, 4-169, 4-193
NW35737	4-105
NW035744-2	4-79
NW035744-3	4-79
NW035744-4	4-79
NW035744-5	4-79
NW035744-6	4-79
NW035744-7	4-79
NW035744-8	4-79
NW035744-9	4-79
NW035744-10	4-79
NW035744-11	4-79
NW035744--12	4-79
NW035744-15	4-79
NW035744-16	4-79
NW035744-19	4-79
NW035744-20	4-79
NW035744-21	4-79
NW035744-24	4-79
NW035744-25	4-79
NW035744-26	4-79
NW035744-29	4-81
NW035744-30	4-81
NW035744-31	4-81
NW035744-35	4-81
NW035744-36	4-81
NW035744-40	4-81
NW035744-41	4-81
NW035744-42	4-81
NW035744-43	4-81
NW035744-44	4-81
NW035744-45	4-81
NW035842	4-49
NW035843	4-49
NW035844	4-49
NW035885	4-119, 4-141, 4-163
NW035886	4-119, 4-141, 4-163
NW035887	4-119, 4-141
NW035891	4-63
NW035901	4-89
NW35944	4-185
NW035997	4-71
NW035998	4-71
NW 036097	4-167
NW036097	4-123, 4-145, 4-191
NW036120	4-77
NW036128	4-29, 4-31
NW036129	4-31
NW 036144	4-143, 4-173
NW036144	4-65, 4-185
NW036145	4-65
NW036155	4-3
NW036156	4-3
NW036160	4-3
NW036161	4-3
NW036162	4-3
NW036164	4-3
NW036180	4-43
NW036194	4-131, 4-153
NW036196	4-131, 4-153, 4-204
NW036198	4-131, 4-153, 4-204
NW036223	4-119
NW036316	4-21
NW36377	4-131, 4-153
NW036378	4-59
NW036379	4-59
NW036490	4-115, 4-137
NW036501	4-19, 4-137, 4-161, 4-181, 4-203
NW036552	4-77
NW036560	4-129, 4-151, 4-171
NW036633	4-167
NW036687	4-115, 4-137
NW036693	4-71
NW036697	4-17
NW36722	4-81
NW36723	4-81
NW036731	4-31, 4-33
NW036767	4-31
NW036776	4-53
NW036784	4-193

PART NO.	PAGE	PART NO.	PAGE	PART NO.	PAGE
NW036790	4-23				
NW36794	4-67				
NW36838	4-131, 4-153, 4-204				
NW036842	4-3				
NW036853	4-11				
NW036855	4-13				
NW036856	4-13				
NW036980	4-11				
NW100899	4-53				
NW0305814	4-23				
RF090504	4-123				
RF090523	4-99				
RF90585	4-119, 4-141				
RF 090896	4-175				
RF090896	4-133, 4-155, 4-189				
SB489	4-143, 4-173				
SW1D555	4-7				
SW2H2047	4-99				
SWXRP202	4-93				
W 015530	4-143				

4. ILLUSTRATED REPAIR PARTS

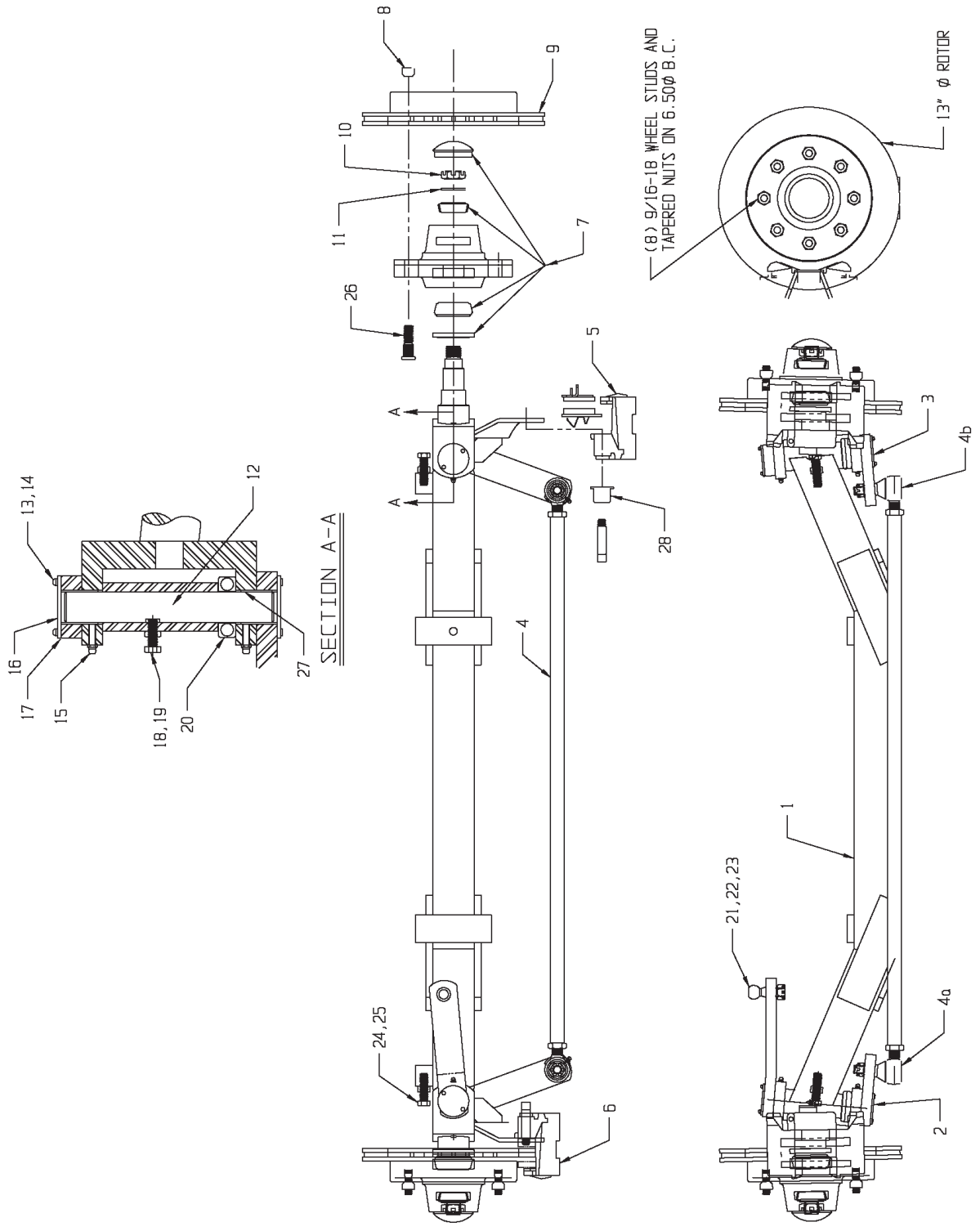


FIGURE 1.
AXLE - FRONT, (BRIERTON)

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
1-	41640	04-40328C	Axle - Front, (0AT39), Rear Mount Steering Cyl		1
	46519		Axle - Front, (0AT39), Front Mount Steering Cyl		
	47484		Axle - Front, (0AT39), Rear Mount Steering Cyl		
1	41821	03-30468	Front Axle Weldment, Rear Mt Steering Cyl		1
	41640-4		Front Axle Weldment, Front Mt Steering Cyl		
	41640-5		Front Axle Weldment, Rear Mt Steering Cyl		
2	41820	03-30469	Knuckle, LH		1
3	41819	03-30470	Knuckle, RH		1
4	41520	03-30265	Tie Rod Tube Assembly (incl. 4A and 4B)		1
4a	NW34967	06-60358	Tie Rod End Assembly, LH (incl. end, boot, nut, and cotter pin)		Ref
4b	NW34968	06-60360	Tie Rod End Assembly, RH (incl. end, boot, nut, and cotter pin)		Ref
5	41823	06-61460L	Caliper, Disc Brake, R.H. (NOTE: Casting is stamped L) See Figure 6		1
6	41822	06-61460R	Caliper, Disc Brake, L.H. (NOTE: Casting is stamped R) See Figure 6		1
7	41521	02-20608	Hub Assembly (incl. 7A-7E)		2
7a	41522	06-61425	Hub, Cupped and Studded		2
7b	NW36156	130580500	Inner Cone, #25580		2
7c	NW36160	130581300	Outer Cone, #14125A		2
7d	NW36155	06-60403	Grease Seal		2
7e	NW36164	06-60402	Grease Cup		2
8	NW36842	06-61516	Nut, 9/16-18 Tapered Wheel		Ref
9	41828	06-61515	Rotor, 13" Dia.		2
10	NW36162	06-62085	Nut, 1-14 Slotted Hex Jam		2
11	NW36161	06-60295	Washer, Spindle		2
12	41523	06-60779	King Pin		2
	43586		King Pin Re pair Kit for Axle 41640		1
13	41524	06-61080	Screw, #10 BHC x .63 lg.		8
14	F9541	06-61081	Washer, #10 Lock		8
15	Comm	390406410	Grease Zerk		4
16	41824	06-60547	King Pin Cap w/ Zerk Hole		4
17	41526	06-61376	Gasket, King Pin Cap		4
18	44153	06-62089	Nut, Jam, 3/8-24		2
19	44152	06-62090	Set Screw, Cup Pt, 3/8-24 x .75		2
20	43096	06-61908	Bearing, Thrust T113		2
21	NW34208	06-60297	Steering Ball		2
22	37813	321900110	Nut, 5/8-18 Slotted Hex		1
23	Comm	324601060	Cotter Pin, 3/32 x 3/4 Lg.		1
24	Comm	320224100	HHCS 1/2-13x2		2
25	F16818	321800090	Nut 1/2-13 Hex		2

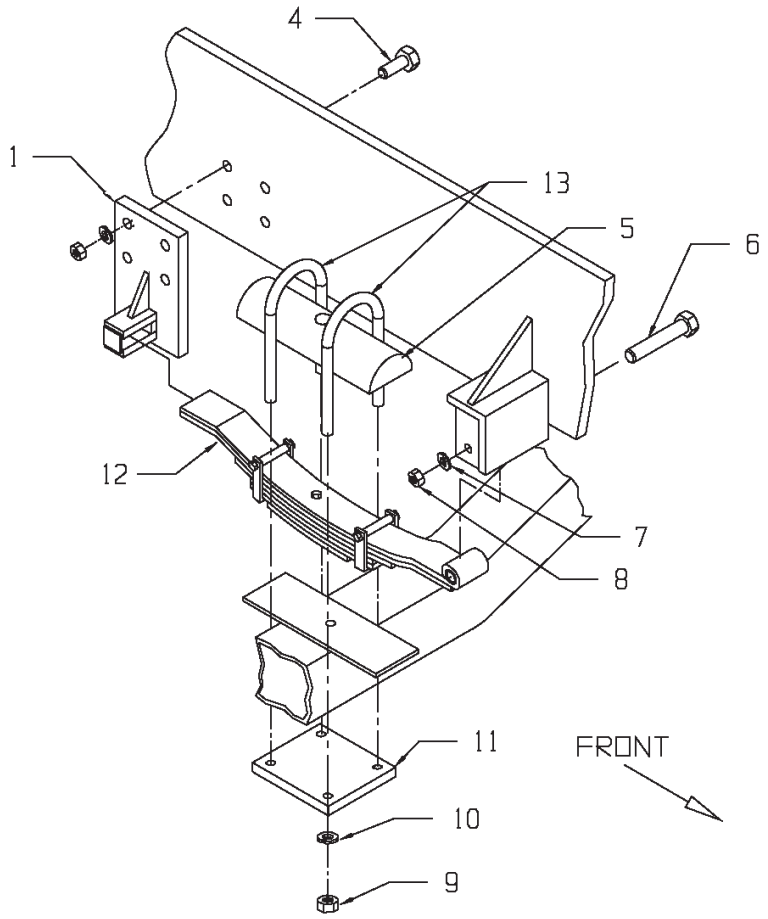
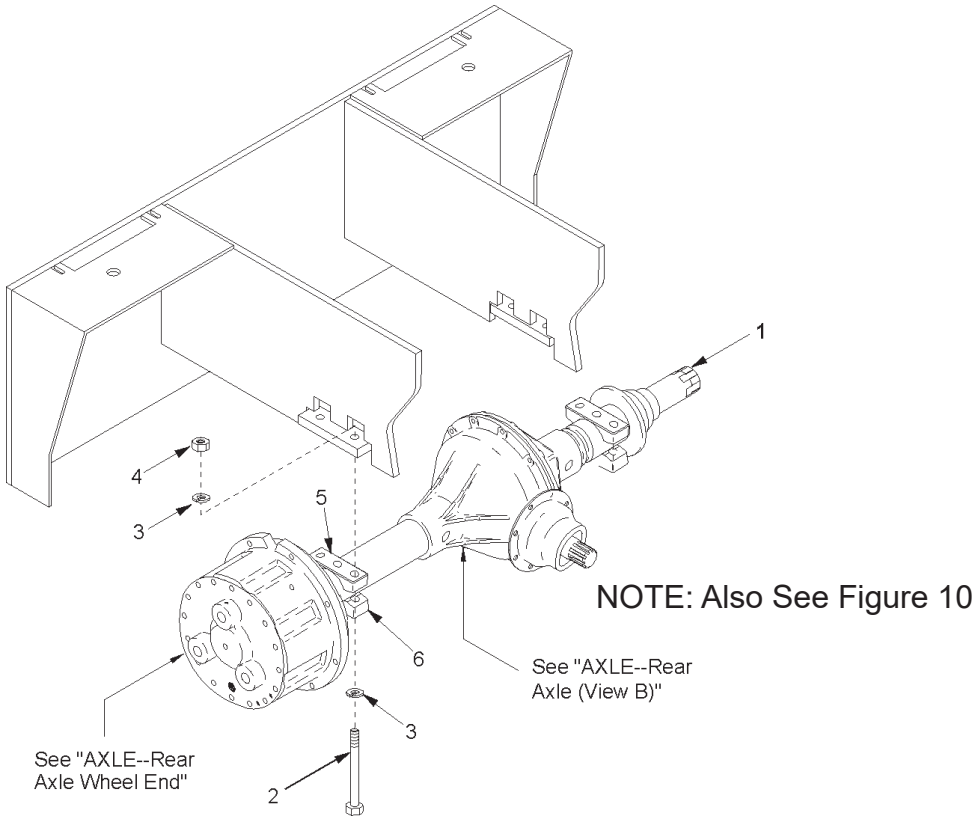


FIGURE 2.
AXLE-FRONT SPRING

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
2-	46519		Axle Assy, Front, Hyd		Ref
1	46646		Spring Hanger		2
2	Comm		Lock Washer, 1/2		8
3	Comm		Hex Nut, 1/2-13		8
4	Comm		HHCS, 1/2-13 x 2.50		8
5	45695		Plate, Top, U-Bolt, 6”		2
6	39077		HHCS, 5/8-11 x 5.00 GR8		2
7	Comm		Lock Washer, 5/8		2
8	Comm		Hex Nut, 5/8-11		2
9	Comm		Hex Nut, 9/16-18		8
10	Comm		Lock Washer, 9/16		8
11	NW33761		Spring Plate		2
12	40986		Spring Assembly, Heavy Duty (6H839)		2
13	12654.36		U-Bolt, RD, 9/16-18 x 2.12 x 8.75		4

Also see Figure 10.



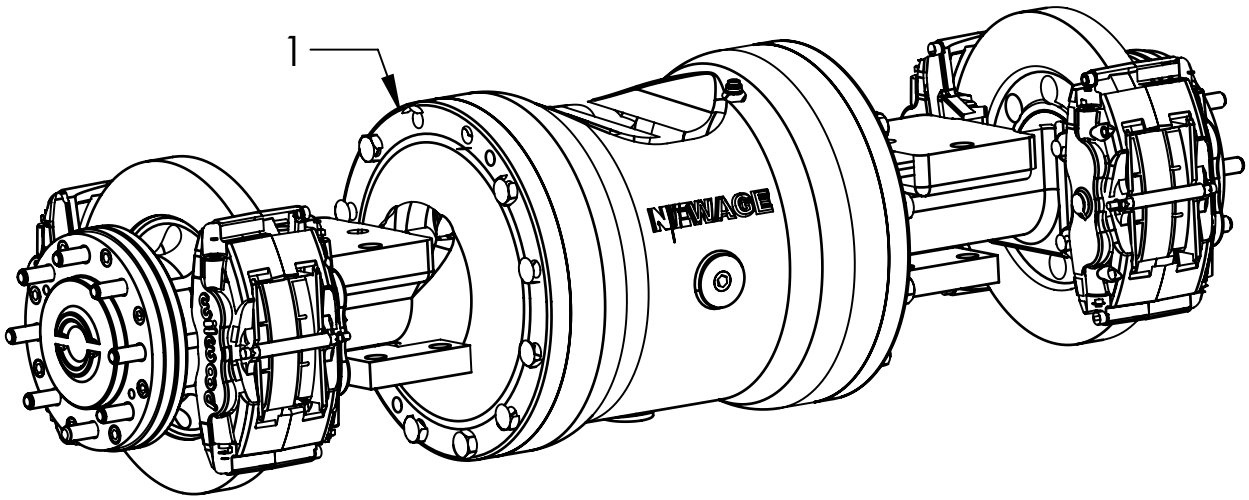


FIGURE 3.
AXLE, REAR

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
3-	42627		Axle Assembly - Rear		Ref
	41842	TA268DS H117 586	Axle Assembly, TA268, 19.33:1 (69633)		1
2	44667		HHCS, 3/4-16 x 7.00 GR8		4
3	204614		Washer, 3/4 Hardened		8
4	SW1D555		Hex Nut, 3/4 - 16 Top Lock		4
5	38118		Pad, Axle, Upper		2
6	42120	3277A105	Pad, Axle, Lower (69633)		2
Fig.-Item	**NMC Wollard Part No.**	**Vendor Part No.**	**Nomenclature**	**Eff**	**Units Per Assy**
3-	52599		Axle Assy, Rear, 140, Newage	H	Ref
1	52598		Axle, Rear, 612 Newage	H	1
2	52886		HHCS, 3/4-16 x 8.00 GR8		4
3	204614		F, FW, 3/4 SAE, Hardened		8
4	SW1D555		F, Nut, Hex, 3/4-16, Top Lock		4
6	52678		Pad, Axle, Lower	H	2

NOTE: Also See Figure 10

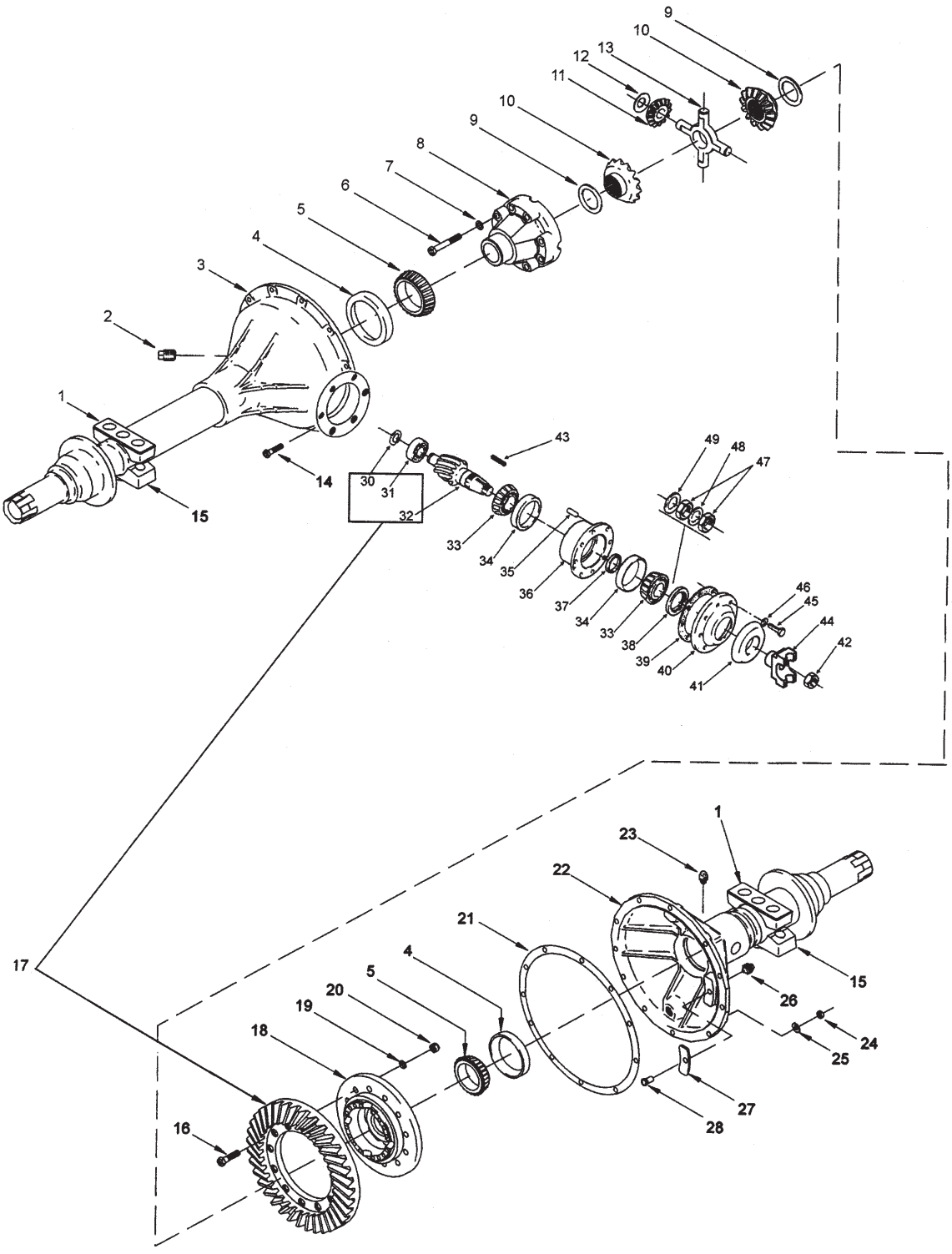


FIGURE 4.
AXLE, REAR, REPAIR
1 OF 2

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
4-	41068		Axle Rear, TA268DSH116-358, 11.81:1 (23 mph)		Ref
	41124		Axle Rear, TA268DSH117-586, 19.33:1		
	41155		Axle Rear, TA268DSH117-514, 16.97:1		
	41156		Axle Rear, TA268DSH117-411, 13.57:1 (18 mph)		
	41840		Axle Rear, TA268DSH118-411, 13.57:1 (18 mph)		
	41842	TA268DSH 118-586	Axle Rear, 19.33:1 (13 mph) (69633)		
1	NSS	NSS	Axle Pad, Upper (69633)		2
2	39150	P-112	Plug (69633)		1
3		A96-3800D654	Carrier and Tube Assy, Pinion Half (includes items 2 and 4) (69633)		1
4	39152	3920	Cup, Differential Carrier (69633)		2
5	39153	3984	Cone, Differential Carrier (69633)		2
6	39154	S2822-1	Capscrew (69633)		8
7	39155	1229-C-1511	Washer, Hardened (69633)		8
8	NSS	NSS	Case, Differential, Plain Half (See item 18) (69633)		1
9	39156	1229-V-412	Thrust Washer (69633)		2
10	39157	2834-F-58 2234K1311	Side Gear, Differential (69633) Side Gear, Differential(1-2-2001 & Later)		2
11	39158	2233-W-75 2233-N-1132	Pinion, Differential (69633) Pinion, Differential (1-2-2001 & Later)		4
12	39159	1229-U-1061	Thrust Washer (69633)		4
13	39160	3278-T-72	Spider, Differential (69633)		1
14	39161	S-1714-1	Capscrew, Carrier Halves (69633)		11
15	NSS	NSS	Axle Pad, Lower		2
16	39164	15-X-776	Bolt (69633)		12
17	42340-1	A-41692-1-358	Gear Set for 41068 Axle		1
		A-41580	Gear Set for 41124 Axle		
		A-34958-2-514	Gear Set for 41155 Axle		
		A-40498-1-411	Gear Set for 41156 Axle		
		A-40498-3-411	Gear Set for 41840 Axle		
		A-41580-4-586	Gear Set for 41842 Axle		

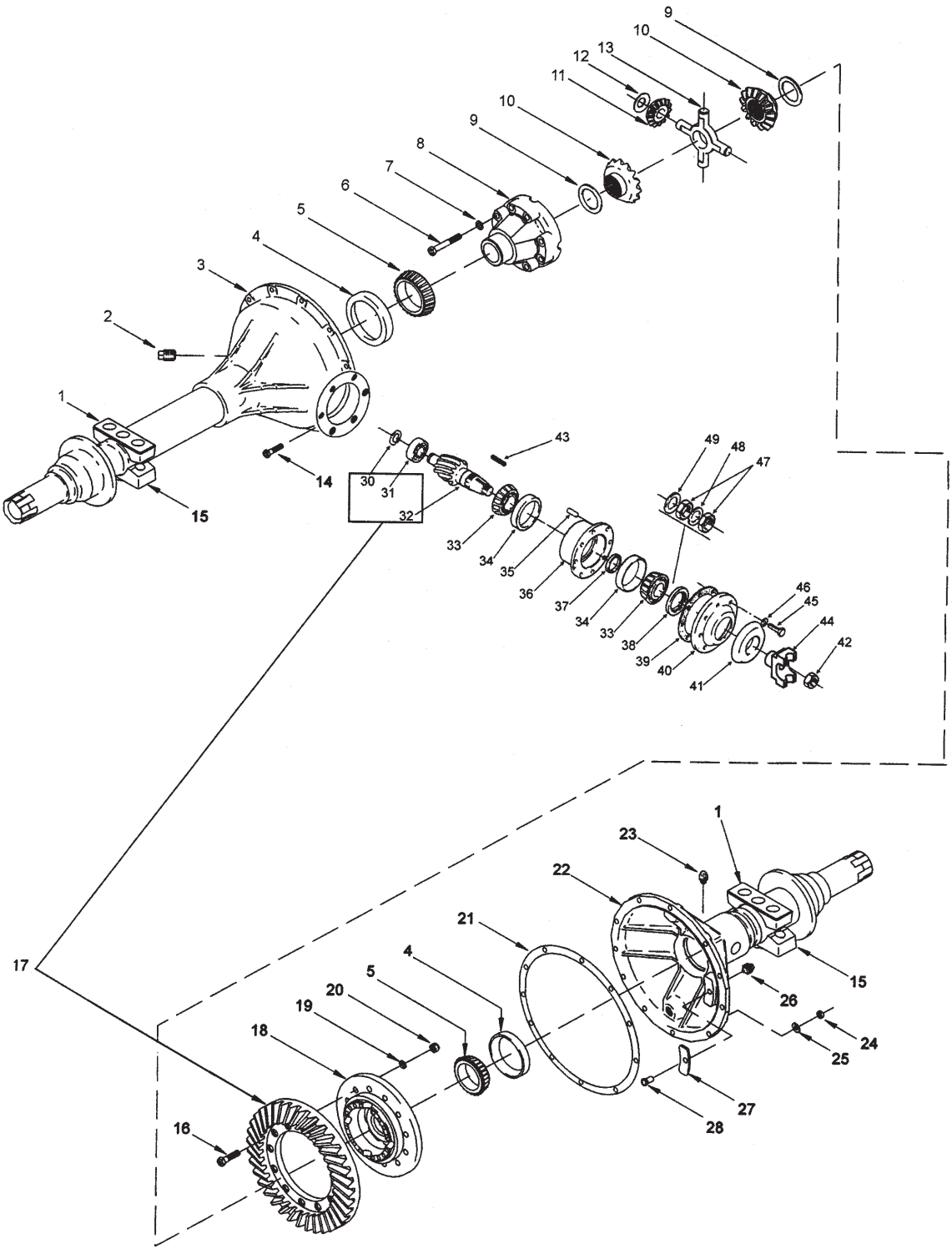


FIGURE 4.
AXLE, REAR, REPAIR
2 OF 2

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
4-			Axle-Rear, 2 of 2		Ref
18		A2-3235-N-1262	Case, Differential, Flange Half Kit, Differential Case Assembly (includes items 6-8 and 18)		1 Ref
19	39165	1229-E1513	Washer, Hardened (69633)		12
20	39166	NL-17-1	Nut (69633)		12
21	39167	2208-H-112	Gasket, Carrier Halves (69633)		
22	39168	A43-3200S-487	Carrier and Tube Assy, Plain Half (includes items 4 and 26-28)		1
23	39169	A-1199-C-1043	Oil Breather (69633)		1
24	39166	NL-17-1	Nut (69633)		11
25	39165	1229-E-1513	Washer, Hardened (69633)		11
26	39185	1850T150	Plug, Fill/Drain, Magnetic (69633)		1
27	39170	2297-S-175	Thrust Block (69633)		1
28	39171	1246-D-134	Pin, Thrust Block (69633)		1
30	39172	1229-Y-1299	Lock Ring, Bevel Pinion RR		1
31	39173	1228-E-83	Bearing, Bevel Pinion RR (69633)		1
32		NSS	Pinion, Bevel (See item 17)		1
33	39174	HM-803149	Cone, Pinion Bearing (69633)		2
34	39175	HM-303110	Cup, Pinion Bearing (69633)		2
35	39176	1246-C-211	Dowel, Bearing Cage (69633)		1
36	39177	A1-3226-A-677	Bearing Cage Assembly (69633) (includes items 33 and 34)		1
37			Same as item #49		
38			Same as item #48		
39	NW036853	2808E863	Gasket (69633)		1
40	39181	A-1205K167	Oil Seal, Pinion Cage Cover		1
41	NW036980	A-3266-W-49	Cover Assembly (incl. item 41)		1
43	Comm		Key		1
44	41935	141NYT22-22	Input Yoke For U-Bolt Connection (69633)		1
	41496	3897Q1993	Input Yoke For Flat Shaft To Shaft Connection (69633)		1
45	39183	S-2912-2	Capscrew, Long (69633)		5
	39184	S-2910-1	Capscrew, Short (69633)		1
46	39182	1229-X-1558	Washer (69633)		6
47	39179	1227-M-117	Nut (69633)		2
48	39180	1229-H-528	Lock, Bevel Pinion Nut		1
49	39178	1229-J-530	Thrust Washer (69633)		2
NS	NW23102		Bushing, Rear Axle		2

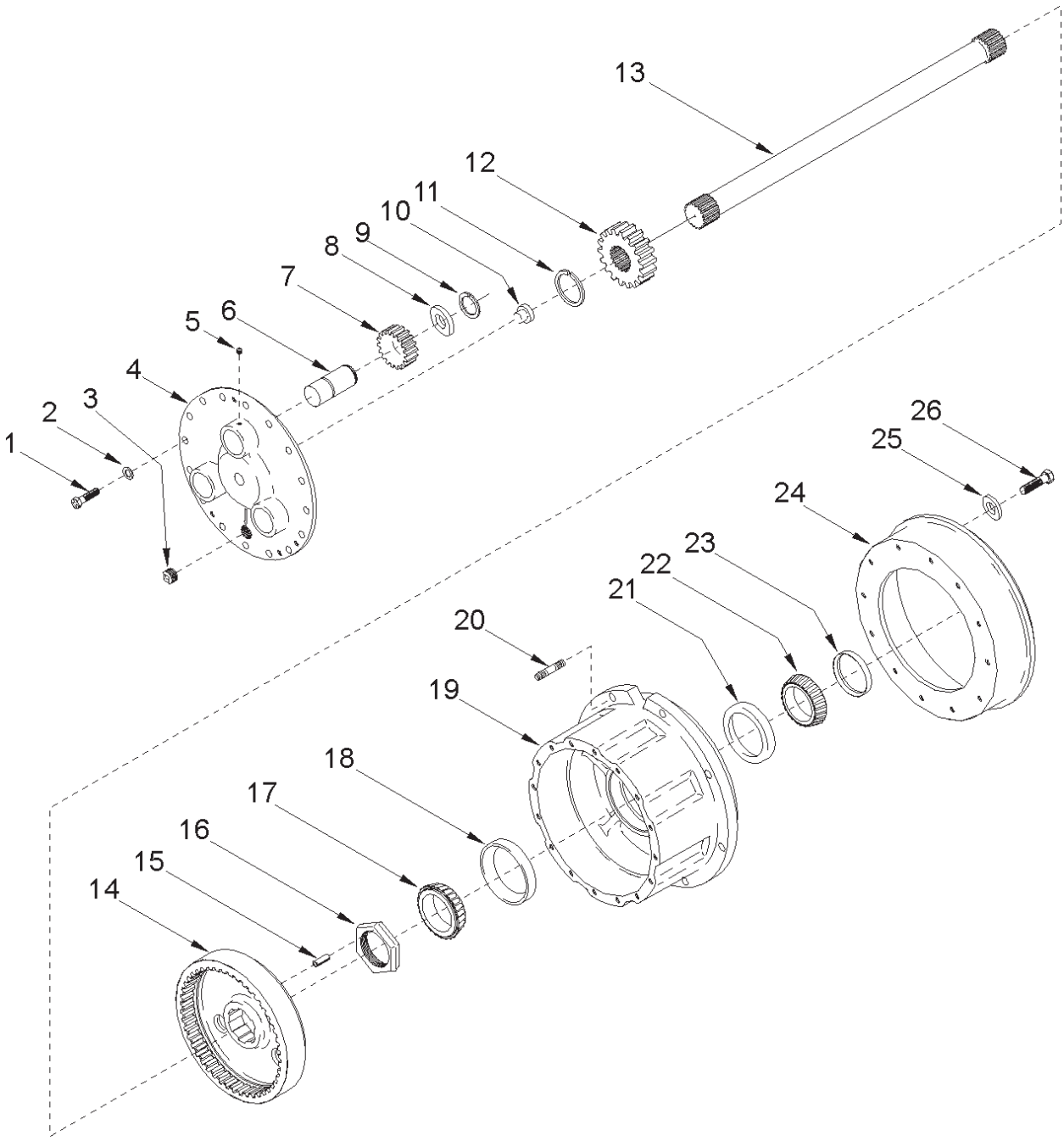


FIGURE 5.
AXLE, REAR, WHEEL END

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
5-			Axle - Rear Wheel End		Ref
1	39183	S-2812-1	Capscrew (69633)		32
2	39155	1229-C-1511	Washer, Hardened (69633)		32
3	39185	2850-T-150	Plug, Magnetic (69633)		2
4	39186	A1-3298-B-1094	Spider Assembly (includes item 10) (69633)		2
5	39187	26-X-237	Setscrew, Pinion Shaft (69633)		6
6	39188	3198-W-1089	Shaft, Planetary Pinion (69633)		6
7	39189	3891-Q-1629	Pinion, Planetary (69633)		6
8	39190	1229-F-2814	Thrust Washer (69633)		6
9	39191	1854-Z-182	Snap Ring (69633)		6
10	39192	2297-T-4570	Thrust Button (69633)		2
11		1854-C-289	Snap Ring (69633)		2
12	39194	3892-Z-3588	Gear, Planetary Sun (69633)		2
13	39195	3202-E-9911	Axle Shaft (69633)		2
14	39196	3892-C-4059	Gear, Planetary Ring (69633)		2
15	39197	1246-G-553	Dowel (69633)		2
16	39198	A-1227-J-972	Lock Nut Assy (Includes Item 15)		2
17	NW015764	3326B	Cone, Outer (69633)		2
18	NW015766	33462	Cup, Outer (69633)		2
19	41168	333-S-4283	Hub Assembly, 9/16” studs (incl. 18, 20, and 21) (69633)		2
20	41063	675046	Stud, Wheel, 9/16" (Sam’s)		16
21	NW015767	394AS	Cup, Inner (69633)		2
22	NW015769	399AS	Cone, Inner (69633)		2
23	NW036855	A1805E368	Oil Seal (69633)		2
24	NW036856	3219A5097	Brake Drum (69633)		2
25	41060		Washer, Hardened		24
26	41059		Capscrew		24

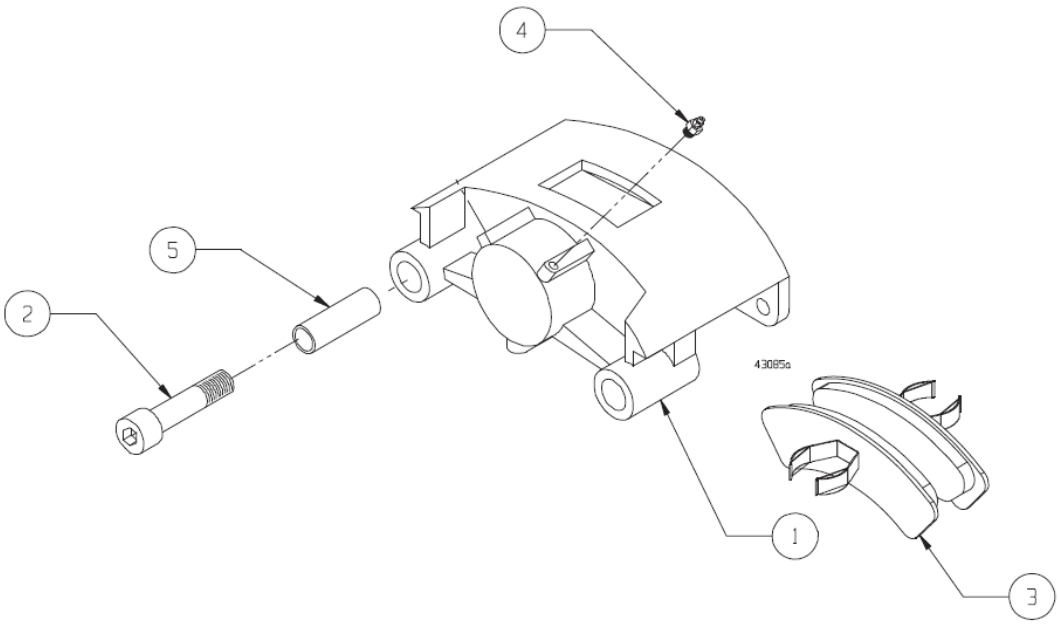


FIGURE 6.
BRAKE, DISC BRAKE, CALIPER

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
6-			Brake, Disc Brake, Caliper		Ref
1	41822	06-61460R	Caliper, Disc Brake LH (NOTE: Casting is stamped R)		1
	41823	06-61460L	Caliper, Disc Brake RH (NOTE: Casting is stamped L)		
2	41829	06-61655	Screw, Caliper Mounting Blue Loctite		4
3	41830-1	06-62085	Pad, Disc Brake, Set of 4 Machined		1
4	42913	22660	Screw, Bleeder, GM Caliper (NAPA)		2
5	42176	06-61654	Caliper Bushing		4

IMPORTANT: Small metal tabs project through the mounting holes of the outboard brake pads on the outside of the caliper. To keep the pads from floating, peen the tabs over the edge of the hole. This should extend the life of the outer pad and eliminate premature rotor wear. Do this in assembly with the rotor while applying pressure to the caliper to prevent the mounting bolts from bending. To insure that the caliper floats check for adequate grease in the caliper mounting sleeves, we recommend Stalube #3303 synthetic brake caliper grease with added graphite and teflon.

NOTE: Always install calipers with bleed screw to top.

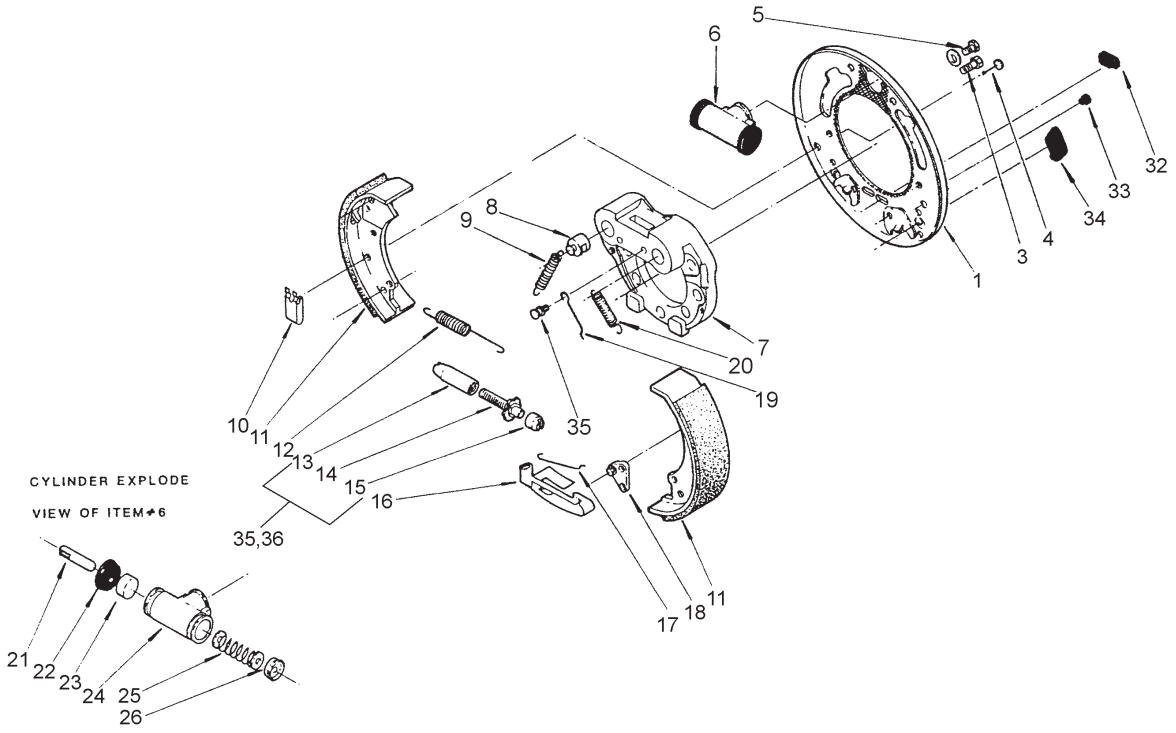


FIGURE 7.
BRAKE - REAR, DUAL WHEELS

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
7-			Brakes - Rear, Dual Wheels		Ref
0	39557K		Kit, Brake, LH, TA268 (Inc. 4,8-12,13,16-20)		Ref
	39556K		Kit, Brake, RH, TA268 (Inc. 4,8-12,14,16-20)		
1	NW33918	A-3736-M-2353	Plate Assy - Back ing		1
3	39283	15-X-1801	Screw and Washer Assy		2
4	37856	2297V4520	Rod (3E157)		3
5	39286	15-X-1799	Screw and Washer Assy (3E157)		2
6	NW34154	A-3261-K-349	Cyl in der Assy-Wheel (3E157)		1
7	39287	A-3211-M-4433	Spi der Assy - Brake (3E157)		1
8	39288	1259-L-298	Pin, Brake An chor (3E157)		2
9	38757	2558-M-767	Spring Re turn - Black, LH (3E157)		1
	38764	2558-N-768	Spring Re turn - Green, RH (3E157)		
10	38758	2257-B-132	Clip-Hold Down, Shoe		6
11	NW33929	A8-3722-Y-1715	Shoe Brake and Lin ing Assy		2
12	38759	2758-P-770	Spring Re turn - Gray		1
13	39552	2297-Y-4523	Nut-Ad justing Bolt, LH		1
	38760	2297-Z-4524	Nut-Ad justing Bolt, RH		
14	39553	2297-W-4521	Bolt-Ad justing, LH		1
	38761	2297-X-4522	Bolt-Ad justing, RH		
15	38762	2245-U-99	Sleeve, Ad justing Bolt (3E157)		1
16	39555	3501-Y-1013	Le ver, LH (3E157)		1
	38763	3501-Z-1014	Le ver, RH (3E157)		
17	38078	1245-V-437	Link (3E157)		1
18	38079	A1-2247-G-111	Le ver Assy - Auto Ad just(3E157)		1
19	37249	1245-V-438	Link (3E157)		1
20	38764	2558-N-768	Spring - Re turn, Green, LH (3E157)		1
	38757	2558-M-767	Spring - Re turn, Black, RH (3E157)		
21	39289	1245-W-439	Push Rod (3E157)		2
22	39290	2260-J-36	Boot (3E157)		2
23	39291	2230-V-204	Pis ton (3E157)		2
24	39292	3261-K-349	Housing - Wheel Cyl in der (3E157)		1
25	39293	A-2258-Q-771	Spring Assy - Re turn(3E157)		1
26	39294	1205-H-1984	Cup, Brake Cyl in der (3E157)		2
32	39295	1250P536	Plug, Brake Rear Ac cess		2
33	39296	1250Q537	Plug, Brake Rear Ac cess		2
34	39297	1250R538	Plug, Brake Rear Ac cess		1
35	44745	MPS 2867 LH	Kit, Brk Adj, LH (In cludes items 13,14,15)		1
36	44746	MPS 2868 RH	Kit, Brk Adj, RH (In cludes items 13,14,15)		1
NS	NW36697	FC-5354	Kit, Wheel Cyl in der Re pair (63477)		Ref

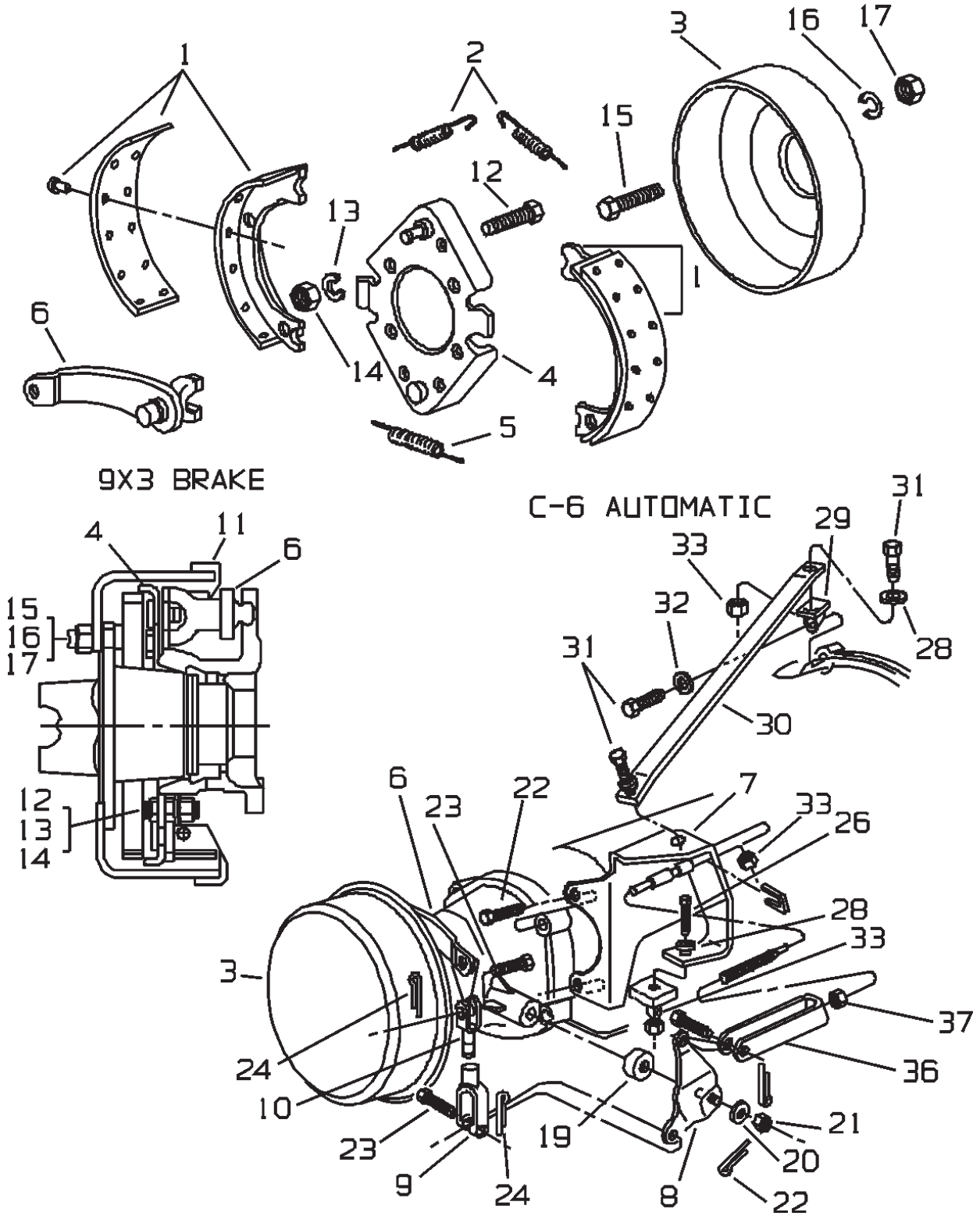


FIGURE 8.

BRAKE C6 - PARKING

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
8-	NW034879	2598	Brake C6 - Parking, 9x3 (39569)		
1	NW034880	2648	Shoe and Lining Kit 9” x 3”		1
2	NW034881	2634	Spring Set - Parking Brake Release		1
3	NW034882	2614	Drum - Parking Brake		1
4	NW034883	22818	Plate - Mounting		1
5	NW034884	2749	Spring - Parking Brake		1
6	NW034885	4446553	Cam & Lever Assy.		1
7	NW034886	2649	Bracket - Cable Support		1
8	NW034887	2A663	Bellcrank		1
9	NW034888	2857	Clevis - Parking Brake Lever		1
10	NW034889	2857	Clevis		1
11	NW034890	2A703	Shield		1
12	F100403	58675	Bolt - 1/2 -13x1.5 Torque 73-107 Nm		4
13	F015973	34794	Lockwasher - 1/2		4
14	F016818	385732	Nut - 1/2 x 13)		4
15	F100403	385524	Bolt - 1/2x13 - 1.5 Torque 73-107 Nm		4
16	F016824	44879	Washer - 1/2 Flat		4
17	F016825	34989	Nut - 1/2x13 Hex		4
18		385554	Stud - 9/16 - 12 - 18x2.28		1
19		385555	Spacer		1
20	41060	44880	Washer - 9/16 Flat		1
21		386034	Nut - 9/16 - 18 Slotted		1
22		72035	Pin - Cotter 1/8x1.0		1
23		76009	Pin - 5/16x1.0		2
24		72009	Pin - Cotter		2
25		N803496	Clip - Vacuum Tube Front		1
26	F101448	58636	Bolt - 3/8 - 16x1.5 Torque 30-43 Nm		1
27	F101331	58638	Bolt - 3/8 - 16x2.0 Torque 30-43 Nm		2
28	F9669	44877	Washer - 3/8 Flat		6
29	48559	2A865	Bracket - Strap		1
30	48560	2A866	Strap		1
31	F101377	58633	Bolt - 3/8-16x.75 Torque 30-43 Nm		2
32	Comm	373603	Washer - 3/8 Flat		2
33	Comm	34987	Nut - 3/8-16 Hex Lock		3
34	F018708		Nut, Hex 3/8-24		1
35	NW036501	D3TZ-7089-B	Yoke, Output (26377)		1
36	90652		Clevis, 3/8-24x3/8		1

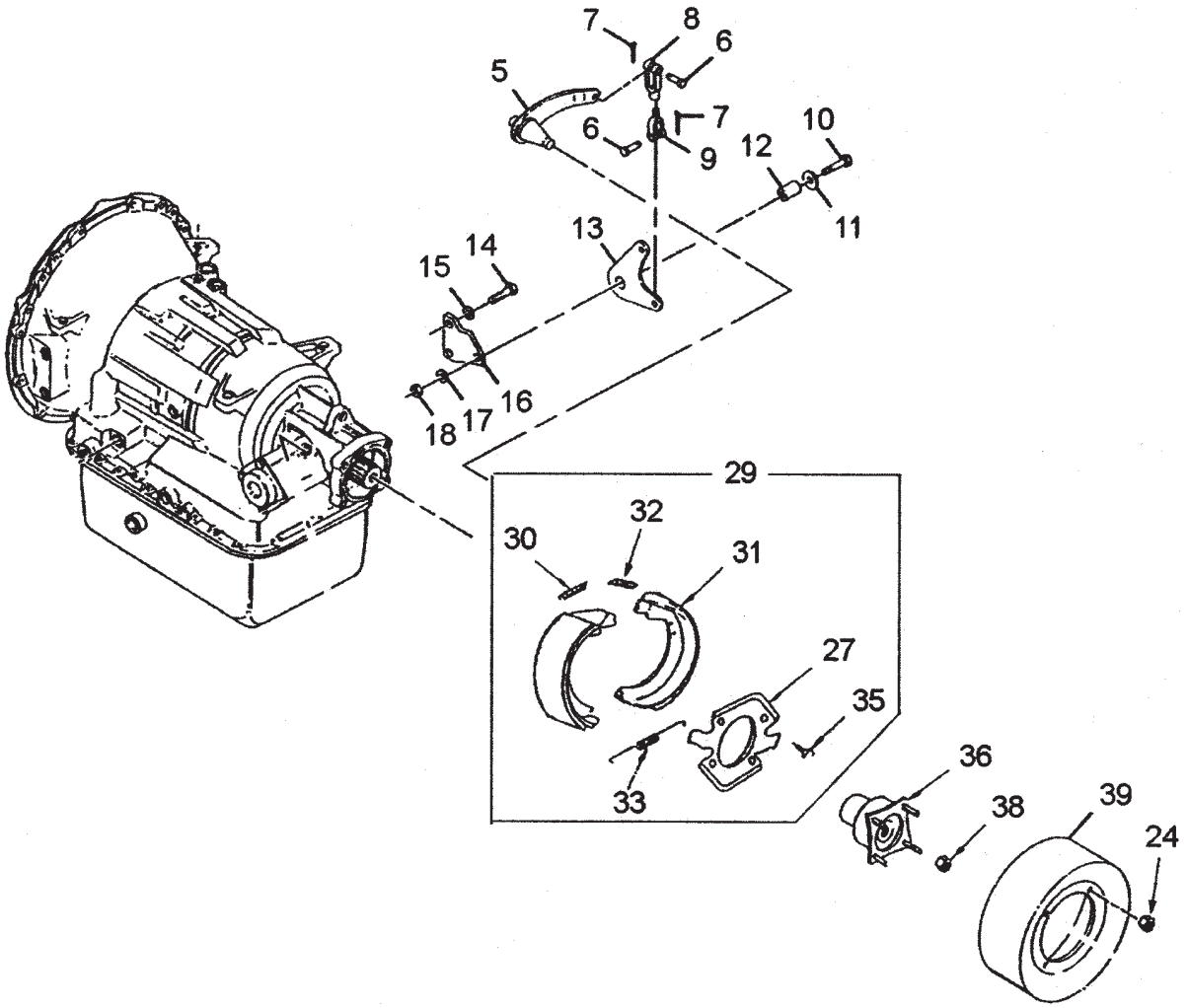


FIGURE 9.

BRAKE - ALLISON TRANSMISSION PARKING

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
9-			Parking Brake, Allison AT542/545		Ref
5	NW033074	2005754	Cam (73342)		1
6		121741	Pin, Clevis (73342)		2
7		103372	Pin, Cot ter (73342)		2
8		681664	Clevis, Rod End (73342)		1
9		144242	Clevis, Adj Rod End (73342)		1
10		9442250	Bolt, 3/8-16x2.75 (73342)		1
11		2374941	Washer (73342)		1
12		611380	Spacer, Sleeve (73342)		1
13	NW034469	701314	Crank, Bell, Park Brk (73342)		1
14		9441893	Bolt, 7/16-14x1.25 (73342)		2
15		2436164	Washer, Flat 7/16 (73342)		2
16	NW034470	15647373	Plate, Park Brake, Brkt (73342)		1
17		15531204	Washer, M10 Flat (73342)		1
18		9422297	Nut, 3/8-16 (73342)		1
24	F016825		Hex Nut, 1/2-13		4
27	308743		Support Plate Asm		1
29	NW033073	4153501	Brake - Transmission Parking (05WC5)		Ref
30		308664	Spring, Red (05WC5)		
31		4152204	Assembly, Shoe & Lining-one shoe (05WC5)		2
32		3203360	Spring, Brown (05WC5)		1
33		308665	Spring, Green (05WC5)		1
35	NW036316		HHCS, 1/2-13 x 1-3/4		4
36	NW033068		Drive Shaft Flange		1
38	Comm		Hex Nut, Slotted, 1/2-13		1
39	NW022072		Brake Drum		1

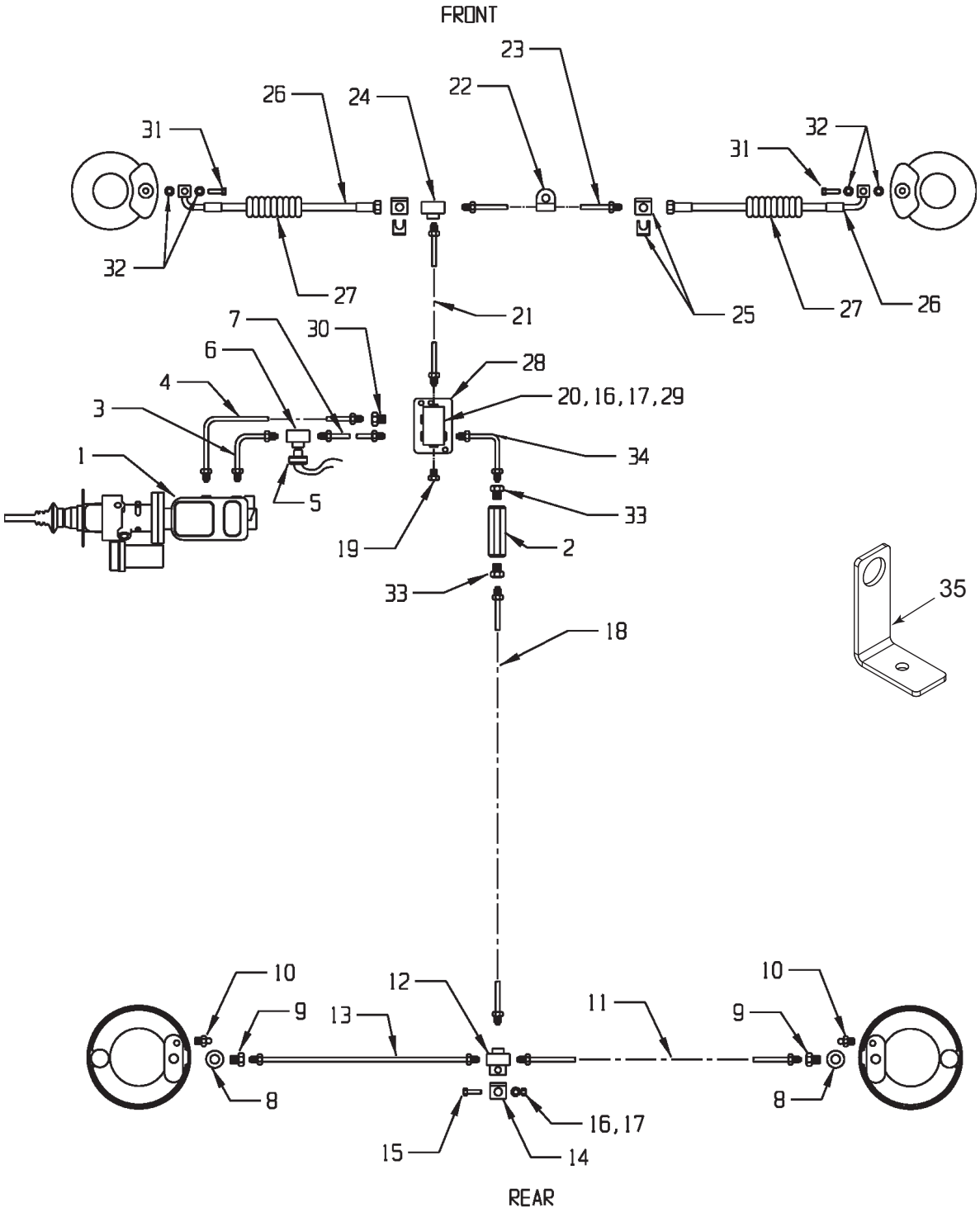


FIGURE 10

BRAKE PEDAL & MASTER CYL, HYD TUBES, HOSES & CONNECTIONS

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
10-	46529		Brake Assy, M140		Ref
	52998		Brake Assy, M140, Newage		Ref
1	46420		Booster, w/Master Cylinder (14894)		Ref
2	46635		Chk Valve (14894) (Not Used on Eff I)		1
3	38511		Brake Line, MC to Switch		1
	47033		Brake Line, MC to Switch	I	1
4	41812		Brake Line, MC to Valve		1
	47032		Brake Line, MC to Valve	I	1
5	NW10370EB	8629	Stop Light Switch (13445)		1
6	NW032342	652X3	Tee, Female Branch (79470)		1
7	41811		Brake Line, Switch to Valve		1
8	NW033848		Washer, 29/64, Copper		2
9	NW034758	M99JT03200	Brake Fitting, 1/4 x 7/16-20 (79470)		2
10	NW033891		Bleeder		2
11	NW036790		Brake Line, RH Rear to Tee		1
	53107		Line,Brk, Tee to RH Rear Caliper	I	1
12	NW032343	7765	Tee w/Bracket (79470)		1
13	NW030435		Brake Line, Left Rear Brake to Tee		1
	53105		Line,Brk, Tee to LH Rear Caliper	I	1
14	NW015632		Bracket, Mounting		1
15	Comm		HHCS, 5/16-18 x 0.75		1
16	F9546		Lock Washer, 5/16		1
17	F9547		Hex Nut, 5/16-18		1
18	41814		Brake Line, Valve to Rear Tee (Not Used on Eff I)		1
19	NW034448		Plug, Equalizer Valve		1
20	F101573		Equalizer Valve (V00540)		1
	Comm		HHCS, 5/16-18 x 2.50		2
	F9546		Lock Washer, 5/16		
	F9549		Flat Washer, 5/16		
	F9547		Hex Nut, 5/16-18		
21	41813		Brake Line, Valve to Front Tee		1
22	F101127		Clip, Insulated, .31 ID		1
	F101137		Clip, In su lated, .19 ID		6
23	38513		Brake Line, Front Cross-over		1
24	F100728	7900	Tee, Run, 3/16 (79470)		1
25	NW022778	FC3052	Clip, Brake Line Wag ner)		3
26	F101921	381238	Brake Hose, 24.00" (NVC)		2
	53104		Line,Brk, Tee to LH Frt Caliper	I	1
	53106		Line,Brk, Tee to RH Frt Caliper	I	1
27	F103924		Sleeve, Plastic Coil		90"
28	43114		Plate, Equal izer Valve, Cummins		1
29	Comm		HHCS, 5/16-18 x 0.75		1
30	NW030263	7818	Adapter ((79470)		1
31	NW0305814		Banjo Bolt, Met ric		2
32	1.8732		Washer, Cop per 10 mm		4
33	3.2793		Ftg, Brk, 02MP-03FI		2
34			Brk Line		1
35	52884		Brkt, Brake Line Mnt, Newage	I	2
NS	3.2792		Ftg, Brk, 03T-MI, 3/8-24, Plug	I	1
NS	3.0397		Ftg, Brk, 03T-MI, 3/8-24	I	4

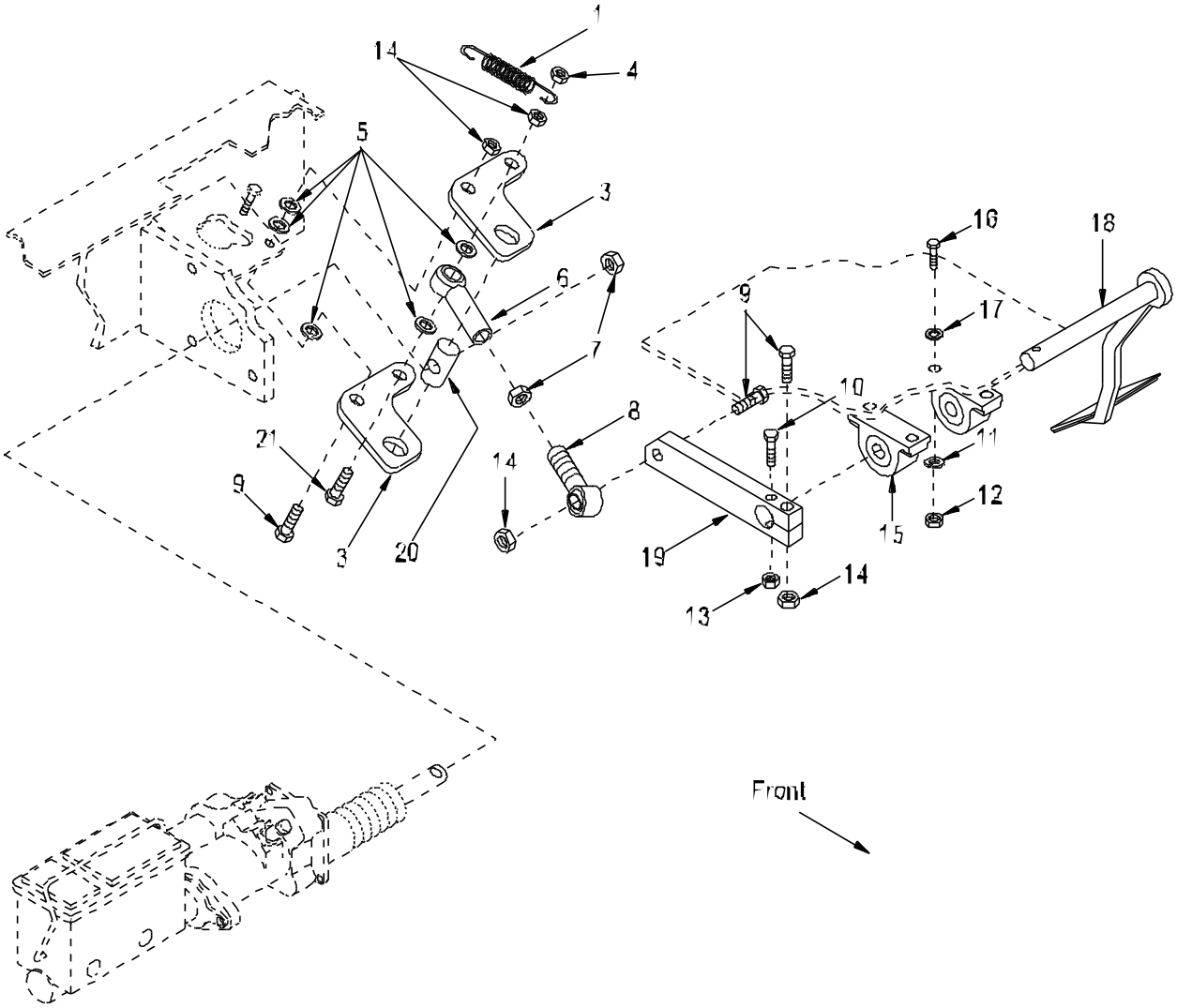


FIGURE 11.

BRAKE - PEDAL LINKAGE

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
11-			Brake - Pedal Linkage		Ref
1	F104435		Spring, .85 OD x 3.00		1
2	Comm		Lock Nut, 1/2-13		2
3	NW33835		Plate, Brake Pivot		2
4	Comm		Lock Nut, 1/2-13, Ny lon		2
5	Comm		Flatwasher, 1/2		5
6	NW33861		Rod End, 1/2-20, Fe male		1
7	Comm		Lock Nut, 1/2-20		2
8	90474	CFM-8N	Rod End, Male (41625)		1
9	Comm		HHCS, 1/2-13 x 2.25		3
10	Comm		HHCS, 3/8-16 x 2.25		1
11	Comm		Lockwasher, 3/8		5
12	Comm		Hex Nut, 3/8-16		5
13	Comm		Lockwasher, 1/2		1
14	Comm		Hex Nut, 1/2-13		4
15	1000519		Bearing, Pillow Block		2
16	Comm		HHCS, 3/8-16 x 1.75		4
17	Comm		Flat Washer, 3/8		4
18	38461		Pedal Weldment		1
19	38504		Arm, Brake Shaft		1
20	NW34265		Pivot, Brake Actuator		1
21	Comm		HHCS, 1/2-13 x 2.50		1

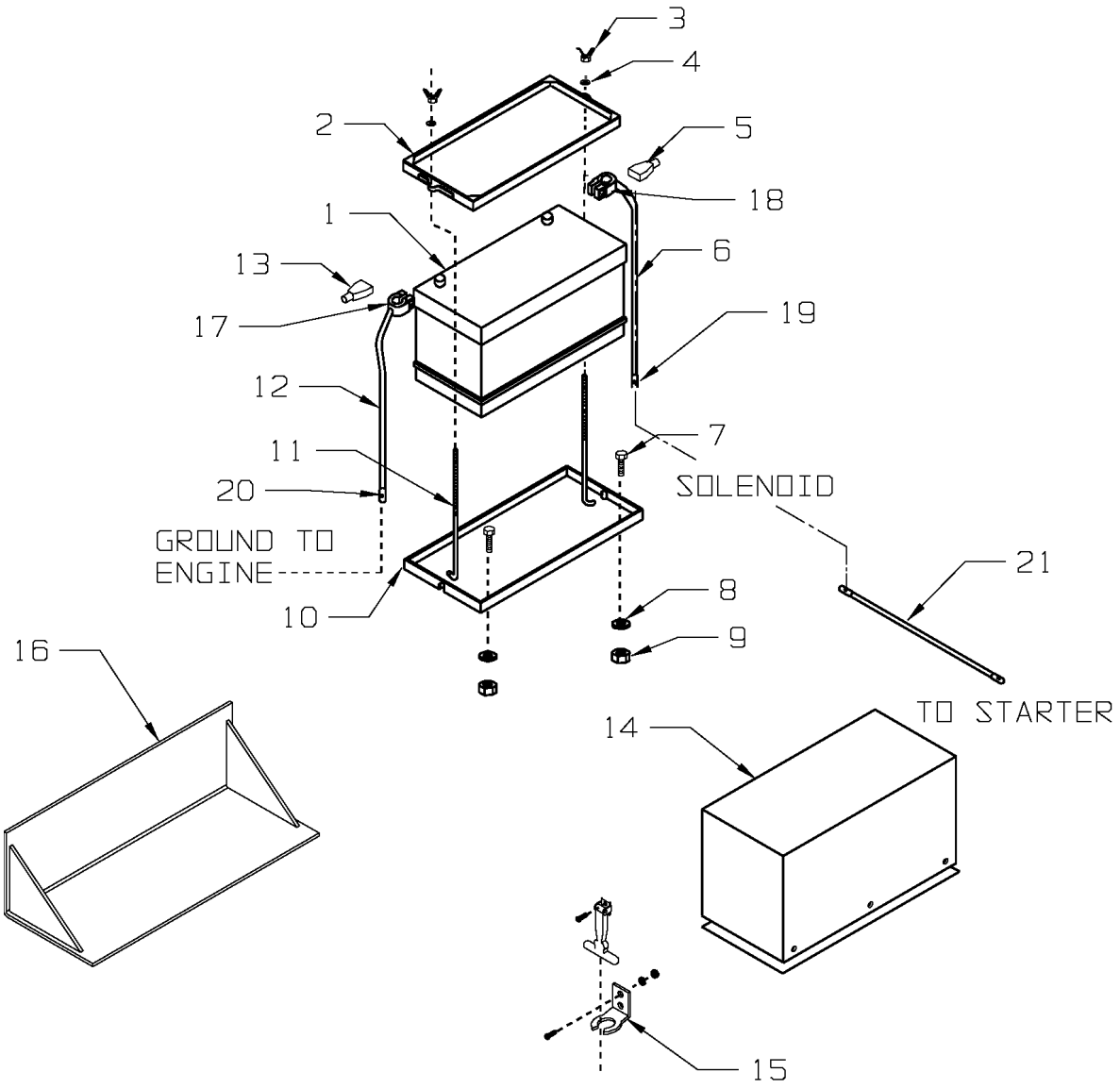


FIGURE 12.
BATTERY SYSTEM

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
12-	46544		Battery System		1
	47310-10		Bat tery System, B3.3 Turbo T3		
	51225-10		Bat tery System, M140,W/ Box,1000CC	G	
1	42942	AABC31-1000	Bat tery, 12V, Top, 1000CCA		1
2	NW29923	AABH2424F	Bat tery Hold-Down (V00539)		1
	48531		Bat tery Hold-Down (Perkins)		
3	NW21810		Wing Nut, 5/16-18		2
4	F9549		Flat Washer, 5/16		2
5	F100930	23505	Battery Cable Boot, Red (58961)		1
6	NW32137		Battery Ca ble, 48”, Red w/Terminals (QSB4.5 & B3.3T)		1
7	F100311		HHCS, 3/8-16 x 1.00		2
8	F9665		Lock Washer, 3/8		2
9	F9666		Hex Nut, 3/8-16		2
10	NW29866		Battery Base		1
11	NW22821		J-Bolt, 5/16-18		2
12	NW30043		Battery Cable, w/Terminals (QSB4.5 Only)(6K866)		1
	2.3267		Cable, Neoprene 1/0 AWG w/o Terminals) (B3.3T)		48”
13	F100931	23504	Battery Boot, Black (58961)		1
14	NW34156		Box Weldment, Battery, 140		1
15	NW22814	37-10-086-10	Latch Assy, Flex, Draw, Hood (94222)		2
16	41461		Brkt Wldmnt, Battery Box		1
17	2.3359		Terminal, Battery, Neg 9/16 Wire		1
18	2.3360		Terminal, Battery, Pos 9/16 Wire		1
19	2.3274		Terminal, 3/8 #1/0 Ring		1
20	2.3277		Terminal, 5/16 #1/0 Ring		1
21	46036		Cable Assembly		1

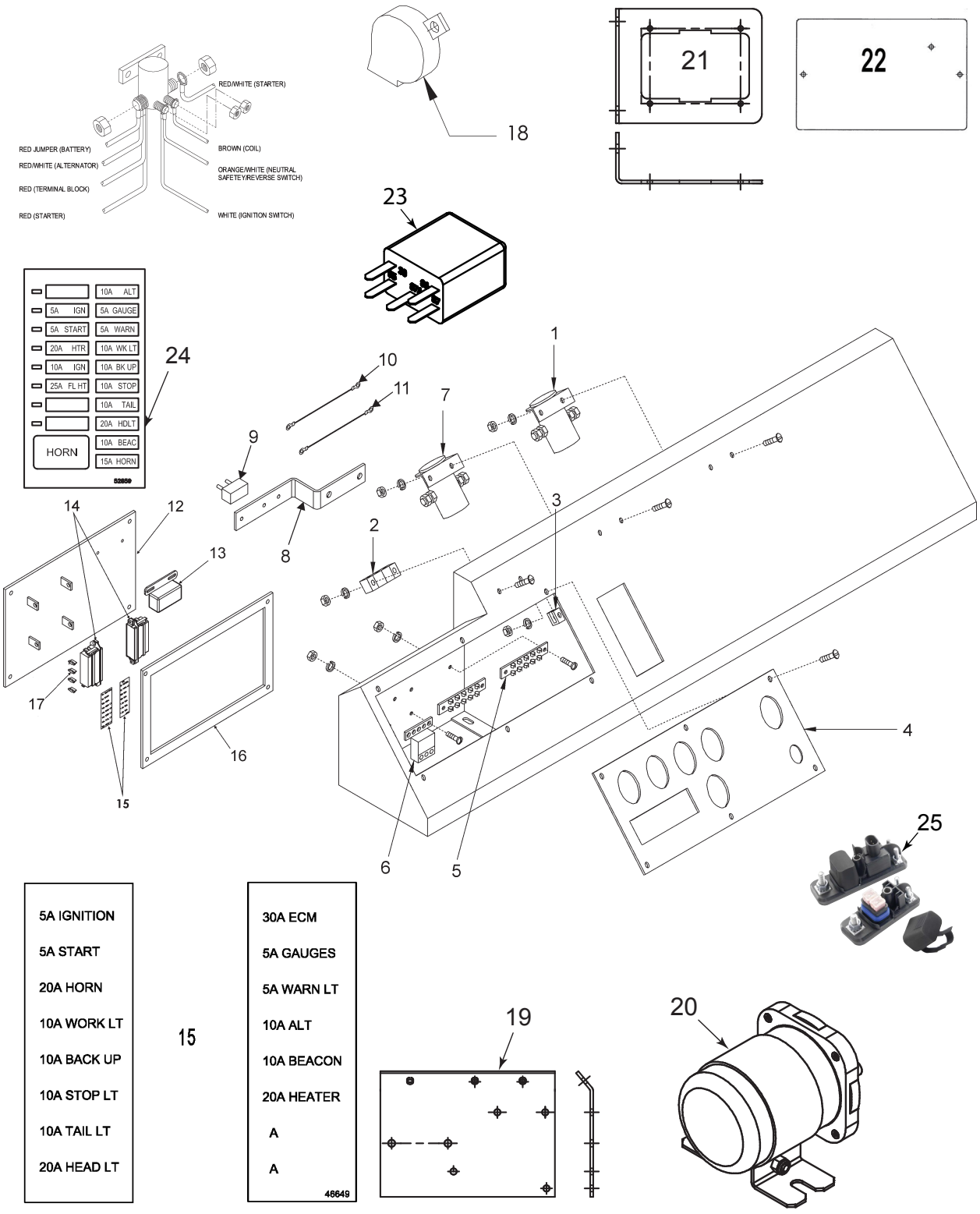


FIGURE 13.

ELECTRICAL ASSEMBLY RELAYS

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
13-	46700		Electrical Assembly - Relays		Ref
	52987		Electrical Assembly - Chassis	I	Ref
1	F102160		Relay, Starter (Cummins)		1
	F102162		Cable, 4GA x 36” Starter/Relay		1
2	37681	47382	Block, Term., 2-wire, 50 Amp (58961)		1
3	NW34955		Screw, Tinnerman, 1/4-20		16
4	NW036128		Plate, Panel, Instrument		1
5	NW23360	4766	Panel, Fuse (13445)		2
	40046		Mounting Plate		1
	39239		Gasket, Fuse Mounting Plate		1
	NW10526C10		Fuse, 10 Amp		7
	NW10526C20		Fuse, 20 Amp		3
	38601		Decal, Fuse		1
6	NW23700		Horn Relay (56118)		1
7	2.1401		Relay, Power, SPNO, 12VDC (Cummins)		1
8	41393		Brkt, Relay, Anti Restart (Cummins 4.5)		1
9	2.0131		Breaker, 20A Auto Reset (Cummins)		1
10	44476		Wire Assy, Sol/Sol 12 G (Cummins)		1
11	44477		Wire Assy, Sol/Sol 12 G (Cummins)		1
12	45360		Plate Wldmnt, Fuse Block		1
13	NW023700	2306-HB5	Relay, Horn, 12V/30Amp		1
14	45099		Block, Fuse, attached, 8-Gang		2
15	46649		Decal, Fuse Block		1
16	40046		Gasket, Fuse Mntg Plate		1
17	M257005		Fuse, 5A/32V, ATC		1
	M27507.5		Fuse, 7.5A/32V, ATC		3
	304682		Fuse, 10A/32V, ATC		9
	200084	7200021	Fuse, 20A/32V, ATC		3
18	152864		Horn (V00544)		1
19	50279		Brkt, Relay/Fuse Mnt	H	1
20	50113		Relay, Power, SPNO, 12VDC	H	1
21	52983		Brkt, Fuse Holder, Mini	I	1
22	45361		Plate, Fuse Block Mnt	I	1
23	48144		Relay, Micro, 280	I	1
24	52859		Decal, Fuse/Relays	I	1
25	49124		Holder, Fuse, Power, Mod	I	1
NS	305007		Holder Fuse, Mega/AMG	H	1
NS	47862		Fuse, 300A/48V, Mega/Amg	H	1
NS	52858		Holder, Fuse, Mini, Dist, 1/2 Buss	I	1
NS	307216		Fuse,10 Amp/32V, ATM, Mini	I	5
NS	307217		Fuse,15 Amp/32V, ATM, Mini	I	1
NS	307218		Fuse,20 Amp/32V, ATM, Mini	I	1
NS	307215		Fuse,5 Amp/32V, ATM, Mini	I	1
NS	48915		Fuse, 60 Amp, FMX	I	1
NS	49085		Fuse, 30 Amp, FMX	I	1

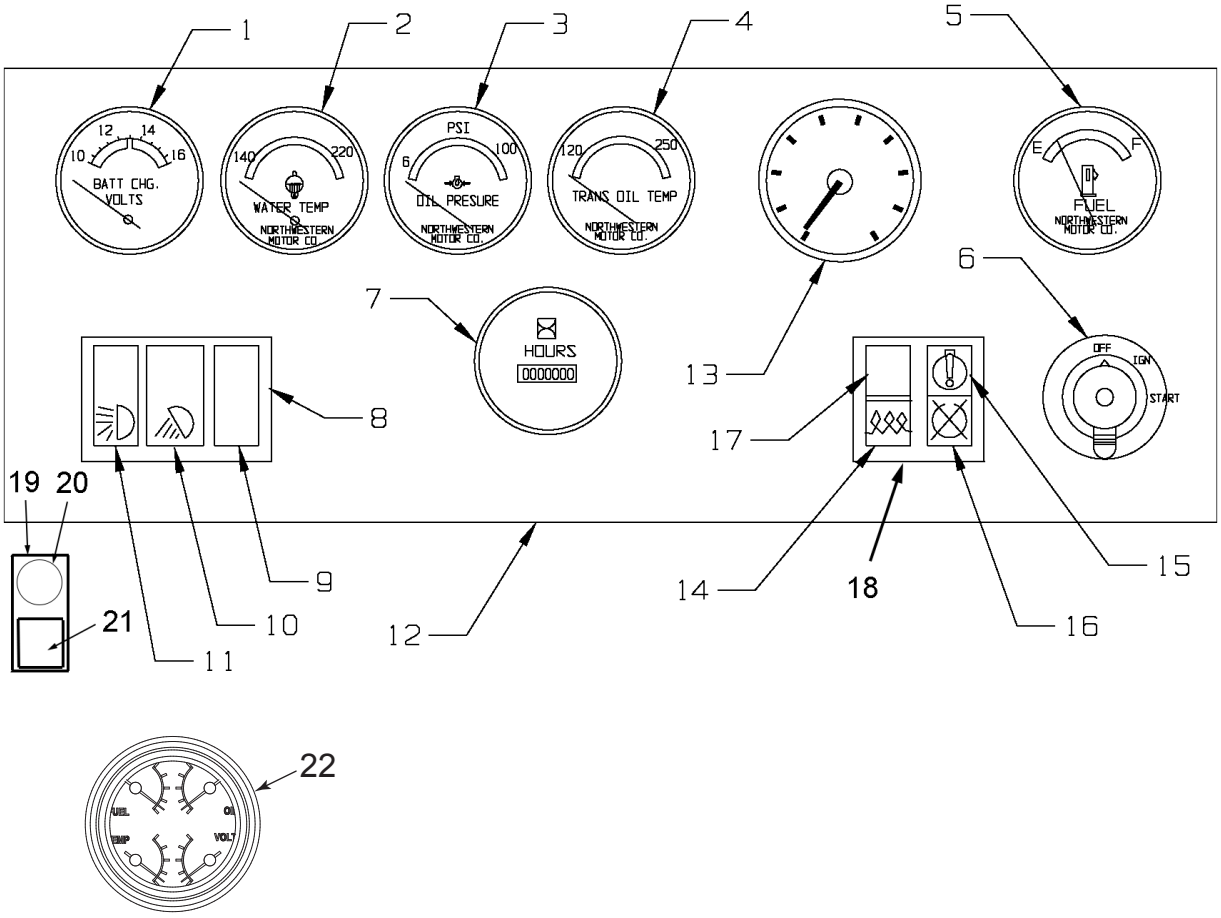


Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
14-	53003		Gauge Pkg, Std, 140	I	Ref
7	41434		Hourmeter Gauge (16476)		1
4	NW024701	06118-12	Trans Oil Temp. Gauge (16476)		1
22	52656		Gauge, 4” Fuel, Temp, Oil, Volts		1
NS	52997		Haness Dash		1

FIGURE 14.

INSTRUMENT PANEL, SPEEDOMETER OPTION, TACHOMETER OPTION

1 OF 2

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
14-			Instrument Panel		Ref
	43968		Panel Assy, Instrument, M140	G	
1	NW36129	06863-38	Voltmeter (16476)		1
2	NW24700		Engine Coolant Temp. Gauge		1
3	NW24699		Engine Oil Pressure Gauge		1
4	NW24701	06118-12	Trans Oil Temp. Gauge (16476)		1
5	NW24702		Fuel Gauge		1
6	37844	31-302	Switch, Ignition, Keyed (77326)		1
	52487		Disc, Ignition	all	
	NW030247		Placard, Ign. Switch		
	F104281		Switch, Ign, Anti-Restart, Keyless (Cummins)		
	44720		Keyed Anti Restart Ign.		1
	37844	31-302	Switch, Igni tion, Keyed (Opt. Cummins) (77326)		1
	2.0134		Breaker, Circuit, 20A		1
	44735		Harness, Preheat, 1004		1
7	41434	100222	Hourmeter Gauge (16476)		1
8	NW35380		Switch Housing, 3-Frame		1
	NW035381		Switch Housing, 6-Frame used w/item 13		1
9	NW35379	596273	Switch Blank (56289)		1
10	NW34176	511005	Work Light Switch (Simms)		1
	NW35383	596315	Work Light Insert (56289)		
11	NW35376	511106	Head/tail Light Switch (56289)		1
	NW35386	596648	Head/tail Light Insert (56289)		
12	NW36128		Plate, Instrument Panel - Standard		1
	45363		Plate, Instrument Panel - 140DCT		1
13	43964		Grp, M100/140, Speedo, C6/TA26		1
	37443		Speedometer, 0-20mph, Option		1
	NW33159		Sender, Generator		1
	37445		Adapter, Speedometer		1
	37446		Gear, Speedometer Driver		1
	37447		Adapter Speedometer		1
	NW21261		Plug, Button		1
	NW33179		Harness, Electric		1
	NW33180		Wire, Speedometer Ground		1
	NW035226		Panel, Instrument		1
14	NW035385		Insert, Glo Plug		1
15	45143		Insert, Switch, Engine		1
16	45164		Insert, Switch, Eng Warning		1
17	NW035382		Insert, Switch, Blank		2
	NW035388		Insert, Switch, Blank, Fault, Red		1
18	NW036731		Holder, Switch End Piece		2
19	NW035378		Housing Light, Indicator, 2 Lamp(43968 Panel Only)		1
20	NW035388		Switch, Brake, Fault, Red(43968 Panel Only		1
21	NW035382		Insert, Switch, Blank (43968 Panel Only)		1
NS	37654		Bulb, Repl. for Switches		A/R
	NW36767		Bulb, Replacement for Dash		A/R

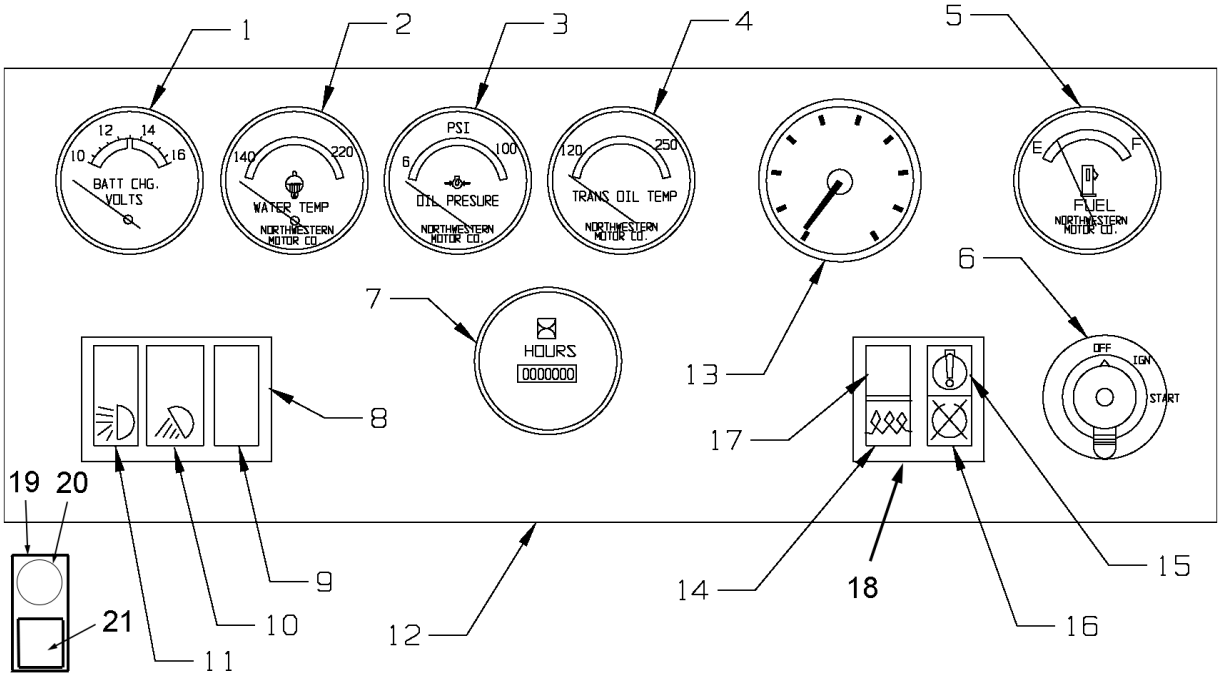


FIGURE 14.

INSTRUMENT PANEL, SPEEDOMETER OPTION, TACHOMETER OPTION

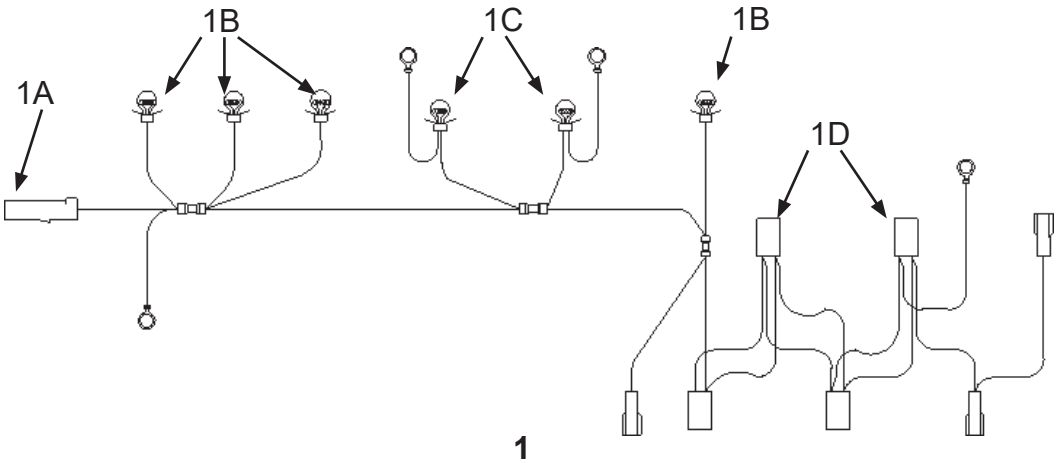
2 OF 2

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
14-	43575		Shut down, Lo Oil/Hi Temperature		Ref
2	41401		Gauge, Water Temperature		1
3	41400		Gauge, Oil PSI		1
NS	41705		Shut down Module Assembly		1

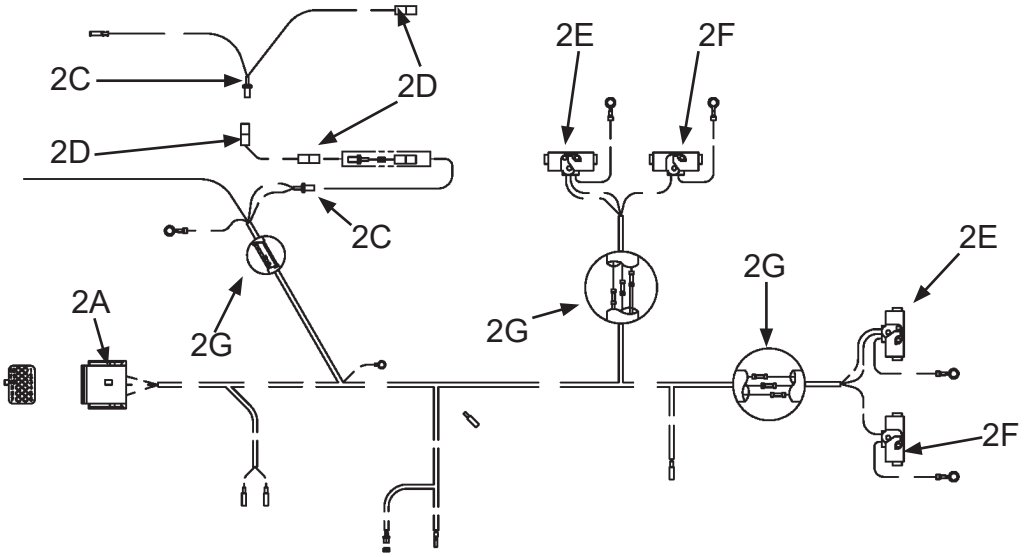
Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
14-	43961		Grp, TT, No Shutdown		Ref
2	NW024700		Engine Coolant Temp. Gauge		1
3	NW024699		Engine Oil Pressure Gauge		1

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
14-	43963		Grp, TT, No Speedometer		Ref
8	NW035380		Frame,3 Switch		1
12	45363		Instrument Panel		1
18	NW036731		Holder, Switch, End		2
9	NW035379		Blank, Switch Cover		2

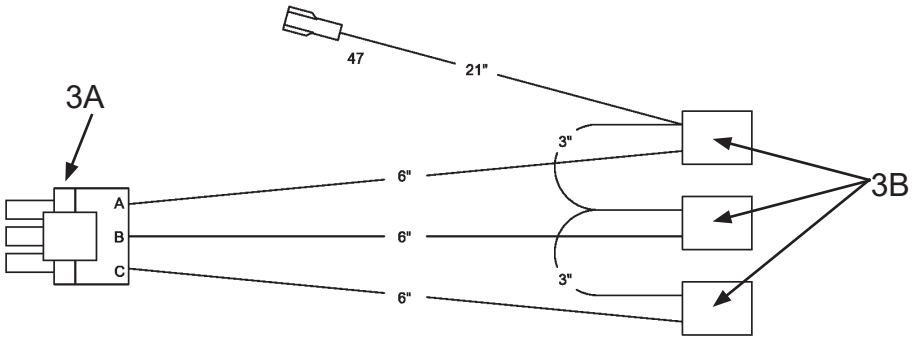
Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
14-	43958		Grp, TT, Ign Switch, Keyless		Ref
6	F104281		Switch, Ign, Anti-Restart		1
NS	NW035374		Switch, Rocker, Off-MOM		1
14	NW035385		Insert, Switch, Glo Plug		1
NS	46249		Harness, Preheat, 1104		1
Fig.-Item	**NMC Wollard Part No.**	**Vendor Part No.**	**Nomenclature**	**Eff**	**Units Per Assy**
14-	52948		Grp, TT, Inst Panel	I	Ref
12	52739		Pane, Inst, TT		1
9	NW035379		Blank, Switch Cover		2
	NW035381		Switch Housing, 6-Frame used w/item 13 (See page 31)		1
	NW035378		Housing Light, Indicator, 2 Lamp(43968 Panel Only) (See page 31)		1



1



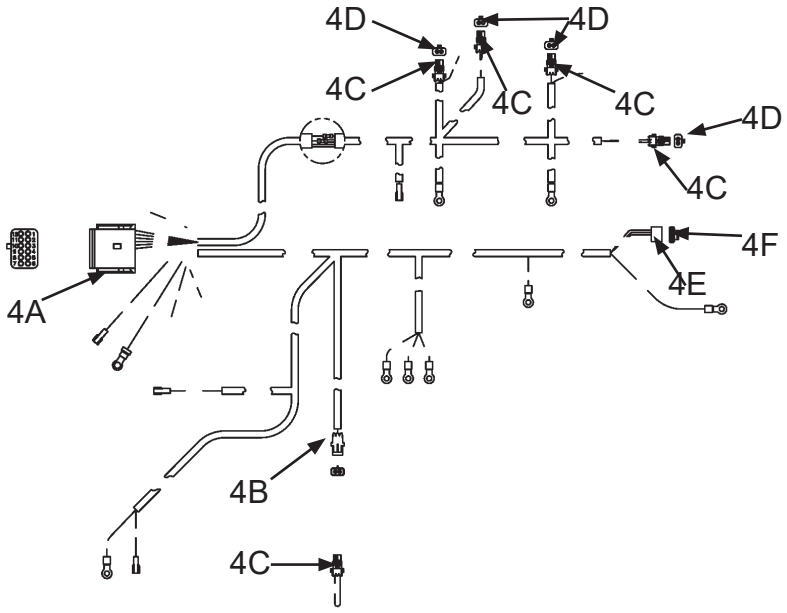
2



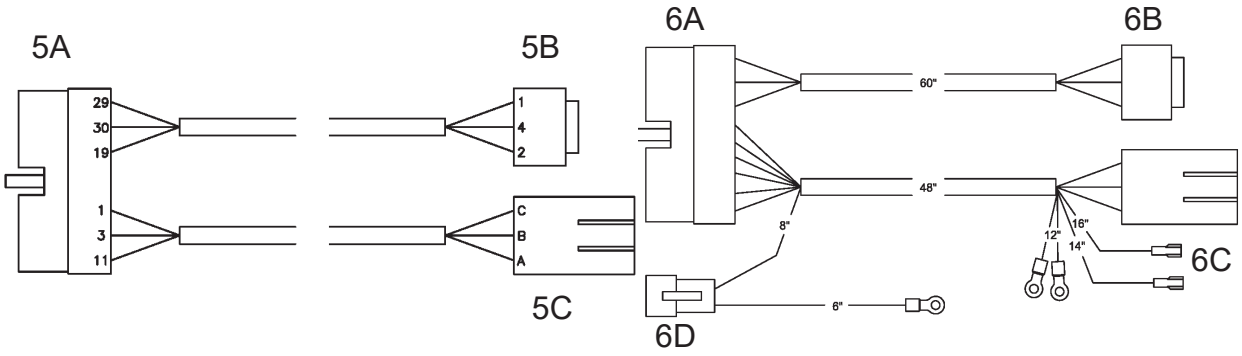
3

FIGURE 15.
HARNESSES
1 OF 4

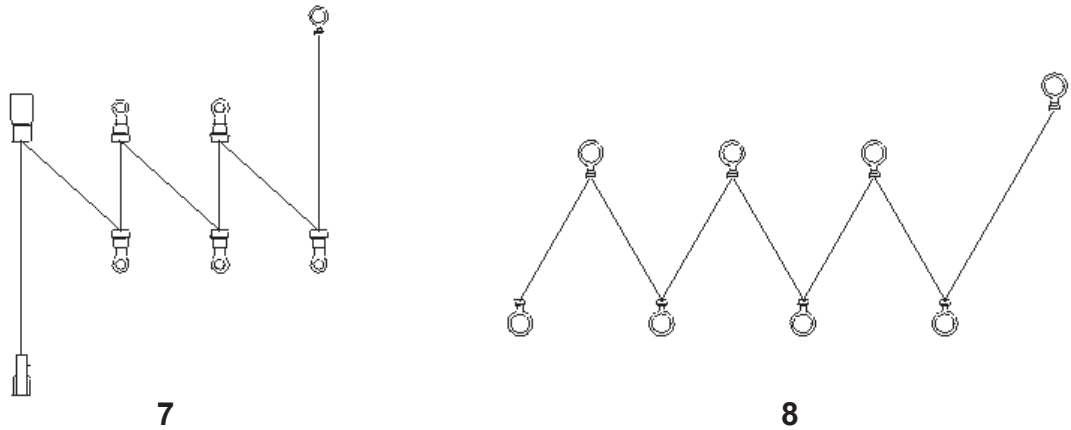
Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
15-			HARNESSES		REF
1	37729		HARNESS, GAUGE AND LIGHTS SWITCH		1
1A	38001		CONNECTOR		1
1B	F101597		LIGHT BULB		4
1C	NW33538		LIGHT ASSEMBLY		2
1D	37409		CONNECTOR, LIGHT		4
2	46669		HAR NESS, REAR, AT542		1
2A	45016	DT06-12SA P012	CONN,EL,DEUTS,P,DT06-12SA-P012		1
	206117	0462-209-16 141	CONN,EL,DEUTSCH,SKT,14-16 AWG		10
	45017	W12S-P012	CONN,EL,DEUTSC,WEDGE,W12S-P012		1
	206101	114017	CONN,EL,DEUTSCH,SEAL PLG,12-16		2
2B	37640	38043	CONN,EL,W-PAK,BODY,TOWER,2-WAY (58961)		1
	37309	39000	CONN,EL,W-PAK&280,SEAL,16-18GA (58961)		1
2C	203999	38041	CONN,EL,W-PAK,BODY,TOWER,1-WAY		2
	37309	39000	CONN,EL,W-PAK&280,SEAL,16-18GA (58961)		1
2D	37307	31034	CONN,EL,W-PAK,PIN,14-16AWG		3
	45666	38040	CONN,EL,W-PAK,BODY,SHROUD,1WAY		3
	37309	39000	CONN,EL,W-PAK&280,SEAL,16-18GA (58961)		1
2E	NW035616	67000	PIG TAIL,LIGHT,3-WIRE,90 DEG (75175)		2
2F	NW035615	67014	PIG TAIL,LIGHT,2-WIRE,90 DEG (75175)		2
2G	F104341	31760	CONNECTOR,BUTT SPLICE,14-16 GA (58961)		5
3	45400		HARNESS,INDICATOR LTS,140		1
3A	37306	38045	CONN,EL,W-PAK,BODY,TOWER,3-WAY		1
	37308	31035	CONN,EL,W-PAK,SKT,14-16AWG (58961)		3
	37309	39000	CONN,EL,W-PAK&280,SEAL,16-18GA (58961)		3
3B	37409	913328	CONNECTOR,LIGHT (65439)		3



4



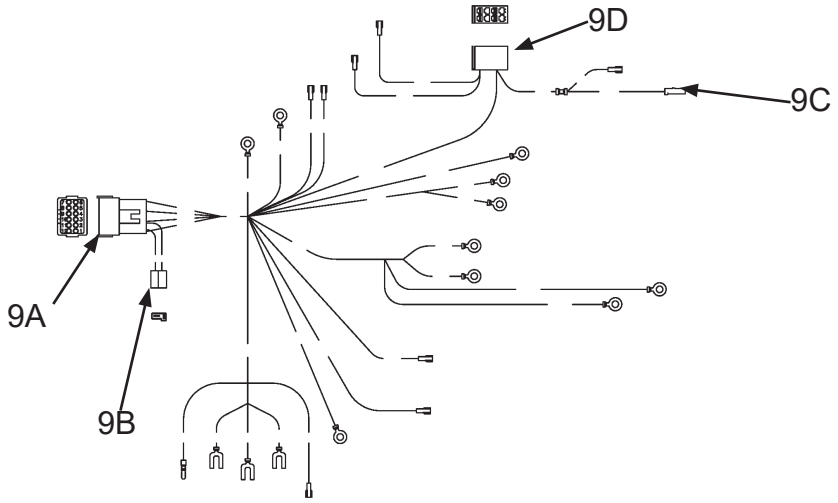
5 **6**



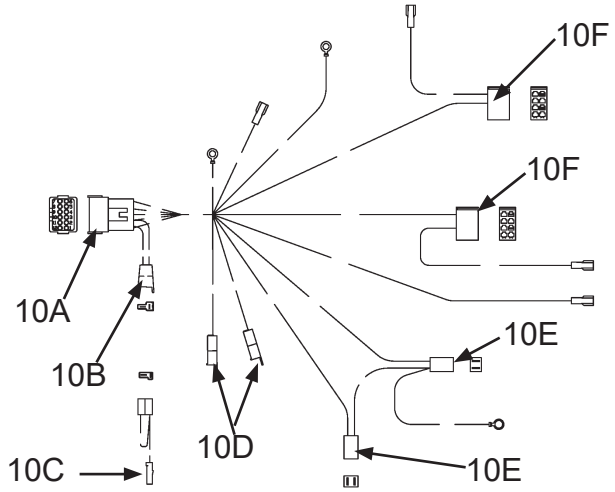
7 **8**

FIGURE 15.
HARNESSES
2 OF 4

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
15-			HARNESSES		Ref
4	46644		HARNESS,ENG,QSB4.5,M140,T3		
4A	206101	114017	CONN,EL,DEUTSCH,SEAL PLG,12-16		2
	45017	W12S-P012	CONN,EL,DEUTSC,WEDGE,W12S-P012		1
	45016	DT06-12SA-P012	CONN,EL,DEUTS,P,DT06-12SA-P012		1
	206117	0462-209-16141	CONN,EL,DEUTSCH,SKT,14-16 AWG		10
4B	37307	31034	CONN,EL,W-PAK,PIN,14-16AWG		2
	37639	38042	CONN,EL,W-PAK,BODY,SHROUD,2WAY		2
4C	37640	38043	CONN,EL,W-PAK,BODY,TOWER,2-WAY (58961)		5
4D	37309	39000	CONN,EL,W-PAK&280,SEAL,16-18GA (58961)		6
	37310	39001	CONN,EL,W-PAK&280,SEAL,14GA (58961)		6
4E	45051	12186568	CONN,EL,M-PAK 150,BODY,F,4WAY		1
4F	206098	31077	CONN,EL,M-PAK 150,SKT,16-20AWG		3
	206099	39008	CONN,EL,M-PAK 150,SEAL,16-18GA		3
	45028	39011	CONN,EL,M-PAK 150,CAVITY PLUG		1
5	45398		HARNESS,THROTTLE/IND.LTS		1
5A	45009		CONN, DEUTSCH,DRC26-50S-05		1
	45010		PIN, DEUTSCH		6
	45011		SEAL, CAVITY PLUG		44
5B	45357		CONN, THROT TLE SENSOR		1
5C	37305		CONN, SHROUD, WAYTEK, 31034		1
	37307		PIN, WAYTEK, 31034		3
	37309		SEAL, WAYTEK, 39000		3
6	46483		HARNESS,ECM/THROTTLE/IND.LT		1
6A	46300		CONN, DEUTSCH,DRC26-50S-04		1
	45010		PIN, DEUTSCH		9
	45011		SEAL, CAVITY PLUG		41
6B	45357		CONN, THROT TLE SENSOR		1
6C	37305		CONN, SHROUD, WAYTEK, 31034		1
	37307		PIN, WAYTEK, 31034		3
	37309		SEAL, WAYTEK, 39000		3
6D	46261		CONN, DEUTSCH,P, DTP06-4S		1
	308070		SOCKET, DEUTSCH, 12-14		2
	206101		PLUG, DEUTSCH, SEAL, 12-16		2
	46264		CONN, EL, DEUTSCH, WEDGE, WP-4S		1
7	NW035412		HARNESS, GAUGE JUMPER		1
8	NW035413		HARNESS, DASH PANEL JUMPER		1
NS	NW031776		HARNESS,STARTER		1
NS	50151		Harness, ECM/THRT/IND.	H	1
NS	48522		Harness, Eng	H	1
NS	50155		Harness, Starter, Cumns	H	1
NS	50305		Harness, WIF, 48”, QSB3.3 Cummins	H	1

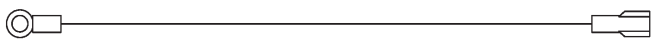


9



10

11 **12**



13

FIGURE 15.
HARNESSES
3 OF 4

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
15-			HARNESSES		Ref
9	46670		HAR NESS, DASH I		1
9A	206616		CONN, DEUTSCH, PIN, 14-16 AWG		10
	45018		CONN, DEUTSCH, RECP, DT04-12PA		1
	45019		CONN, DEUTSCH, WEDGE, W12P		1
	206101		CONN, DEUTSCH, SEAL, PLG, 12-16		2
9B	F101551		CONN, 2 POS MALE. HALF		1
9C	F101549		CONN, WAYTEK, 38001		1
9D	37408		CONN, SW, 596289		1
10	46671		HAR NESS, DASH II		1
10A	206616		CONN, DEUTSCH, PIN, 14-16 AWG		10
	45018		CONN, DEUTSCH, RECP, DT04-12PA		1
	45019		CONN, DEUTSCH, WEDGE, W12P		1
	206101		CONN, DEUTSCH, SEAL, PLG, 12-16		2
10B	F101550		CONN, 2 POS, FEM, HALF		1
10C	F101557		CONN, 2 POS MALE. HALF		1
10D	F101548		CONN, WAYTEK, 38000		2
10E	37409		CONN, LIGHT		2
10F	37408		CONN, SWITCH		2
11	44476		WIRE ASSY, SOL/SOL 16 GA OR		1
	44477		WIRE ASSY, SOL/SOL 12 GA RD/W		1
	50356		Wire Assy, Blk, 2Ga, 12”	H	1
	50355		Wire Assy, Blk, 2Ga, 12”	H	1
	50359		Wire Assy, Blk, 2Ga, 12”	H	1
	50354		Wire Assy, Blk, 8Ga, 16”	H	1
12	45393		HARNESS, M140 (not for QSB T3)		3
	45998		HARNESS, FUSE BLOCK, B+ (for QSB T3)		3
13	45394		HARNESS, M140 (not for QSB T3)		1
	46997		HARNESS, BATTERY, B+ (for QSB T3)		1
	45996		HARNESS, BATTERY, B+ (for QSB T3)		1

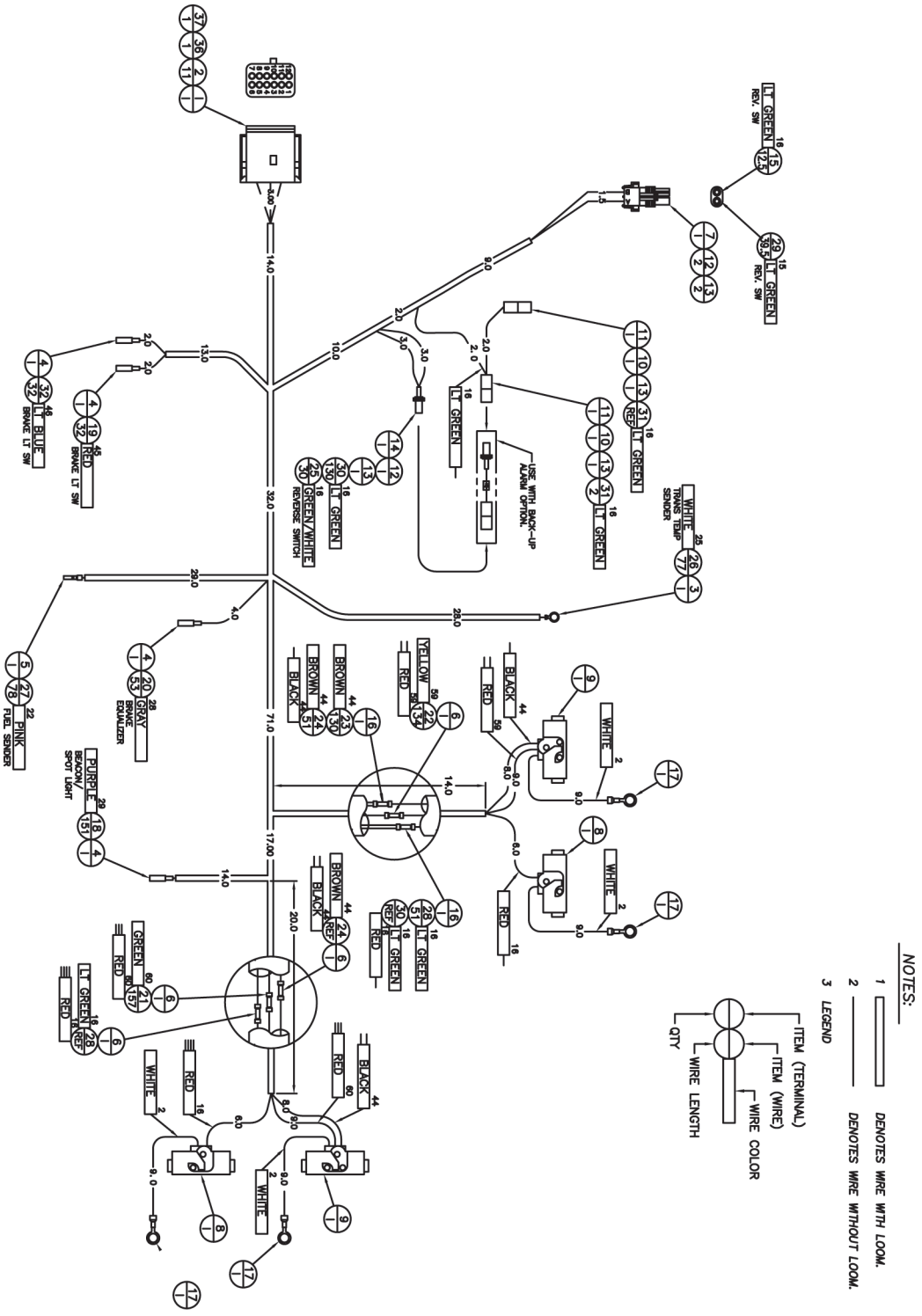
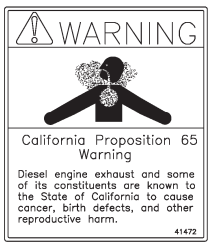
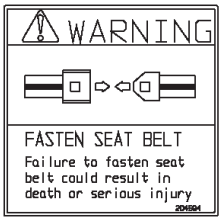


FIGURE 15.
HARNESSES 46648
4 OF 4

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
15-	46648		Har ness, Rear, C6, M140		Ref
1	45016		Conn, El, Deuts, P, DT06-12SA-P012		1
2	206117		Conn, El, Deutsch, SKT,14-16 AWG		11
3	F100846	31503	#10 Ring Term, Waytek		1
4	F101890	31568	Bul let, Conn, Waytek		4
5	F100527	31561	Bullet, Waytek		1
6	F104341	31760	Butt Conn, Waytek		5
7	37640		Conn, El, W-Pak, Body, Tower, 2-Way		1
8	NW35615		Harness, Light, Wire		2
9	NW35616		Harness, Light, Wire		2
10	37307		Conn, El, W-Pak, Pin, 14-16 AWG		2
11	45666		Conn, El, W-Pak, Body, Shroud, 1 Way		2
12	37308		Conn, El, W-Pak, SKT, 14-16AWG		3
13	37309		Conn, El, W-Pak&280, Seal, 16-18Ga		5
14	203999		Conn, El, W-Pak, Body, Tower, 1-Way		1
15	F9791		Wire, Lt Green 16Ga		12.5"
16	F100899	32560	Butt Conn, Waytek		2
17	F100898	31506	Ring Ter mi nal, Waytek		4
18	F101783		Wire, Pur ple 16Ga		151"
19	F9797		Wire, Red 16Ga		32"
20	F101895		Wire, Gray 16Ga		53"
21	F100933		Wire, Green 16Ga		157"
22	F9792		Wire, Yellow 16Ga		134"
23	F101531		Wire, Brown 16Ga		130"
24	F101531		Wire, Brown 16Ga		51"
25	F101899		Wire, Green/White 16Ga		30"
26	F9797		Wire, White 16Ga		77"
27	F101647		Wire, Pink 16Ga		78"
28	F9791		Wire, Lt Green 16Ga		51"
29	F9791		Wire, Lt Green 16Ga		39.5"
30	F9791		Wire, Lt Green 16Ga		130"
31	F9791		Wire, Lt Green 16Ga		2"
32	F101787		Wire, Lt Blue 16Ga		32"
33	*******				
34	*******				
35	*******				
36	45017		Conn, El, Deutsc, Wedge, W12S-P012		1
37	206101		Conn, El, Deutsch, Seal PLG, 12-16		1

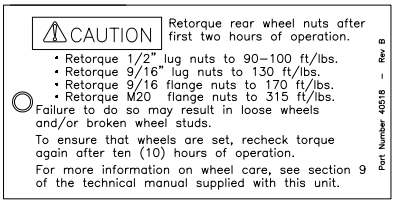


1

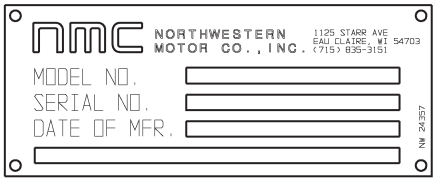


2

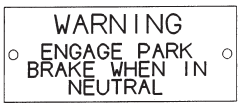
3



4



5

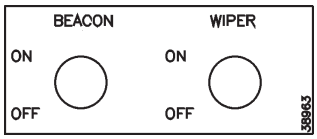


6

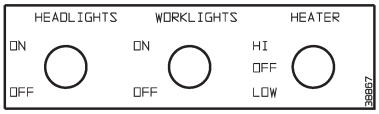
7

8

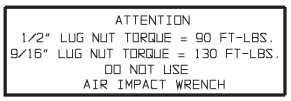
9



10



11



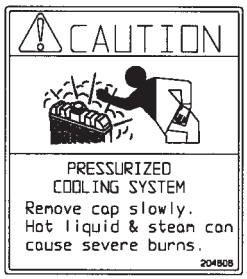
12

13

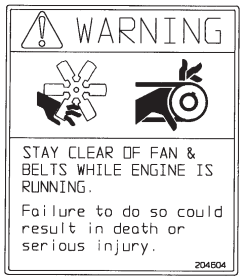
14

15

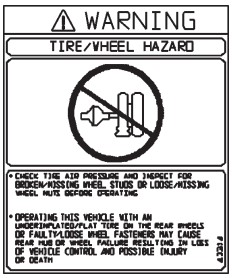
16



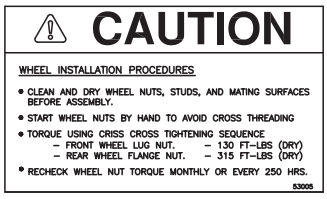
17



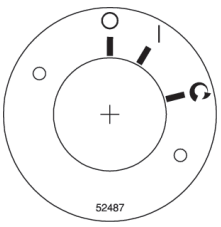
18



19

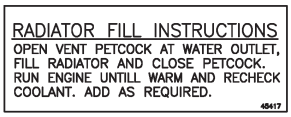


20



21

22



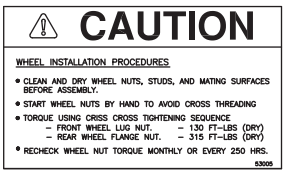
23

FIGURE 16.

DECALS AND PLACARDS

Fig.-Item	NMC Wollard Part No.	Nomenclature	Eff	Units Per Assy
16-	42738	Decals and Placards		Ref
	43970	Decals and Placards		
	52999	Decals and Placards	I	
1	41472	Decal, Diesel Exhaust Warning		1
2	204594	Decal, Seat Belt		1
3	NW017237	Plate, Warning (Parking brake not to be used as service brake.		1
4	40518	Tag, Wheel Torque		1
5	NW024357	Plate, Serial #		1
6	NW035561	Plate, Warning (Engage Park Brake)		1
7	42382	Placard, Hi Speed Tow Tractor		1
8	42814	Decal, Heater Temp Control		1
9	1018145	Decal, Fan Warning		1
10	38963	Plate, Switch Data (on overhead guard) (Optional)		1
11	38867	Plate, Switch Data (on dash)		1
12	40329	Decal, Lug Nut Torque		4
13	NW036180	Decal, Caution, Munitions (Optional)		1
14	562A279	Decal, Gasoline Only		1
15	42944	Decal Kit, Black		Ref
	42536	Decal, NMC-Wollard, Black, 6.36”		3
	306521	Decal, NMC-Wollard, Black, 31.5”		1
	42943	Decal Kit, White		Ref
	42537	Decal, NMC-Wollard, White, 6.36”		3
	306522	Decal, NMC-Wollard, White, 31.5”		1
16	153768	Decal, Diesel Fuel Only (with diesel engine)		1
17	204606	Decal, Caution, Cooling Sys		1
18	204604	Decal, Warning, Fans/Belts		1
19	43314	Decal, Warning, Tire/Wheel Hazard		4
20	53005	Decal, Wheel Nut Torque	I	4
21	NW030247	Plate, Ignition		1
	52487	Plate, Ignition ISO Symbols		
22	45417	Decal, Radiator Fill		1
23	305732	Decal, Warning, Read Manual		1
24	46867	Decal,Power Steer Pump Fill,RH		1
25	51464	Placard, EPA		1
26	53005	Decal, Wheel Nut Torque	I	1
NS	37244	Decal (NMC) (Optional)		3
NS	46341	Decal, Contact Info,Cus.Ser.		1

25



26

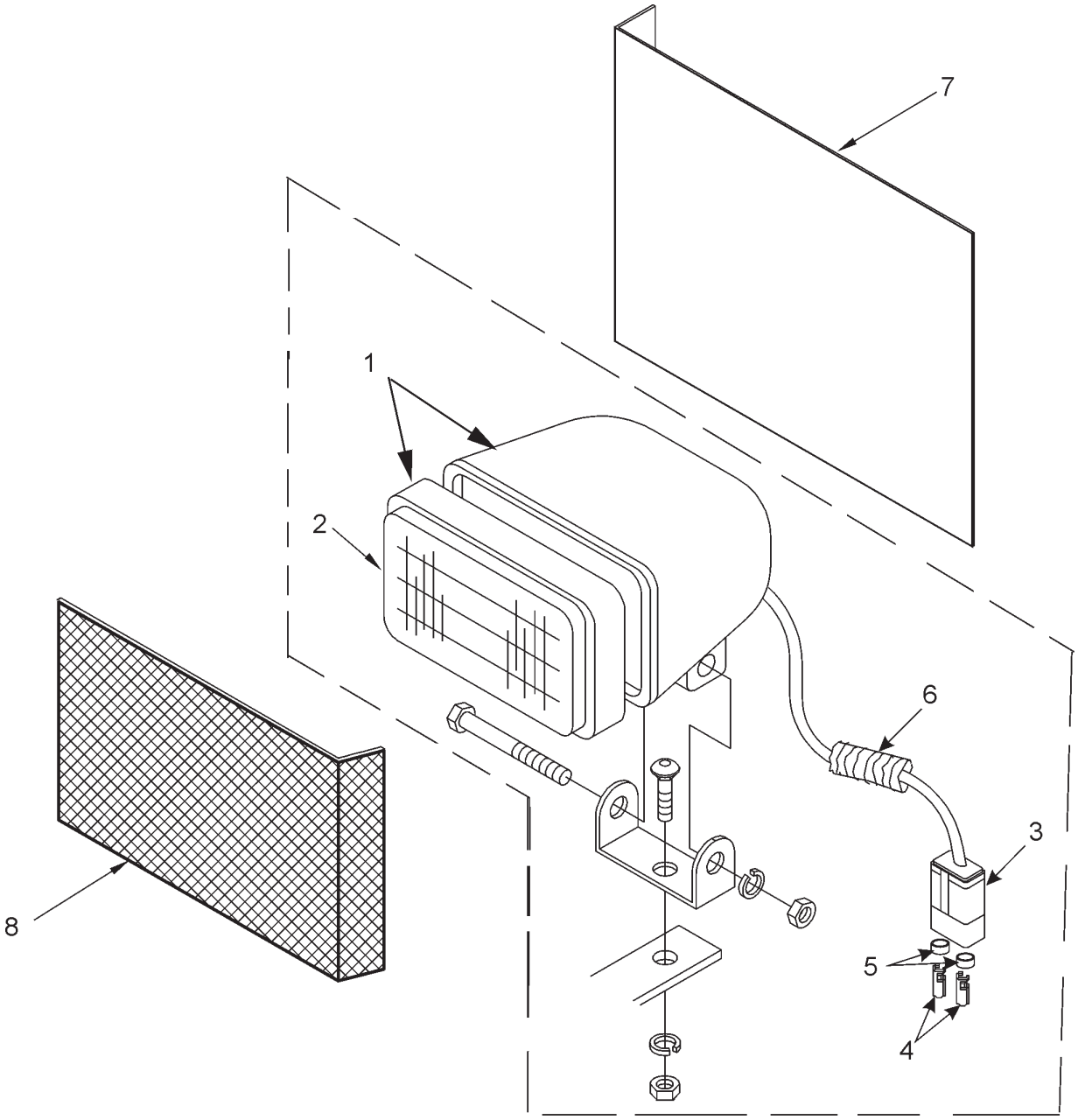


FIGURE 17.
LIGHTS-HEADLIGHT

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
17-	43959		Lights - Headlight		Ref
0	37734		Headlight Assembly		2
1	37578		Headlight Assembly, Rectangular		2
2	43468	1229622	Sealed Beam, Halogen Replacement, H9411		1
3	37639		Connector, 2 Pos, Shroud Half		1
4	37307		Terminal, Male, 16-4 Packard		2
5	37310		Seal, wire		2
6	2.3478		Loom, 1/4”		8.5”
7	38041		Headlight Protection Plate (Option)		2
8	38040		Headlight Grate (Option)		2

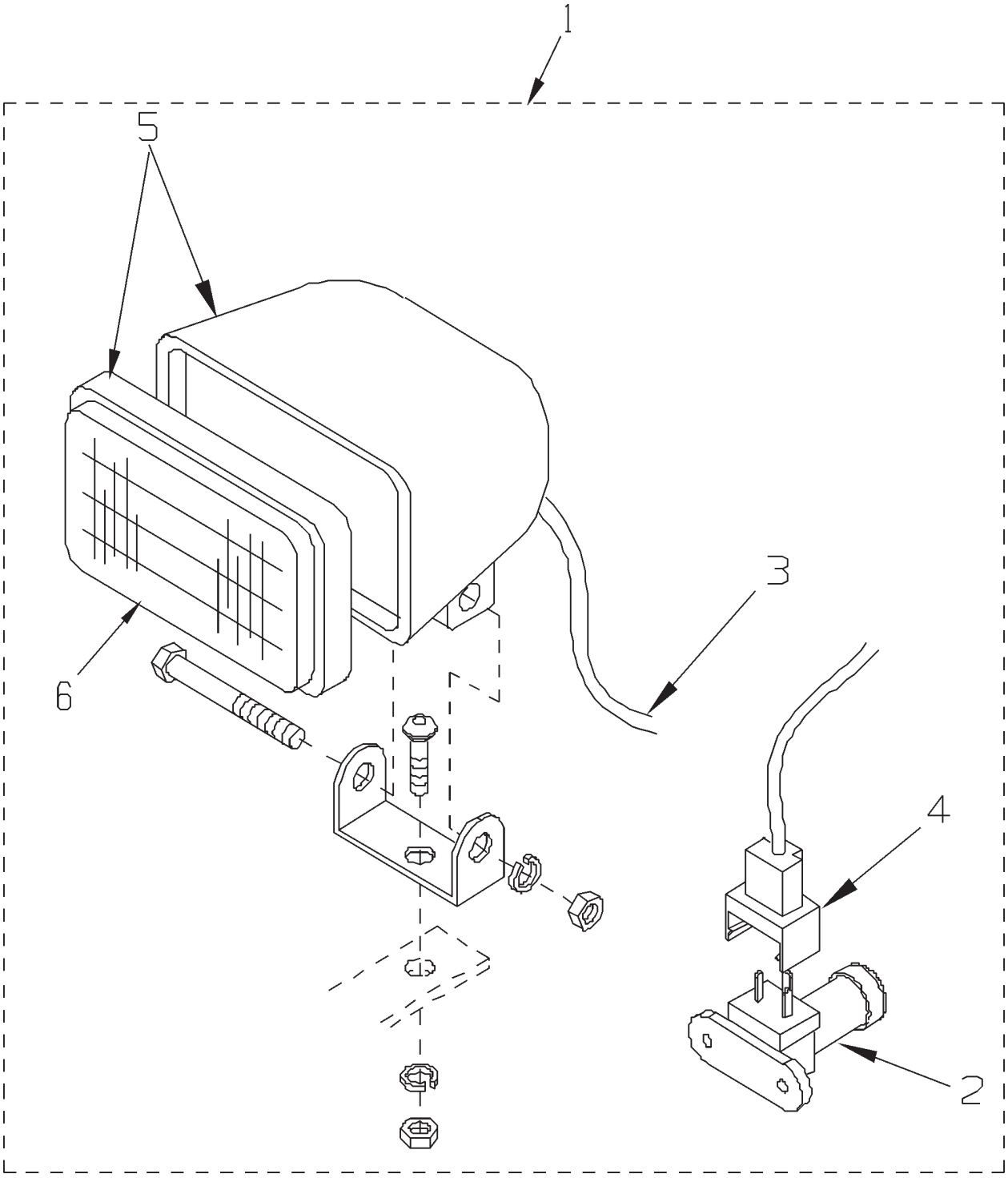


FIGURE 18.

LIGHTS-HEADLIGHT HI-LO BEAM, OPTION

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
18-	43960		Lights - Headlight Hi-Lo Beam, Option		Ref
1	NW033813	95151	Headlight, Hi-Lo		2
2	F101622	DS72 Standard	Switch, Dimmer,		1
3	NW033223		Harness, Hi-Lo Beam		1
4	F100905		Connector, Inline		1
5	43056	78155	Bulb, H4 12V (Hella)		1
NS	NW031880		Connector, Flasher		2

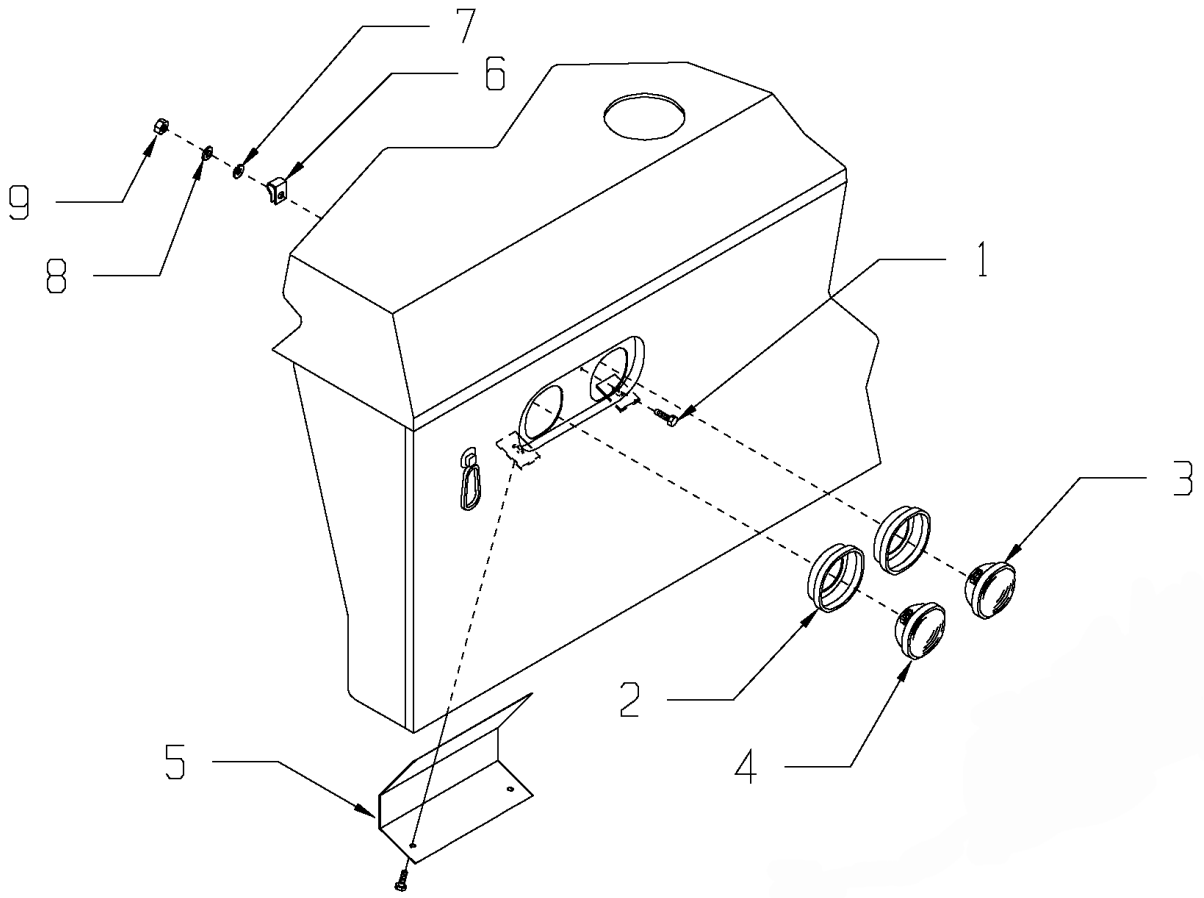


FIGURE 19.
LIGHTS - REAR

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
19-	43960		Lights - Rear, Mirrors		Ref
1	NW034546		THMS, 1/4-20 x 0.75		2
2	NW035843	43826-201-B	Grommet (75175),		4
3	NW035842	62271	Back-up/Work Light Assy, 2-wire, Clear (81834)		2
4	NW035844	759-0655-B	Tail/Stop Light Assy, 3-wire, Red (75175)		2
5	40996		Plate, Light Bracket		2
6	Comm		Clip, Insulated		2
7	Comm		Flat Washer, 1/4		2
8	Comm		Lock Washer, 1/4		2
9	Comm		Hex Nut, 1/4-20		2

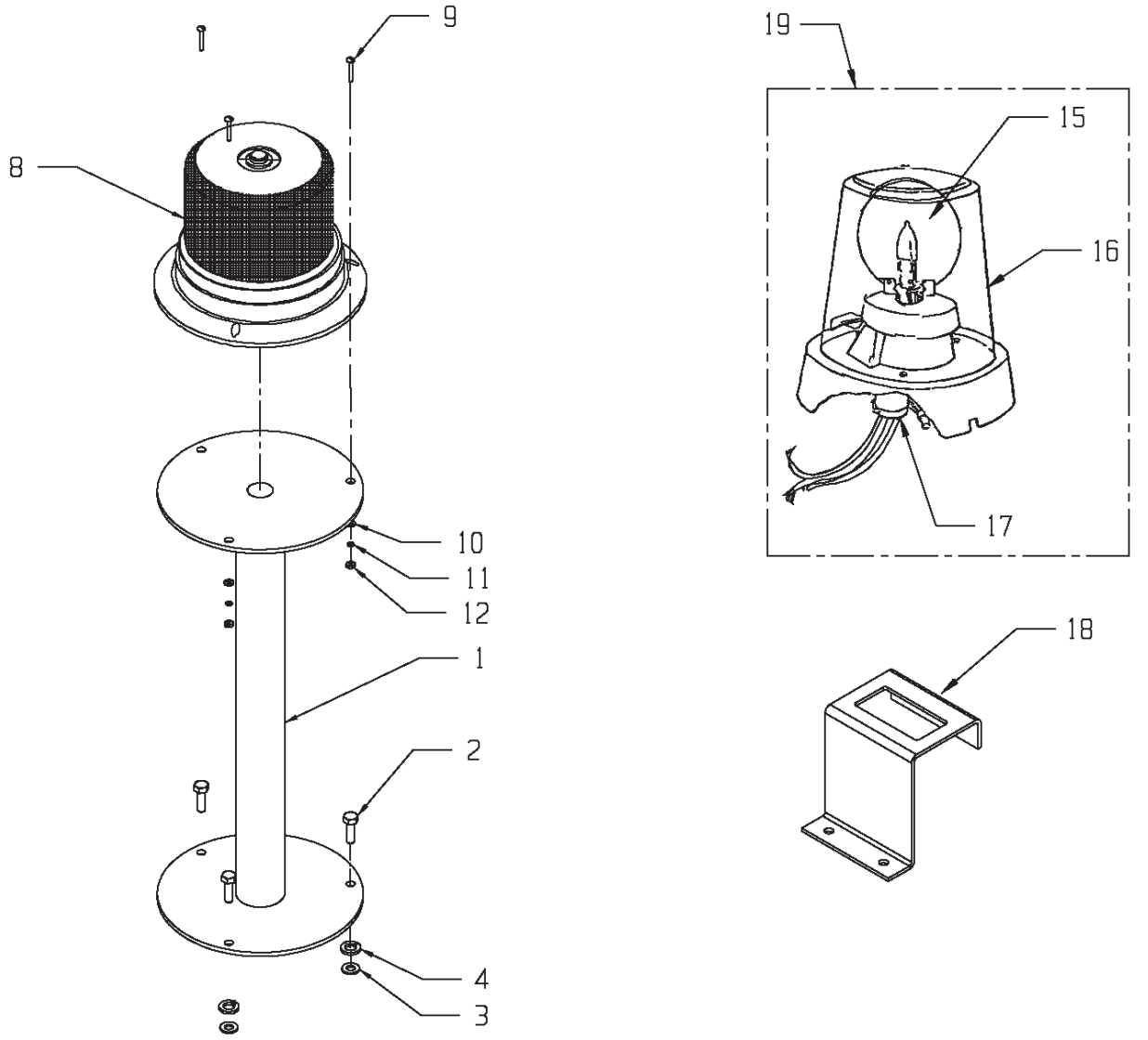


Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
20-	52993		Option, Beacon, 140 W/Cab	I	Ref
8	NW031334	5813A	Light, Beacon, Rotating, Amber (NW028039)		1
9	F100484		RHMS 10-32 x 1 ZP		3
10	F010046		FW #10		3
11	F009541		LW #10 Reg		3
12	F100010		Hex Nut #10-32, Mach		3
NS	NW034176	511005	Rocker Switch (65439)		1
	NW035384	596628	Switch Insert, Beacon, Green (65439)		1

FIGURE 20.
LIGHTS-STROBE AND BEACON

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
20-	41005		Lights - Amber, Rotating on Pole, Option		Ref
1	39976		Stand, 27” Beacon		1
2	F100378		HHCS 5/16-18 x 1, GR5		3
3	F009549		FW 5/16		3
4	F009546		LW 5/16		3
8	NW031334		Light, Beacon, Rotating, Amber (NW028039)		1
9	F100484		RHMS 10-32 x 1 ZP		3
10	F010046		FW #10		3
11	F009541		LW #10 Reg		3
12	F100010		Hex Nut #10-32, Mach		3
NS	F100851		Terminal, Butt, 14-16 GA, Vi nyl		1
NS	NW26601		Wire, 13 Assembly		1
NS	F0009794		Wire 16 GA Red Primary		A/R
NS	41798		Dwg,Instr, Rotating Light, Amber		1
NS	F100522	1751	Loom 0.18 (Whitaker)		A/R
NS	F100846	31503	Terminal, Ring, #10, 16-14 GA (58961)		1
NS	NW10526C10		Fuse, 10 Amp		1
NS	NW034176	511005	Switch Assembly, Light (65439)		1
	NW035384	596628	Insert, Switch, Beacon, Green (65439)		1

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
20-	51224		Beacon, Rotating, Amber, Option		Ref
8	NW031334	5813A	Light, Beacon, Rotating, Amber (NW028039)		1
9	F100484		RHMS 10-32 x 1 ZP		3
10	F010046		FW #10		3
11	F009541		LW #10 Reg		3
NS	38863		Switch, Toggle, SPST		1

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
20-	NW026290E		Beacon, Rotating, Option w/Cab/OH Guard		Ref
15	38495		Bulb, 55 Watt		Ref
16	38493		Lens, Beacon, Amber (2Y580)		Ref
17	38494	H3BP-55	Motor, Beacon (V00523)		Ref
18	42057		Brkt, Switch		1
19	NW031334	5715	Light, Amber (62465)		1
NS	NW034176	511005	Rocker Switch (65439)		1
	NW035384	596628	Switch Insert, Beacon, Green (65439)		1
NS	F100864		Terminal, Fork		1
NS	304682		Fuse, 10 A/32V ATC		1
NS	F100484		RHMS 10-32 x 1 ZP		3
NS	F009541		LW #10 Reg		3
NS	F100010		Hex Nut #10-32, Mach		3
NS	F010046	31525	Terminal, Fork, #10 (58961)		1

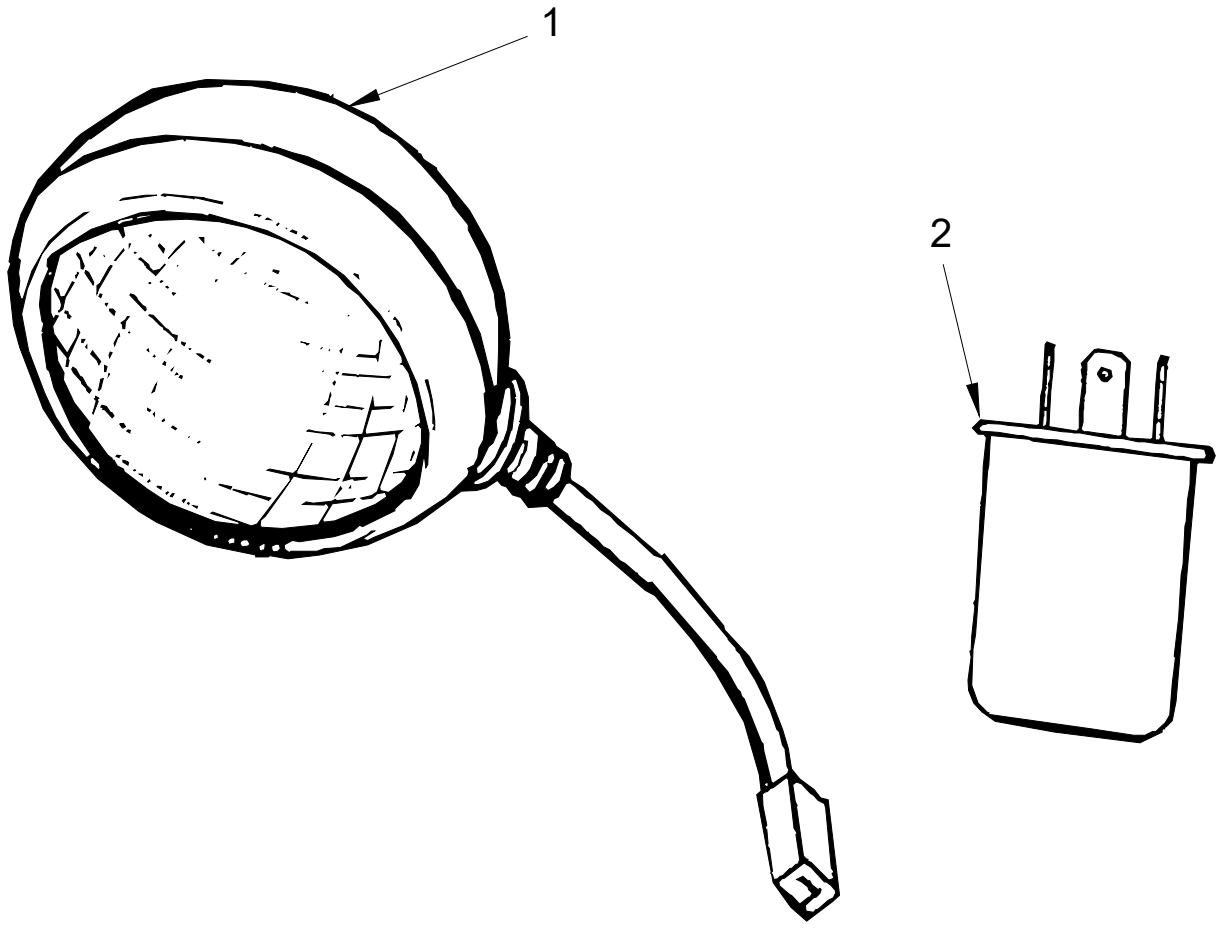


FIGURE 21.
LIGHTS- TURN SIGNALS, OPTION
LIGHTS - 4 WAY FLASHERS, OPTION

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
21-	NW34536		4-Way Flasher Option		Ref
	NW30677K		Light, Turn Signal, Option		Ref
1	NW030220		Light, Amber Turn Signal		2
	F101550		Connector, 2-Position, Female Half		4
	F101552		Terminal, Male		4
	F101793		Loom, 0.350 ID Flex Guard		22”
2	F101567	550	Flasher (V00523)		1
NS	NW30820	288-75-302	Switch, Turn Signal (20984)		1
NS	NW34575		Harness, 4-Way Flasher (for NW34536)		1
NS	NW34176		Switch Assembly (for NW34536)		1
NS	NW36776		Insert, Switch (for NW34536)		1
NS	NW34519		Guard, Headlight & Turn Signal (for NW34536)		2
NS	NW19009		Strap, Adjustable		2
NS	NW100899		Terminal, Butt, 12-10 GA		3

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
21-	48500		Opt, Lt, Turn Signal, Sealed Conn	I	Ref
1	NW030220		Light, Amber Turn Signal		2
	37639		Conn, El, W-Pak, Body		4
	37307		Conn, El, W-Pak, Pin		4
	37309		Conn, El, W-Pak & 280, Seal		4
	F101793		Loom, 0.350 ID Flex Guard		11”
2	F101567	550	Flasher (V00523)		1
NS	NW30820	288-75-302	Switch, Turn Signal (20984)		1
NS	NW100899		Terminal, Butt, 12-10 GA		3

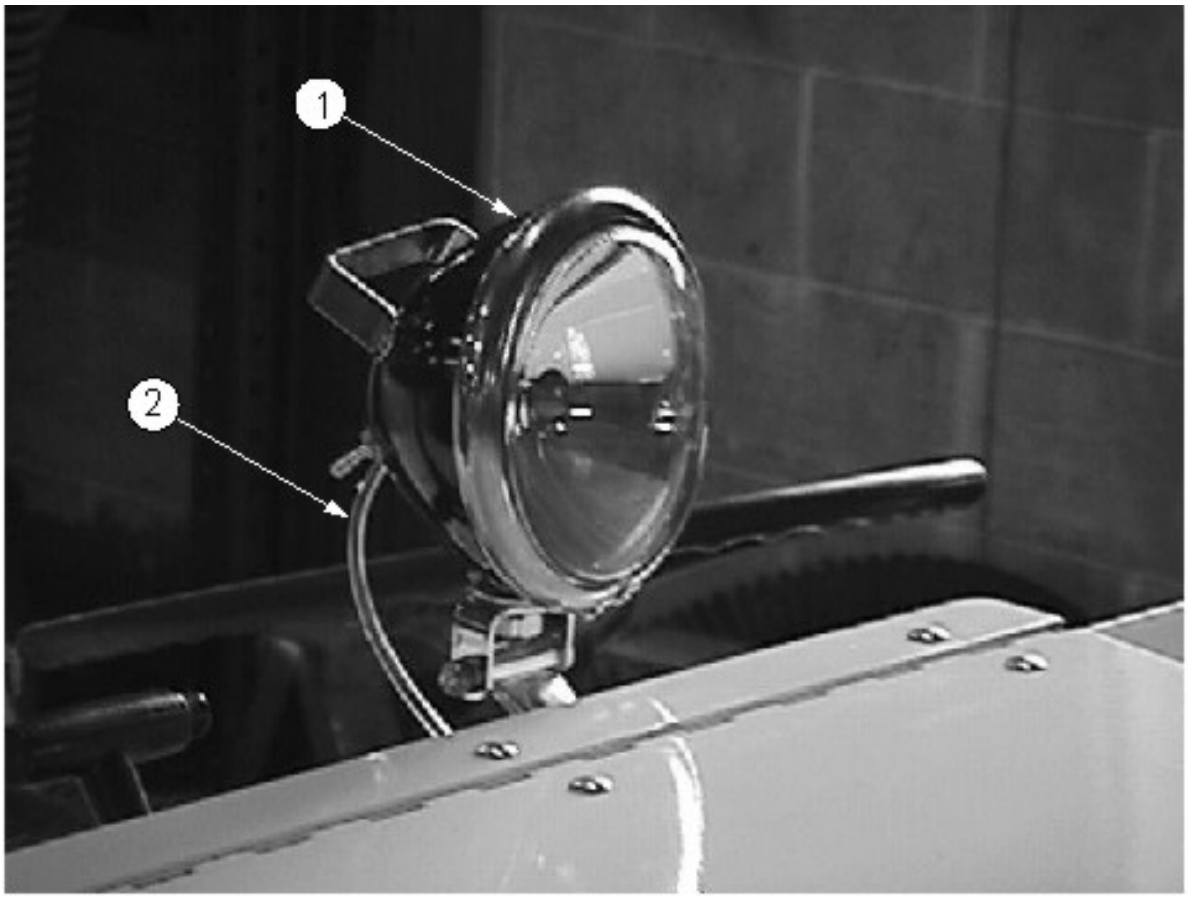


FIGURE 22.
LIGHTS- SPOTLIGHT, OPTION WITHOUT CAB

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
22-	NW024101E		Lights - Spotlight, Option without Cab		Ref
1	F101767		Spotlight, Clear, 12V		1
2	F100522		Loom 0.18 (Whitaker)		13”
NS	Comm		Terminal, Ring - 51200		1
	Comm		HHCS 5/16-24 x 1.00 GR 5		2

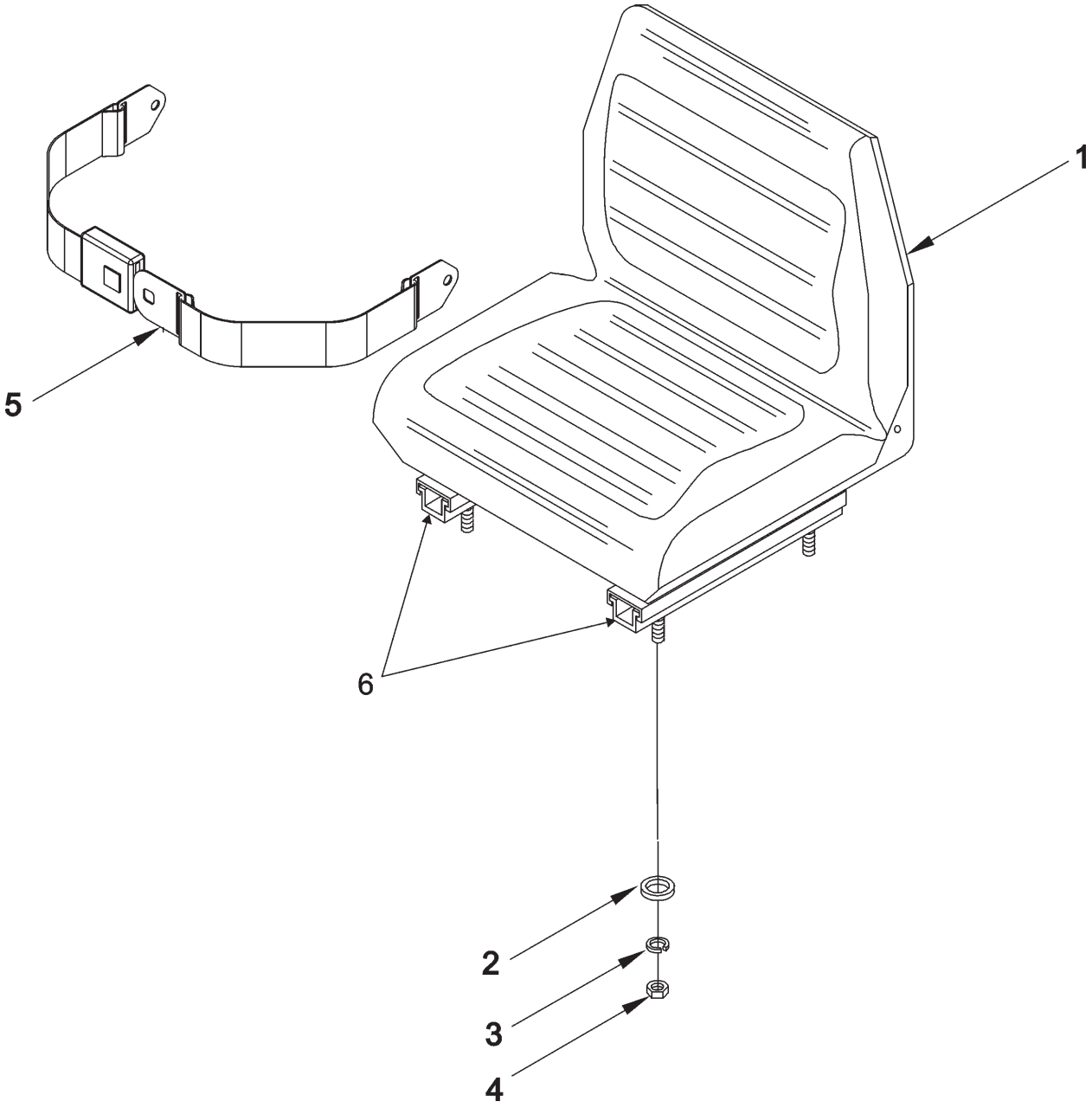


FIGURE 23.
SEAT

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
23-	42552		Seat Assembly with Slide		Ref
	NW26697E		Seat, Op tional Passenger		Ref
	43966		Pas sen ger Seat, Op tional		Ref
	43965		Seat, Driver's w/ Armrest		Ref
1	NW23843		Seat Assy, w/Slide (0X098)		2
	NW23734		Cush ion, Seat		1
	NW23733		Cush ion, Back		1
	38138		Arm rest (Op tional)		1
	38969		Hip Guard (Op tional)		1
2	F09549		Flat Washer, 5/16		8
3	F09546		Lock Washer, 5/16		8
4	F09547		Hex Nut, 5/16-18		8
5	NW34728	7066	Seat Belt (0X0P8)		1
6	90559		Slider Set, W/ Han dle		1
NS	38478		Bracket, Seat, RH		1
NS	38138		Arm Rest (Optional)		1
NS	42343		Plate, Seat		1

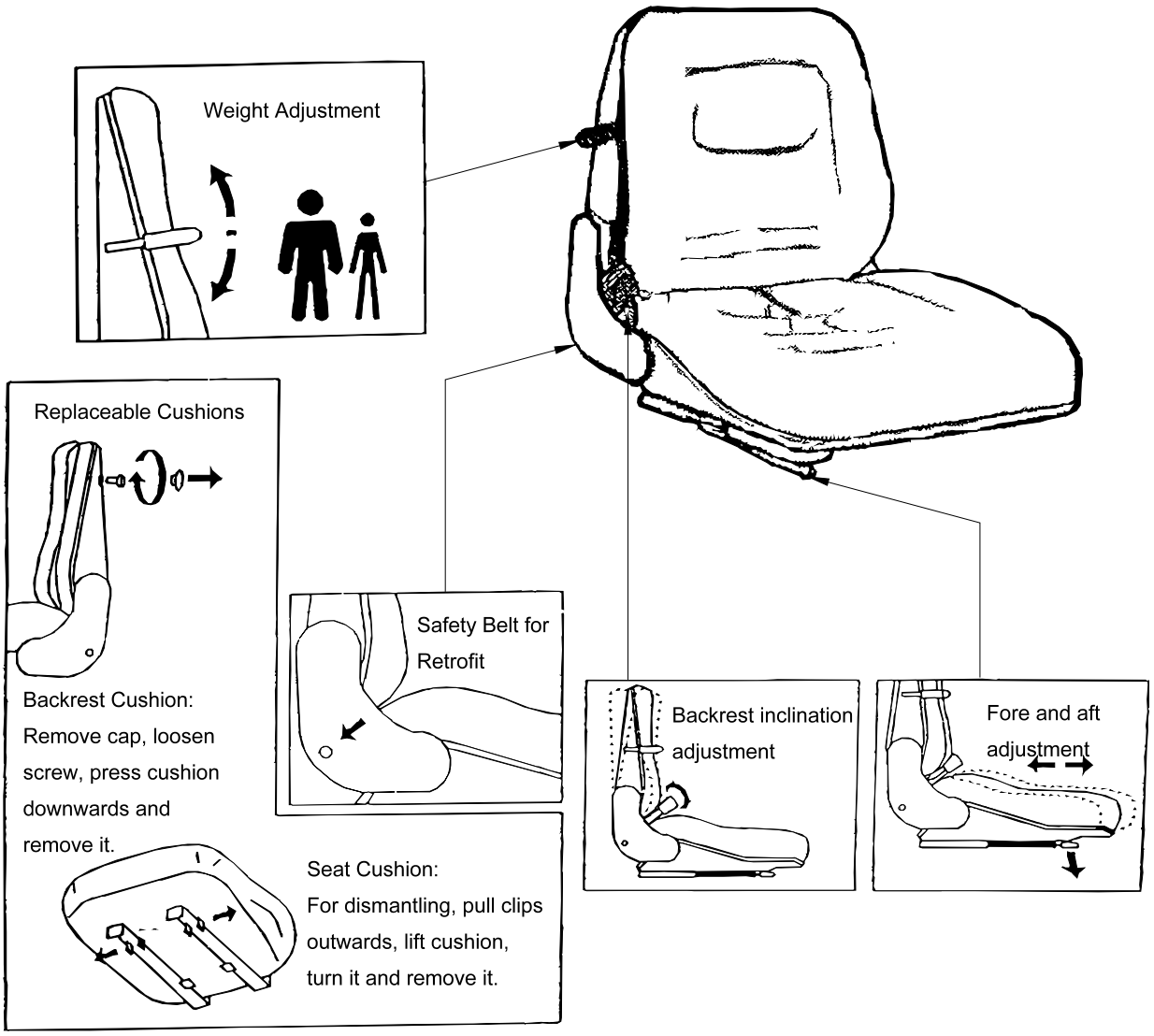


FIGURE 24.
SEAT, SUSPENSION, GRAMMAR, OPTION

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
24-	NW032310		Seat, Suspension, Grammar, Option		Ref
	NW036379		Cushion, Back, Vinyl		1
	43184		Cushion, Back, Grammer, Blk Cloth		1
	NW036378		Cushion, Seat, Blk Vinyl, Grammer		1
	41506		Cushion, Seat, Blk Cloth, Grammer		1
NS	NW027041		Bracket, Seat		1
NS	NW034728	7066	Seat Belt (0X0P8)		1
NS	NW022834		Washer, Cup		4
NS	F100403		HHCS, 1/2 -13 x 1.50		4

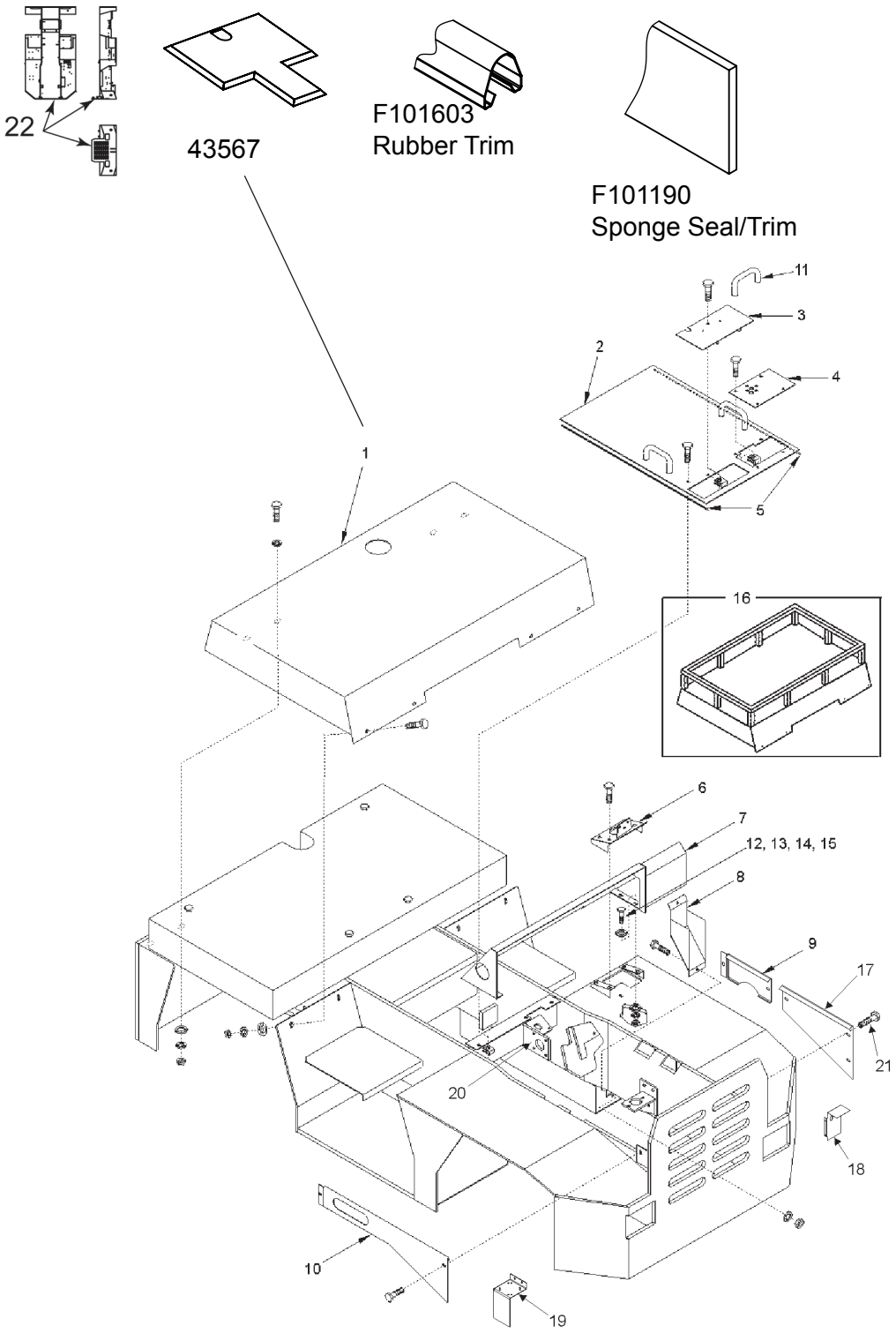


FIGURE 25.
SHEET METAL

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
25-			Sheet Metal		REF
1	46538		Chassis Assy, M140, Hyd		
	38311		Rear Body Weldment		1
	43567		Rear Body For Dropped 37” Rear Deck		1
	Comm		HHCS, 1/2-13 x 2.00		4
	120917		Carriage Bolt, 1/2-13 x 1.50		
	Comm		Flat Washer, 1/2		12
	Comm		Lock Washer, 1/2		8
	Comm		Hex Nut, 1/2-13		
	NW28109R		Sealant		106”
2	38308		Plate, Deck		1
	Comm		THMS, 5/16-18 x 1.50		2
	F100030		Nut, 5/16, J-Type Tinnerman		
3	38605		Cover, Cyl.		1
	Comm		THMS, 5/16-18 x 1.00		2
	F100030		Nut, 5/16 J-type Tinnerman		
	NW34658	2786 1/2G	Handle, Hood (Black Austin)		1
	Comm		RHMS, 10-32 x .50		2
	Comm		Lock Washer, #10		
	Comm		Hex Nut, 10-32		
4	38675		Plate, Parking Brake Le ver		1
	Comm		THMS, 5/16-18 x 1.00		2
	F100030		Nut, 5/16 J-Type Tinnerman		
5	F101190		Seal, 3/16 x 1/2 Neoprene Sponge		164”
6	53338		Cover, Steering Column		1
	38615		THMS, 5/16-18 x 1.00		4
	F100030		Nut, 5/16 J-Type Tinnerman		
7	46841		Hood Support		1
	F101603	SD 1250	Trim, Rubber (Austin)		10”
	F101601	SD-503	Trim, Seal (Austin)		27”
8	38640		Cover, Pitman Arm		1
	38615		THMS, 5/16-18 x 1.00		4
	F100030		Nut, 5/16 J-Type Tinnerman		
9	46675		Side Panel, LH, Back		1
10	38508		Side Panel, RH		1
	46540		Side Panel, RH (B3.3T)		1
	Comm		THMS, 5/16-18 x 1.00		2
	F100030		Nut, 5/16 J-Type Tinnerman		
11	NW34658	2786 1/2G	Handle, Hood (Black Austin)		1
12	F100312		HHCS, 3/8-16 x 1.25		4
13	Comm		Flat Washer, 3/8		8
14	Comm		Lock Washer, 3/8		4
15	F009666		Hex Nut, 3/8-16		4
16	42314		Rearbody Weldment w/ Cargo & Guard, Opt.		1
17	46539		Panel, Side, LH, Front		1
18	46651		Guard, Fuel Pump		1
19	46647		Brkt, Oil Fil ter Mounting		1
20	38487		Brkt Wldmnt, Mas ter Cyl		1
21	F100378		THMS, 5/16-18 x 1.00		2
	F100030		Nut, 5/16 J-Type Tinnerman		2
22	46857		Frame Wldmnt, 140, Wide Sprg, 129"	G	1
	52675-1		Frame Wldmnt, 12-14K, 24.5”	H	1
	52988		Frame Wldmnt, 140,129”	I	1
	52675-3		Frame Wldmnt, 140, 12-14k w/Cab		1
NS	39465		Plate, Accel. Pedal		1
NS	38721		Guard, Fuel Cap		1
NS	46743		Panel Assy, Side M140, Cmn, 129”	H	1
9	46675		Side Panel, LH, Back		1
NS	46676		Side Panel, LH, Front	H	1

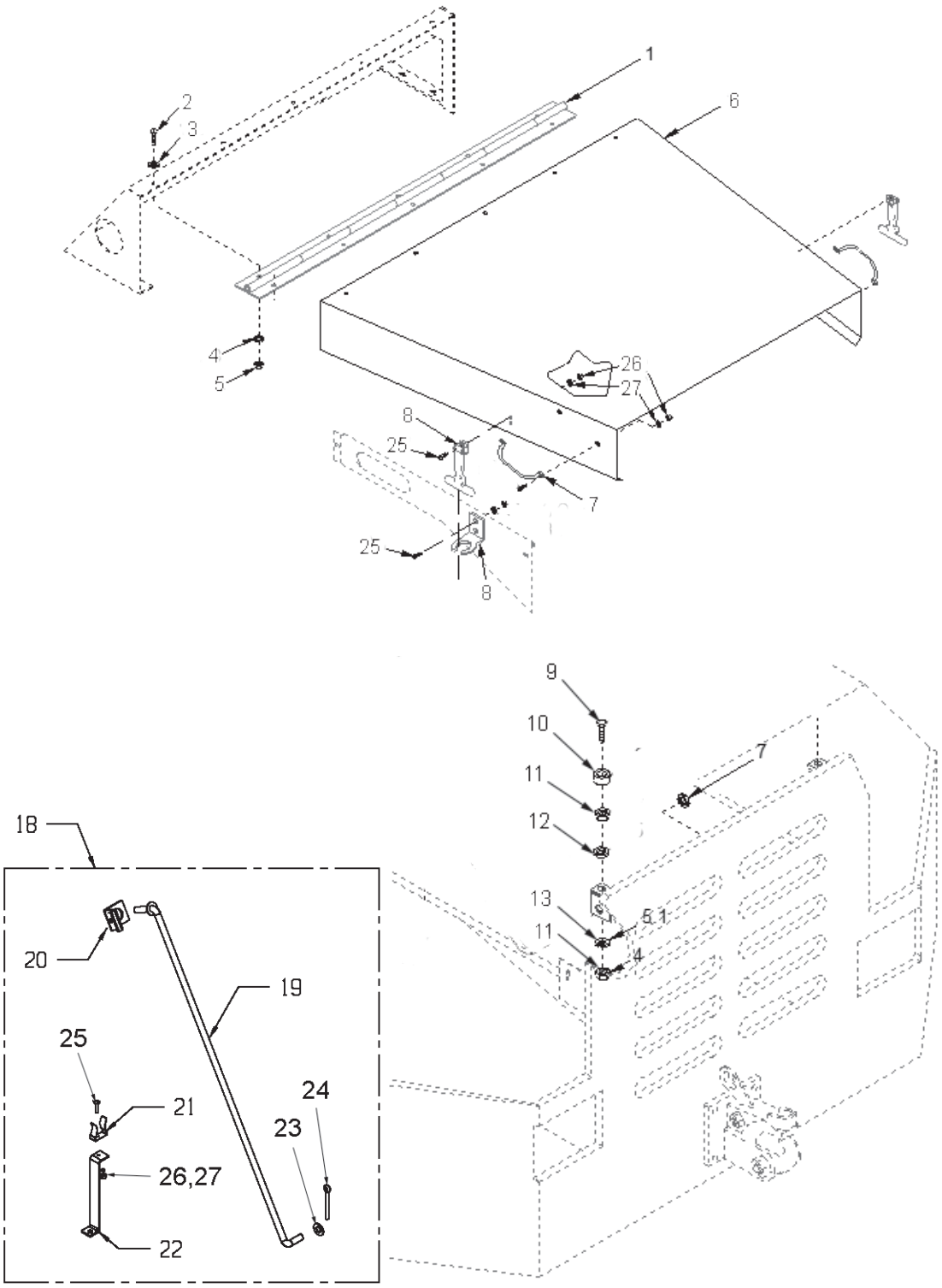


FIGURE 26.
HOOD

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
26-			Sheet Metal, Hood		Ref
1	37604		Hinge, Hood		1
2	Comm		THMS, 1/4-20 x 0.75		10
3	Comm		Lockwasher, 1/4		10
4	Comm		Flatwasher, 1/4		10
5	Comm		Hex Nut, 1/4-20		10
6	46541		Hood		1
7	NW34658	2786 1/2G	Handle, Hood (Black Aus tin)		2
8	NW22814	37-10-086-10	Latch Assem bly (94222)		2
9	NW23065	3963260	Screw, Hood Bumper (24617)		2
10	NW23066	3792828	Bumper, Hood (24617)		2
11	Comm		Nut, Hex 5/16-18		4
12	Comm		Flat Washer, 5/16		4
13	Comm		Lockwasher, 5/16		4
18	42637		Hood (Rod As sem bly)		Ref
19	38610		Hood		1
20	38043		(Not Used)		
21	NW16340		Clip, Hood Lock Rod		1
22	38739		Brkt, Hood Rod		1
23	Comm		Flat Washer, 1/2		1
24	Comm		Pin, Cotter, 1/8 x 7/8		1
25	Comm		RHMS, 10-32 x 0.50		4
26	Comm		Lockwasher, #10		4
27	Comm		Hex Nut, 10-32		4
NS	NW35891		Gas Shock (Optional)		2
NS	NW35714		Ball Stud (Optional)		4

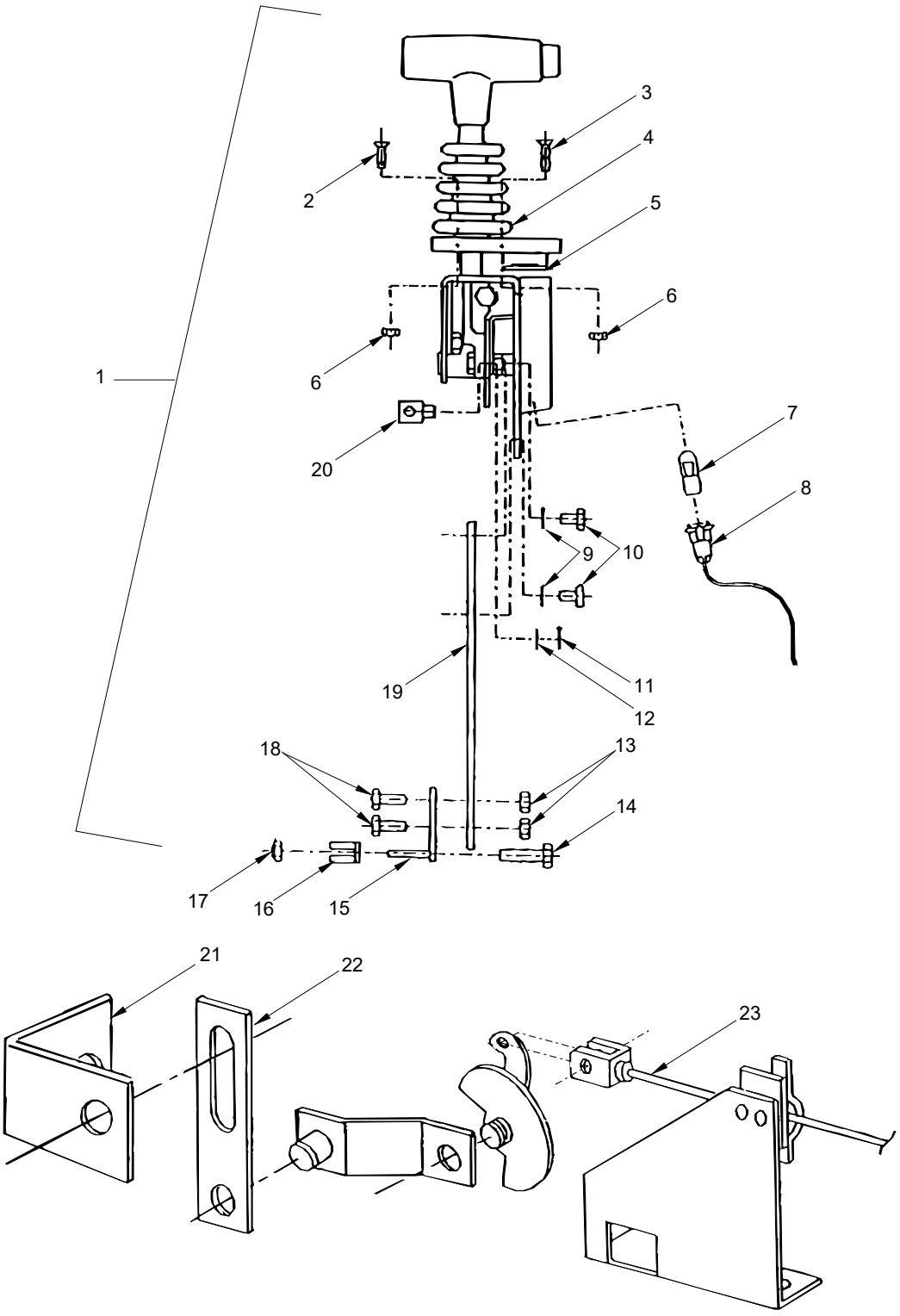


FIGURE 27.
SHIFT CONTROL ASSEMBLY - QUADRASTAT

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
27-	43953		Shifter - Quadrastat		Ref
1	NW36144	T73538	Shift Control Assembly (58051)		1
2	Comm		SHCS, #10-32 x 5/8		1
3	Comm		SHCS, #10-32 X 3/4		1
4	NW31948		Shifter Boot		1
5		DTP473	Lens		1
6	Comm		Lock Nut, #10-32, Nylon Insert		2
7		DZ982	Lamp		1
8		DY2300	Socket Assembly		1
9	Comm		Lock Washer, 1/4, Ext. Tooth		2
10	Comm		HHCS, 1/4-20 x 3/8		2
11	Comm		Cotter Pin, 3/32 Dia.		1
12	Comm		Flat Washer, .328 ID		1
13	Comm		Lock Nut, 1/4-20		2
14	Comm		HHCS, 1/4-20 x 1.00		1
15		DC062	Bracket, Angle		1
16		DC063	Clamp		1
17	Comm		Hex Nut, 1/4-20		1
18	Comm		HHCS, 1/4-20 x 5/8		2
19		DC076	Strap		1
20		DR050-2	Swivel		1
21	37667		Bar, Kickdown Adjustment		1
22	NW34238		Bracket, Kickdown Plate		1
23	NW31669	307484-3-84	Transmission Shift Cable (1FDW0)		1
NS	37188		Transmission Rubber Mount		Ref

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
27-	43956		Shifter, Quadrastat, AT542 Transmission		1
1	NW36145		Le ver, Shift Control		1
23	NW32842		Ca ble, 6’ Shift		1
NS	NW32841		Kit, Shift Connector		1

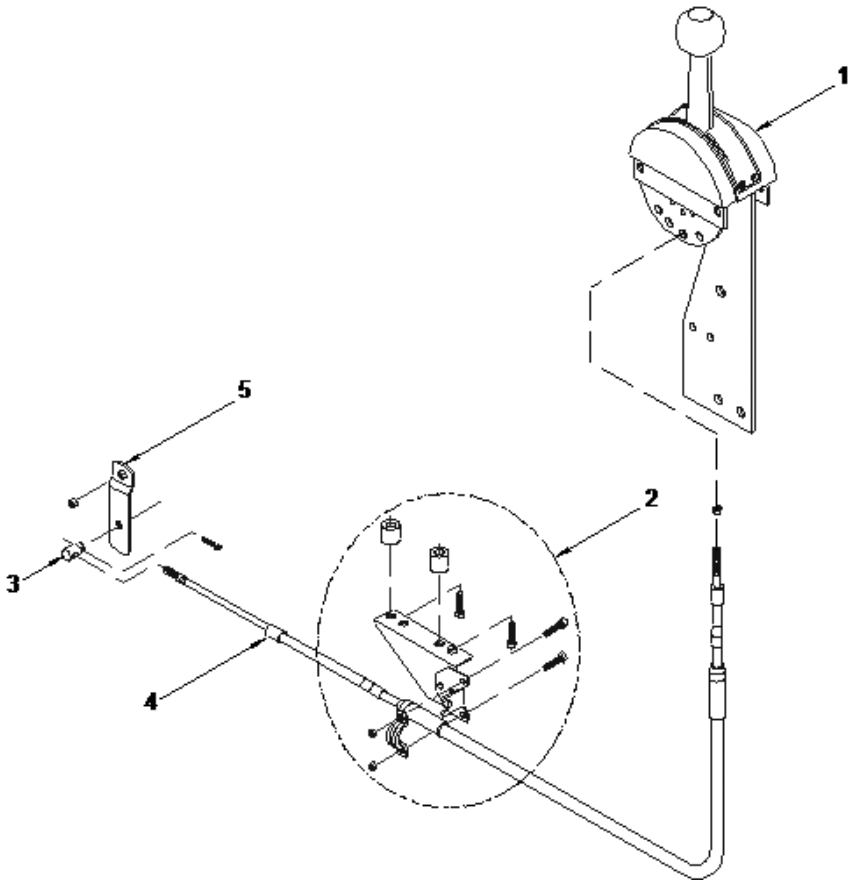


FIGURE 28.
SHIFT - MORSE, OPTIONAL

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
28-	43954		Shift - Morse, Optional		Ref
1	NW34591		Shift Control Assembly		1
3	F101863		Ball Joint, 1/4-28		1
4	NW34592		Cable, Transmission Shift, 84"		1
5	42602		Lever, Trans. Shift		1
NS	NW34238		Bracket, Kickdown		1
NS	NW34551		Clip, .25 Shaft		1

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
28-	43957		Shifter, Morse, AT542		Ref
1	40481		Con trol, Shift, AT542		1
2	40479		Kit, Connec tor, AT542		1
3	F101863		Ball Joint, ND, 1/4-28		1
4	NW31669		Cable Assembly, Shift, 84”		1
5	NW36794		Bracket, Shift Cable, 60B		1

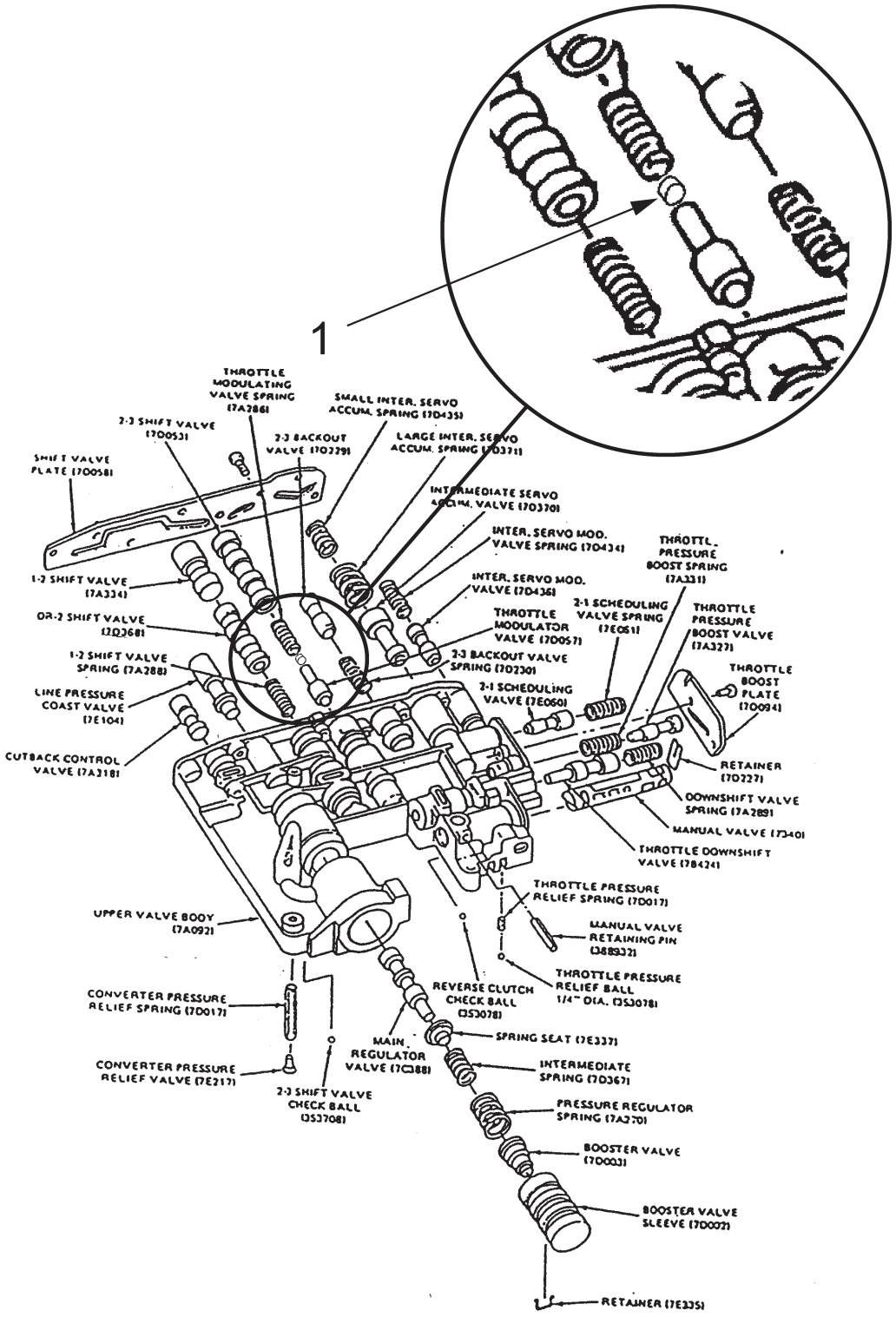


FIGURE 29.
3RD GEAR LOCK OUT

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
29-			3rd Gear Lock Out		Ref
1	37934		Plug, 3rd Gear Lock Out - C6		1

Instructions to install 3rd gear lockout in C6 transmission:

1. Remove transmission oil pan.
2. Locate upper valve body.
3. Remove shaft valve plate.
4. Carefully, so you do not lose internal parts, remove 2-3 shaft valve and throttle modulating valve spring.
5. Insert plug, part number 37934, and reinstall throttle modulating valve spring and 2-3 shaft valve.
6. Reinstall shaft valve plate.
7. Reinstall transmission oil pan and add transmission oil as required.

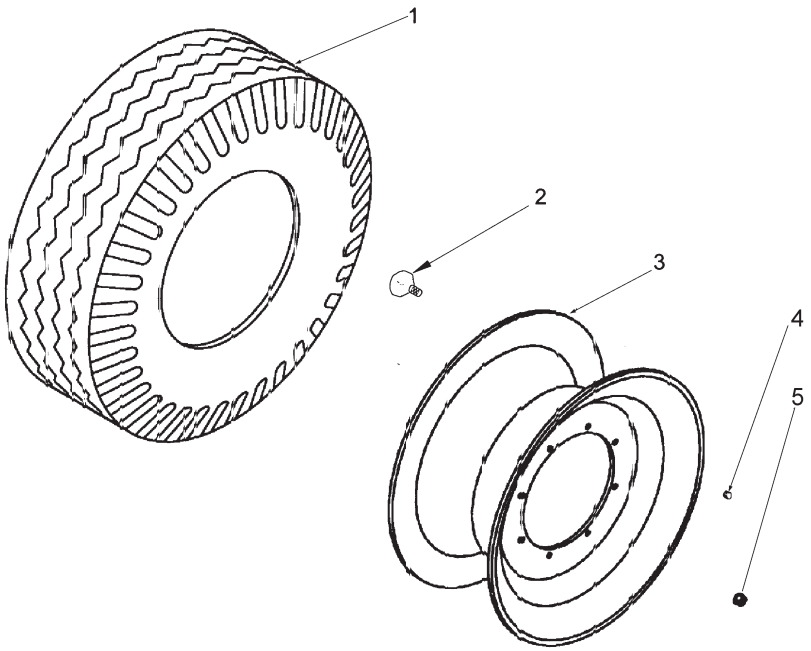


FIGURE 30.
WHEELS AND TIRES - FRONT

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
30-	42545		Wheels and Tires, Front		REF
1	NW022755-2		Tire, 8.00 x 16.50LT, LRD Bias Ply		1
2	NW018775		Valve Stem		1
3	NW036693	W-636131	Wheel, 6.00 x 17.5 (Brierton) (41640)		1
4	F101630		Valve Cap		1
5	NW017242	91292191	Wheel Nut (Brierton) (41469),		8

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
30-	43948		Wheel And Tires - Front		Ref
1	37897		Tire, LT8.00 R16.5 Fire Stone		
3	NW018775		Stem, Valve, .625 Hole, 1.25", 60#		
4	NW036693		Wheel, 6.00 x 17.5		
5	F101630		Valve Cap		
6	NW017242	91292191	Wheel Nut (Brierton) (41469),		

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
30-	43950		Wheel And Tires - Front		REF
1 & 3	NW035304		Tire, 6.50 x 16, Solid Pneumatic		2

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
30-	NW035997		Wheel/Tire Assy, 6.50 x 16, SOFSHO		REF
1 & 3	NW035998		Wheel Assy, 6.50 x 16, Front, 140		2

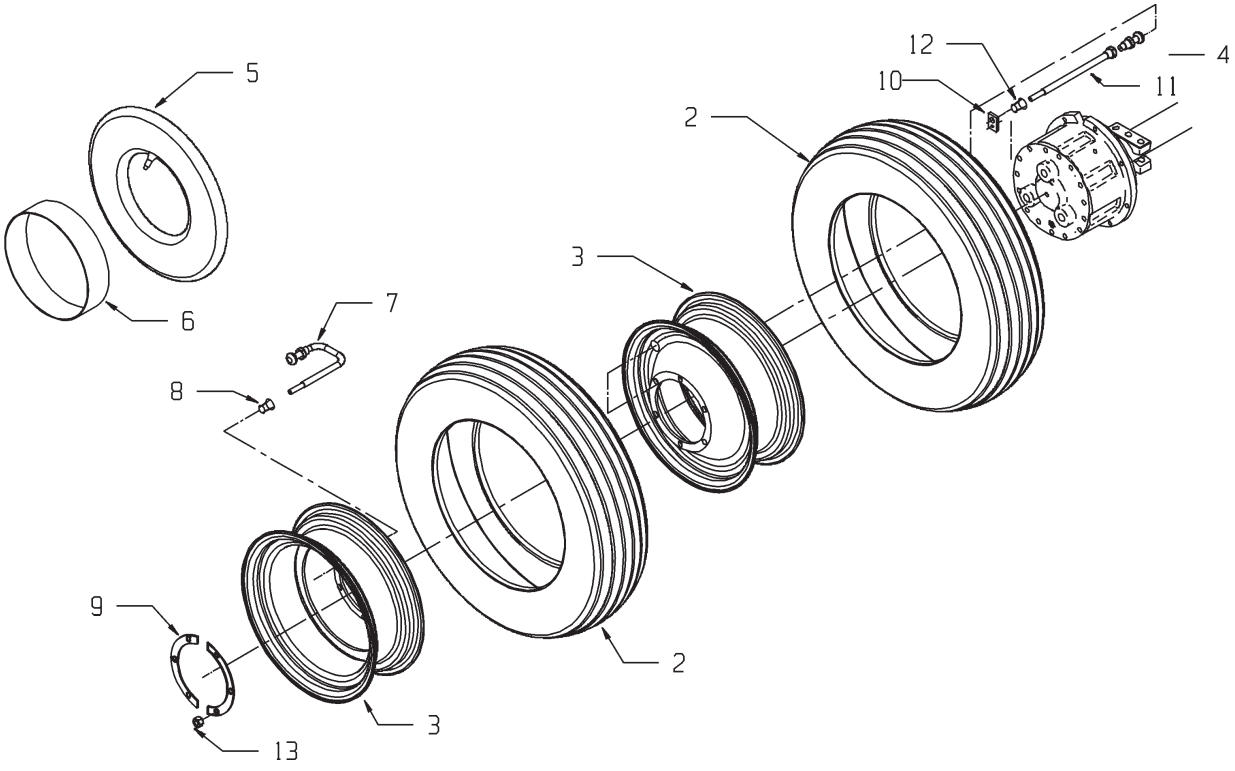


FIGURE 31.
WHEELS AND TIRES - REAR

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
31-	42546		Wheel And Tires - Rear		REF
2	38452.2		Tire, 215/75R17.5, LRH Std, Dunlap		4
3	41069		Wheel, Rear, 6.00 x 17.5		4
4	37698	TV6008B	Valve Stem (V00551)		2
7	37725	TV6008B	Valve Stem, 90-deg. Extension (V00551)		2
8	F101630	Comm	Valve Cap, Comm		4
9	42248		Plate, Wheel Clamp (includes 2 halves)		4
10	37718		Plate, Valve Extension		2
11	NW034835		Valve Stem, Flexible		2
12	F101630	Comm	Valve Cap, Comm		2
13	41059		Wheel Nut, 9/16-Flanged (3E525)		16

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
31-	43947		Wheel And Tires - Rear, Optional		Ref
2	NW34568		Tire, LT7.50 R16 w/Multi Piece Rim, Fire Stone		4
3	41437		Wheel, Rear, 5.5 x 16		4
5	41676		Tube, Tire 7.50 x 16		4
6	41677		Flap, Radial Tire		4
10	37718		Plate, Valve Extension		2
11	NW34835		Valve Stem, Flexible		2
12	F101630	Comm	Valve Cap		2
13	41059		Wheel Nut, 9/16-Flanged (3E525)		16
14	42248		Plate, Wheel Clamp (includes 2 halves)		4

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
31-	43949		Wheel And Tires - Rear, Optional		Ref
2	NW34801		Wheel/Tire, 7.50 x 16, Solid Pneumatic		4
3	41437		Wheel,Rear, 5.5 x 16 Included in Item 2		4
13	41059		Wheel Nut, 9/16-Flanged (3E525)		16
14	42248		Plate, Wheel Clamp (includes 2 halves)		4

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
31-	52695		Wheel And Tires - Rear, Optional	H	Ref
2	38452.2		Tire, 215/75R17.5, LRH Std, Dunlap	H	4
3	52693		Wheel, Wldmnt 6.75 x 17.5, 5” offset	H	4
4	NW035682		Stem Valve		4
13	52694		F, Nut, Lug M20 x 1.5, w/Washer	H	16

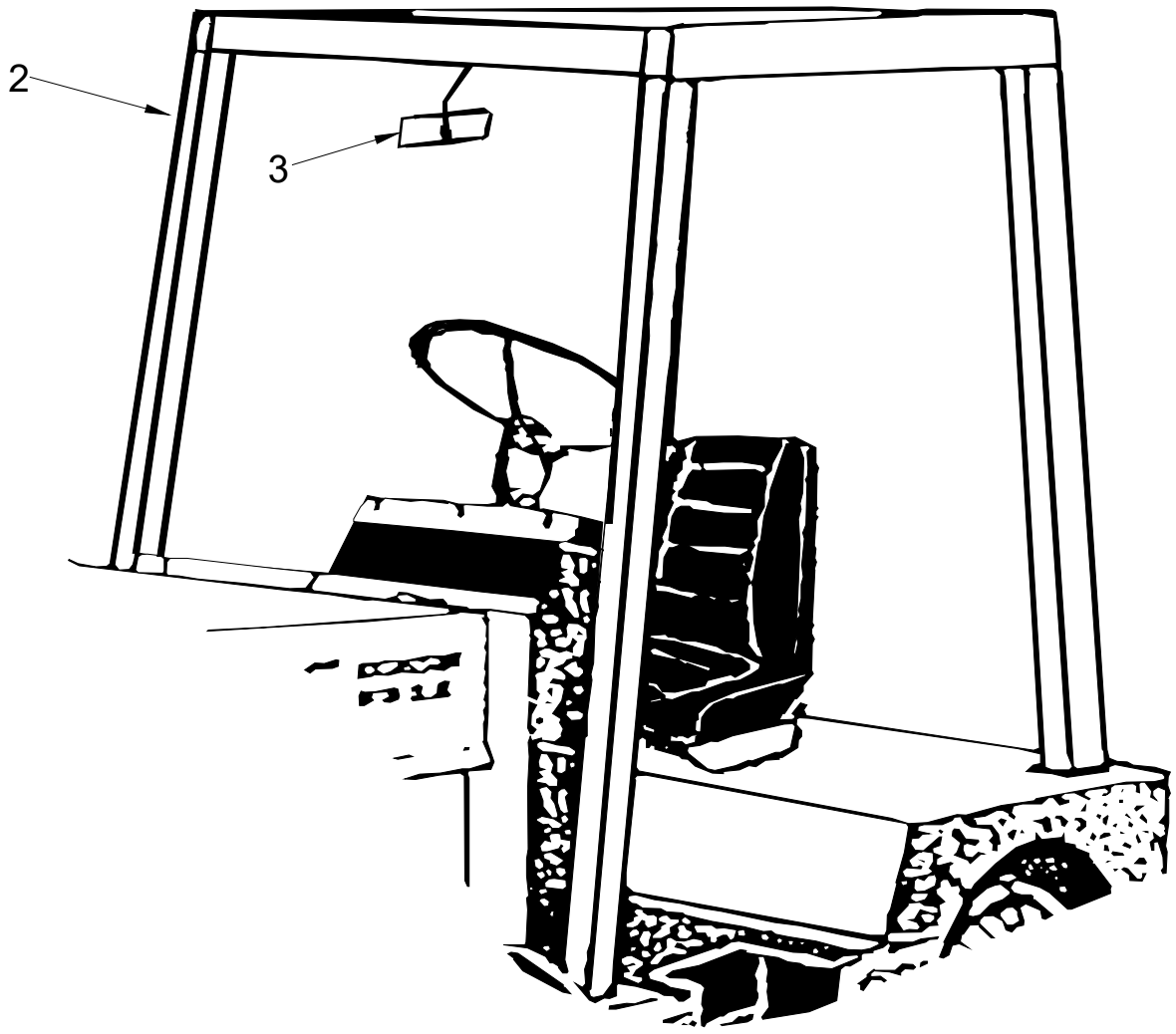


FIGURE 32.
GUARD OVERHEAD

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
32-	41780		Guard, Overhead		Ref
2	41781		Guard Weldment, Overhead		1
3	NW33318		Mirror, Inside		1
NS	F102544		Stud 1/2 x 1-1/2		4

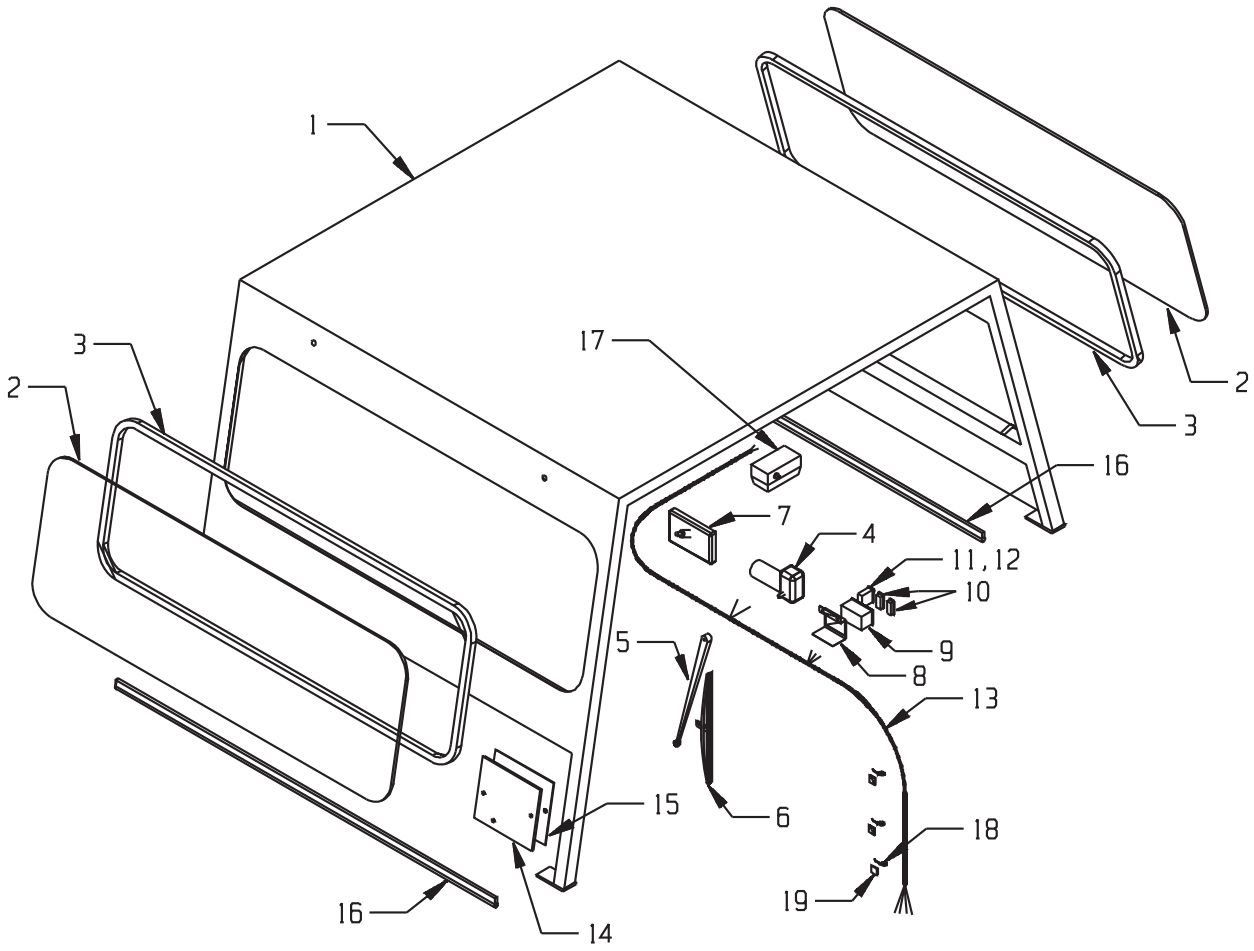


FIGURE 33.
GUARD OVERHEAD

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
33-	40043		Guard, Overhead		Ref
1	40091		Guard Weldment		1
2	40085		Window, M140		2
3	37711		Seal, Window		302”
4	NW36120		Motor, Wiper, Cab		1
5	NW32439		Arm, Wiper		1
6	NW33314		Blade, Wiper		1
7	NW33318		Mirror, Inside		1
8	40049		Bracket, Switch, Cab		1
9	NW35380		Frame, 3-Switch		1
10	NW35379	596273	Blank, Switch (56289)		1
11	NW34176	511005	Switch, Rocker (Simms)		1
12	NW36552		Insert, Switch, Wiper		1
13	40117		Harness		1
14	40116		Panel, Front		1
15	39239		Gasket		1
16	NW34579		Seal, Rubber Trim-Front		62”
	NW34579		Seal, Rubber Trim-Rear		58”
17	40559		Domelight		1
18	F101661		Tie Strap-5.5”		11
19	F101160		Clip Adhesive Backed		11
NS	NW10526C20		Fuse, 20A		2
NS	48685		Option, Sound Supression		
NS	48683		Pad		1
NS	48684		Pad		1

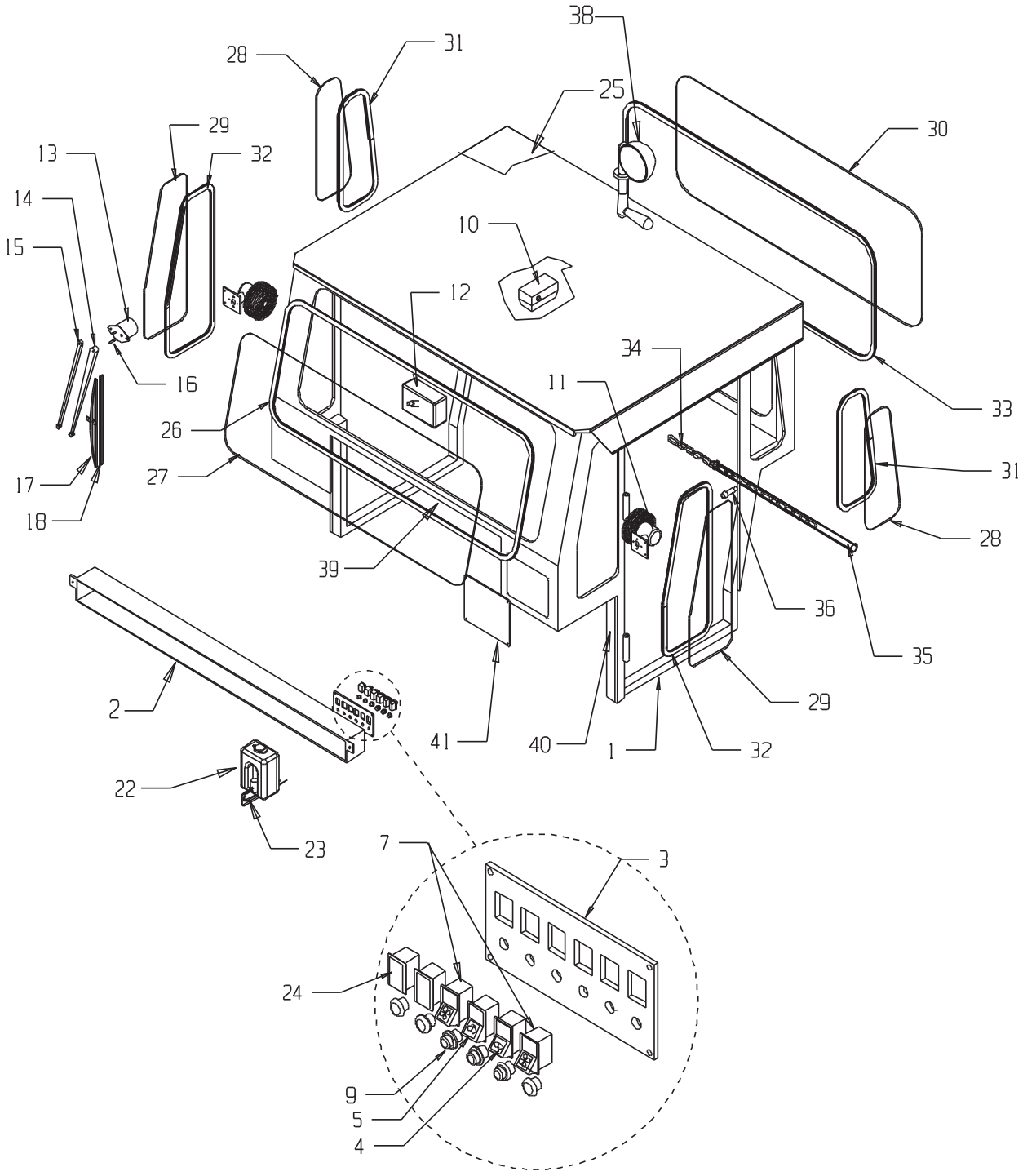


FIGURE 34.
CAB ASSEMBLY GROUP, OPT
(1 OF 2)

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
34-	39992		Cab Assembly		REF
1	39989	NS002720	Cab Weldment		1
	39984		Cab Weldment		
2	NW035744-2	NS006437	Switch Panel, Wiper Cover		1
3	NW035744-3	NS006438	Switch Plate		1
4	NW035744-4	NS003601	Wiper Switch 511.048/625		
5	NW035744-5	NS003602	Washer Switch 511.010/627		1
NS	NW035744-6	NS003604	Light Switch 511.003/473		
7	NW35394	NS003603	Fan Switch 511.029/195		2
	NW35395		Insert Switch, Blower, Green		2
NS	NW035744-7	NS006628	Beacon Switch		
9	NW35268	NS003609	Breaker 10A 1600-235		1
10	43023	NS003428	Dome Light M-391		1
11	43024	NS003376	Fan R-73-9052 12V		2
12	NW035744-8	NS005809	Mirror Peterson #609		1
13	NW035744-9	NS00619	Wiper Motor WWJ 6577540		1
14	NW035744-10	NS006620	Wiper Motor Drive Arm 6211340		1
15	NW035744-11	NS006621	Wiper Motor Link 22.5 LK721035-8		2
16	NW035744--12	NS006622	Wiper Motor Pivot Shaft 3 Inch 6271440		2
17	39992-1	NS008632	Wiper Arm 16 Inch 6702440		2
18	39992-2	NS008633	Wiper Blade 16 Inch 5217040		2
NS	NW035744-24	NS006625	Panto Post Kit 48519		2
NS	NW035744-25	NS006626	Washer Cowl Fitting 5036440		2
NS	NW035744-26	NS006627	Wet Arm Adapter Kit 521940		2
22	43142	NS003774	Washer Bottle and Mo tor		1
	51444		Brkt-Washer Bottle Mnt		1
23	NW035744-15	NS003776	Washer Tubing 3/16 ID		1
24	W35382	NS010059	Blank Switch Covers (Where Applicable)		1
25	NW035744-16	NS006069	Foam Insulation 3/4 Black Perforated		A/R
26	39992-3	NS003380	Window Gasket AS1615, Front, xxx”		2
27	39992-4	NS004319	Front Glass		2
28	39992-5	NS006432	Side Tear Drop Glass		2
29	39992-6	NS006431	Rear Side Glass		1
30	39992-7	NS004320	Rear Solid Glass (Where Applicable)		1
31	39992-8	NS003380	Window Gasket AS1615, Side Tear Drop Glass, 73”		2
32	39992-9	NS003380	Window Gasket AS1615, Rear Side Glass, 86”		2
33	39992-10	NS003380	Window Gasket AS1615		A/R
34	NW035744-19	NS006059	Door Holdback Chain 3/16 DIA 19 Links		2
35	NW035744-20	NS006065	Door Holdback Chain Sleeve Yel 1/2 X 16 Long		2
36	NW035744-21	NS003807	Door Latch Striker Stud EMC40052ZN		2
38	NW32893		Spot Light		1
39	NW034579		Trim w/ Seal, .06 x .62		75”
40	NW034853		Seal, Neop. .50 x 1 ADH.		300”
41	44887		Cover, Fuse Access		1
NS	40053		Heat/Defrost, 140D, Opt.		1
NS	F100311		HHCS, 3/8-16 x 1.00		2
NS	51443		Cover, Fenders		2
NS	F009669		FW, 3/8 STD, ZC		1
NS	F101190		Seal, 3/16 x 1/2 NEO		100”
NS	40694		Support Weldment, Hood		1

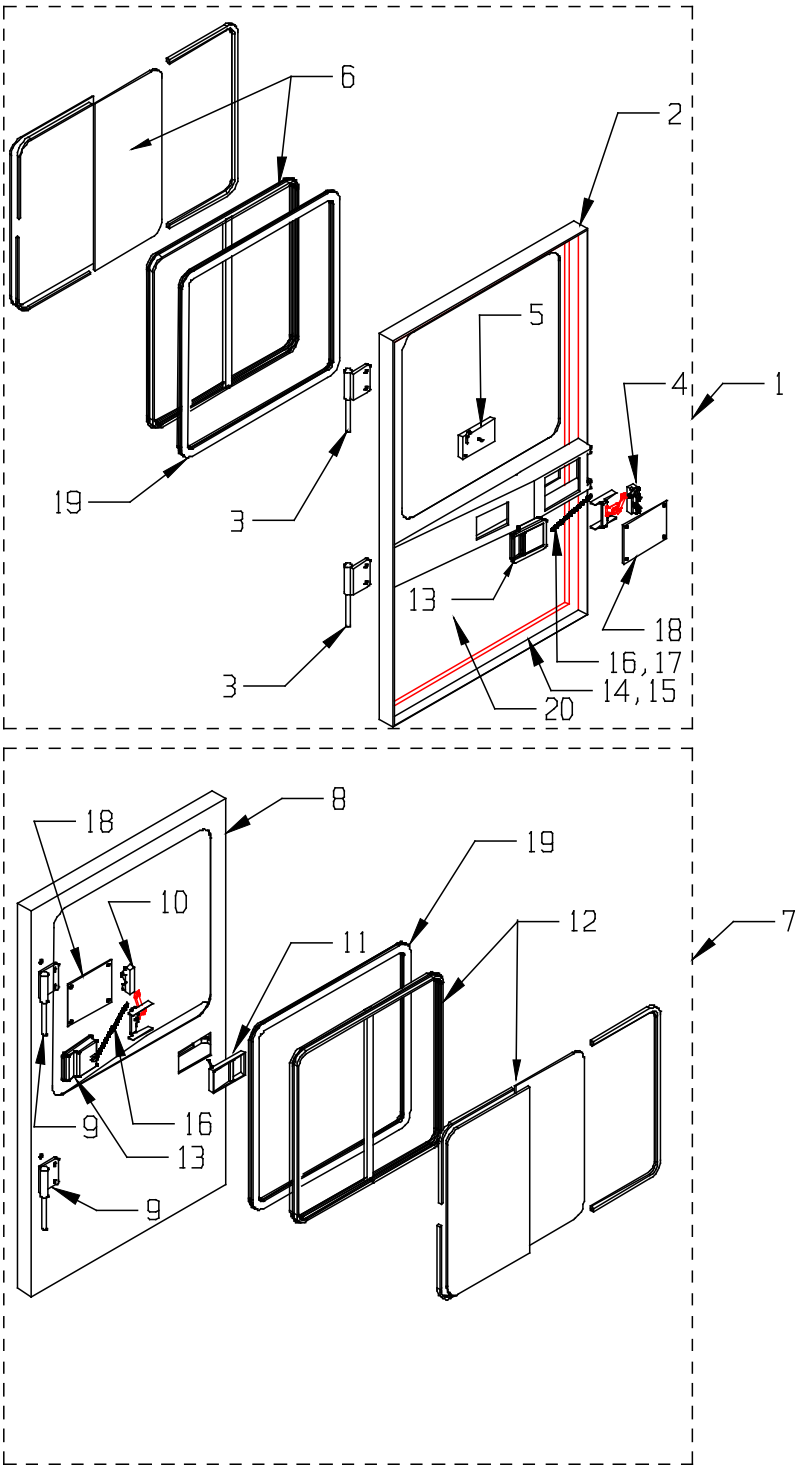


FIGURE 34.

CAB ASSEMBLY GROUP - DOORS, OPT

(2 OF 2)

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
1	39992-11		Door Assembly, Right w/Window, Latch, & Handles		1
2	39992-12	NS008592	Right Door Weldment		1
3	NW035744-29	NS004503	Right Door Hinge		2
4	NW035744-30	NS001925	Right Door Latch EMC-1-400ZN RH		1
5	NW035744-31	NS001928	Right Door Outside Handle TM1195037		1
6	39992-13	NS004323	Right Door Aluminum Slider Assembly 64-7812R		1
7	39992-14		Door Assembly Left w/Window, Latch & Handles		1
8	39992-15	NS008631	Left Door Weldment		1
9	NW035744-35	NS003417	Left Door Hinge		2
10	NW035744-36	NS006063	Left Door Latch EMC-1-400ZN LH		1
11	NW36723	NS001927	Left Door Outside Handle TM1197337		1
12	39992-16	NS004323	Left Door Aluminum Slider Assembly 64-7812L		1
13	NW36722	NS001926	Inside Door Paddle Handle EMS249ZN		2
14	43018	NS003375	Door Gasket TL4100 B3X.06, 143”LG		2
15	NW035744-40	NS006633	Door Edge Trim Trim-Loc Edge Molding		2
16	NW035744-41	NS006062	Door Latch Chain, Sash Type		2
17	NW035744-42	NS006061	Door Latch Link		2
18	NW035744-43	NS006634	Door Latch Mech Cover		2
19	NW035744-44	NS003380	Window Gasket, AS1615		A/R
20	NW035744-45	NS006069	Foam Insulation 3/4 Black Perforated		A/R

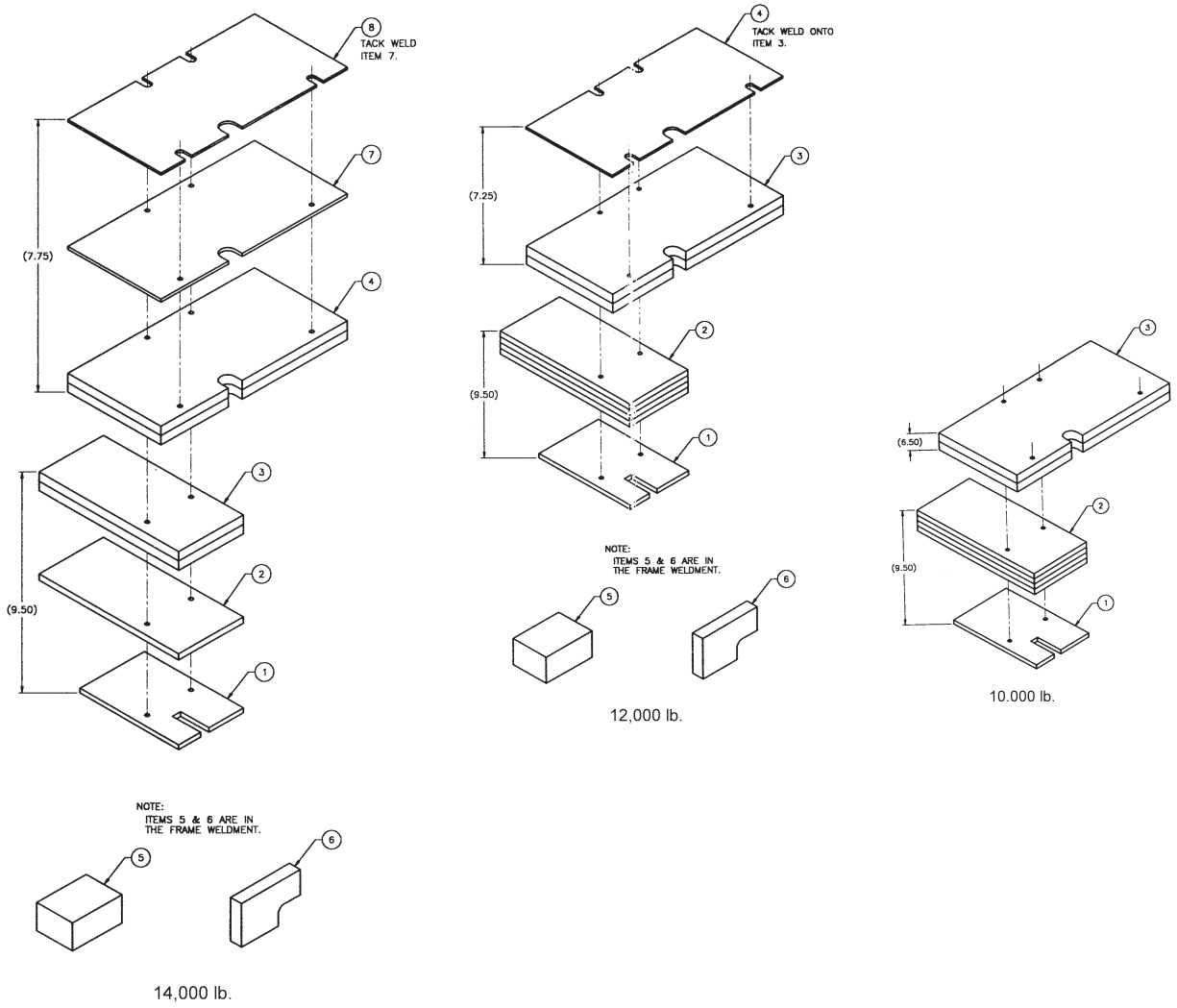


FIGURE 35.
COUNTERWEIGHTS
(1 OF 2)

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
35-	42635		Counter weights (8,000 DBP)		Ref
1	38719		CWT, Base, 140 Comm		1
2	38463		CWT, 8 x 23.5 x 51.75		1
3	38695		CWT, 3 x 34 x 68		1
NS	F16241		Flat Washer 3/4		8
NS	NW34461		HHCS 3/4-10 x 10 GR		2

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
35-	43944		Counterweights (10,000 DBP)		Ref
1	38719		CWT, Base, 140 Comm		1
2	38463		CWT, 8 x 23.5 x 51.75		1
3	38695		CWT, 3 x 34 x 68		1
NS	F16241		Flat Washer 3/4		8
NS	NW34461		HHCS 3/4-10 x 10 GR		2

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
35-	43945		Counterweights (12,000 DBP)		Ref
1	38719		CWT, Base, 140 Comm		1
2	38463		CWT, 8 x 23.5 x 51.75		1
3	38409		CWT, 6.5 x 34 x 68, STL		1
4	38718		CWT, Top, .75 x 34 x 68, STL		1
NS	F16241		Flat Washer 3/4		8

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
35-	43946		Counterweights (14,000 DBP) Ford or Turbo Only		Ref
1	38719		CWT, Base, 1.5 x 23.5 x 36, STL		1
2	40099		CWT, 2 x 23.5 x 51, STL		1
3	40100		CWT, 3 x 23.5 x 51 Lead		2
4	40102		CWT, 3 x 34 x 68, Lead		2
7	40101		CWT, 1 x 34 x 68, STL		1
8	38718		CWT, Top, .75 x 34 x 68, STL		1
NS	F16241		Flat Washer, 3/4		8

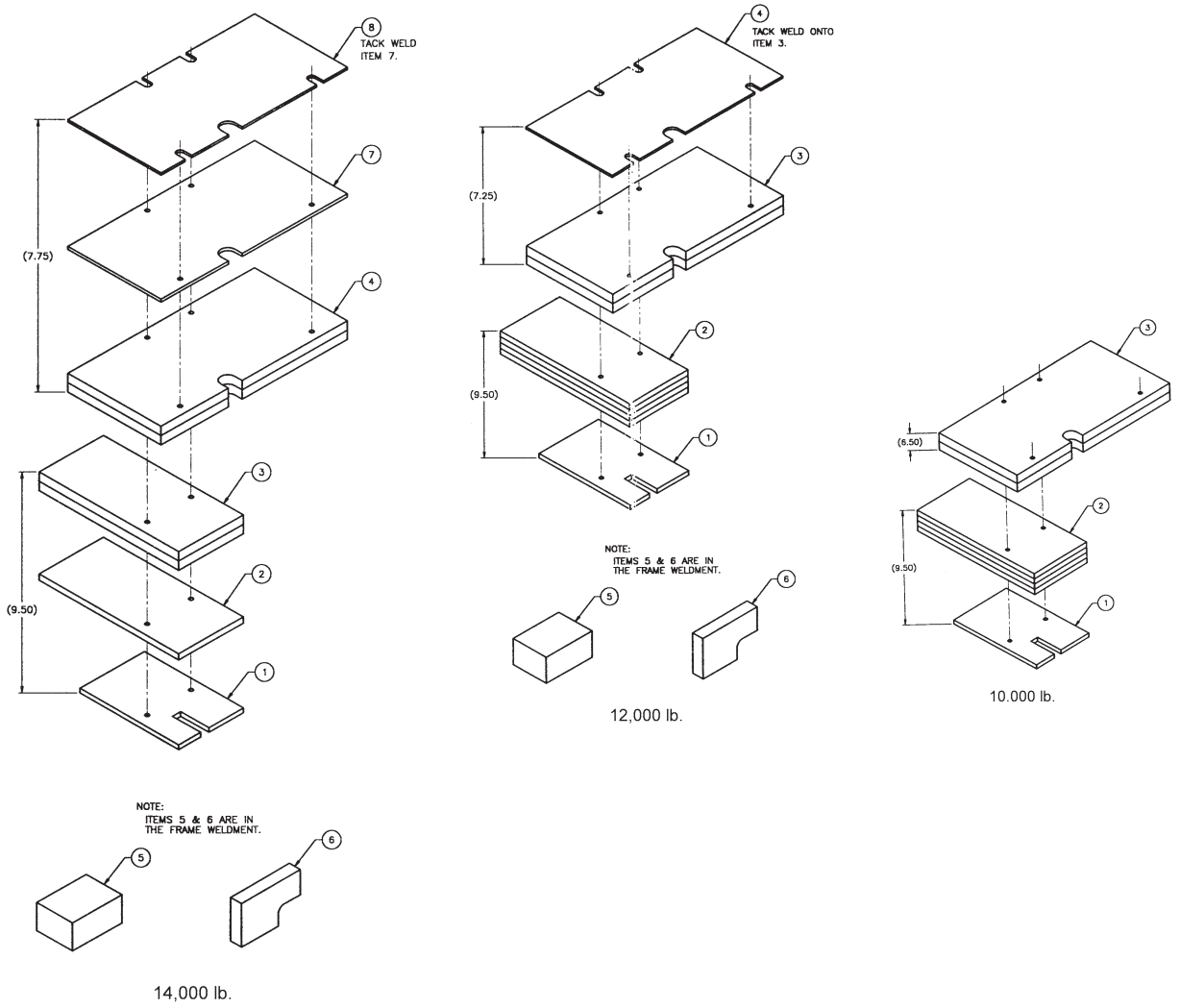


FIGURE 35.
COUNTERWEIGHTS
(2 OF 2)

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
35-	40041		Counterweights, Tires & Lead, 14,000# DBP, Option, 2 of 2		Ref
2	40099		CWT, 2 x 23.5 x 51, STL		1
3	40100		CWT, 3 x 23.5 x 51 Lead		2
4	38718		Counterweight, Top Plate, 3/4 x 34 x 68		1
7	40101		Counterweight, 1 x 34 x 68		1
8	40102		Counterweight, 3 x 34 x 68, Lead		2
NS	38622		Cover, Counterweight, LH		1
NS	38665		Cover, Counterweight, RH		1
NS	38452		Tire, 215/75R17.5, 16-ply		4

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
35-			Com mon Frame Weights		REF
5	38661		CWT, 9 x 13 x 18, STL		2
6	38446		CWT, 4 x 14 x 21.62, STL		2

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
35-	38834		Counterweights, Option		Ref
1	38661		Counterweight, 9 x 13 x 18		2
2	38466		Counterweight, 4 x 14 x 21.62		2
3	38409		Counterweight, 6.50 x 34 x 68		1
4	38718		Plate, Counterweight Top, 3/4 x 34 x 1.50		1
5	38662		Cover, Counterweight, LH		1
6	38665		Cover, Counterweight, RH		1

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
35-	43565		Counter weights 1414, 37” Rear Height, Option		Ref
1	43806		CWT, Base, 1.5 x 23.5 x 36		1
2	43804		CWT, 2 x 23.5 x 51, STL		1
3	43805		CWT, 3 x 23.5 x 51 Lead		2
4	40102		CWT, 3 x 34 x 68, Lead		1
5	38661		CWT, 9 x 13 x 18, STL		2
6	38466		CWT, 4 x 14 x 21.62, STL		2
7	40101		CWT, 1 x 34 x 68, STL		1
8	38718		CWT, Top, .75 x 34 x 68, STL		1

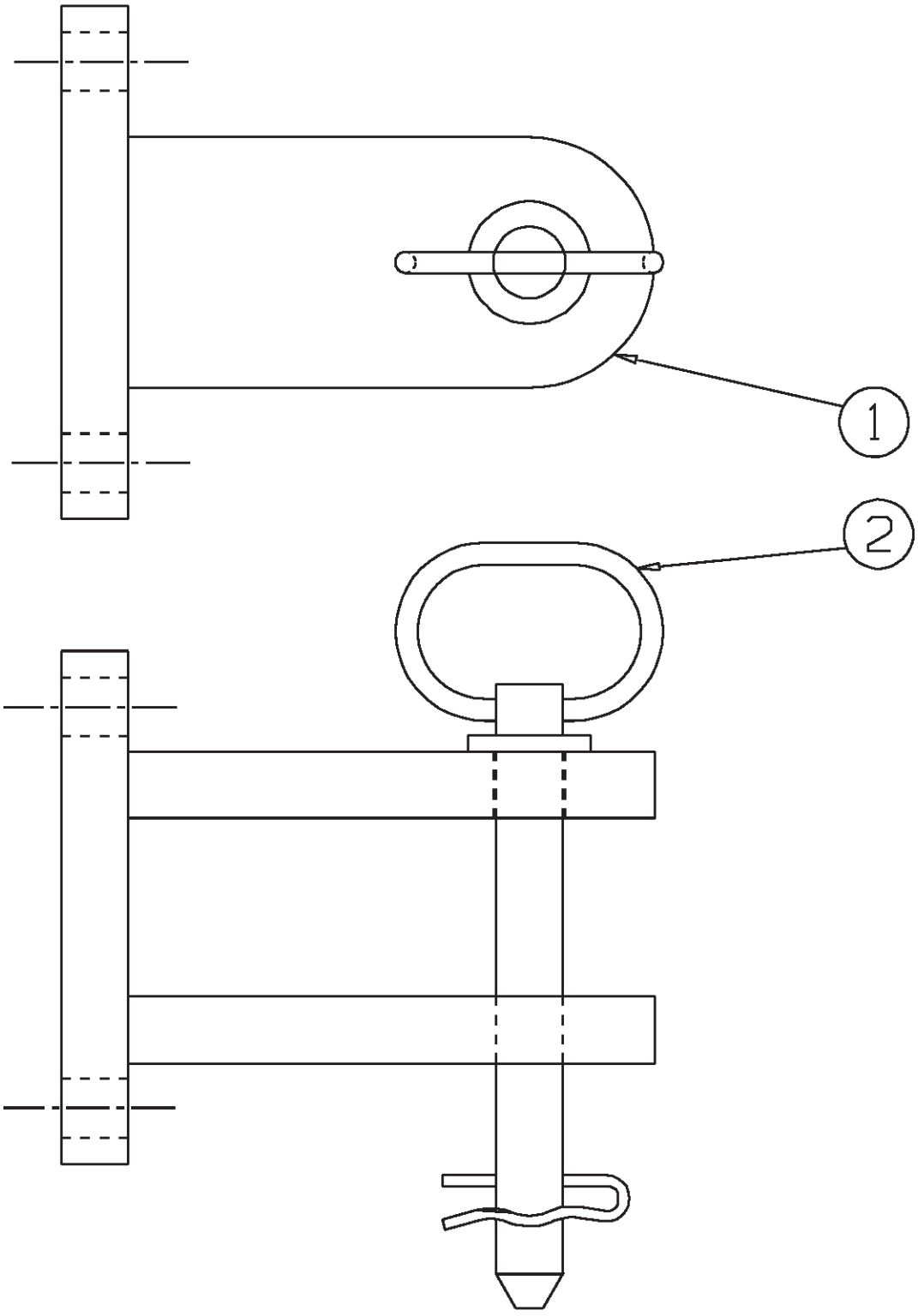
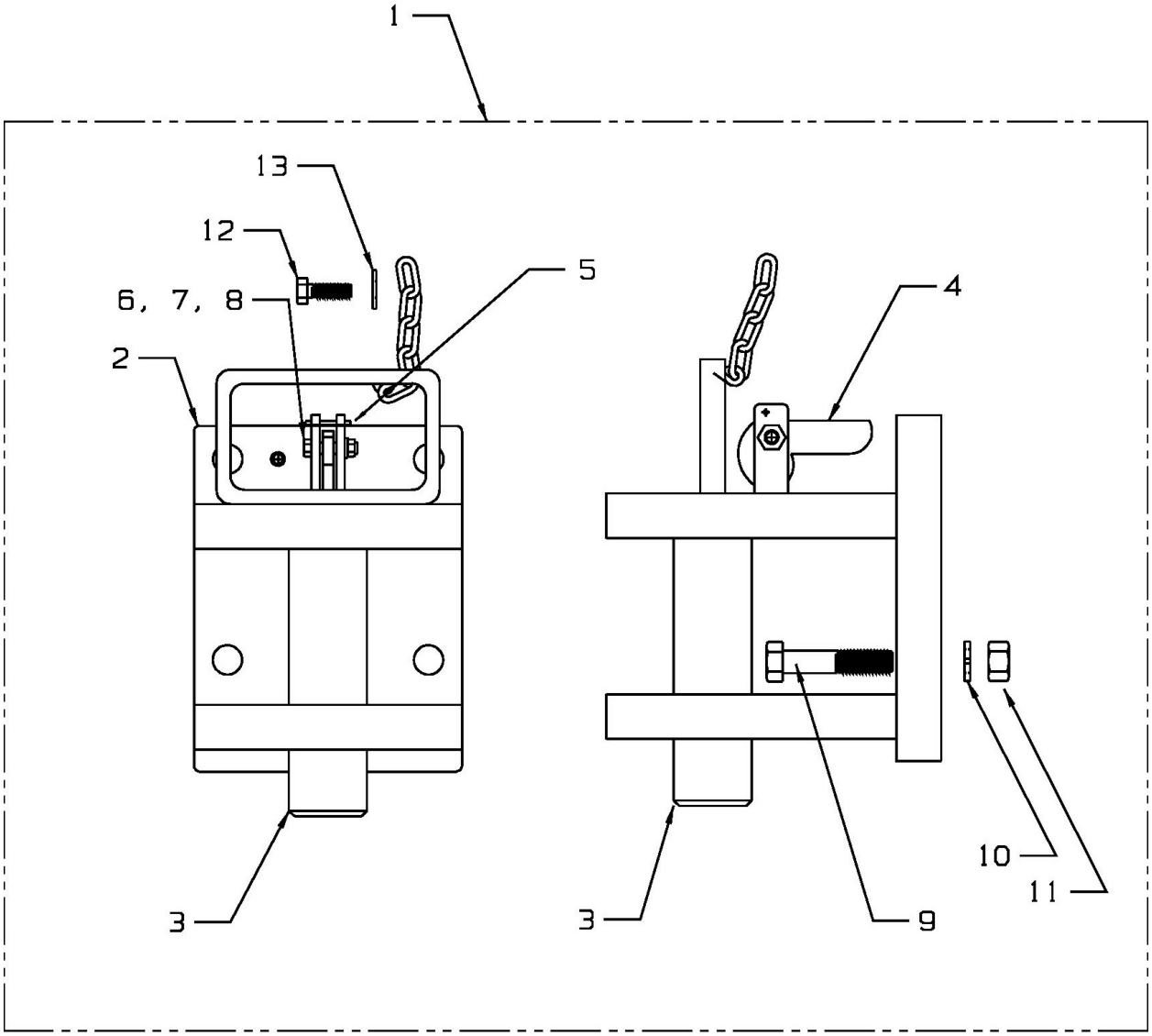


FIGURE 36.
HITCH ASSEMBLY, PIN & EYE

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
36-	38296		Hitch Assembly, Pin & Eye, .75”		Ref
1	38378		Hitch Weldment		1
2	38381		Pin, Hitch		1



SINGLE LEVEL ILLUSTRATED

FIGURE 37.
HITCH, PIN & EYE COUPLER, OPTION

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
37-			Hitch, Pin & Eye Coupler, Option		Ref
1	NW027323E		Hitch, Pin & Eye Coupler 2.25 (Front)		1
	40016		Hitch, Pin & Eye Coupler 2.00 Diameter		1
	38072		Hitch, Pin & Eye Coupler 1.75 Diameter		1
	38743		Hitch, Pin & Eye Coupler 1.50 Diameter		1
	38130		Hitch, 2 Level, 2.25		1
2	NW029846		Weldment, Coupler for 2.25 Pin		1
	40093		Weldment, Coupler for 2.00 Pin		1
	38073		Weldment, Coupler for 1.75 Pin		1
	38744		Weldment, Coupler for 1.50 Pin		1
	38227		Weldment, Coupler, 2.25 for 38130		1
3	NW029842		Pin Weldment 2.25 Diameter		1
	40095		Pin Weldment 2.00 Diameter		1
	38075		Pin Weldment 1.75 Diameter		1
	38746		Pin Weldment 1.50 Diameter		1
	38229		Pin Weldment, 2.25 for 38130		1
4	NW034993		Lever, Safety Catch		1
5	NW035901		Roll Pin		1
6	F017264		HHCS, 1/4-20 x 1, GR5		1
7	F009704		Flat Washer, 1/4		1
8	F009536		Nut Hex, 1/4-20		1
9	F018937		HHCS, 5/8-11 x 2-1/2, GR 8		4
10	F016829		Lock Washer, 5/8		4
11	F100002		Nut Hex, 5/8-11, GR 8		4
12	F100378		HHCS, 5/16-18 x 1, GR5		1
13	F100061		Flat Washer, 5/16, SAE, ZP		1

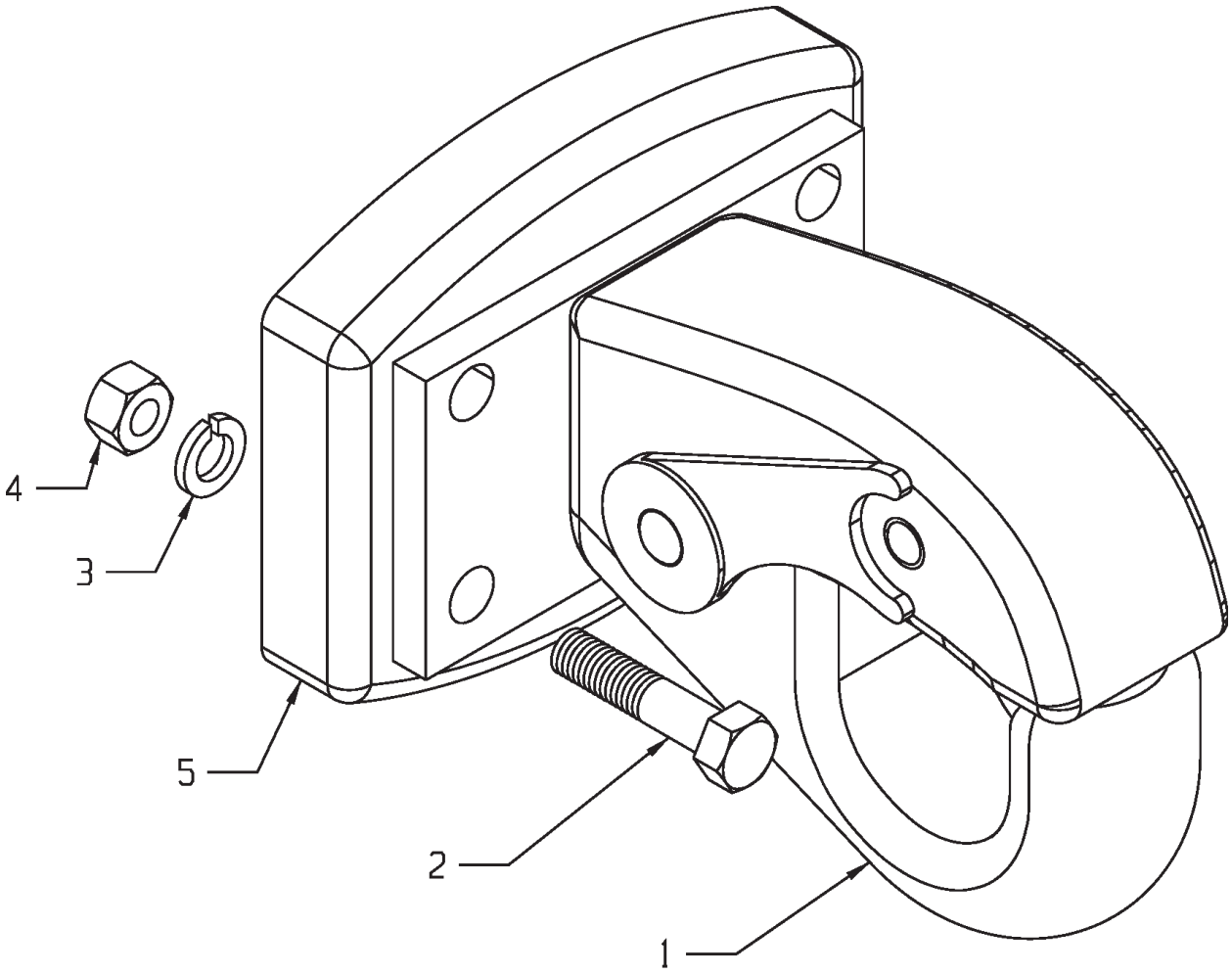


FIGURE 38.
HITCH, COUPLER, PINTLE HOOK, OPTION

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
38-			Hitch, Pintle Hook, Option		Ref
1	NW024110E		Hitch, Coupler, Pintle Hook		1
2	203194		HHCS, 1/2-13 x 2.50 GR 8		4
3	F015973		Lock Washer, 1/2		8
4	F016825		Hex Nut, 1/2-13, GR 8		4
5	NW034352		Plate, Hitch Extension		1

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
38-	43217		Hitch, Pin/Eye, .69 Diameter, Option		Ref
1	43216		Hitch, Spring Load, .69 dia		1
2	F100272		HHCS, 1/2-13 x 1-1/4		4
3	F015973		LW 1/2 Reg		8
4	F016825		Nut Hex 1/2-13 Full GR8		4
5	NW034352		Plate, Adapter, Holland		1
NS	F100357		HHCS, 1/2-13 x 2.25 GR8		4

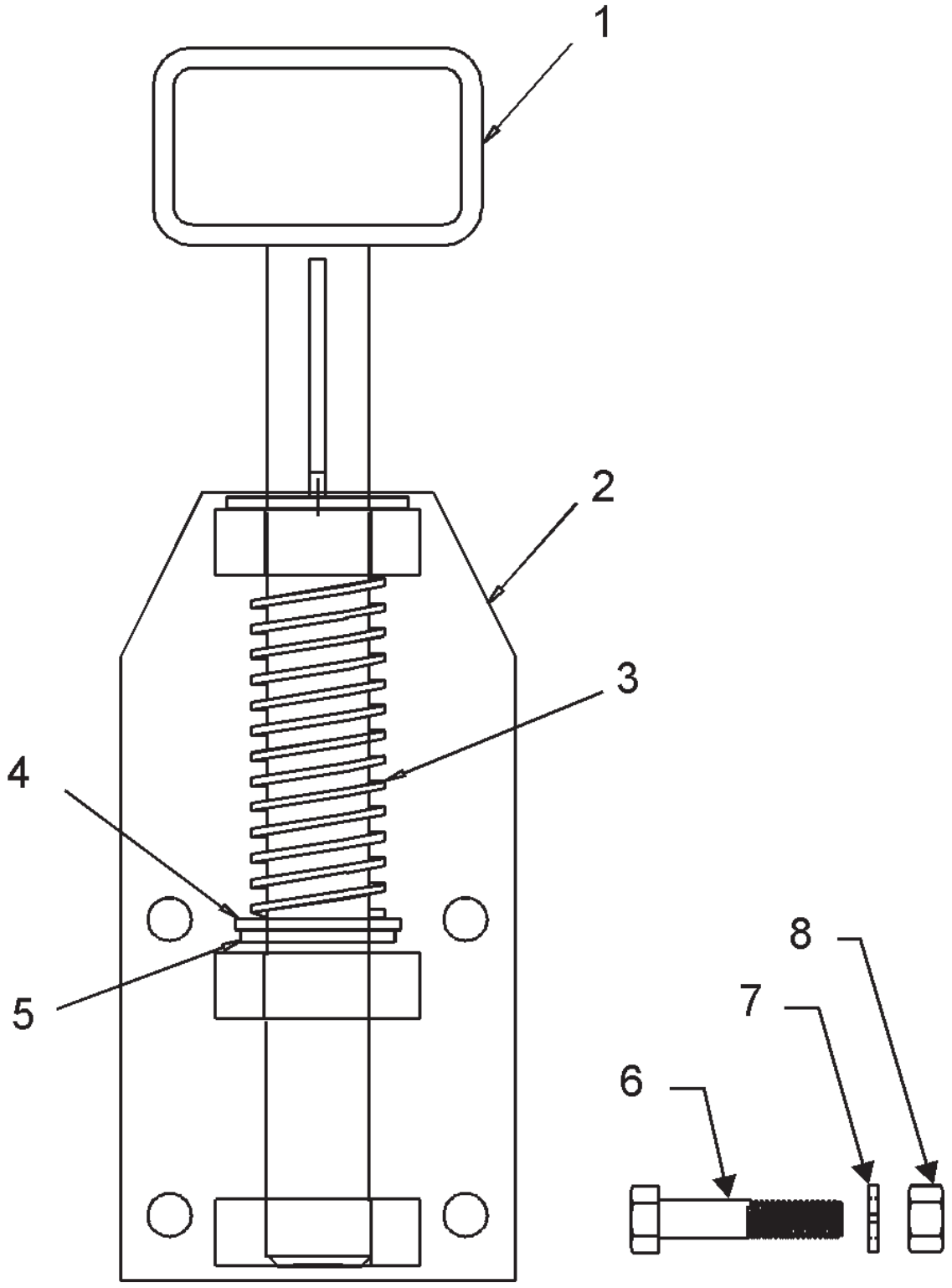


FIGURE 39.

HITCH, PIN/EYE, SPRING-LOADED, OPTION

Fig.-Item	NMC Wollard Part No.	Nomenclature	Eff	Units Per Assy
39-	39138	Hitch, Pin/Eye, Spring-Loaded, Option		Ref
1	39140	Pin Assembly		1
2	39139	Hitch Weldment		1
3	39141	Spring		1
4	39487	Washer		1
5	SWXRP202	Pin		1
6	F016829	Lock Washer, 5/8		4
7	Comm	Nut, Hex, 5/8-11, GR8		4
8	Comm	HHCS, /58-11 x 3.00 GR8		4

Fig.-Item	NMC Wollard Part No.	Nomenclature	Eff	Units Per Assy
39-	38876	Hitch, Pin/Eye, Spring-Loaded, Optional		Ref
1	39131	Pin, Hitch, 1"		1
2	39129	Hitch, Spring-Loaded		1
3	39127	Spring		1
4	1008837	Pin, Roll		1
5	F013412	Flat Washer, 1.0 ID x 2.5 OD x 0.17		1
6	F016829	Lock Washer, 5/8		4
7	Comm	Nut, Hex, 5/8-11 GR8		4
8	Comm	HHCS, 5/8-11 x 3.00 GR8		4

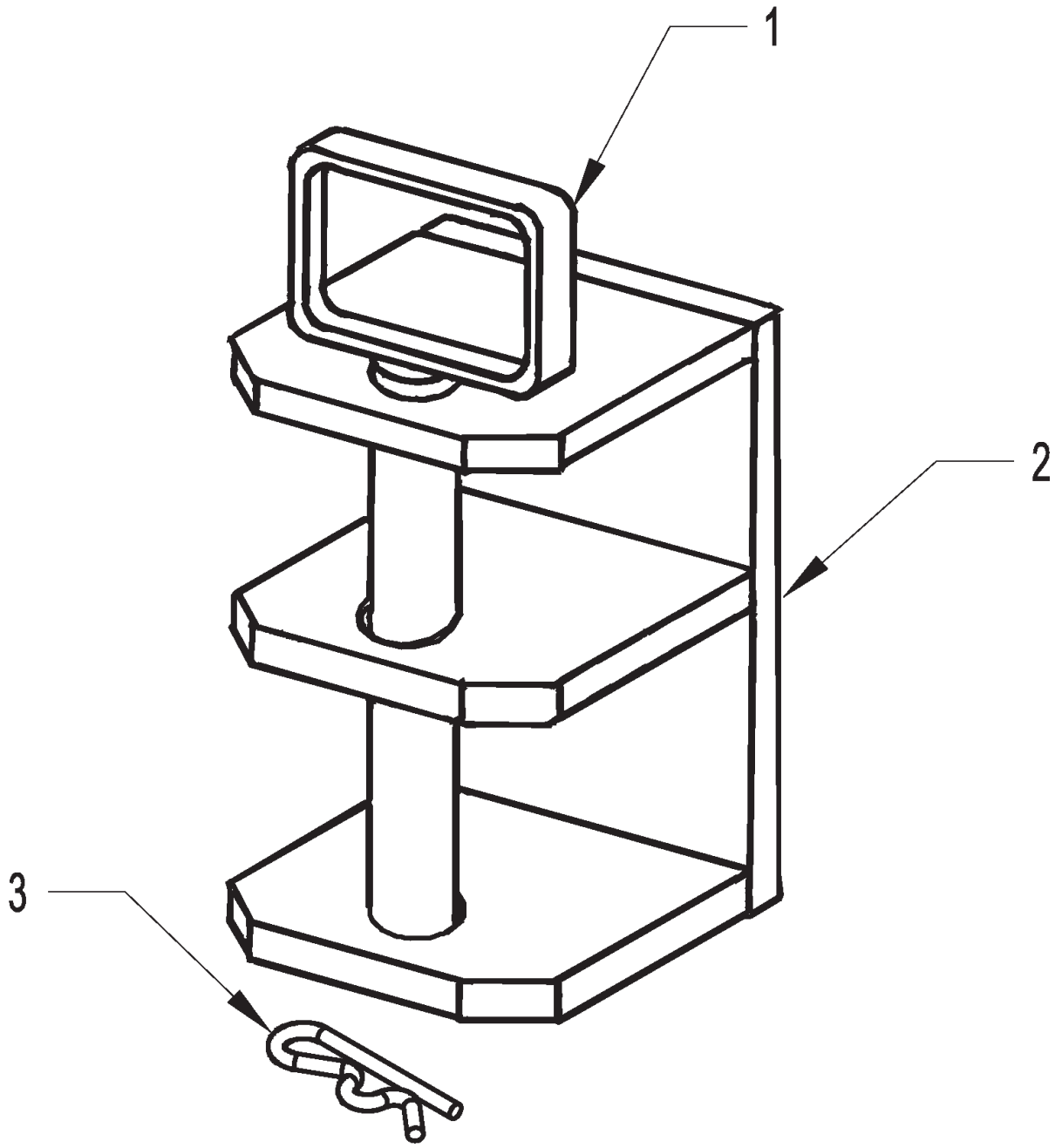


FIGURE 40.
HITCH, MULTI-LEVEL, REAR, OPTION

Fig.-Item	NMC Wollard Part No.	Nomenclature	Eff	Units Per Assy
40-	NW034019	Hitch, 3-Position Tow, 1.50” Pin, Option		Ref
1	NW034021	Pin, Weldment, Hitch, 3 Level		1
2	NW034020	Hitch, Weldment, 3 Level		1
3	151427	Clip, Hair Pin, #8		1

Fig.-Item	NMC Wollard Part No.	Nomenclature	Eff	Units Per Assy
40-	NW034727	Coupler, 2 Level, 1.50” Pin, Option		Ref
1	NW034725	Pin Weldment		1
2	NW034726	Hitch Plate Weldment		1
3	151427	Hair Cotter Pin		1

Fig.-Item	NMC Wollard Part No.	Nomenclature	Eff	Units Per Assy
40-	40307	Hitch, 2-Level, Option 2.0”		Ref
1	40308	Pin Weldment, Hitch, 2.00		1
2	40310	Hitch Weldment, 2.00 Diameter		1
3	151427	Clip, Hair Pin, #8		1

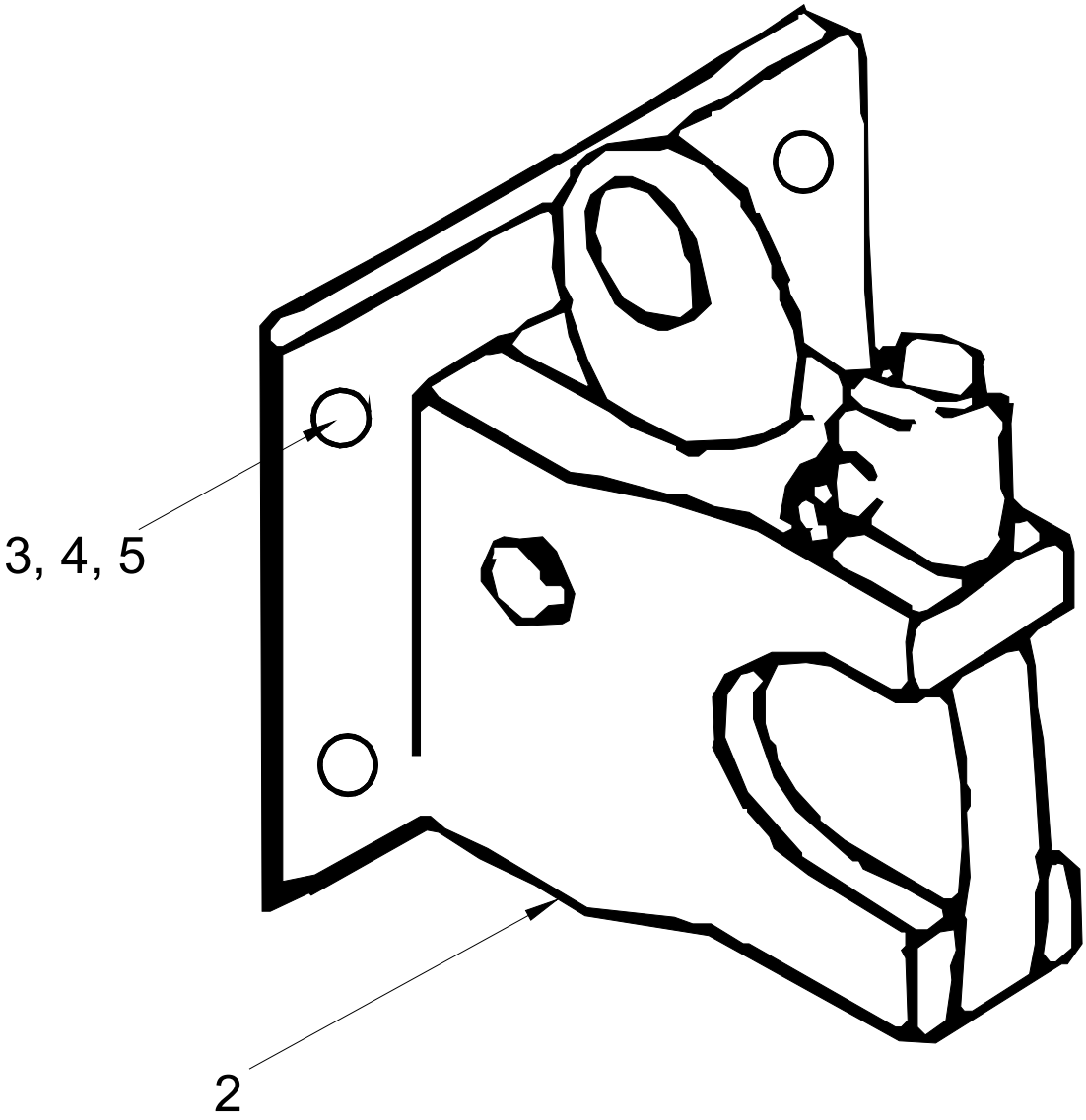
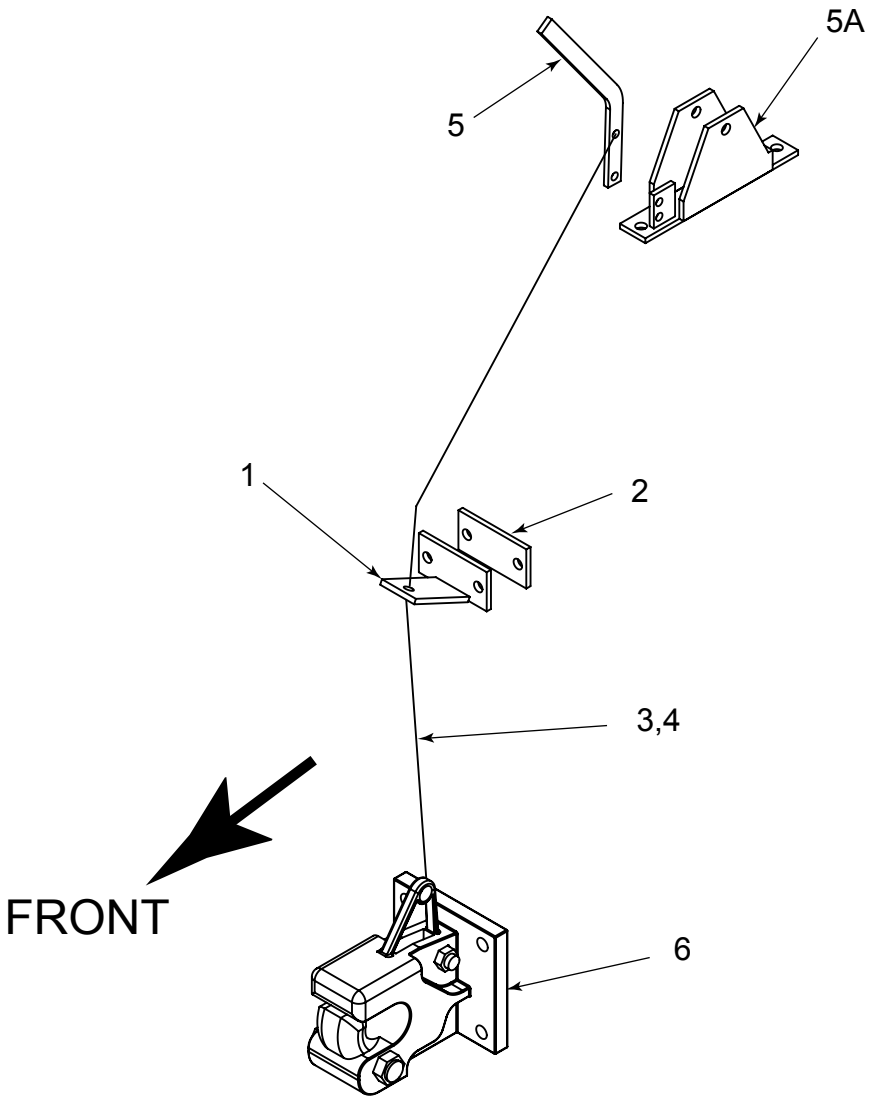


FIGURE 41.
HITCH, COUPLER KIT

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
41-	NW024626E		Hitch, Coupler Kit		Ref
2	F101889		Holland Coupler, 30,000#		1
3	Comm		Lock Washer, 5/8		4
4	Comm		Nut, Hex, 5/8-11 GR8		4
5	38852		HHCS, 5/8-11 x 3.00 GR8		4



Front shown rear typical

FIGURE 42.
HITCH, HOLLAND W/RELEASE

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
42-	39927		Hitch, Holland, w/Release, Rear		1
	40040		Hitch, Holland Cou pler w/Release, Front		1
	37915		Hitch, Holland Coupler Dual w/Release		1
NS	38154		Bracket, Weldment, Hitch Mount, For Dual Coupler		1
1	38183		Cable Mount Weldment		2
2	38186		Plate, Backing, Front		1
3	SW2H2047		Cable, Hitch Release		2
4	165412		Clamp, Hold Down		2
5	39962		Handle Weldment, Hitch		1
5A	38189		Mount Weldment, Hitch Hand		1
6	F101889		Hitch, 30,000#		2
NS	NW33056		Clamp, Cable		4
NS	F100003		Nut, Hex, 5/8-18		4
NS	F016829		Lock Washer, 5/8		4
NS	F100331		HHCS 3/8-16 x 2.0		2
NS	122077		HHCS 5/16-18 x 2-1/2		4
NS	F100333		HHCS 1/2-13 x 3-1/2		1
NS	F100377		HHCS 3/8-16 x 0.75		2
NS	165412		Clamp, Hold Down		1
NS	F016824		Flat Washer 1/2, USS		6
NS	F013500		Nut Lock, 1/2-13 Ny lon		1
NS	F100304		HHCS 1/4-20 x 3/4		2
NS	F013588		Nut Lock, 1/4-20 Nylon		2
NS	F101865		Clip, U-Bolt, Zinc Plated		1
NS	F009547		Nut, Hex, 5/16-18		2
NS	303108		Grommet, 0.63ID, 0.88HD		1
NS	RF090523		Cable, .125 Diameter, Wire		20/hitch

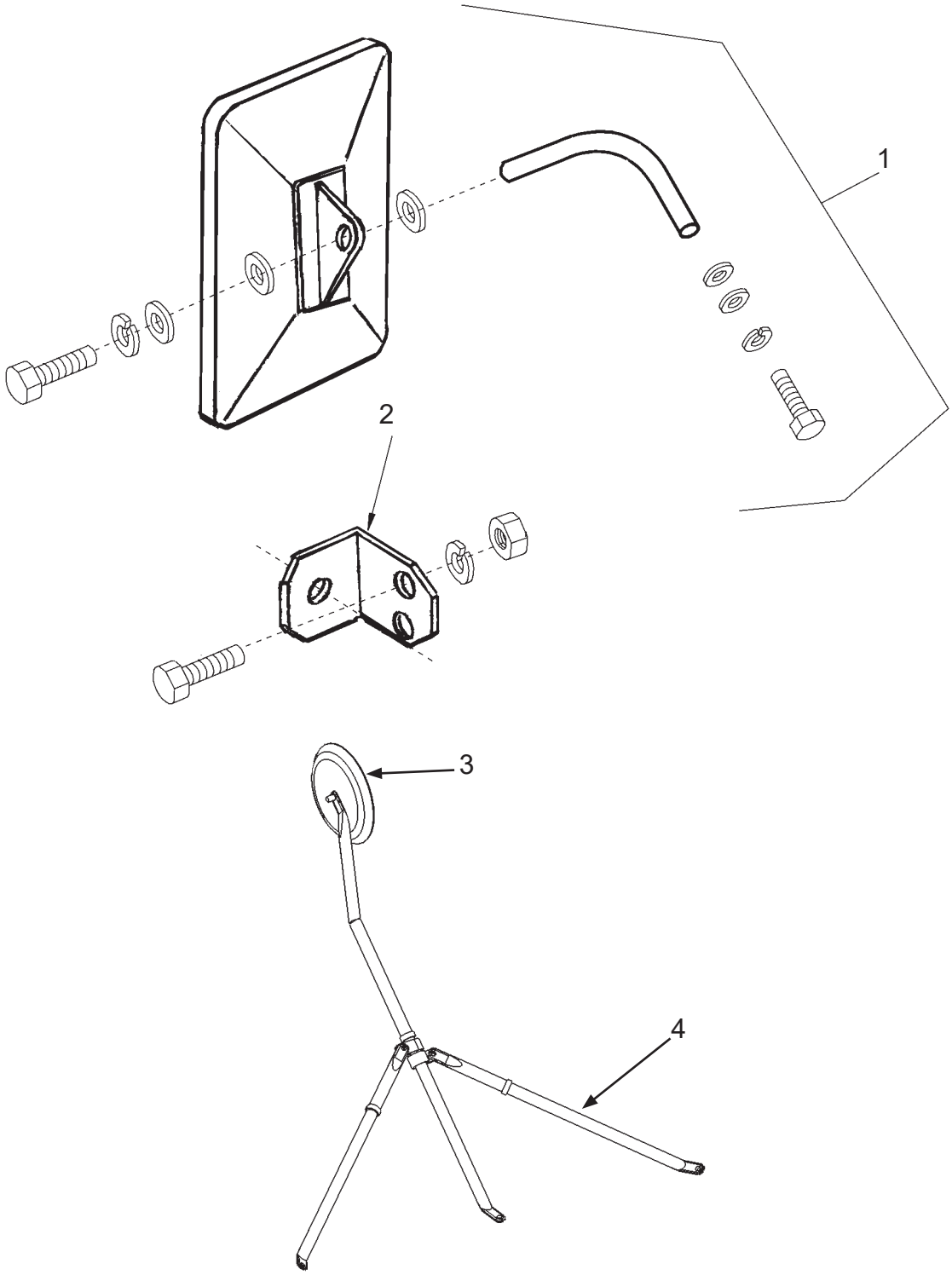


FIGURE 43.
MIRROR, OPTION

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
43-	NW035029		Mirror, Option		Ref
	50696		Mirror, Option		
1	NW20686		Mirror, Single		2
2	37292S		Angle, Mirror Mounting		2
	37292		Angle, Mirror Mounting (For 50696)		
NS	39986		Bracket, Mirror Mounting		1
NS	F100378		HHCS, 5/16-18 x 1 GR5		4
NS	F009546		Washer, Lock 5/16		4
NS	F009547		Nut, 5/16-18 X		4
NS	NW034546		THMS 1 1/4-20 x .75		2
NS	F009536		Nut, Hex 1/4-20		2
NS	F009535		Washer, Lock 1/4		2

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
43-	F101920		Mirror for Front Hitch, Option		Ref
3	40181		Head, 8.00” Mirror		1
4	40216		Bracket		1

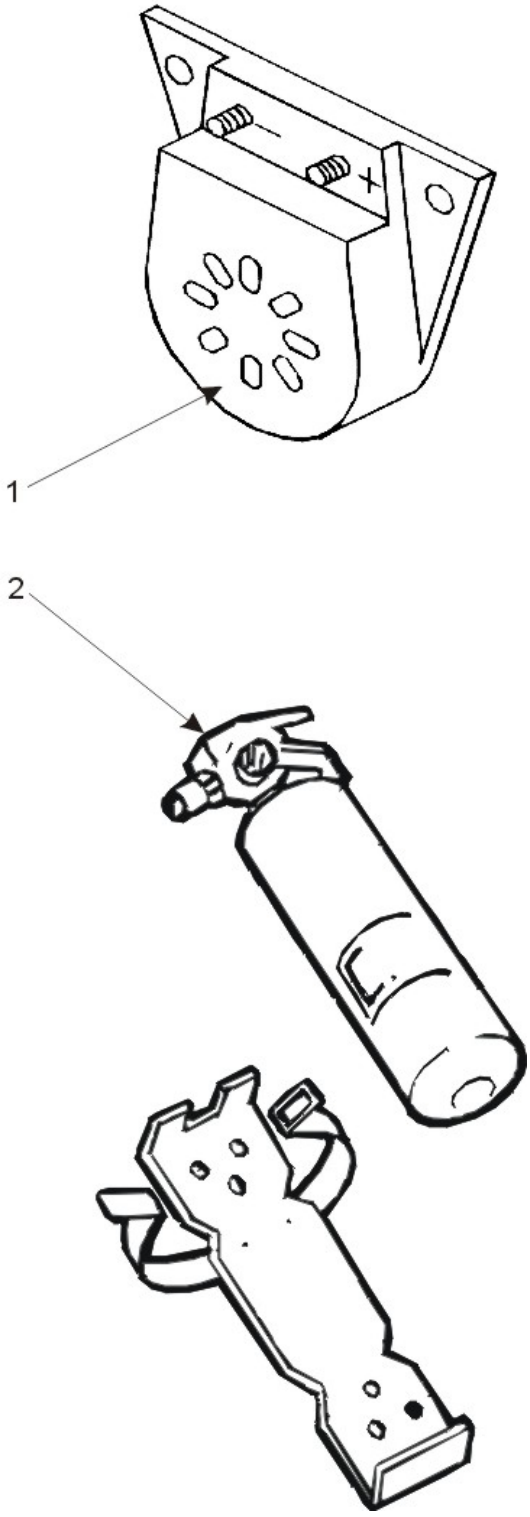


FIGURE 44.
BACK-UP ALARM, OPTION
FIRE EXTINGUISHER, OPTION

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
44-	NW024103E		Back-Up Alarm, Option		Ref
1	NW024637	LDA 50	Back-up Alarm (57013)		1
	F018975		HHCS, 1/4-20 x 1.25		2
	F009535		Lock Washer, 1/4		2
	F009536		Hex Nut, 1/4-20		2
	F100895		Terminal, Ring, 1/4		1
	F009792		Wire, 16 Ga. Yellow		70"
	F100522		Loom, 0.187 ID (Whitaker)		70"
	NW032329		Wire Assembly, Diode		1
	F101549		Connector, Body, Female, 1-way		1
	45537		Diode, 6 Amp		1
	F101552		Terminal, Male, 16-14		1
	F101548		Connector, Body, Male		1
	F101927		Terminal, Female, 18G		1
	NW030828		Tbg. Shrink 0.25, Blk		1
2	NW033236	A456 w/809 Brkt	Fire Extinguisher 10# (Optional) (North Star Fire Sys/Hannafin)		1
	33899		Fire Extinguisher 5# (Optional) (North Star Fire Sys/Hannafin)		1
	1.8786		Fire Extinguisher, 5#, ABC		1

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
44-	47268		Back-Up Alarm, Option	I	Ref
1	NW024637	LDA 50	Back-up Alarm (57013)		1
	F018975		HHCS, 1/4-20 x 1.25		2
	F009535		Lock Washer, 1/4		2
	F009536		Hex Nut, 1/4-20		2
	F100895		Terminal, Ring, 1/4		1
	F009792		Wire, 16 Ga. Yellow		70"
	2.3478		Loom, 0.25 ID (Flexguard)		70"
	F101549		Connector, Body, Female, 1-way		1
	46890		Diode, Harness		1
	F100846		Terminal, Ring #10		2
	F101549		Connector, Body, Female		1
	F101553		Terminal, Female		1

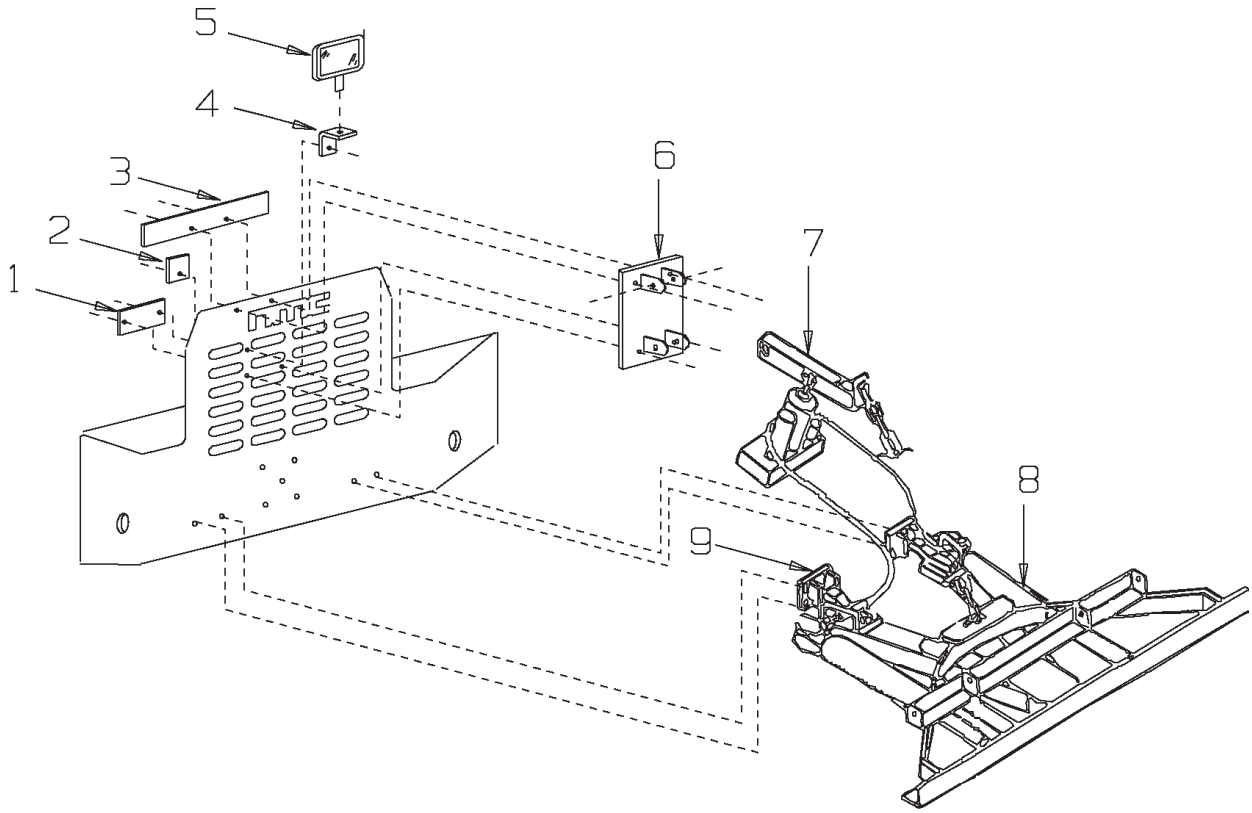


FIGURE 45.
SNOW PLOW, OPTION

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
45-	NW35728E		Snow Plow Option		Ref
1	40027		Plate, Back, Snow Plow Mount		1
2	40029		Plate, Back, Light Mounting		2
3	NW35737		Plate, Back, Cen ter Mounting		1
4	40028		An gle, Light Mounting		2
5	37734		Headlight		2
6	NW20940		Bracket As sem bly, Lift Snow Plow		1
7	NW20904		Lift and Controls		1
	NW24796		Arm		1
8	39086		A-Frame Assembly		1
9	NW35727		Mount ing Weldment, Lower		2
NS	NW20903		Mold board Assembly		1
NS	NW16220		FW 5/8 ID x 20 D x 1/4		4
NS	F100358		HHCS 1/2-13 x 2		2
	F100398		HHCS 1/2-13 x 2-3/4		2
	F016825		Nut Hex 1/2-13 Full		2
	F015973		LW 1/2 Reg		4

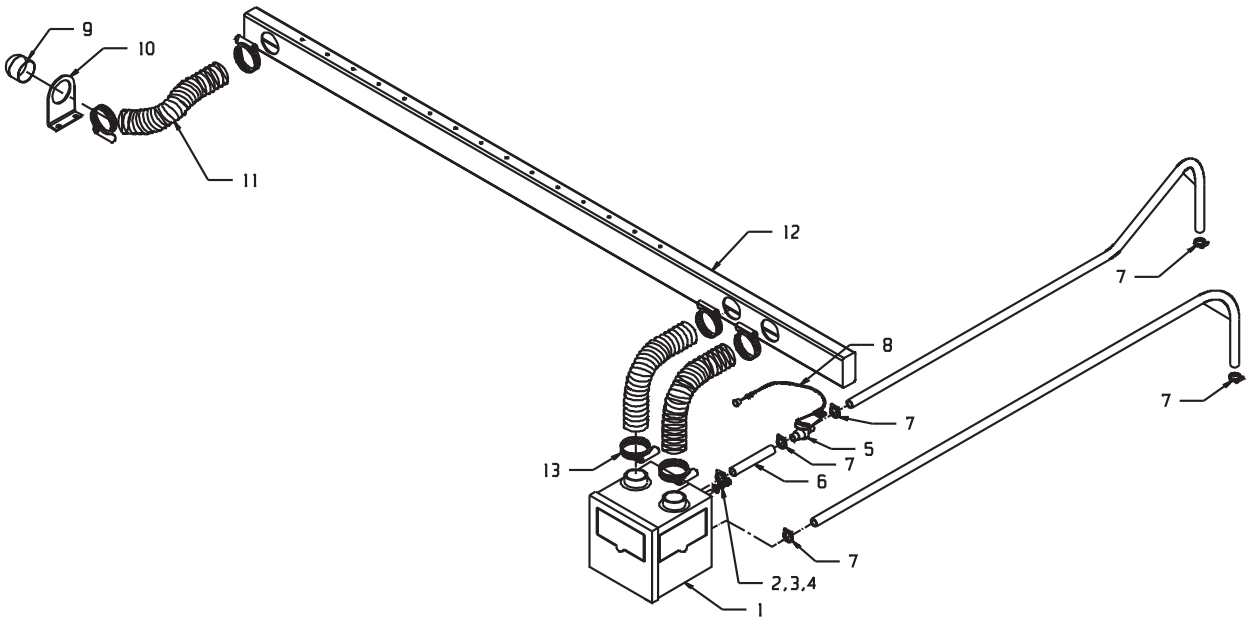


FIGURE 46.
HEATER/DEFROST 140 D, OPTION

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
46-	NW016196		Heater, Evans		1
1	NW016196		Heater, Evans		1
2	F009546		Washer, 5/16 Lock		3
3	F009549		Washer, 5/16 Flat		12
4	F011487		Nut 5/16-24 Hex		3
5	NW023205		Valve, Heater Con trol		1
6	NW021634		Hose, .62IDx.90 OD		76”
7	F101156		Clamp #12 Hose		5
8	NW022828		Cable, Control		1
9	37206		Louver, 2” Ball		1
10	37333		Bracket, Louver		1
11	F101685		2” ID Flex		46”
12	40122		Tube Wldmt, Defroster		1
13	F100937		Clamp, #28 Hose		6
NS	200084		Fuse, 20A/32V,ATC		1
NS	46677		Wire Assy, Heater		1
NS	39512		Hose, Heater, 5/8 90°, 36”		1
NS	37210		Resistor Asm, Heater		1
NS	NW035394		Switch, Rocker		1
NS	NW035395		Insert, Switch		1
NS	NW032352		Ftg, Hose, 08M-10F		2
NS	42814		Decal, Heater Temp		1

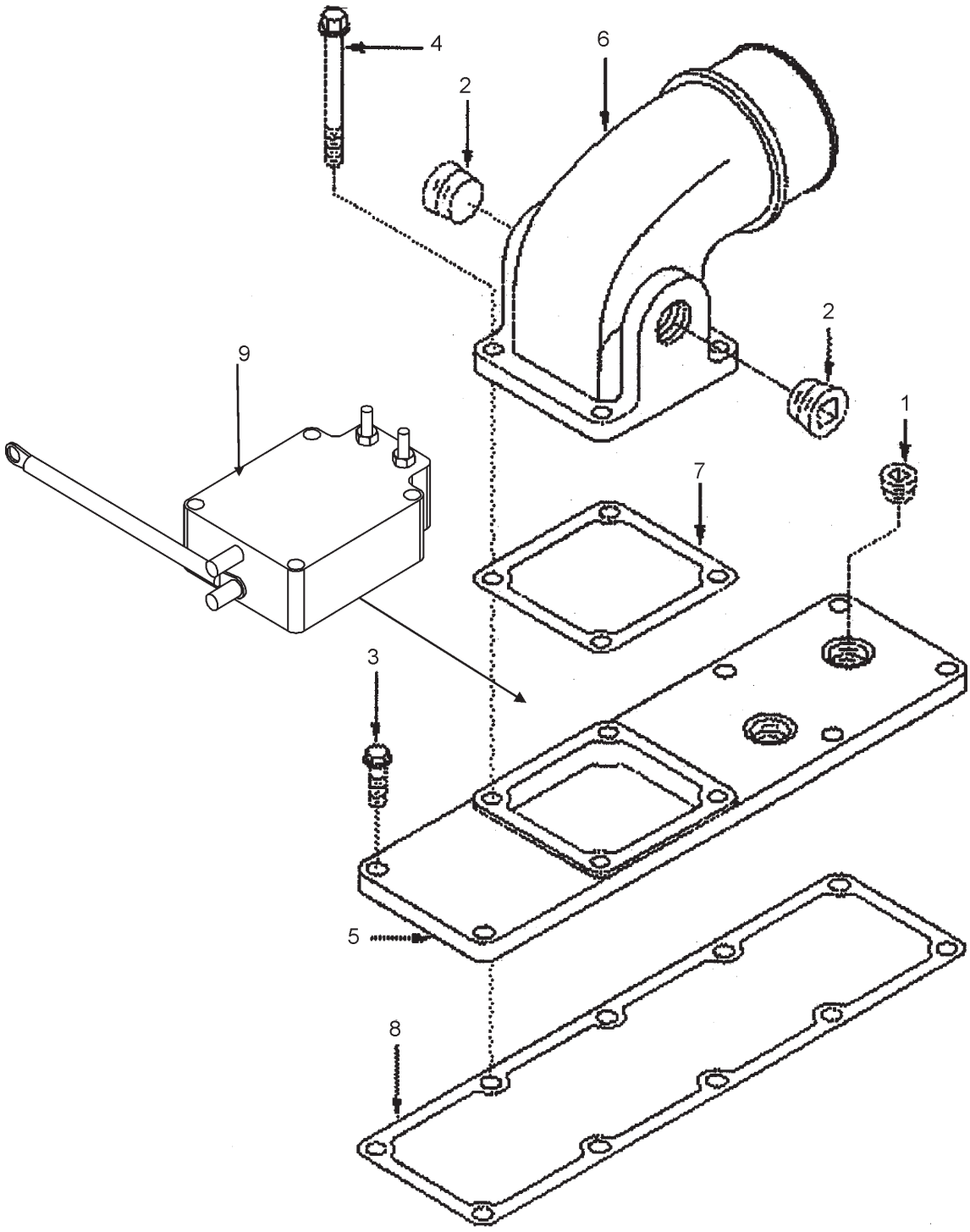
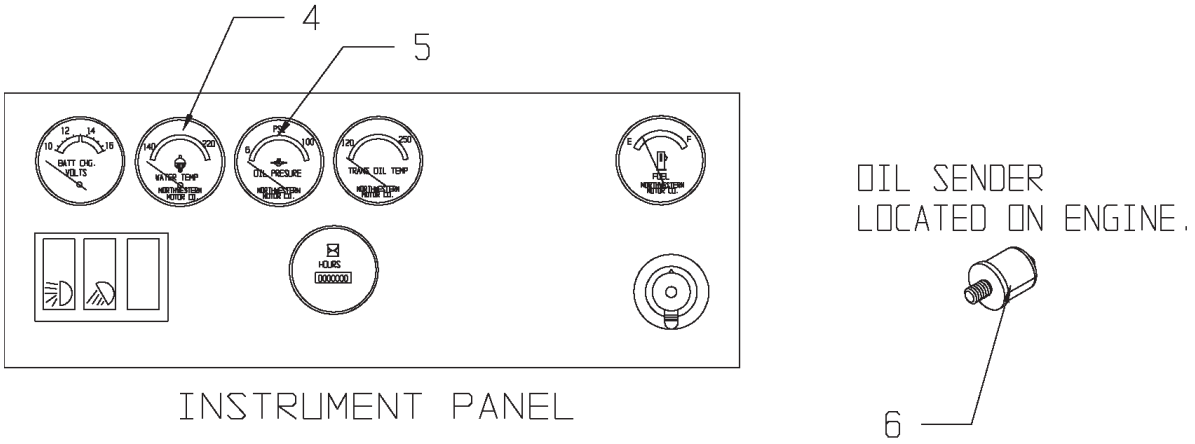


FIGURE 47.
AIR HEATER STARTING AID, OPT (CUMMINS)

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
47-			Air Heater Starting Aid Opt.		Ref
1		3008468	Plug, Pipe		2
2		3008469	Plug, Pipe		2
3		3918109	Screw, Hex Flange Head Cap		6
4		3919864	Screw, Hex Flange Head Cap		4
5			Cover, In take Manifold		1
6		3924990	Con nec tion, Air In take		1
7		3938153	Gas ket, Int Man i fold Cover		1
8			Gas ket, Connection		1
9		AH9044	Air Heater Starting Aid		1
NS	43145	120-901STANCO	RELAY,POWER,SPNO,12VDC/100A		1
NS	305006	AMG-125BUSSMA	FUSE,125A/48V,MEGA/AMG		1
NS	46650		BRKT,FUSE HOLDER,QSB4.5,M100		1
NS	46601	51204	ISOLATOR,STUD/PLATE MNT		1

Note: Requires 160 Amp Alternator



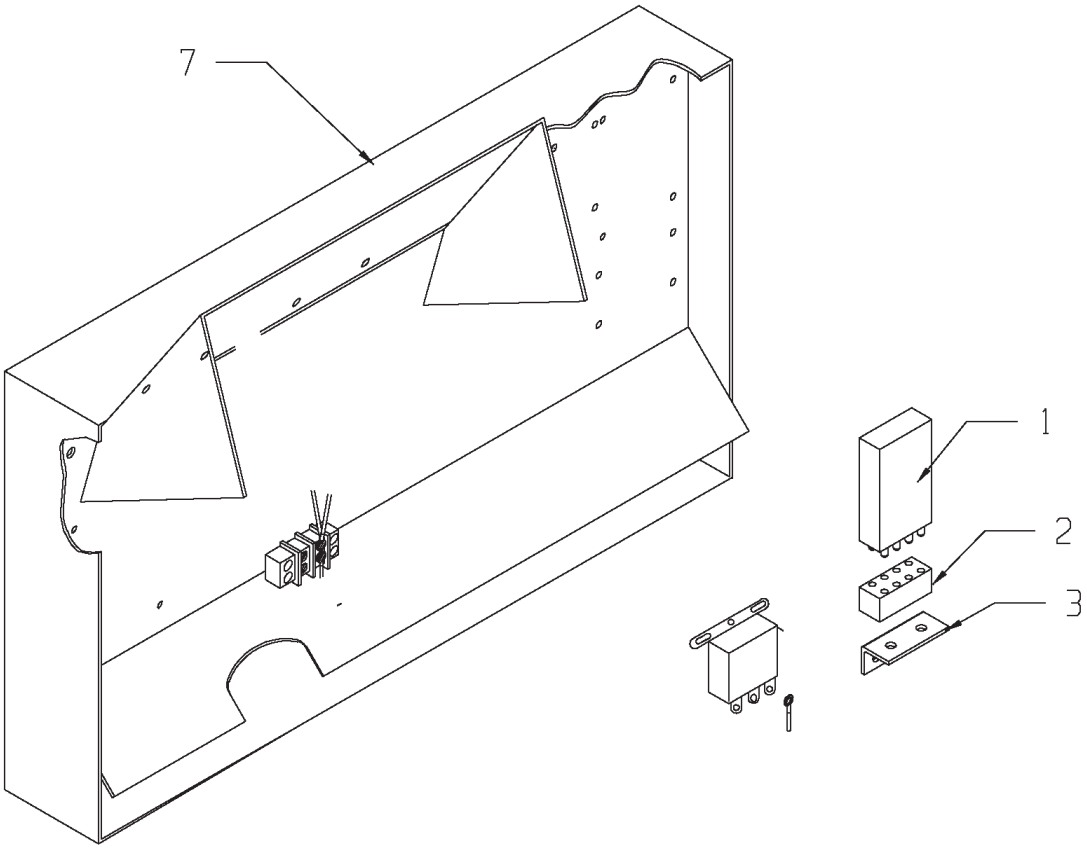


FIGURE 48.

SHUTDOWN, LOW OIL/HIGH TEMPERATURE

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
48-	43962		Shutdown, Low Oil / High Temperature		Ref
1	2.3010		Relay, TDM 12VDC		1
2	2.2441		Socket, Relay, 8-Pin		1
3	42165		Bracket, Relay		1
4	41401		Gauge, Water Temp, w/ Shutdown		1
5	41400		Gauge, Oil Press, 0-80psi Shutdown		1
6	42039		Sender, Oil Press, 0-80#, 1/8NPT		1
7	45426		Support Wldmnt, Rear Hood, AC		1

Illustration Not Available At Time Of Publication.

FIGURE 49.

ENGINE/TRANS ASSEMBLY, CUMMINS QSB4.5/AT

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
49-	46555		ENG/TRANS ASSY, CUMMINS QSB4.5/AT T3	D	1
	46555-1		ENG/TRANS/MNTG ASSY,QSB4.5/AT		1
	46555-2		LINKAGE SYS,M140,QSB4.5/AT		1
	46555-3		ELEC SYS,ENG,M140,QSB4.5/AT		1
	45309		EXHAUST SYS,M140,4BT4.5		1
	46550-5		AIR INTAKE SYS,M140,QSB4.5		1
	46555-6		COOLING SYS,M140,QSB4.5/AT		1
	46544		BATTERY SYS,M140 W/BOX,1000CC (SEE FIG 12)		1
	43974		FUEL SYS,M140,CUMMINS		1
	46482		PUMP ASSY,GEAR,4B4.5T3		1
	46550-9		HYD ASSY,M140,QSB4.5		1
	46743		PANEL ASSY,SIDE,M140,CMN,129"		1

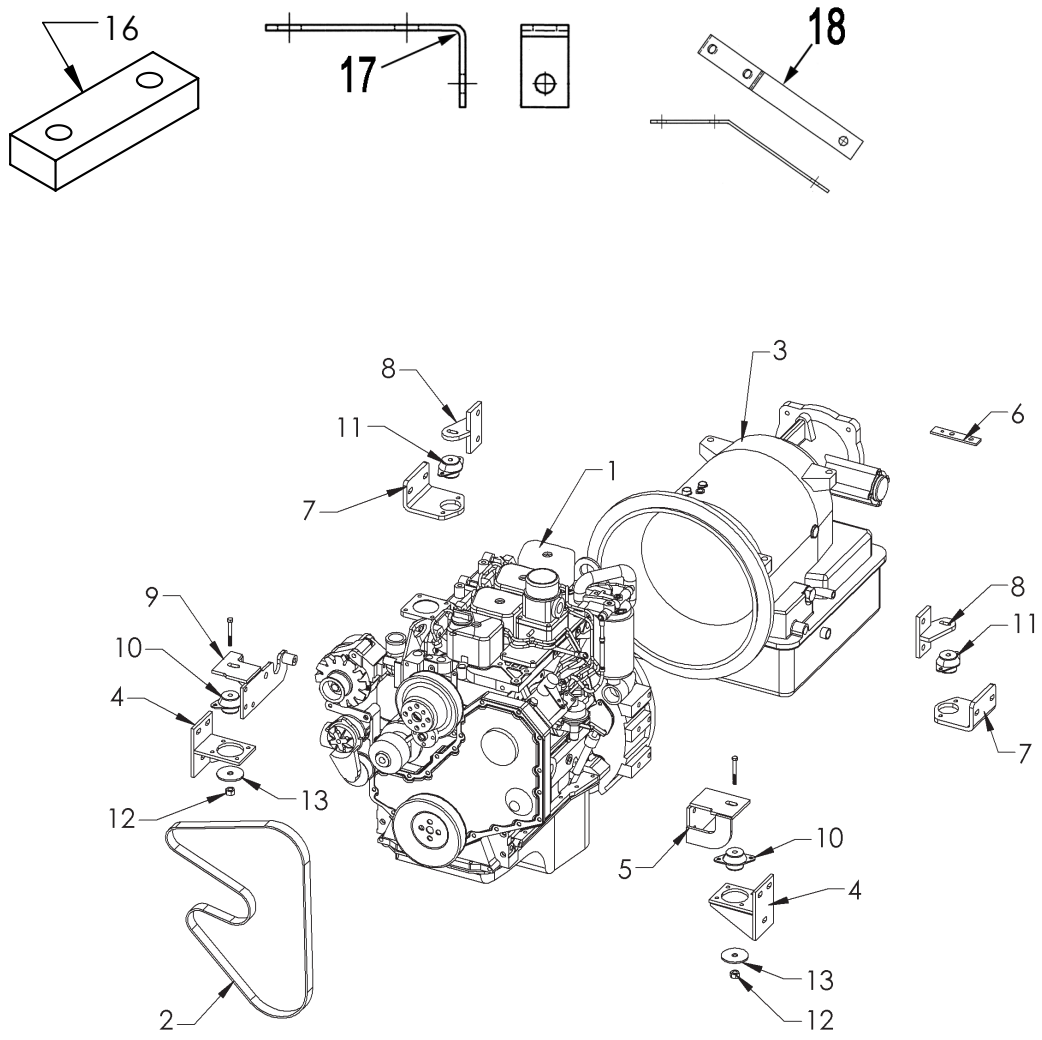


FIGURE 50.

ENGINE/TRANSMISSION MOUNTING, CUMMINS QSB4.5/AT

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
50-	46555-1		Eng/Trans/Mntg Assy,QSB4.5/AT		Ref
	53000-1		Eng/Trans/Mntg Assy,QSB4.5/AT		Ref
1	46070		Engine,Cummins,QSB4.5/AT,100/140		1
2			Belt, Engine		1
3	43443	29505029	Trans,AT545,2400RPM,Retrans		1
	53001		Trans, A2500, Allison	I	1
4	46451		Brkt Wld,Eng/Frame,LH,100,28"W		2
5	46453		Brkt Wld,Eng,LH,QSB4.5 Tier 3		1
6	46575		Brkt Wld,Trans/Frame,140,AT,RH		1
7	46576		Brkt Wld,Trans/Frame,140,AT,LH		1
8	43277		Brkt Wld,Trans,AT,LH,140		1
9	46454		Brkt Wld,Eng,RH,QSB4.5 Tier 3		1
10	37357	17/0566-60	Isolator,Rubber,Engine		2
11	38634	51508-5	Isolator,Rubber,Engine,White (V00512)		2
12	37537		Nut,Hex,5/8-18,Ctr Lock		2
13	37535		Fw,.66ID,3.12,OD,.19Thk		2
14	41450		Plate,Trans Dip Stick Mnt		1
15	41752		Brkt Wldmnt,Trans,AT,RH		1
16	42096		Spacer, Plate, Trans	I	1
17	46863		Brkt, Dipstick Trans	I	1
18	46864		Brkt, Dipstick, Engine	I	1
NS	46573		Driveshaft,15.75,1410,Slip,AT		1
NS	48079	3910128	Spacer, Fan		1
NS	48080	4932633	Connector, Air, CAC		1
NS	NW036490	F445	HHCS,M8 X 1.25 X 45,GR8.8		4
NS	NW036687		HHCS,M8 X 1.25 X 75 MM,G8.8		4
NS	42096		Spacer Plate, Transmission		1

Illustration Not Available At Time of Publication

FIGURE 51.

ENGINE REPAIR PARTS, CUMMINS QSB4.5, TIER III

Not Available At Time of Publication

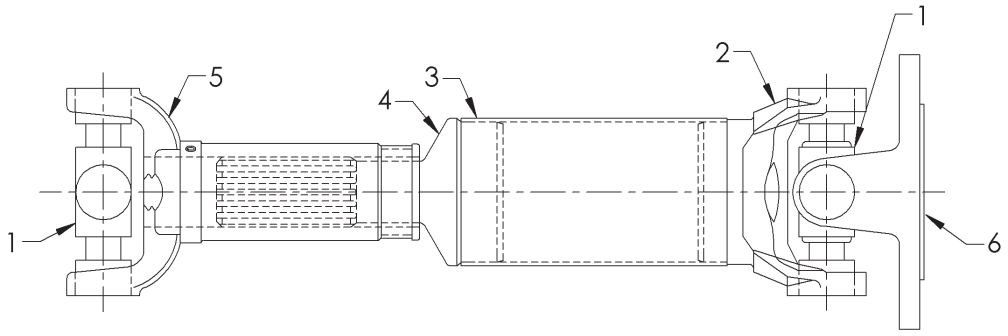


FIGURE 52.
DRIVESHAFT, CUMMINS QSB4.5/AT

Fig.-Item	NMC Wollard Part No.	Nomenclature	Eff	Units Per Assy
52-	46573	Drive Shaft 15.75, slip		Ref
1	NW033731	U-Joint		2
2	NW035885	Tube Yoke		1
3	42581.3	Tubing 3” OD x .083 W		1
4	NW035886	Slip Tube Shaft		1
5	NW034377	Slip Yoke		1
6	NW036223	Flange, Yoke		1

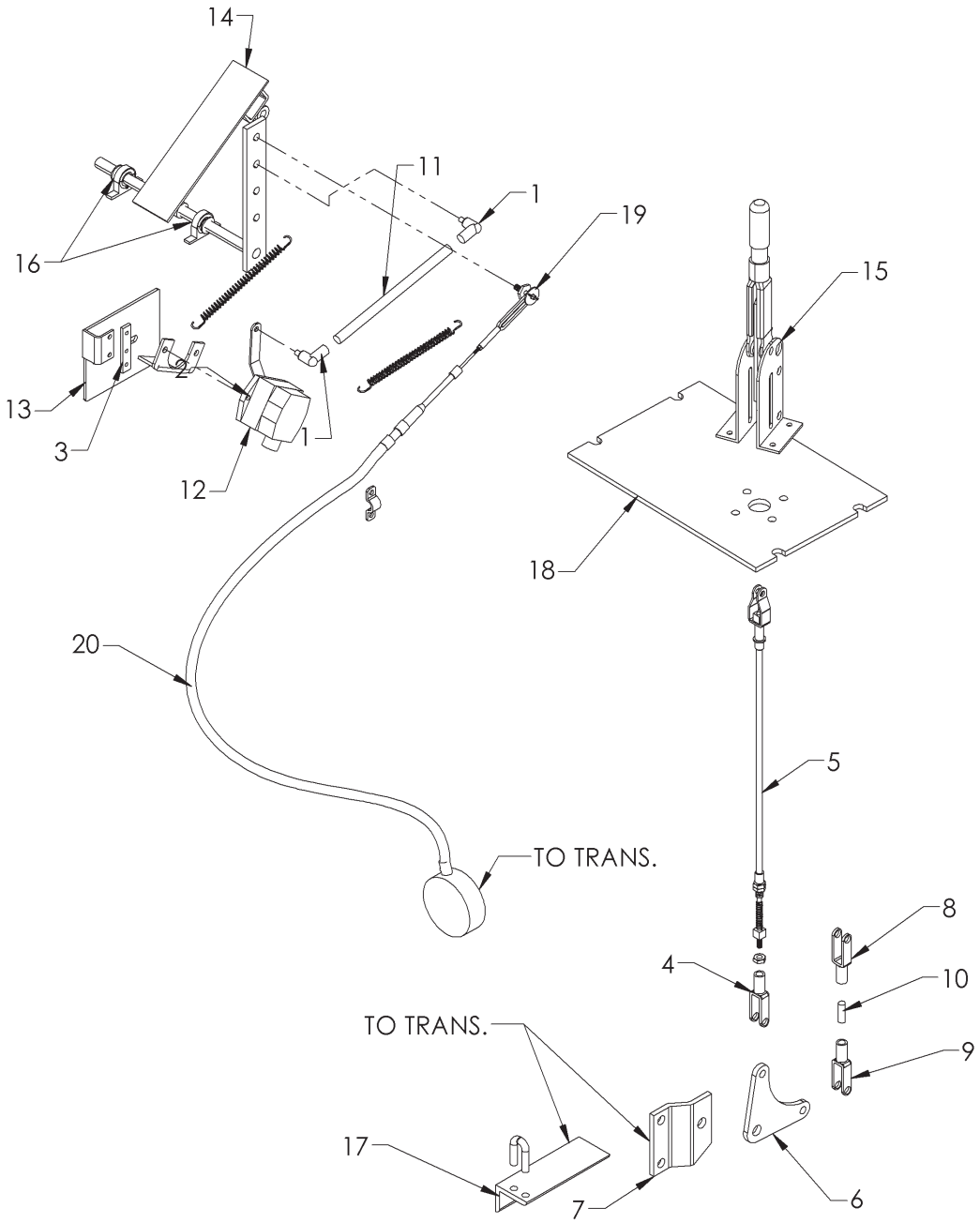


FIGURE 53.

LINKAGE SYSTEM, CUMMINS QSB4.5/AT

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
53-	46555-2		Linkage Sys, M140,QSB4.5/AT		Ref
	53000-2		Linkage Sys, M140, QSB4.5/AT		Ref
1	F101863	R107G	Ball Joint,ND,1/4-28,1/4-28ST (0NZJ1)		2
2	39924		Spring,Modulator Return		1
3	39925		Brkt,Spring Return *B*		1
4	90562	2803SS/CPC 2803	Clevis,3/8-24 X 3/8 Pin,w/Pin (29404)		1
5	NW034404	16651800	Cable Assy,Prk Brk,44.12",140		1
6	NW034469		Crank,Bell,Park Brk,140w/Allis		1
7	NW034470		Plate, Park Brake Brkt,140DPA		1
8	NW034889	C1TT-2857-L	Clevis, Park Brake,C6 Ford (39569)		1
9	NW034888	D3TZ-2857-A	Clevis, Park Brake (39569)		1
10	429902		Cut,4299, 0.52		1
11	406203		Cut,4062, 7.38		1
12	45357	TPS001	Sensor,Throttle Position,Cummins		1
13	46656		Brkt Wldmnt,Accel Sensor,M140		1
14	46636		Pedal Wldmnt, Accel		1
15	NW022767		Lever, Park Brake		1
	42460		Rubber Hose for Park Brake, Optional		1
16	NW015530	BDN8	Brg, 0.50 ID,w/Housing		2
17	NW034459		Angle, Anchor, Cable ,Park brake		1
18	38422		Park Brake Plate, Lever		1
NS	51606	FDM002	Pedal Wldmnt, Accel	I	1

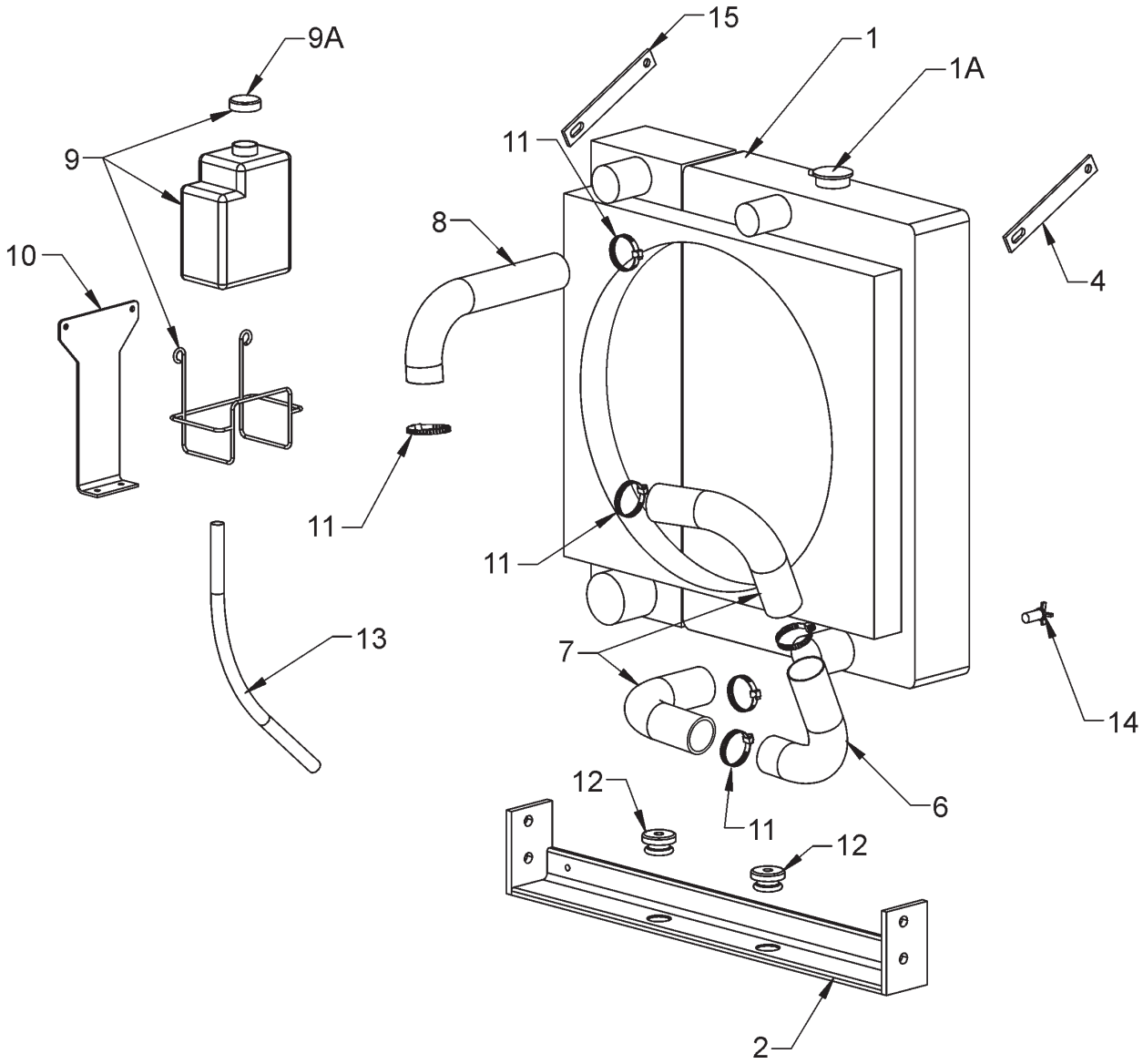


FIGURE 54.

COOLING SYSTEM, CUMMINS QSB4.5/AT

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
54-	46555-6		COOLING SYS,M140,QSB4.5/AT		1
1	46412	12932CP	RADIATOR/OIL/CAC ASSY,QSB4.5		1
1A			CAP, RADIATOR		1
2	46447		SUPPORT WLDMT,RAD,100/140,28"W		1
3	43459		ANGLE,MNTG,RADIATOR		2
4	46589		STRAP,RADIATOR MTG,TOP,140		1
5	46674		STRAP,RADIATOR MTG,140		1
6	46551		TUBE,RAD,W/I,100/140,QSB4.5,T3		1
7	45036	20172S	HOSE,RAD,LOWER,200MB4V2		2
8	37551	20057S	HOSE,RAD,1.75 X 12.25		1
9	44544	BVR-4	RESERVOIR,COOLANT OVERFLOW		1
9A	40164		CAP, RESERVOIR		1
10	44556		BRKT,COOLANT RESER VOIR		1
11	F101140	5732	CLAMP,HOSE,#32,1.56-2.50		6
12	203566	60230	ISOLATOR,RUBBER,BUSHING, CENTER		2
13	NW036097		CLIP,RE TAIN,RES HOSE *B*		1
13	NW031849		HOSE,RE COVERY,MODEL 1000 DP		1
14	F100669	46-086	VALVE,DRAIN COCK,1/4" NPT,BRS		1
NS	91930		FTG,HYD,08MJ-08MB90		1
NS	91926		FTG,HYD,08MJ-10MB90		2
NS	NW034365	848-FS-08X12	FTG,HYD,08MJ-12MP		2
NS	RF090504	K010-0507-100	TBG VI NYL 0.43 X 0.06W		62

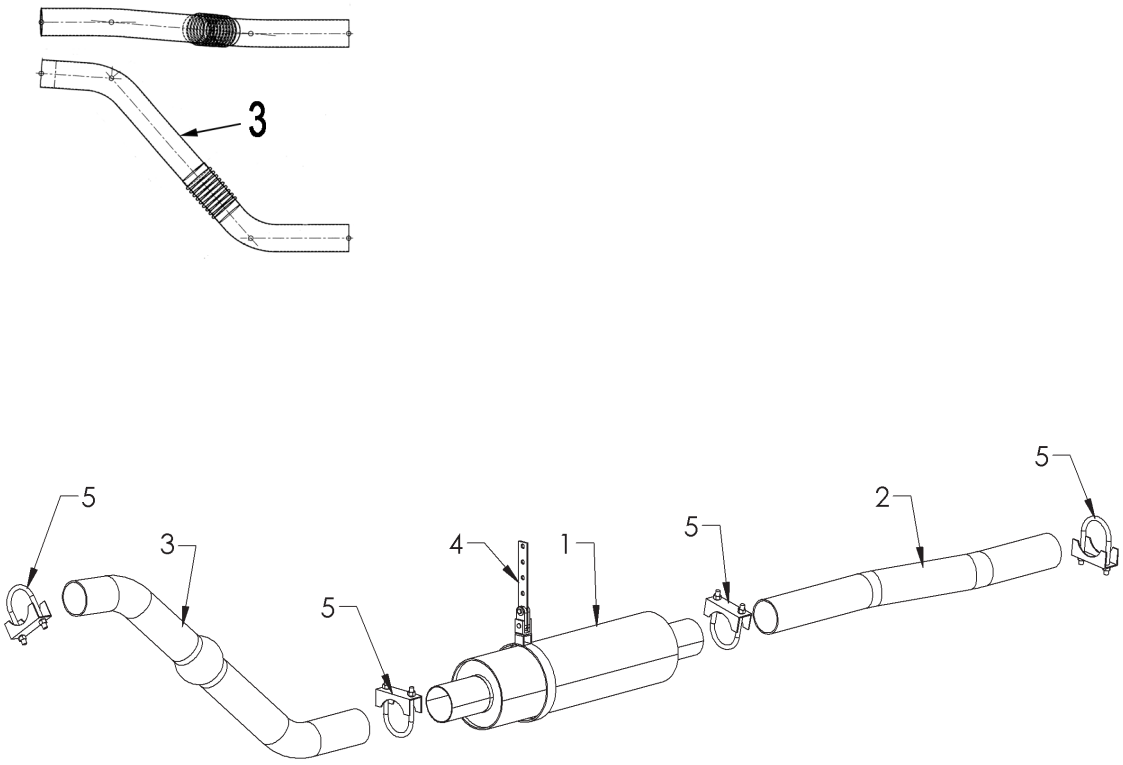


FIGURE 55.

EXHAUST SYSTEM, CUMMINS QSB4.5/AT

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
55-	45309		Exhaust Sys,M140,4BT4.5		Ref
	46555-4		Exhaust Sys,M140,4BT4.5	I	Ref
1	45368	86187M	Muffler,RD,6.1x21",3"I/L & O/L		1
2	45367		Pipe,Exhaust,O/L,140 DCTC6		1
3	45366		Pipe,Exhaust,I/L,140 DCTC6		1
	48687		Pipe Wld, Exh, I/L 140	I	1
4	NW017079		Hanger,Muffler,JG80-5,5 1/2"		1
5	NW035606	HPC300	Clamp,Muffler,3.00"		4

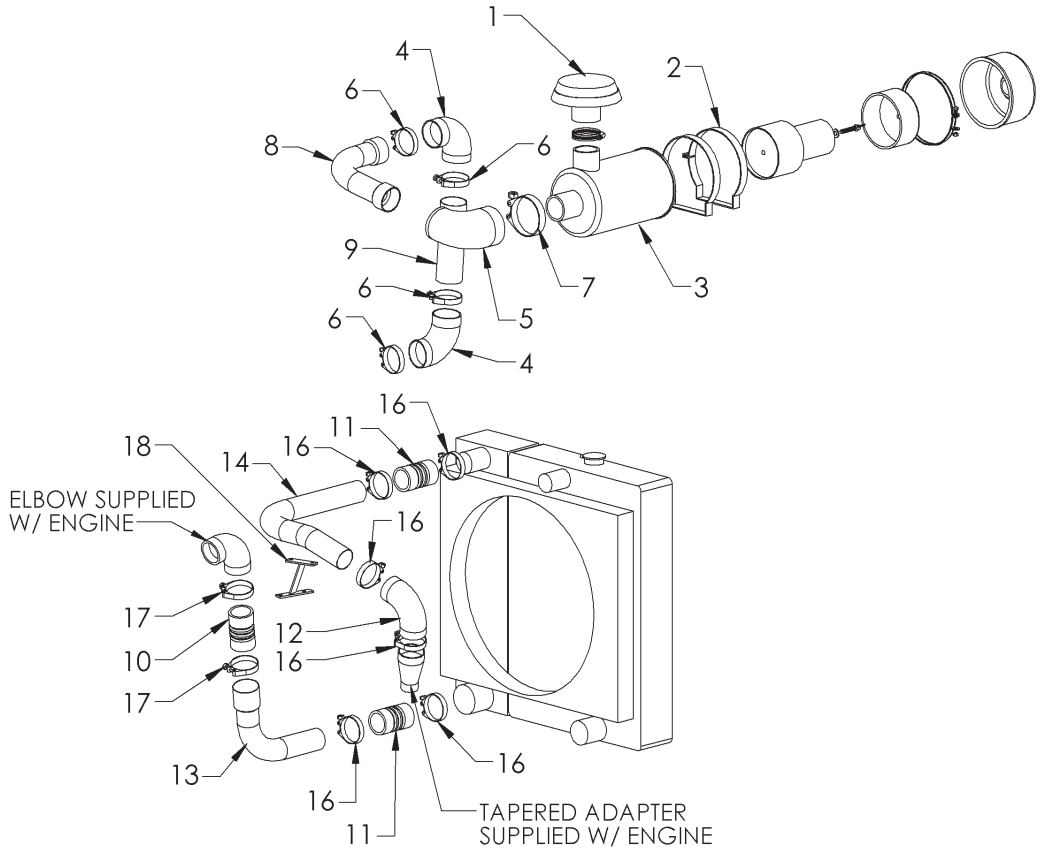


FIGURE 56.

AIR INTAKE SYSTEM, CUMMINS QSB4.5/AT

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
56-	46550-5		AIR IN TAKE SYS,M140,QSB4.5		
1	46604	H000468	HOOD,AIR CLEANER,PLAS TIC,4.5"		1
2	45983	P004073	BAND,MNT,AIR CLEANER,9"		2
3	45982	G090245	AIR CLEANER,9",DUAL,4" OUT LET		1
4	NW030064	P105532	ELL,3 ID,RUBBER,90 DEG (8S377)		2
5	NW035733	P536163	ELL,3 X 4,RUBBER,90 DEG (8S377)		1
6	NW033103	P14-8339	CLAMP,T-BOLT,3.31-3.59 (8S377)		4
7	NW035628	P148343	CLAMP,T-BOLT,4.31-4.59" (8S377)		1
8	42908		TUBE,AIR,3OD,9X11,90D		1
9	37489		TUBE,AIR,3OD,9.5		1
10	45201	26200	HOSE,3",FLEX,CHARGE AIR		1
11	46591		HOSE,2.5",FLEX,CHARGE AIR		2
12	46592		ELL,2.5",90DEG,FLEX,CHARGE AIR		1
13	46593		TUBE,CHARGE AIR,BTM,QSB4.5,T3		1
14	46594		TUBE,CHARGE AIR,TOP,QSB4.5,T3		1
16	NW033102		CLAMP,T-BOLT,2.81-3.09" (8S377)		6
17	NW035623	P148340	CLAMP,T-BOLT,3.06-3.34"		2
18	46611		SUPPORT WLDMNT,AIR TUBE,QSB4.5		1

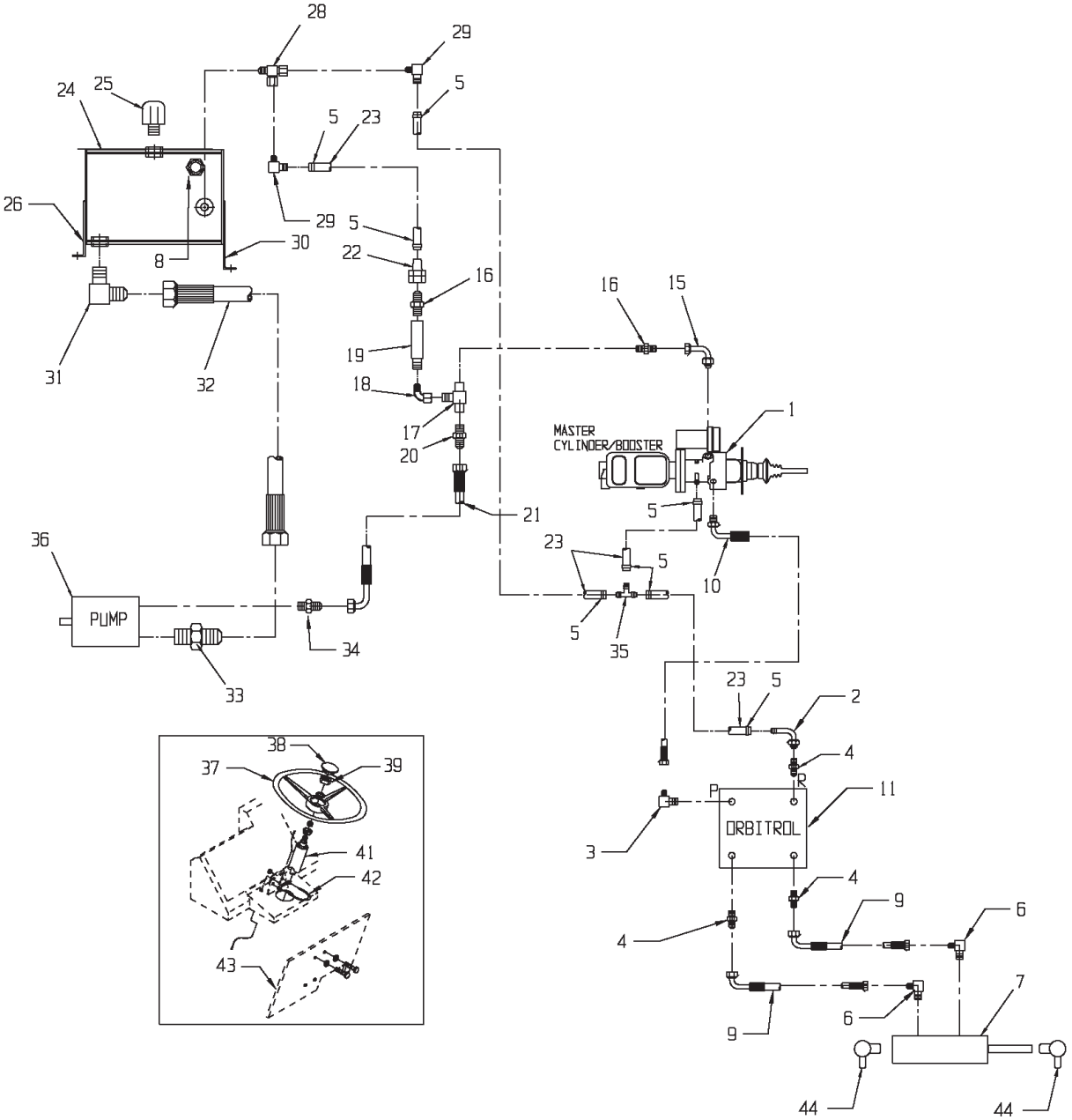
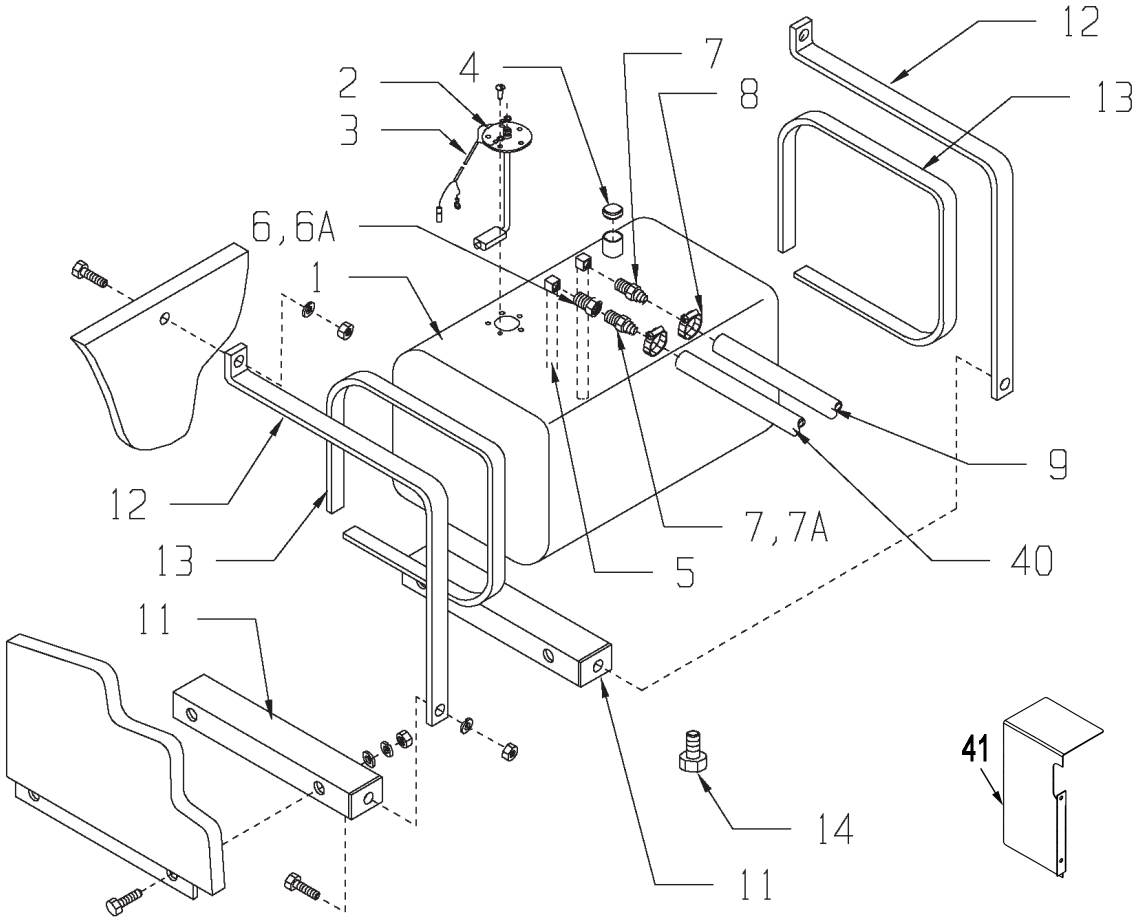


FIGURE 57.

STEER SYS, CUMMINS QSB4.5/AT

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
57-	46550-9		HYD ASSY,M140,QSB4.5		1
	46482		PUMP ASSY,GEAR,4B4.5T3		1
	46530		STEERING ASSY, M140 HYDRAULIC		1
1	46420		MASTER CYLINDER W/BOOSTER		REF
2	F104402		Ftg, 06-06FJX 90		1
3	NW036560		FTG, HYD, 08MB-06MJ90		1
4	3.2519		FTG, HYD, 06MJ-06MB		2
5	F100979	5406	CLAMP,HOSE,#6,.44-.78 (79470)		10
6	F104402		FTG, 06-06FJX90		2
7	1011081		CYLINDER, STEERING 2B 7.4 ST		1
8	44738	LSP151-05-01	GAUGE,SIGHT PLUG,3/4 NPT (LUBE DE VICES)		1
9	8796.108		HOSE ASSY, #6M 42.38" ST/90		2
10	38828		HOSE ASSY, PS, #6M, 30.5"		1
11	1.7864		STEER UNIT, 5.9 CI		1
15	NW26799	FF5300-0645	FTG, HYD,ELL,PRESSURE (01276)		1
16	3.1572	6/6/2404	FTG,HYD,06MJ-06MP (V00565)		1
	F101847		FTG, 06MJ-16MJ		2
	3.1572		FTG,HYD,06MJ-06MP (V00565)		2
17			FTG, TEE		1
18					1
19	NW029020		VALVE,RELIEF,INLINE,ADJ,1100PS (V00534)		1
20	3.1317		FTG, HYD, O8MJ-06MP90 (not as illustrated)		1
21	8797.105		HOSE ASSY #8M 24” ST/90		1
	8797.104		HOSE ASSY		1
22	1.8808		FTG,HYD,06H-06FJX (01276)		2
23	F101679	D13KG61160	HOSE 0.37 ID X 0.66 OD LOW		AR
24	46658		TANK WLDMNT,HYD,1.75 GAL,M140		1
25	202993		BREATHER,3/4 NPT,STL		1
26			BRKT,HYD TANK, LH (NOT USED)		0
28	3.1391	5602-06-06-06	FTG,HYD,TEE,06MP-06FP-06FP (V00565)		1
29	46247	6/6/4501	FTG,HYD,06H-06MP90 (V00565)		1
30			BRKT,HYD TANK, RH (NOT USED)		0
31	3.0143	12/12/2501	FTG,HYD,12MJ-12MP90 (V00565)		1
32	46240.2		HOSE ASSY,#12L, 15.5",ST/90		1
	46420.5		HOSE ASSY		1
33	F101258	6801-12-16-NOW	FTG,HYD,12MJ-16MB90 (V00565)		1
34	91926	6801-08-10-NOW	FTG,HYD,08MJ-10MB90 (V00565)		1
35	F002691		FTG,P,TEE,06 MALL		1
36	46624	26004-LZA	PUMP,HYD.GEAR,.66CID,SAE”A”11T (15605)		1
	43834	102930-000	GASKET,HYD PUMP,SAE A-2BOLT (15605)		1
37	202735		STEERING WHEEL, 14"		1
38	202736		BUTTON, HORN FOR VIP WHEEL		1
39	150526		NUT, 13/16-20 HEX		1
41	NW035372		COLUMN, STEERING, 10"		1
42	F103213		CLAMP, 1.75 ID MUFFLER		1
43	46642		COVER PLATE, ORBITROL		1
44	NW034968		TIE ROD END 3/4-16 RH		2



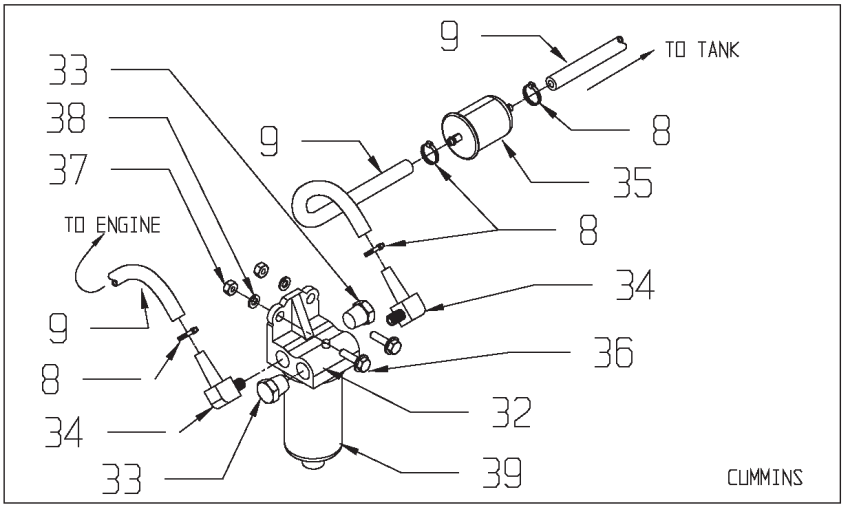


FIGURE 58.

FUEL SYSTEM CUMMINS & PERKINS 1104D

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
58-	43974		Fuel System (QSB4.5 & B3.3T)		REF
1	51225		Fuel System (Perkins 1104D-44T/C6,T3		
	38692		Fuel Tank, 20.7 Gal., w/Cap		1
	NW36194		Fuel Tank, 20 Gal., For Dropped 37” Rear Deck		1
	51449		Fuel Tank Mod, 140 W/2		1
	NW36377		Cap, Red Fill For NW36194		1
2	41533		Sending Unit, Fuel Level, w/Gasket		1
	F101529		Gasket, Fuel		1
	F10824		RHMS, #10-32 x 3/8, Brass		5
	F10046		Flat Washer, SAE, 3/8		
3	NW36838		Harness, Fuel Tank		Ref
4	37833		Cap, 1/4 Turn, Vented, Std.		Ref
	39037		Cap, 1/4 Turn, Protect-O Seal		1
5	NW36196		Tube, Fuel Return, 9.5”		1
6	F100671		Adapter		1
6A	43118		Ftg, Hyd, 14mm-04FP		2
7	NW36198		End, Hose, 5/16 x 1/4 NPT		2
7A	42051		Ftg, Hyd, 06H-04MP (For .37 ID Hose)		2
8	F101150		Hose Clamp, #4, .25 - .625		A/R
9	9.2066		Feed Hose, .37 ID Low Press.		A/R
11	NW27824		Support, Tank, Left		1
	NW27825		Support, Tank, Right		
12	NW26327		Fuel Tank Strap		2
13	F101588		Tank Protection Strip		120”
14	220110		Plug, 1/4 NPTF Hex Socket		1
32	43697	3902309S	Filter Head, Fuel, Remote Mount		1
33	Comm		Plug		2
34	NW34736		Ell, 90°		2
35	43481		Filter, In Line		1
36	Comm		Bolt		2
37	Comm		Nut		2
38	Comm		Lock Washer		2
39	43424	FS1251	Element, Fuel Water Separator		1
	39580		Fuel/Water Separator		Ref
40	F101015		Return Hose, .31ID		A/R
41	50851		Guard, Fuel Filter	I	1
NS	52882		Harness, Fuel Tank	I	1

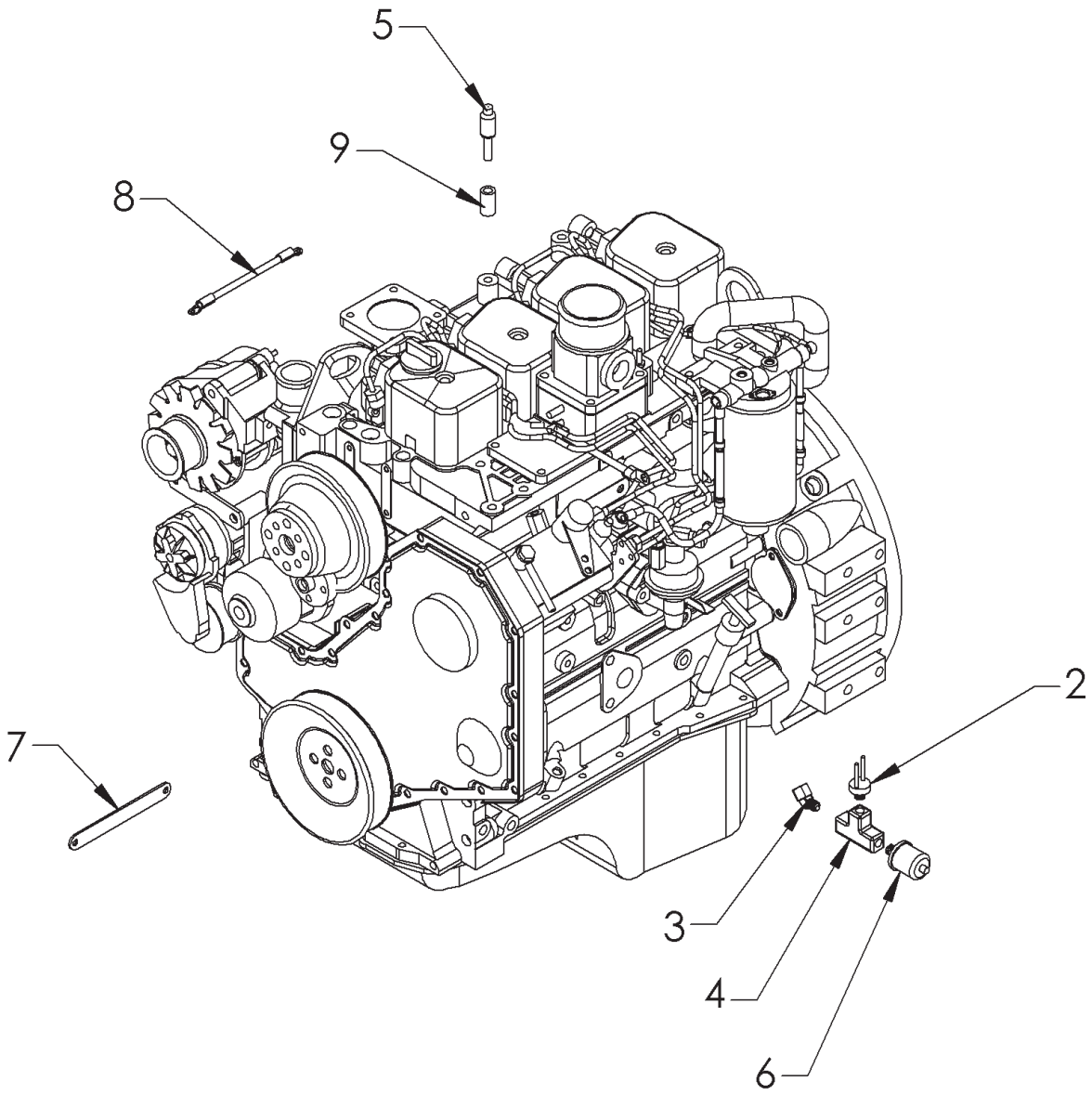


FIGURE 59.
ELECTRIC ASSEMBLY, CUMMINS QSB4.5/AT

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
59-	46555-3		ELEC SYS,ENG,M140,QSB4.5/AT		1
2	NW021649	8647	SWITCH,OIL PRES SURE,HOURMETER (13445)		1
3	3.2642		FTG,HYD,02MP-02FP45 (V00565)		1
4	3.1820		FTG,HYD,TEE,02MP-02FP-02FP (V00565)		1
5	NW030236	02023-00	SENDER,TEMP,HI-RANGE,1/4 NPT (8S377)		1
6	F101527	02505-00	SENDER,OIL PRESS,0-100#,1/8NPT (V00542)		1
7	NW010518FB		STRAP,GROUND,4 GA X 9" (59587)		1
8	46036		CABLE ASSY,GND,CMNS 4B4.5		1
9	F100780		FTG,HYD,08MP-02FP		1
	46580		FTG,HYD,02FP-M14MB		1
	F101146	COV2113Z1	CLIP,INSUL,1.25 ID, .41 HOLE		1
	RF090896		SLEEVE ALUM FBRGLS 2.50		40
	200085	46230	FUSE, 30A/32V,ATC		1
	M257005	46205	FUSE, 5A/32V,ATC		1

See Figure 15 for Harnesses.

Also See Figure 13.

This Page Intentionally Blank

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
	46550		ENG/TRANS GRP, CUMMINS QSB4.5 T3 TURBO/ C6	C	1
	46550-1		ENG/TRANS/MNTG ASSY,QSB4.5/C6		1
	46550-2		LINKAGE SYS,M140,QSB4.5/C6		1
	46550-3		ELEC SYS,ENG,M140,QSB4.5/C6		1
	46550-4		EXHAUST SYS,M140,4BT4.5/C6		1
	46550-5		AIR IN TAKE SYS,M140,QSB4.5		1
	46550-6		COOLING SYS,M140,QSB4.5/C6		1
	46544		BATTERY SYS,M140 W/BOX,1000CC (SEE FIG 12		1
	43974		FUEL SYS,M140,CUMMINS		1
	46482		PUMP ASSY,GEAR,4B4.5T3		1
	46550-9		HYD ASSY,M140,QSB4.5		1
	46743		PANEL ASSY,SIDE,M140,CMN,129"		1

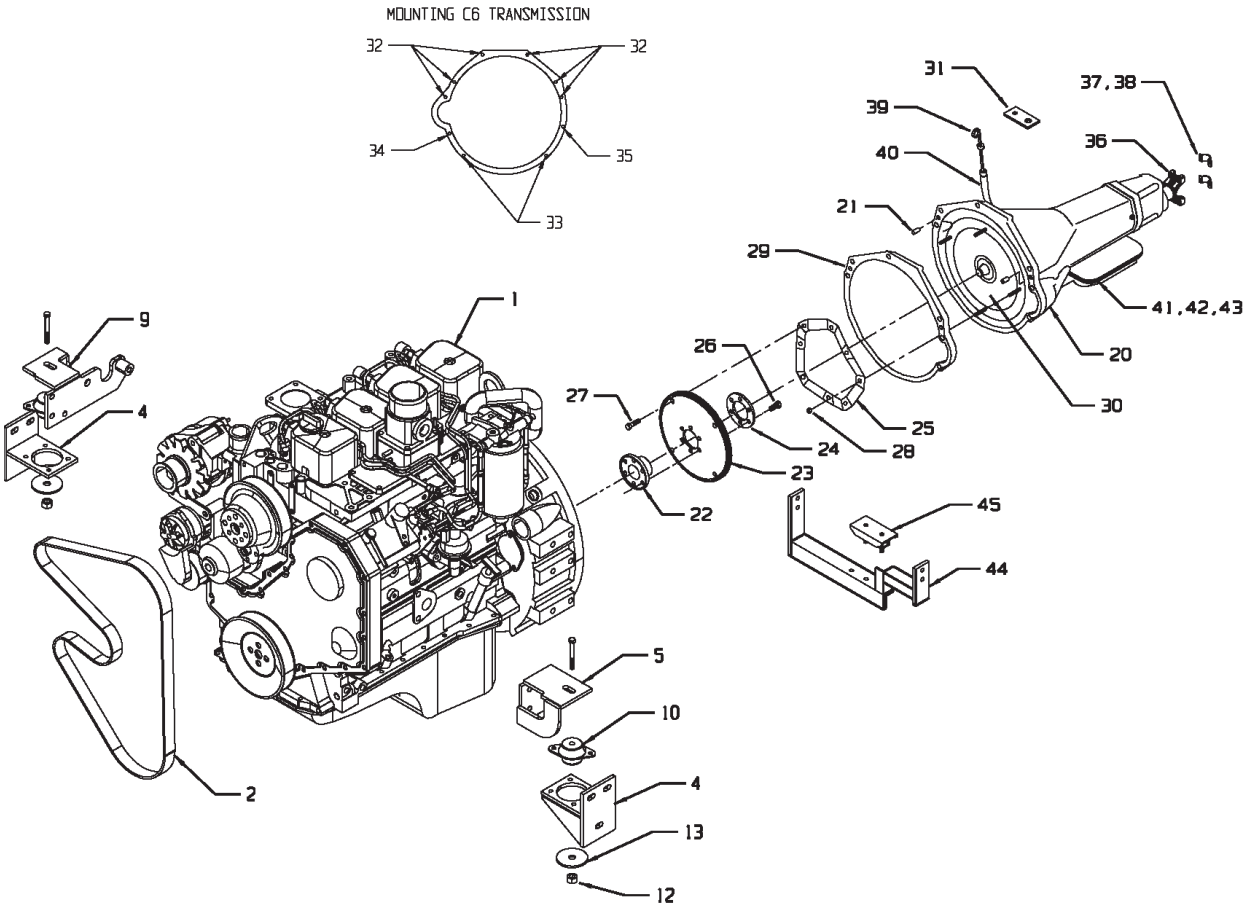


FIGURE 60.
ENGINE/TRANS MOUNTING, CUMMINS QSB4.5T3/C6
1 of 2

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
60-	46550-1		ENG/TRANS/MNTG ASSY,QSB4.5/C6		1
1	46065		ENGINE,CMNS,QSB4.5		1
2			BELT, ENG		1
3	NW034441		TRANS, C6		1
4	46451		BRKT WLD,ENG/FRAME,LH,100,28"W		2
5	46453		BRKT WLD,ENG,LH,QSB4.5 TIER 3		1
9	46454		BRKT WLD,ENG,RH,QSB4.5 TIER 3		1
10	37357	17/0566-60	ISOLATOR,RUBBER,ENGINE		2
12	37537		NUT,HEX,5/8-18,CTR LOCK		2
13	37535		FW,.66ID,3.12,OD,.19THK		2
14	41450		PLATE,TRANS DIP STICK MNT		1
NS	48079	3910128	SPACER, FAN		1
NS	48080	4932633	CONNECTOR, AIR, CAC		1
NS	NW036490	F445	HHCS,M8 X 1.25 X 45,GR88		4
NS	NW036687		HHCS,M8 X 1.25 X 75 MM,G8.8		4
20	NW034441		TRANS,C6,3 SPD,2.40SR,W/BRAKE (39569)		1.0
21	F100444		Pin, Dowel 1/2 x 1 ZP		2
22		3907620	Adaptor, Crank shaft (0AT39)		1
23		3918957	Fly Wheel (0AT39)		1
24		3923049	Ring, Clamping (0AT39)		1
25		3907619	Flex Plate (0AT39)		1
26	42964	3901395	Screw, HHCS (0AT39)		8
27	42965	3910665	Hex Flange Head M10x.63 (0AT39)		4
28	42962	3912253	Nut, Hex (03718)		4
29			Housing Adapter, C6 Transmission		1
30	43365	EATP-7902-B BPR	Converter Assem bly, HD		1
31	44940		ANGLE,DIPSTICK MNT,C6		1.0
32	F100340		HHCS, 7/16-14x2.25		6
	F18486		Washer 7/16 Lock		6
33	Comm		HHCS 1/4-20x2.75		2
	F9704		Washer, 1/4 Flat (both sides)		4
	F13588		Nut 1/4-20 Nylok		2
34	F100320		HHCS, 3/8-16x2.75		1
	F9665		Washer 3/8 Lock		1
35	122077		HHCS, 5/16-18x2.5 (insert from engine side)		1
	F9546		Washer, 5/16 Lock		1
36	NW036501		Yoke Flange		1
37	41072		Bolts		4
38	41073		Strap		2
39	42856		Dipstick		1

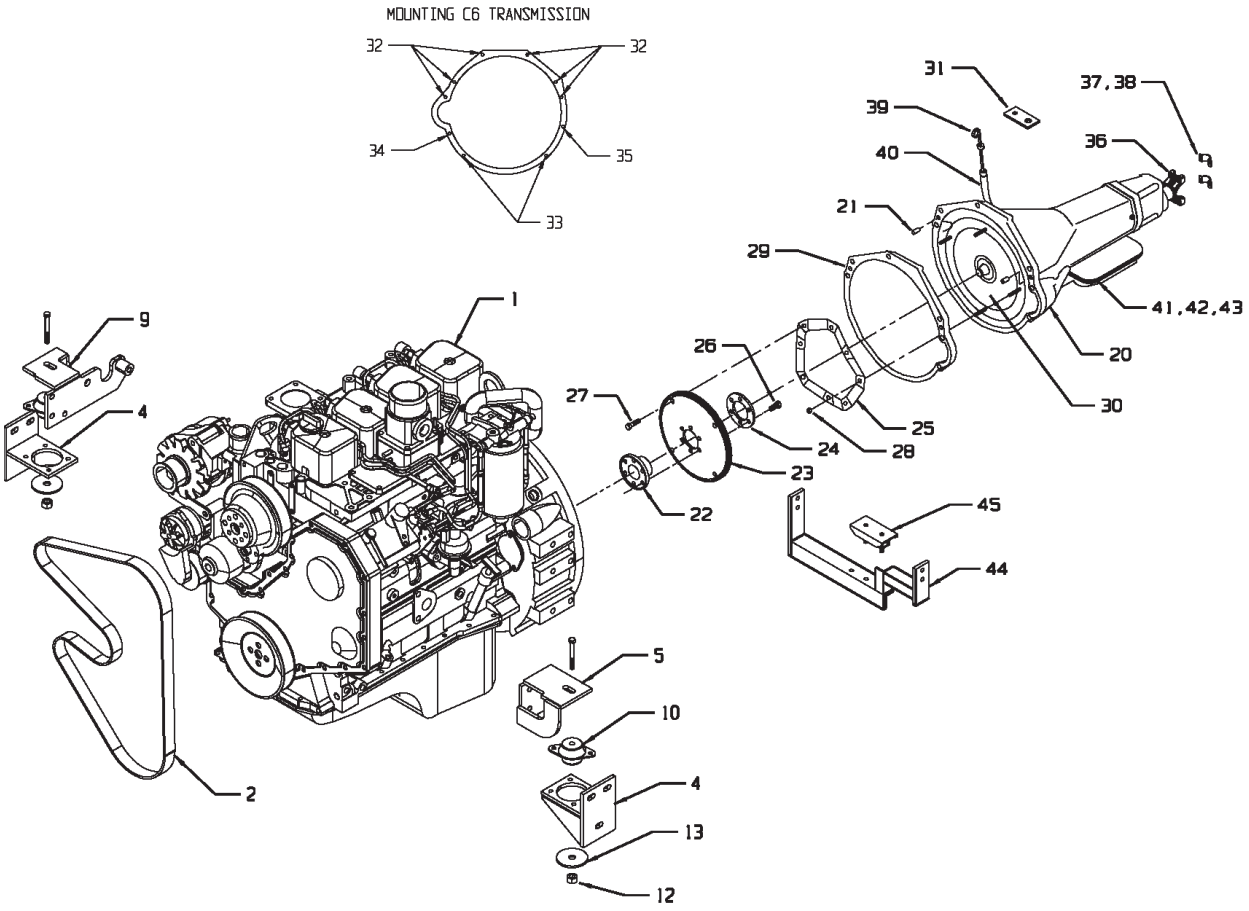


FIGURE 60.
ENGINE/TRANS MOUNTING, CUMMINS QSB4.5T3/C6
2 of 2

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
60-	46550-1		ENG/TRANS/MNTG ASSY,QSB4.5/C6		1
40	44075	EOPZ-7A228-A	Tube, Dip stick C6		1
41	302313		Pan, Oil		1
42	37920		Gas ket, Oil Pan, C6		1
43	NW034532		Filter, Transmis sion		1
44	46535		SUPPORT WLDMT,TRANS,C6,M140		1.0
45	37188		Trans. Isolator C6		1

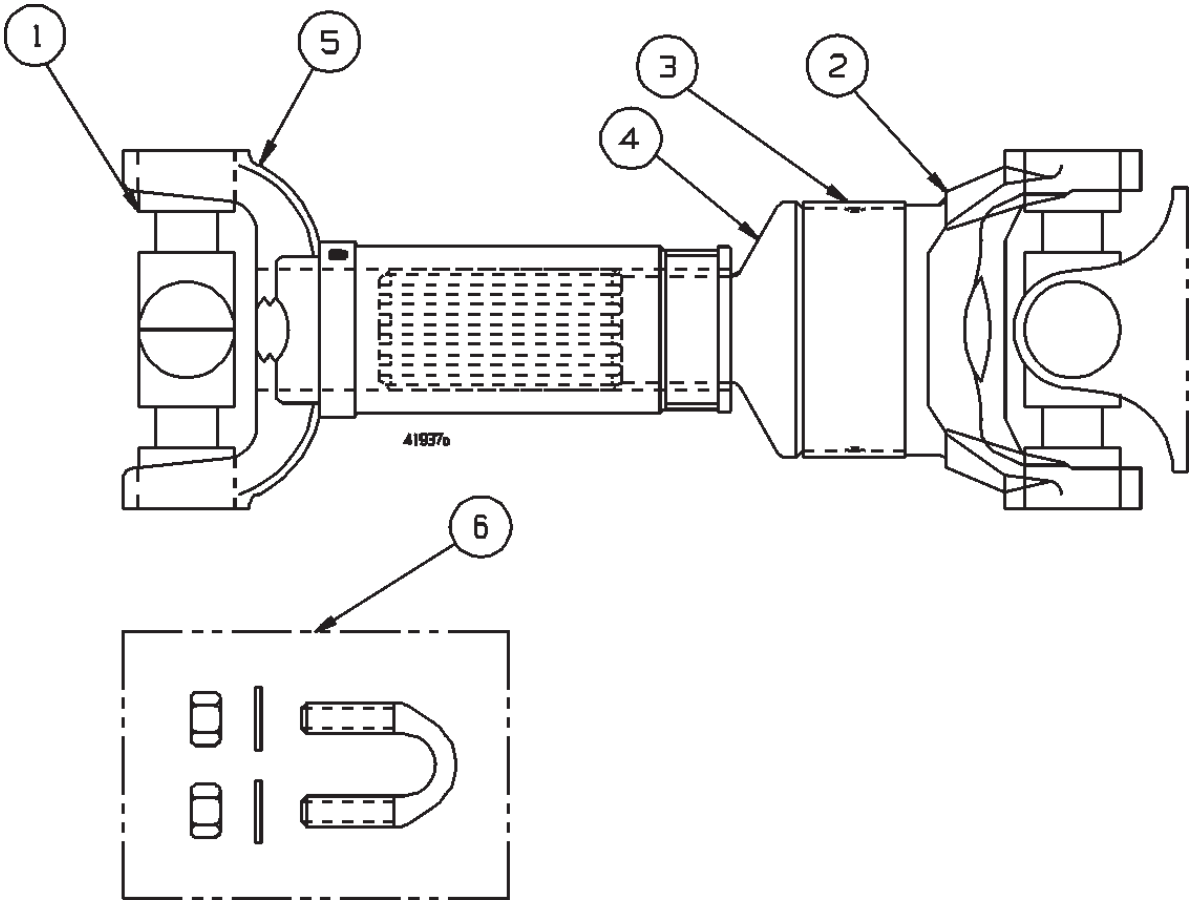


FIGURE 61.

DRIVESHAFT, QSB4.5T3 TURBO OR 1104D

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
61-	46572		Drive Shaft 15.75,1410, slip		Ref
1	NW033731	5-160X	U-Joint		2
2	NW035885		Tube Yoke		1
3	RF90585		Tubing 3” OD x .083 W		1
4	NW035886	3-40-1101	Slip Tube Shaft		1
5	NW034377	3-3-118KX	Slip Yoke		1
6	NW023706	3-94-18X	U-Bolt Assy-Illustrated (95019)		1
	41073		U-Joint Strap (if U-Bolt not used)		2
	41072		Bolt (if U-Bolt not used)		4

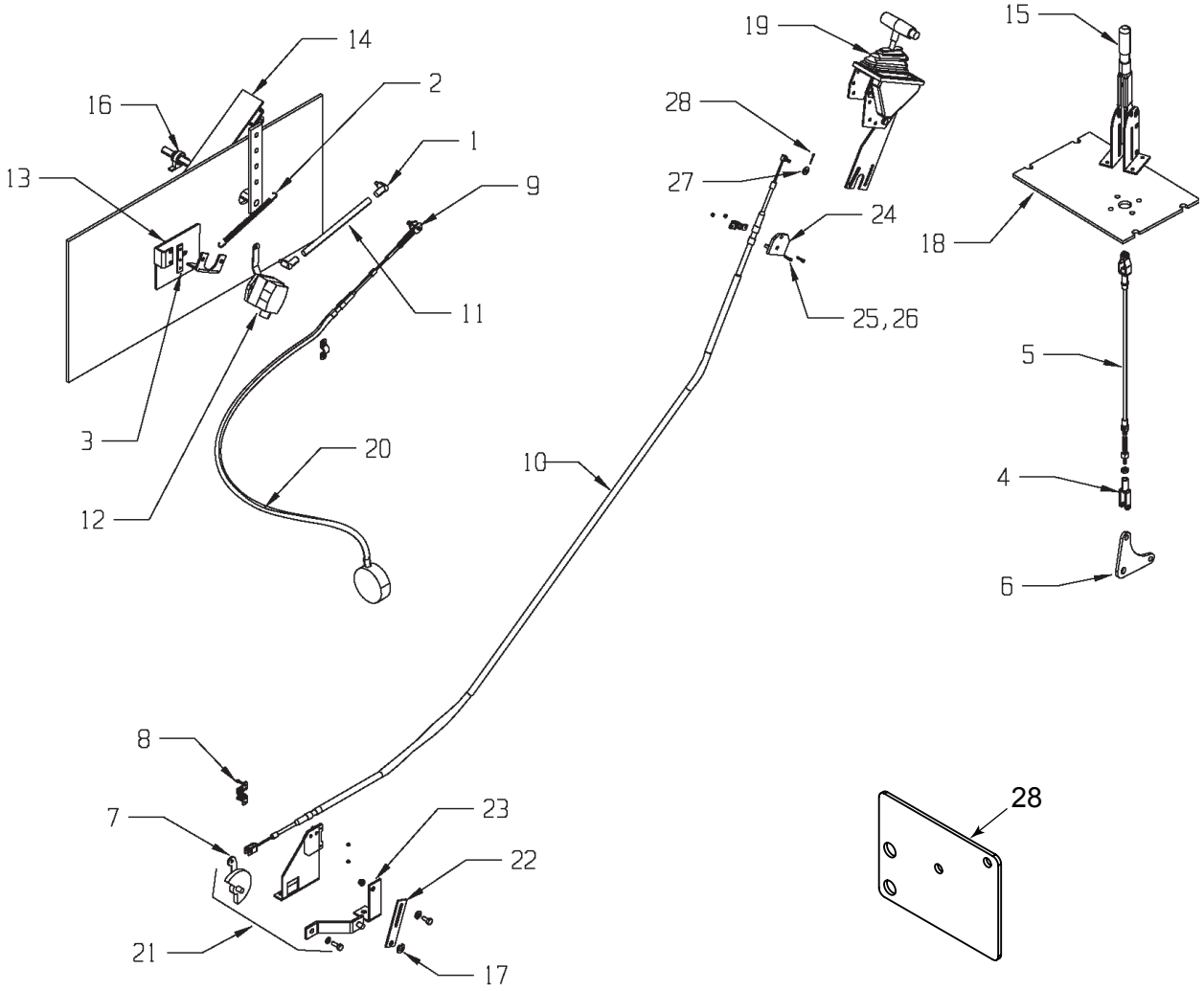


FIGURE 62.

LINKAGE SYSTEM, B3.3 TURBO T3

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
62-	46550-2		Linkage Sys,M140,QSB4.5/C6		1
	43953		Grp,TT,Shifter,C6,Quadrast		1
	46685		Controls Assy,140		1
	50030-2		Linkage Sys, M140, QSB3.3/C6		1
1	F 101863	R107G	Ball Joint,ND,1/4-28,1/4-28ST (0NZJ1)		2.0
2	39924		Spring,Modulator Return		1.0
3	39925		Brkt,Spring Return *B*		1.0
4	90562		Clevis, 3/8-24x3/8 Pin (Included)		1
5	39457	15787700	Cable,Prk Brk,50",W/SPRING		1.0
6	NW 033835		PLATE,BRAKE PIV BRKT 140 *B*		1
7	SB489		Neutral Safety Switch		1
8	NW 034731	39001	CLAMP,CABLE MNTG (6S981)		1.0
9	NW 034718	59049-1	KIT,SLIP LINK,FELSTED,60DPC6 (V00546)		1.0
10	NW 031669	307484-3-84	CABLE ASSY,SHIFT,84" (8S377)		1.0
11	406203		CUT,4062, 7.38		1.0
12	45357	TPS001	SENSOR,THROTTLE POSITION,CUMNS		1.0
13	46656		BRKT WLDMNT,ACCEL SEN SOR,M140		1.0
14	46636		PEDAL WLDMT,ACCEL,M140,129"OAL		1.0
15	NW 022767	02183400	LEVER,PARK BRAKE-M40/60/100 (92867)		1.0
16	NW 015530	BDN8	BRG,.50 ID,W/HOUSING		2
17	NW 034551	633-025	CLIP,'E'.25 SHAFT,C6/C3 KIKDWN		1.0
18	38675		PLATE, PARK BRAKE LEVER		1
19	NW 036144	T73538	LEVER,SHIFT CON TROL,SS NW33909 (58051)		1.0
20	NW 034717	FC2200-84	CABLE,MODULATOR,FELSTED,60DPC6 (V00546)		1.0
21	NW 034343	T895	KIT,CONNECTOR,C6 TRANSMISSIONS		1.0
22	37667		BAR,BRKT,KICKDOWN		1.0
23	NW 034238		BRKT,KICKDOWN ADJ, *B*		1.0
24	39220		Plate, Shift Link		1
25			HHCS, 1/4-20x5/8		1
26	F9536		Nut, 1/4-20 Hex		1
27			Washer, Flat, .328 ID		1
28	43114		Plate, Eq Valve1		

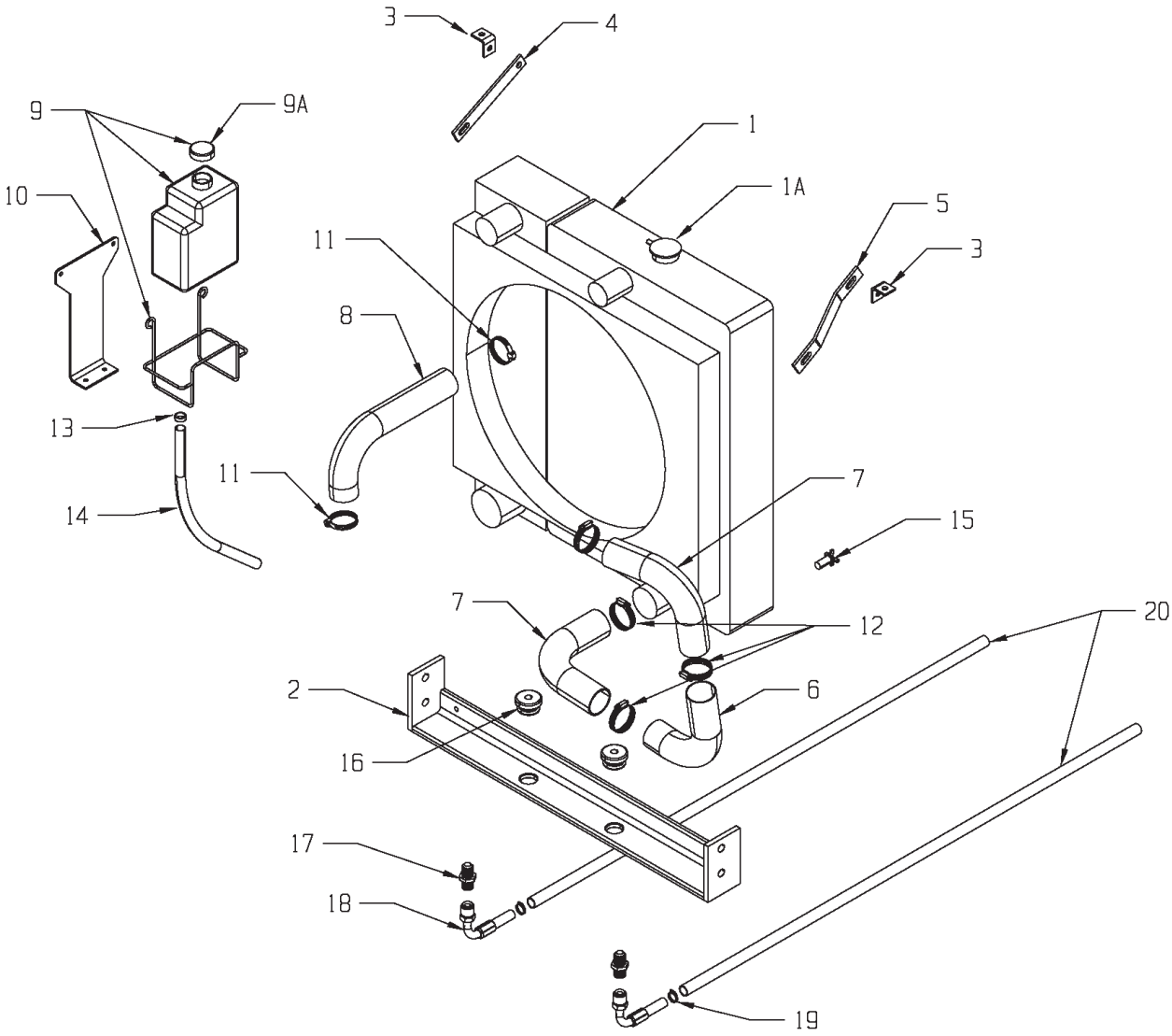


FIGURE 63.

COOLING SYSTEM, CUMMINS QSB4.5T3/C6

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
63-	46550-6		COOLING SYS,M140,QSB4.5/C6		1
1	46412	12932CP	RADIATOR/OIL/CAC ASSY,QSB4.5		1
1A			CAP, RADIATOR		1
2	46447		SUPPORT WLDMT,RAD,100/140,28"W		1
4	43459		ANGLE,MNTG,RADIATOR		2
6	46589		STRAP,RADIATOR MTG,TOP,140		1
7	46674		STRAP,RADIATOR MTG,140		1
8	46551		TUBE,RAD,W/I,100/140,QSB4.5,T3		1
9	45036	20172S	HOSE,RAD,LOWER,200MB4V2		2
9A	37551	20057S	HOSE,RAD,1.75 X 12.25		1
10	44544	BVR-4	RESERVOIR,COOLANT OVERFLOW		1
11	40164		CAP, RESERVOIR		1
11	44556		BRKT,COOLANT RESER VOIR		1
11	F101140	5732	CLAMP,HOSE,#32,1.56-2.50		2
12	F011057		CLAMP,HOSE,#36		
13	NW036097		CLIP,RE TAIN,RES HOSE *B*		1
14	NW031849		HOSE,RE COVERY,MODEL 1000 DP		1
15	F100669	46-086	VALVE,DRAIN COCK,1/4" NPT,BRS		1
16	203566	60230	ISOLATOR,RUBBER,BUSHING,CENTER		2
17	F 101295		FTG,HYD,06MJ-10MB		2.0
18	F 104402	33982-6-6	FTG,HYD,06H-06FJX90 (01276)		2.0
19	F100979		CLAMP, HOSE #6		4
20	9.2066	G13KG50030	HOSE 0.37 ID LOW PRESS 01276)		180.0
NS	91926		FTG,HYD,08MJ-10MB90		2.0
NS	NW 034365	A40JT27380	FTG,HYD,08MJ-12MP		2.0

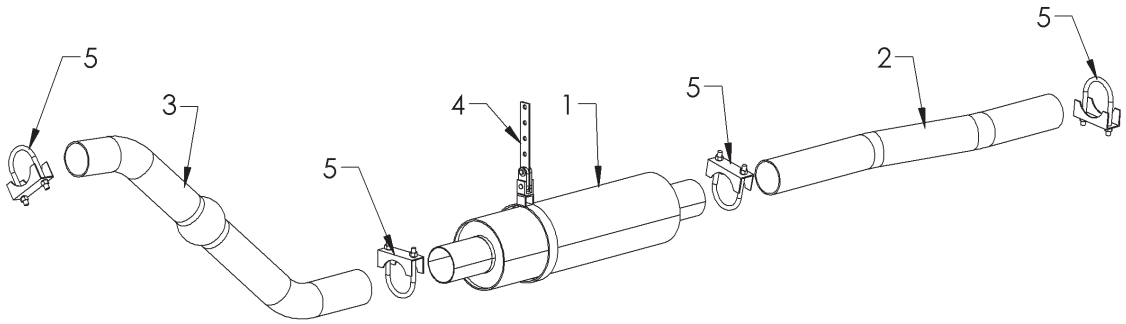


FIGURE 65.

EXHAUST SYSTEM, CUMMINS QSB4.5T3/C6

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
65-	46550-4		EXHAUST SYS,M140,4BT4.5T3/C6		
1	45368	86187M	MUF FLER,RD,6.1x21",3"I/L & O/L		1
2	45367		PIPE,EXHAUST,O/L,140 DCTC6		1
3	45366		PIPE,EXHAUST,I/L,140 DCTC6		1
4	NW017079		HANGER,MUFFLER,JG80-5,5 1/2"		1
5	NW035606	HPC300	CLAMP,MUFFLER,3.00"		4

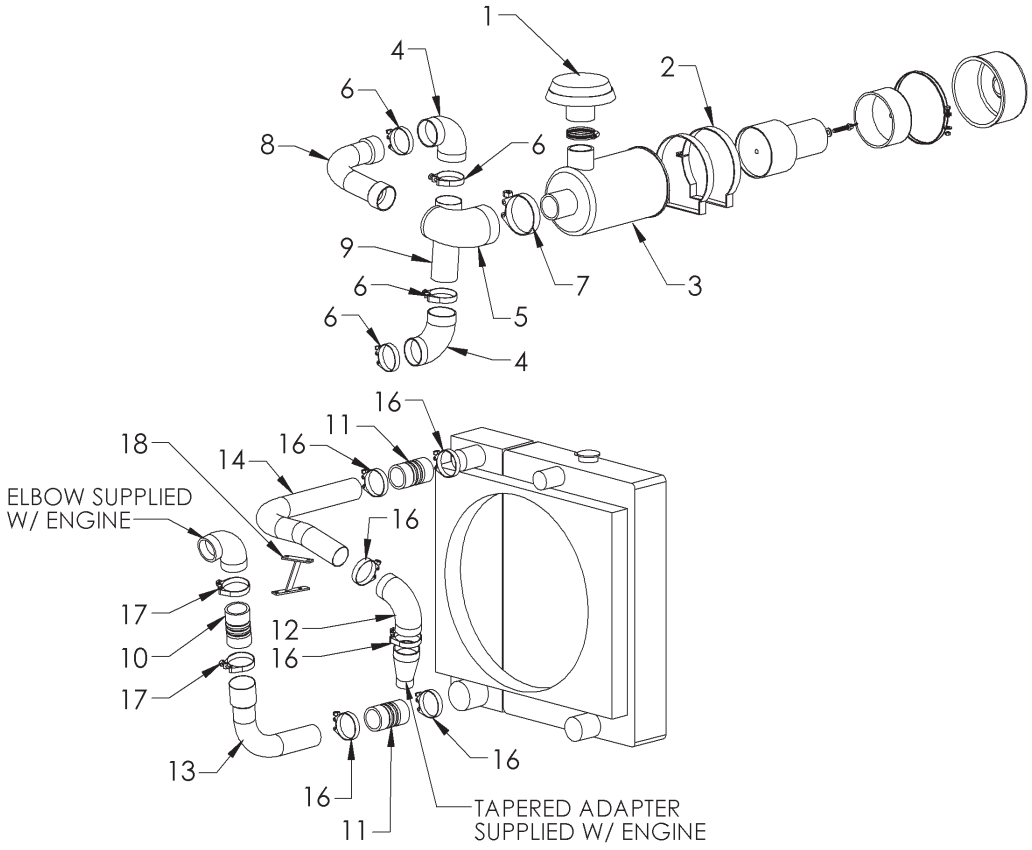


FIGURE 65.

AIR INTAKE SYSTEM, CUMMINS QSB4.5T3/C6

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
65-	46550-5		AIR IN TAKE SYS,M140,QSB4.5		
1	46604	H000468	HOOD,AIR CLEANER,PLASTIC,4.5"		1
2	45983	P004073	BAND,MNT,AIR CLEANER,9"		2
3	45982	G090245	AIR CLEANER,9",DUAL,4" OUTLET		1
4	NW030064	P105532	ELL,3 ID,RUBBER,90 DEG (8S377)		2
5	NW035733	P536163	ELL,3 X 4,RUBBER,90 DEG (8S377)		1
6	NW033103	P14-8339	CLAMP,T-BOLT,3.31-3.59 (8S377)		5
7	NW035628	P148343	CLAMP,T-BOLT,4.31-4.59" (8S377)		1
8	46619		TUBE,AIR,3OD,6X6,45°		1
9	200223		TUBE,AIR,3OD		1
10	45201	26200	HOSE,3",FLEX,CHARGE AIR		1
11	46591		HOSE,2.5",FLEX,CHARGE AIR		2
12	46592		ELL,2.5",90DEG,FLEX,CHARGE AIR		1
13	46593		TUBE,CHARGE AIR,BTM,QSB4.5,T3		1
14	46594		TUBE,CHARGE AIR,TOP,QSB4.5,T3		1
15	NW033103		CLAMP,T-BOLT,3.31-3.59 (8S377), P14-8339		2
16	NW033102		CLAMP,T-BOLT,2.81-3.09"		6
17	NW035623	P148340	CLAMP,T-BOLT,3.06-3.34", P148340		1
18	46611		SUPPORT WLDMNT,AIR TUBE,QSB4.5		1

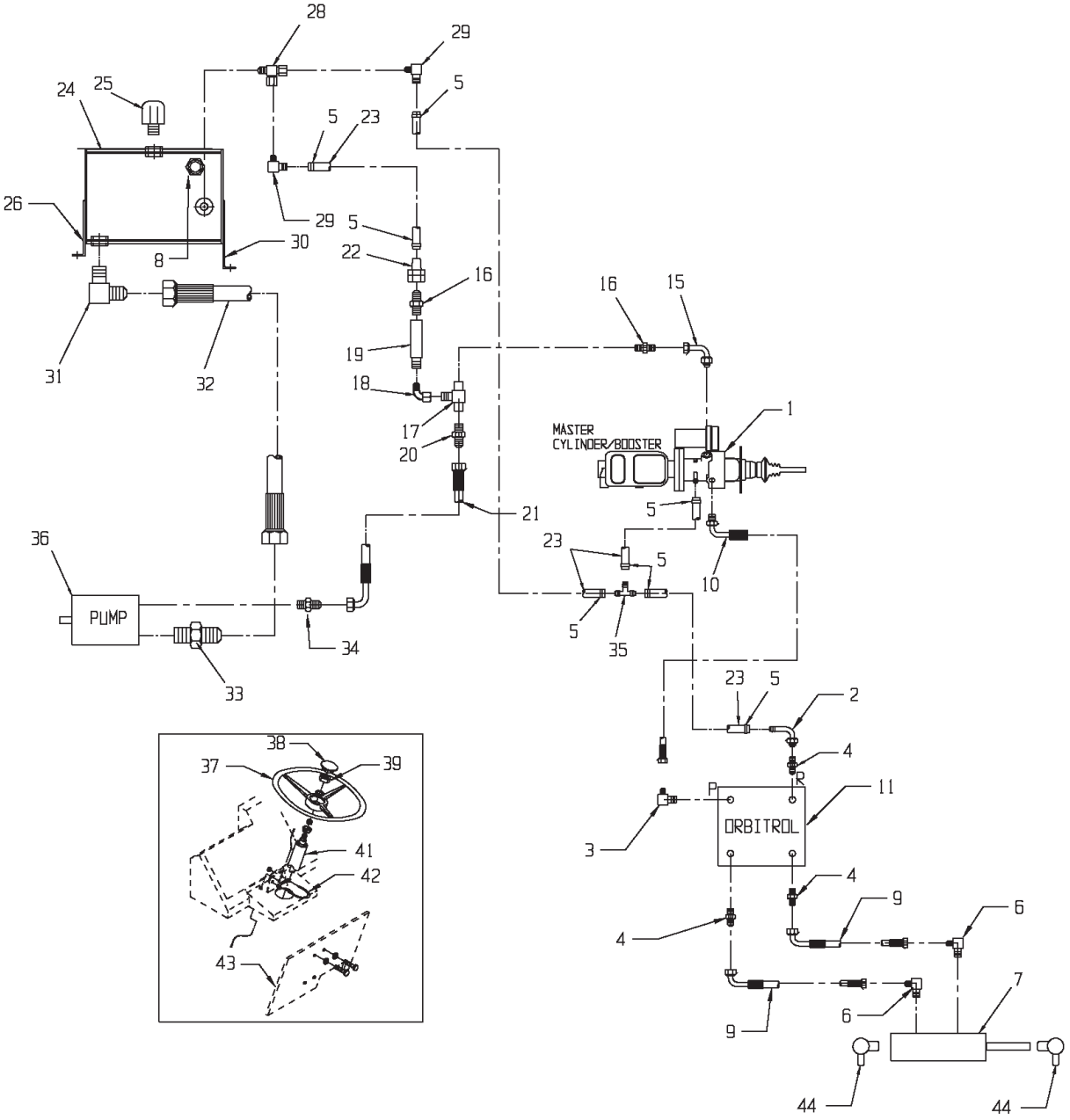
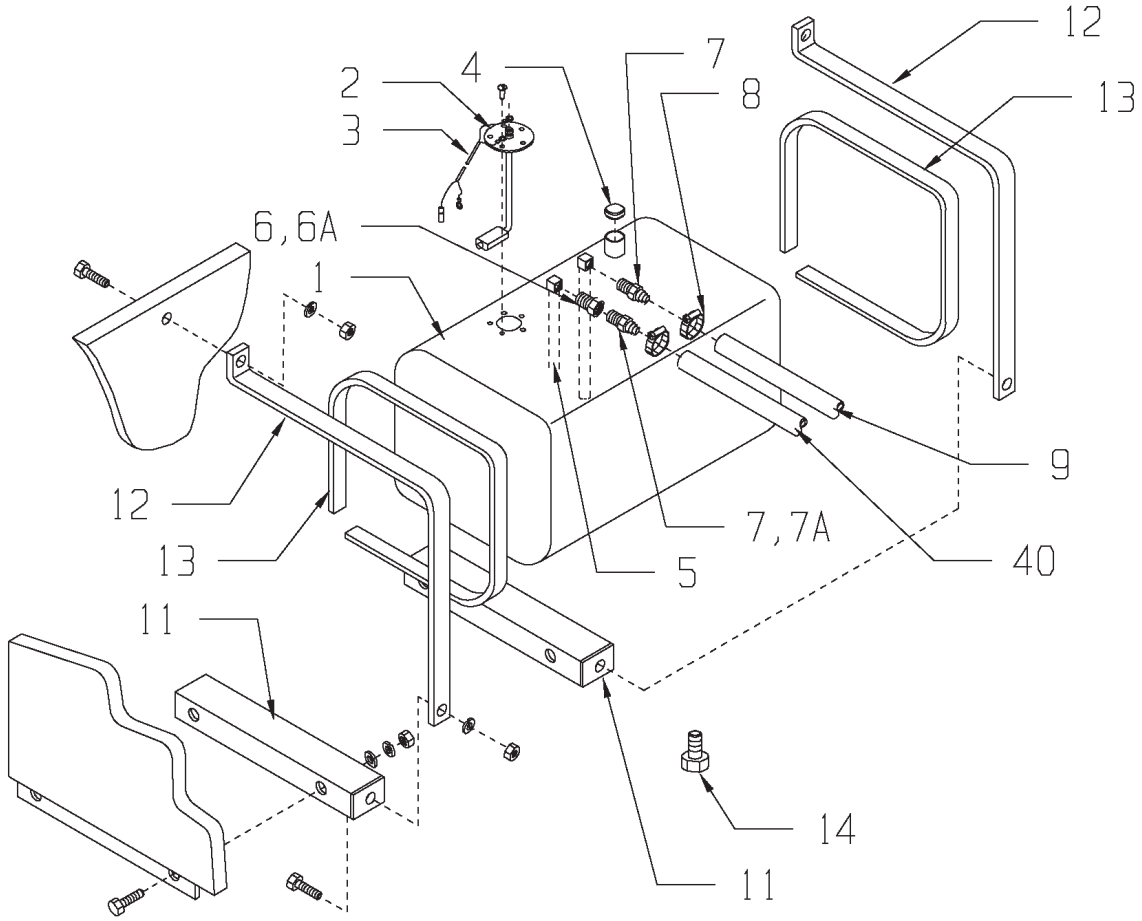


FIGURE 66.

STEER SYSTEM, CUMMINS QSB4.5T3/C6

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
66-	46550-9		HYD ASSY,M140,QSB4.5		1
	46482		PUMP ASSY,GEAR,4B4.5T3		1
	46530		STEERING ASSY, M140 HYDRAULIC		1
1	46420		MASTER CYLINDER W/BOOSTER		REF
2	F104402		Ftg, 06-06FJX 90		1
3	NW036560		FTG, HYD, 08MB-06MJ90		1
4	3.2519		FTG, HYD, 06MJ-06MB		2
5	F100979	5406	CLAMP,HOSE,#6,.44-.78 (79470)		10
6	F104402		FTG, 06-06FJX90		2
7	1011081		CYLIN DER, STEERING 2B 7.4 ST		1
8	44738	LSP151-05-01	GAUGE,SIGHT PLUG,3/4 NPT LUBE DEVICES		1
9	8796.108		HOSE ASSY, #6M 42.38" ST/90		2
10	38828		HOSE ASSY, PS, #6M, 30.5"		1
11	1.7864		STEER UNIT, 5.9 CI		1
15	NW26799	FF5300-0645	FTG, HYD,ELL,PRESSURE (01276)		1
16	3.1572	6/6/2404	FTG,HYD,06MJ-06MP (V00565)		1
	F101847		FTG, 06MJ-16MJ		2
	3.1572		FTG,HYD,06MJ-06MP (V00565)		2
17			FTG, TEE		1
18					1
19	NW029020		VALVE,RELIEF,INLINE,ADJ,1100PS (V00534)		1
20	3.1317		FTG, HYD, O8MJ-06MP90 (not as illustrated)		1
21	8797.105		HOSE ASSY #8M 24” ST/90		1
	8797.104		HOSE ASSY		1
22	1.8808		FTG,HYD,06H-06FJX (01276)		2
23	F101679	D13KG61160	HOSE 0.37 ID X 0.66 OD LOW		AR
24	46658		TANK WLDMNT,HYD,1.75 GAL,M140		1
25	202993		BREATHER,3/4 NPT,STL		1
26			BRKT,HYD TANK, LH (NOT USED)		0
28	3.1391	5602-06-06-06	FTG,HYD,TEE,06MP-06FP-06FP (V00565)		1
29	46247	6/6/4501	FTG,HYD,06H-06MP90 (V00565)		1
30			BRKT,HYD TANK, RH (NOT USED)		0
31	3.0143	12/12/2501	FTG,HYD,12MJ-12MP90 (V00565)		1
32	46240.2		HOSE ASSY,#12L, 15.5",ST/90		1
	46420.5		HOSE ASSY		1
33	F101258	6801-12-16-NOW	FTG,HYD,12MJ-16MB90 (V00565)		1
34	91926	6801-08-10-NOW	FTG,HYD,08MJ-10MB90 (V00565)		1
35	F002691		FTG,P,TEE,06 MALL		1
36	46624	26004-LZA	PUMP,HYD.GEAR,.66CID,SAE”A”11T(15605)		1
	43834	102930-000	GASKET,HYD PUMP,SAE A-2BOLT (15605)		1
37	202735		STEERING WHEEL, 14"		1
38	202736		BUT TON, HORN FOR VIP WHEEL		1
39	150526		NUT, 13/16-20 HEX		1
41	NW035372		COL UMN, STEERING, 10"		1
42	F103213		CLAMP, 1.75 ID MUF FLER		1
43	46642		COVER PLATE, ORBITROL		1
44	NW034968		TIE ROD END 3/4-16 RH		2



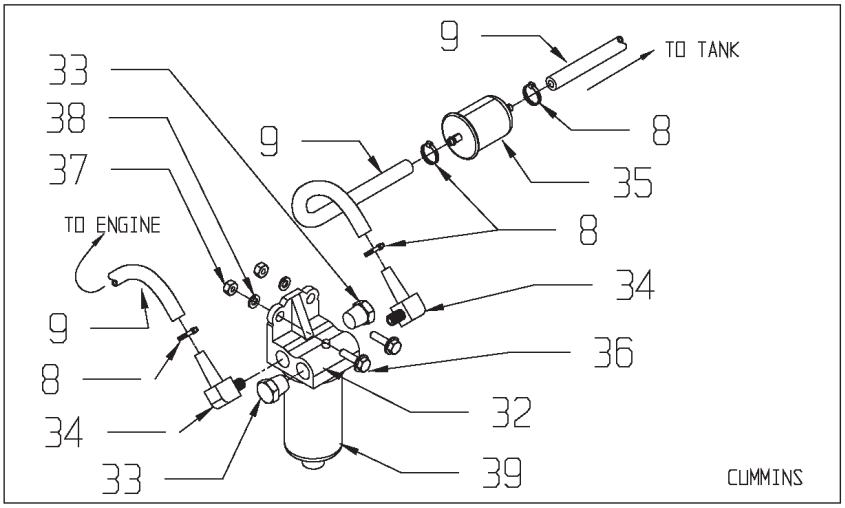


FIGURE 67.
FUEL SYSTEM

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
67-	43974		Fuel System (QSB4.5 & B3.3T)		REF
	38692		Fuel Tank, 20.7 Gal., w/Cap		1
	NW36194		Fuel Tank, 20 Gal., For Dropped 37” Rear Deck		1
	NW36377		Cap, Red Fill For NW36194		1
2	41533		Sending Unit, Fuel Level, w/Gasket		1
	F101529		Gasket, Fuel		1
	F10824		RHMS, #10-32 x 3/8, Brass		5
	F10046		Flat Washer, SAE, 3/8		
3	NW36838		Harness, Fuel Tank		Ref
4	37833		Cap, 1/4 Turn, Vented, Std.		Ref
	39037		Cap, 1/4 Turn, Protect-O Seal		1
5	NW36196		Tube, Fuel Return, 9.5”		1
6	F100671		Adapter		1
6A	43118		Ftg, Hyd, 14mm-04FP		2
7	NW36198		End, Hose, 5/16 x 1/4 NPT		2
7A	42051		Ftg, Hyd, 06H-04MP (For .37 ID Hose)		2
8	F101150		Hose Clamp, #4, .25 - .625		A/R
9	9.2066		Feed Hose, .37 ID Low Press.		A/R
11	NW27824		Support, Tank, Left		1
	NW27825		Support, Tank, Right		
12	NW26327		Fuel Tank Strap		2
13	F101588		Tank Protection Strip		120”
14	220110		Plug, 1/4 NPTF Hex Socket		1
32	43697	3902309S	Filter Head, Fuel, Remote Mount		1
33	Comm		Plug		2
34	NW34736		Ell, 90°		2
35	43481		Filter, In Line		1
36	Comm		Bolt		2
37	Comm		Nut		2
38	Comm		Lock Washer		2
39	43424	FS1251	Element, Fuel Water Separator		1
	39580		Fuel/Water Separator		Ref
40	F101015		Return Hose, .31ID		A/R

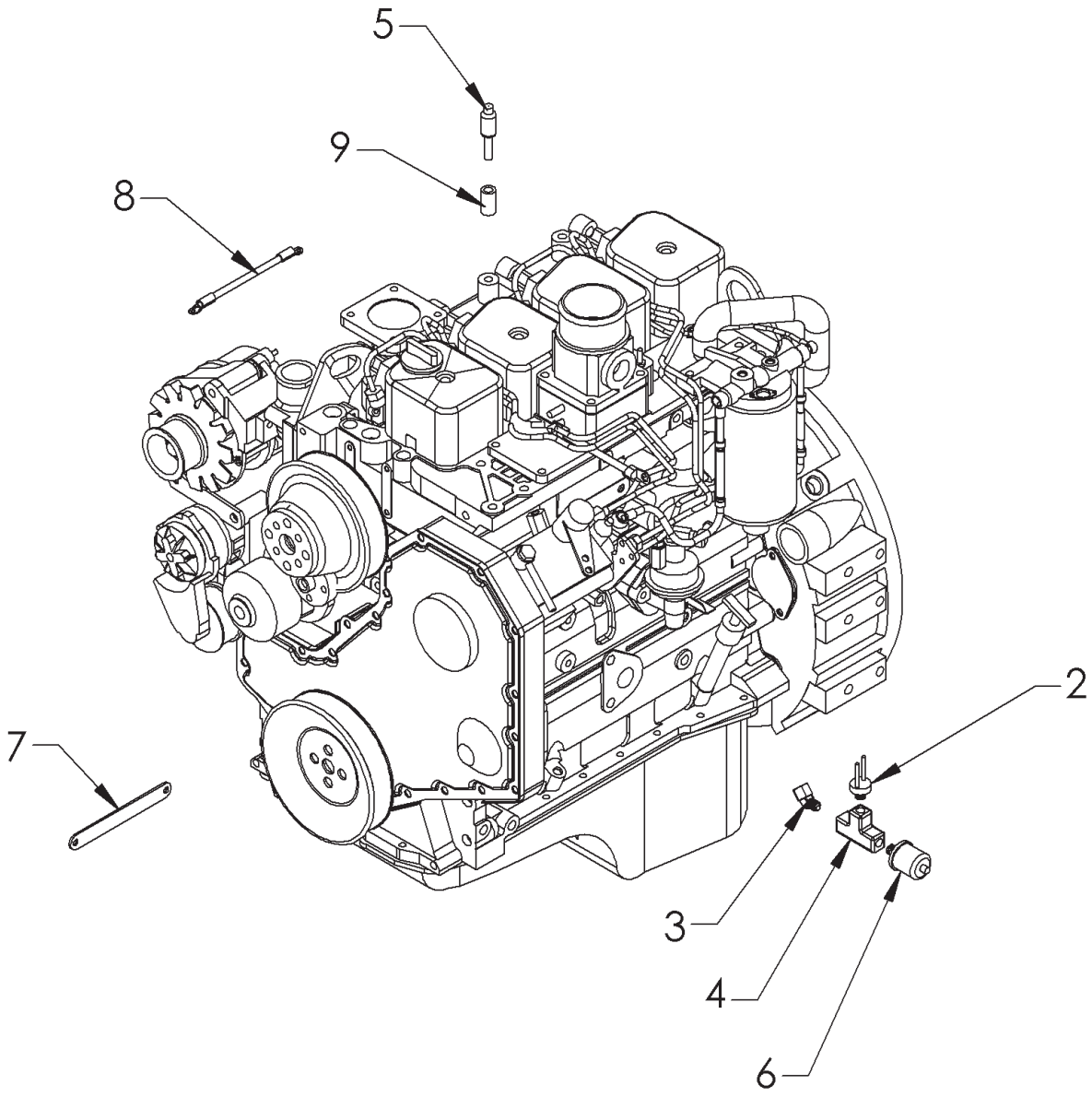


FIGURE 68.
ELECTRIC ASSEMBLY, CUMMINS QSB4.5T3/C6

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
68-	46550-3		ELEC SYS,ENG,M140,QSB4.5/C6		1
2	NW021649	8647	SWITCH,OIL PRESSURE,HOURMETER (13445)		1
3	38733		FTG,HYD,02MP-02FP		1
4	3.1820		FTG,HYD,TEE,02MP-02FP-02FP (V00565)		1
5	NW030236	02023-00	SENDER,TEMP,HI-RANGE,1/4 NPT (8S377)		1
6	F101527	02505-00	SENDER,OIL PRESS,0-100#,1/8NPT (V00542)		1
7	NW010518FB		STRAP,GROUND,4 GA X 9" (59587)		1
8	46036		CABLE ASSY,GND,CMNS 4B4.5		1
9	F100780		FTG,HYD,08MP-02FP		1
NS	46580		FTG,HYD,02FP-M14MB		1
NS	F101146	COV2113Z1	CLIP,INSUL,1.25 ID, .41 HOLE		1
NS	RF090896		SLEEVE ALUM FBRGLS 2.50		40
NS	F102160		RELAY, STARTER, 12VDC		
NS	43145		RELAY, POWER, SPNO, 12VDC		1
NS	305006		FUSE, 125A/48V		1
NS	200085		FUSE, 30A/32V ATC		1
NS	M257005		FUSE, 5A/32V/ATC		1
NS	46650		BRKT, FUSE HOLDER		1
NS	46601		ISOLATOR, STUD PLATE		1
NS	46483		HAR NESS, ECM, THROTTLE		1
NS	46644		HAR NESS, ENGINE		1
NS	53158		HARNESS REAR	I	1
NS	45400		HARNESS, INDICATOR LIGHTS		1
NS	47038		HARNESS, STARTER		1

ALSO SEE FIGURE 15 FOR HARNESSES.

ALSO SEE FIGURE 13.

This Page Intentionally Blank

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
	47310		GRP,M140,ENG,B3.3TAA/C6,T3	E	1
1	47310-1		ENG/TRANS/MNTG ASSY,B3.3TAA/C6		1
2	46550-2		LINKAGE SYS,M140,QSB4.5/C6		1
3	47310-3		ELEC ASSY,M140,B3.3TAA/C6,T3		1
4	47310-4		EXHAUST SYS,M140,B3.3TAA,T3		1
5	47310-5		AIR INTAKE SYS,M140,B3.3TAA,T3		1
6	47310-6		COOLING SYS,M140,B3.3/C6,T3		1
7	43974		FUEL SYS,M140,CUMMINS		1
8	47310-9		HYD ASSY,M140,B3.3T,TIER 3		1
9	47310-10		BATTERY SYS,M140,W/BOX (SEE FIG 12)		1
10	47307		PUMP ASSY,GEAR,B3.3,T3		1
11	46743		PANEL ASSY,SIDE,M140,CMN,		1

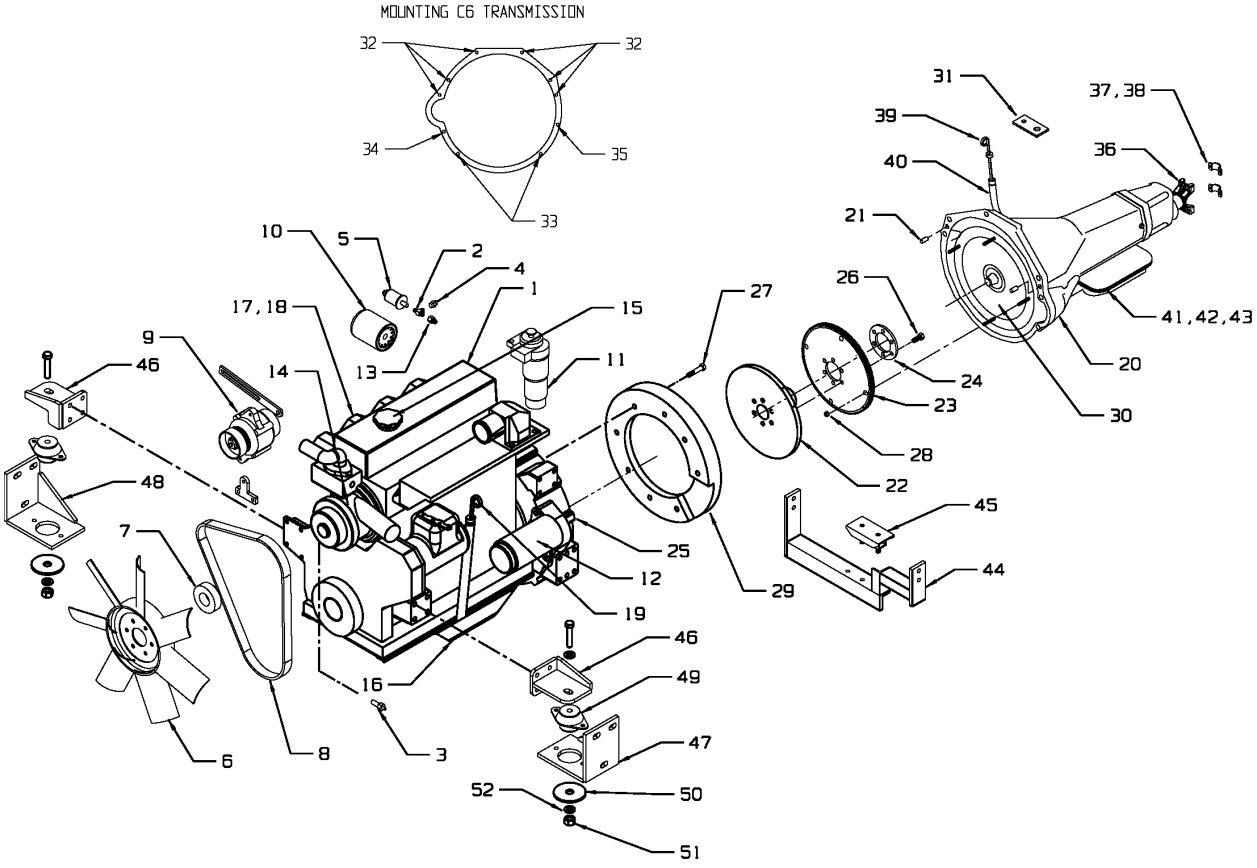


FIGURE 69.

ENGINE/TRANSMISSION ASSEMBLY, CUMMINS B3.3 TURBO T3

1 OF 2

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
69-	47310-1		Eng/Trans/Mntg Assy,B3.3TAA/C6		Ref
	50030-1		Eng/Trans/Mntg Assy,QSBB3.3TAA/C6	H	Ref
1	47240		Engine, Cummins B3.3 Turbo T3		1
	46950		Engine, Cummins QSB3.3 Turbo T3	H	1
2	3.1820		Ftg, Hyd, Tee, 02MP-02FP-02FP (V00565)		1
3	NW030236		Sender, Water Temp, 1/4NPT		1
4	NW021649		Switch, Oil Pres sure Hr Me ter		1
5	F101527		Sender, Oil Press, 1/8NPT		1
6	206405		Fan		1
7	208609		Fan Spacer, Modified		1
8	206498		Belt, Serpentine 60A		1
9	206500		Alternator		1
10	206407		Oil Filter		1
11	206408		Fuel Filter Element		1
12	206409		Starter		1
13	38733		Ftg, 02MP-02FP		1
14	207649		Kit, Water Pump, Cummins		1
15	205065-6		Oil Fill Cap (OB30000)		1
16	205065-4		Pan, Oil (OP30002)		1
17	205065-7		Manifold, Exhaust (XM30001)		1
18	205065-8		Manifold, Exhaust Gasket (C613012558)		1
19	205065-3		Dip stick, Oil Level (LG30001)		1
20	NW034441		TRANS,C6,3 SPD,2.40SR,W/BRAKE (39569)		1.0
21	F100444		Pin, Dowel 1/2 x 1 ZP		2
22		3907620	Drive Flange (0AT39)		1
23	1.8125	D5TZ-6375A	Flex Plate (0AT39)		1
24	1.9016	C20Z-6A366A	Ring, Reinforcing (0AT39)		1
25		3907619	Flex Plate (0AT39)		1
26			HHCS, Self Locking, 7/16-20x1-1/4 (0AT39)		8
27			SHCS, 3/8x1-1/4		4
28	1.8498		Nut, Washer Lock 3/8-24 (03718)		4
29	NW034441	911580	Adapter, C6 Transmission		1
30	43365	EATP-7902-BB PR	Converter Assembly, HD		1
31	44940		Angle,Dipstick Mnt,C6		1.0
32	F100340		HHCS, 7/16-14x2.25		6
	F18486		Washer 7/16 Lock		6
33	Comm		HHCS 1/4-20x2.75		2
	F9704		Washer, 1/4 Flat (both sides)		4
	F13588		Nut 1/4-20 Nylok		2
34	F100320		HHCS, 3/8-16x2.75		1
	F9665		Washer 3/8 Lock		1
35	122077		HHCS, 5/16-18x2.5 (insert from engine side)		1
	F9546		Washer, 5/16 Lock		1

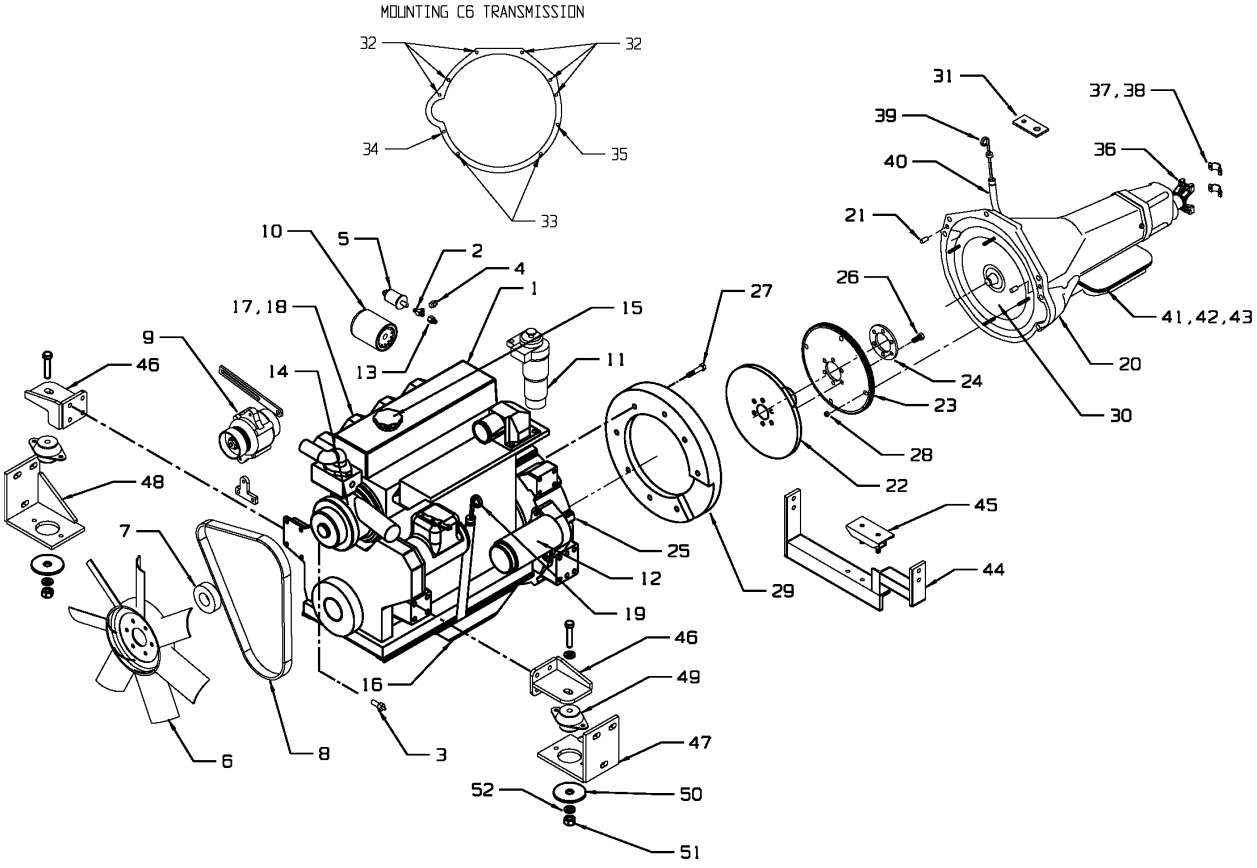


FIGURE 69.

ENGINE/TRANSMISSION ASSEMBLY, CUMMINS B3.3 TURBO, T3
2 OF 2

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
69-	47310-1		Eng/Trans/Mntg Assy,B3.3TAA/C6		Ref
	50030-1		Eng/Trans/Mntg Assy,QSBB3.3TAA/C6	H	Ref
36	NW036501		Yoke Flange		1
37	41072		Bolts		4
38	41073		Strap		2
39	42856		Dipstick		1
40	44075	EOPZ-7A228-A	Tube, Dip stick C6		1
41	302313		Pan, Oil		1
42	37920		Gas ket, Oil Pan, C6		1
43	NW034532		Filter, Transmis sion		1
44	46535		Support Wldmnt,Trans,C6,M140		1
45	37188		Trans. Isolator C6		1
46	47341		Brkt Wld,Eng,M60,Cumns B3.3NA		2
47	48376		Brkt Wld,Eng/Frame,140,LH,3.3T		1
48	48377		Brkt Wld,Eng/Frame,140,RH,3.3T		1
49	37674	51508-3	Isolator,Rubber,Engine,Green		2
50	37535		FW,.66ID,3.12,OD,.19THK		2
51	45832		Nut,Hex,1/2-13		2
52	41052		Washer, 1/2 Hardened Flat		2
53	50394		Guard Fuel Filter		1
NS	45831		HHCS, 1/2-13 x 3.5 Gr 8		2

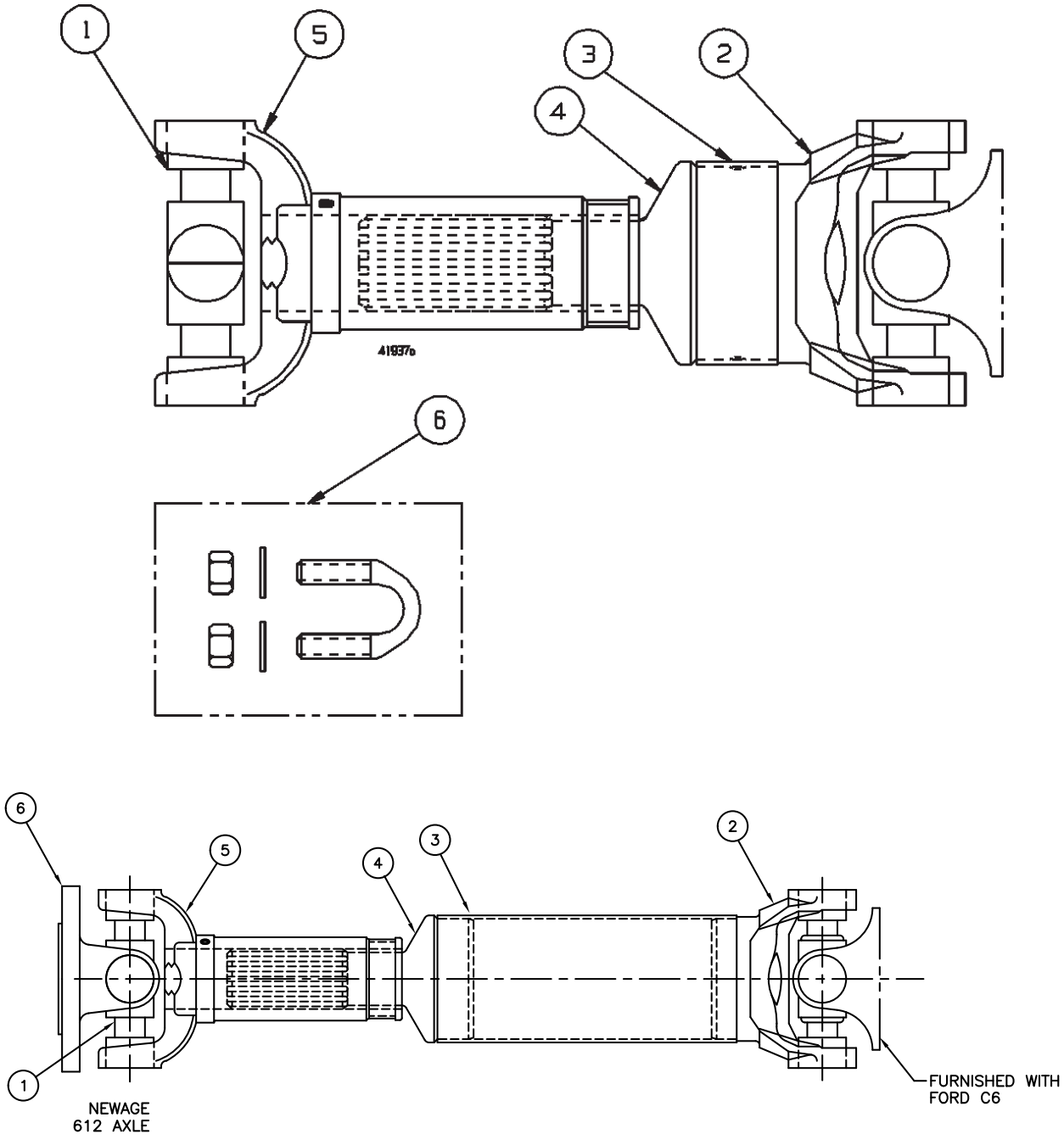


FIGURE 70.
DRIVE SHAFT, B3.3 TURBO, T3

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
70-	47239		Drive Shaft, B3.3 Turbo/C6 T3		Ref
1	NW033731	5-160X	U-Joint (95019)		2
2	NW035885		Tubing Yoke		1
3	404500		Tubing 3.00 x .083 Wall		1
4	NW035886	3-40-1101	Slip Tube Shaft (95019)		1
5	NW034377	3-3-118KX	Slip Yoke (95019)		1
6	NW023706	3-94-18X	U-Bolt Assy-Illustrated (95019)		1
	41073		U-Joint Strap (if U-Bolt not used)		2
	41072		Bolt (if U-Bolt not used)		4

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
70-	52722		Drive Shaft, QSB3.3 Turbo/C6 T3		Ref
1	NW033731	5-160X	U-Joint (95019)		2
2	NW035885		Tubing Yoke		1
3	404500		Tubing 3.00 x .083 Wall		1
4	NW035886	3-40-1101	Slip Tube Shaft (95019)		1
5	NW034377	3-3-118KX	Slip Yoke (95019)		1
6	NW34244	3-2-159	Flange Yoke		1

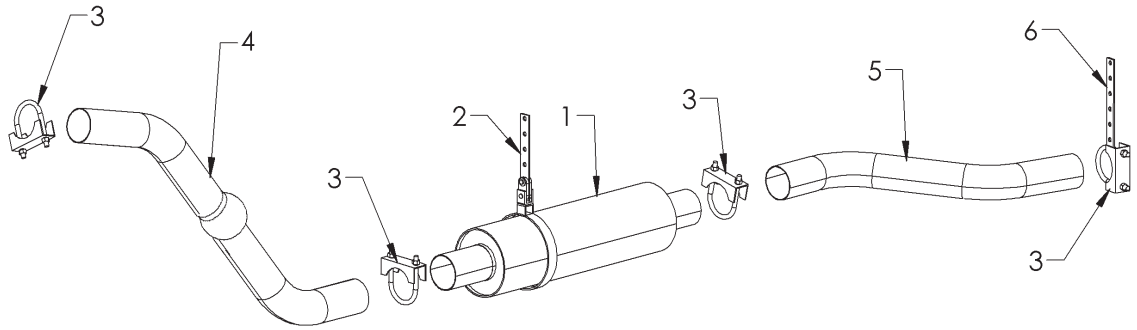


FIGURE 71.

EXHAUST SYSTEM, B3.3 TURBO T3 & PERKINS 1104 C&D

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
71-	47310-4		Exhaust System,B3.3 Turbo, T3		REF
	50030-4		Exhaust System,B3.3/C6,T3		
	51225-7		Exhaust System,Perkins 1104D-44T/C6,T3	G	
	52555-7		Exhaust System,Perkins 1104C-44/C6	G	
1	45368	86187M	Muffler,RD,6.1x21",3"I/L & O/L		1
2	50938		Hanger,Muffler,JG80-5,5 1/2"		1
3	NW035606	HPC300	Clamp,Muffler,3.00"		4
4	47246		Pipe, Exhaust		1
	51318		Pipe, Exhaust, Perkins 1104D		1
4A	46217		Connector, Exhaust, Flex (Required With Item 4)		1
5	48460		Pipe,Exhaust		1
6	NW023112		Hanger Wldmnt, Muffler		1
	50938		Hanger Wldmnt, Muffler (Perkins)		1
NS	46217		Connector, Engine		1
NS	40667		Flange, Wldmnt, Exhaust, Perkins 1104C	G	1
NS	38317		Flange, Exhaust, Perkins 1104C	G	1
NS	42959	13000187	Gasket, Exhaust, Perkins 1104C&D (At Engine)	G	1

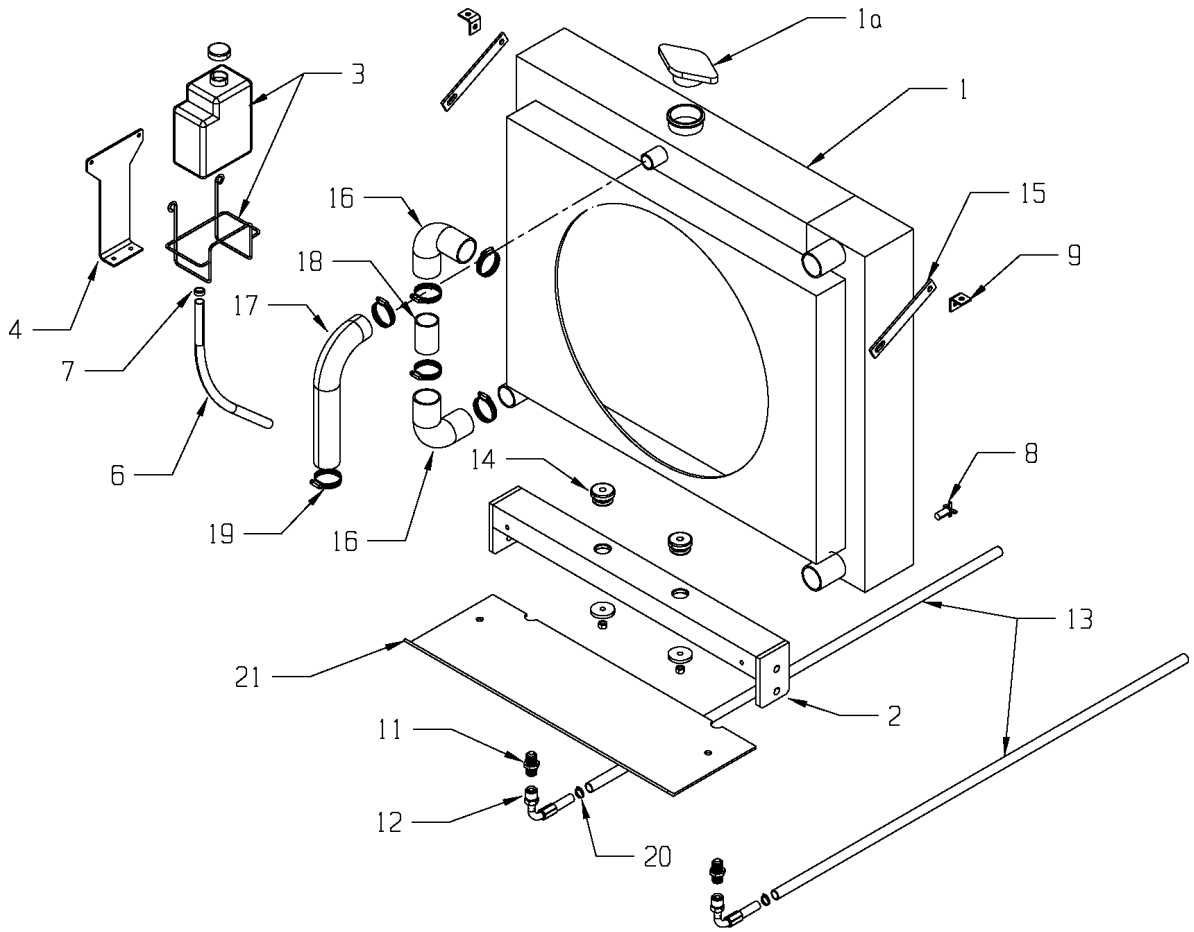


FIGURE 72.
COOLING SYSTEM, B3.3 TURBO T3

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
72-	47310-6		COOLING SYS,M140,B3.3/C6,T3		
1	47231		RADIATOR/OIL/CAC,QSB3.3 & B3.3		1.0
1a			Cap, Radiator		1
2	47235		SUPPORT WLD,RAD,QSB3.3T,B3.3T		1.0
3	44544	BVR-4	RESERVOIR,COOLANT OVERFLOW		1.0
4	44556		BRKT,COOLANT RESER VOIR		1.0
6	NW 031849		HOSE,RECOVERY		1.0
7	NW 036097		CLIP,RE TAIN,RES HOSE *B*		1.0
8	F 100669	M45JV46086	VALVE,DRAIN COCK,1/4" NPT,BRS		1.0
9	43459		ANGLE,MNTG,RADIATOR		2.0
11	F 101295		FTG,HYD,06MJ-10MB		2.0
12	F 104402	33982-6-6	FTG,HYD,06H-06FJX90 (01276)		2.0
13	9.2066	G13KG50030	HOSE 0.37 ID LOW PRESS 01276)		180.0
14	203566	60230	ISOLATOR,RUBBER,CNTR BUSH,3/8"		2.0
15	46589		STRAP, RADIATOR		2
16	208945		HOSE, CURVED, 1.75Æ		2
17	NW036633		HOSE,RADIATOR, 1.25Æ x 19.12		1
18	208967		CUT, 1.75Æ		1
19	F100937		CLAMP, HOSE #28		6
20	F100979		CLAMP, HOSE #6		4
21	48519		AIR DEFLECTOR		1

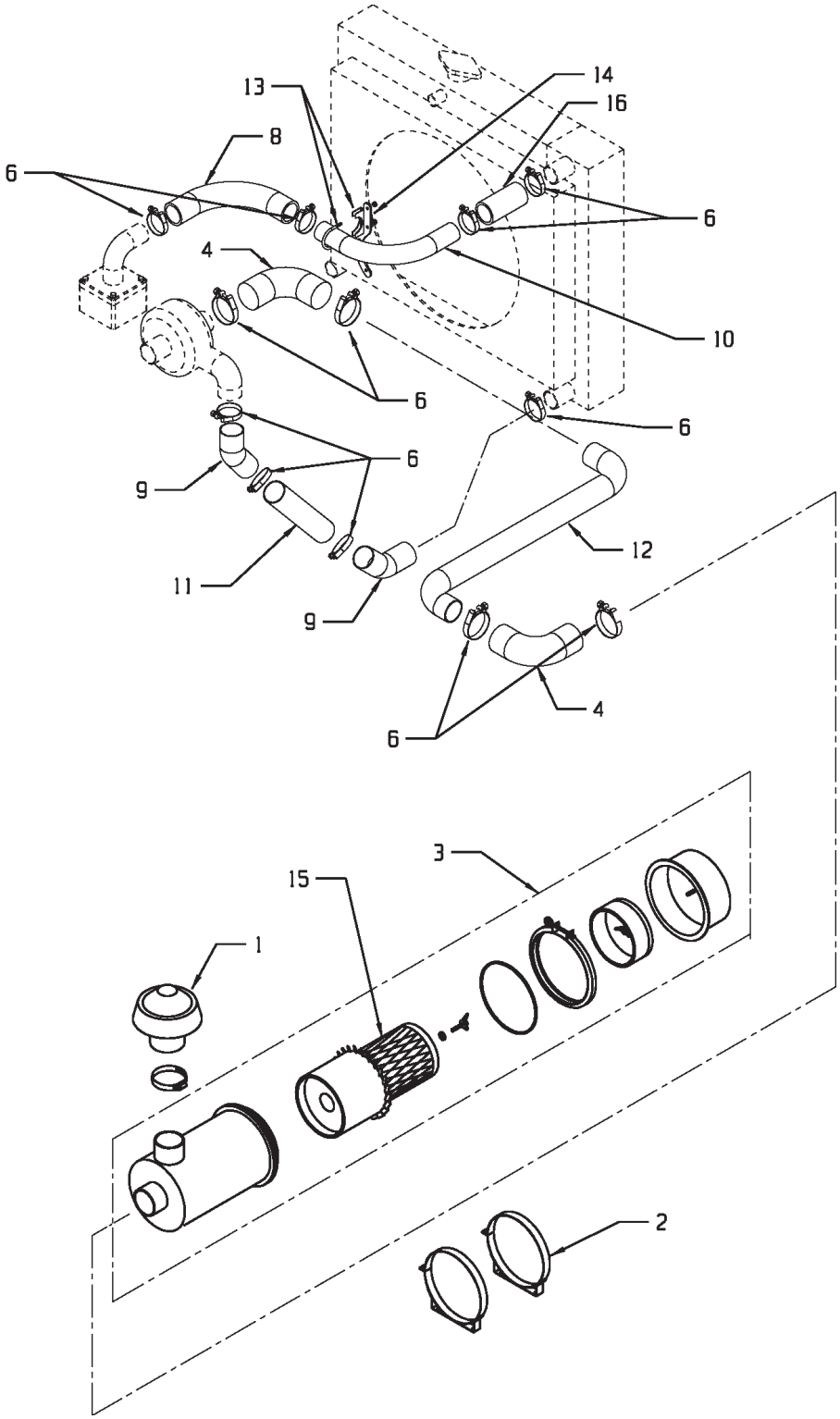


FIGURE 73.

AIR INTAKE SYSTEM, CUMMINS B OR QSB 3.3 TURBO

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
73-	47310-5		Air Intake Sys,M140,B3.3TAA,T3		
1	F104159		Cap, Air Inlet, Metal		1
2	F104049		Band,Mnt,Air Cleaner,9"		2
3	NW029952		Air Cleaner		1
4	NW030064	P105532	Ell,3 ID,Rubber,90 Deg (8S377)		2
6	NW033101	P14-8339	Clamp,T-Bolt,2.50-2.78 (8S377)		5
8	46591	367-250-060	Hose,2.5",Flex,Charge Air		1
9	48471	3648-250-MK	Ell,2.5",45Deg,Flex,Charge Air		2
10	48387		Tube,CAC,Top,100/140,B3.3T		1
11	421806		Cut,4218, 6.60		1
12	48472		Pipe, Air Cleaner Cross Over		1
13	NW035606		Clamp, Muffler		1
14	48474		Brkt, Air transfer Support		1
15	NW029951	P18-1054	Filter Element (8S377)		1
16	46591		Hose,2.5",Flex,Charge Air		2

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
73-	50030-5		Air Intake Sys, M140, QSB3.3 Cummins	H	Ref
1					
2					
3	NW029952		Air Cleaner 8”, Body		1
4	NW030064	P105532	Ell,3 ID,Rubber,90 Deg (8S377)		1
6	NW033101	P14-8339	Clamp,T-Bolt,2.50-2.78 (8S377)		5
8					
9	48471	3648-250-MK	Ell,2.5",45Deg,Flex,Charge Air		2
10	48387		Tube,CAC,Top,100/140,B3.3T		1
11					
12	48472		Pipe, Air Cleaner Cross Over		1
13					
14	48474		Bracket, Air Transfer Support		1
15					
16	46591		Hose,2.5",Flex,Charge Air		2
NS	45982		Air Cleaner (See Fig 73)		1
NS	45983		Band, Mnt, Air Cleaner (See Fig 83)		2
NS	NW035733		Ell, 3x4, Rubber (See Fig 83)		1
NS	NW033103		Clamp,T-Bolt (See Fig 65)		6
NS	46592		Ell, 2.5”, 45 Degree, Flex (See Fig 65)		1
NS	NW033102		Clamp, T-Bolt (See Fig 65)		2
NS	206725		Clamp, Muffler, 2.25”		1

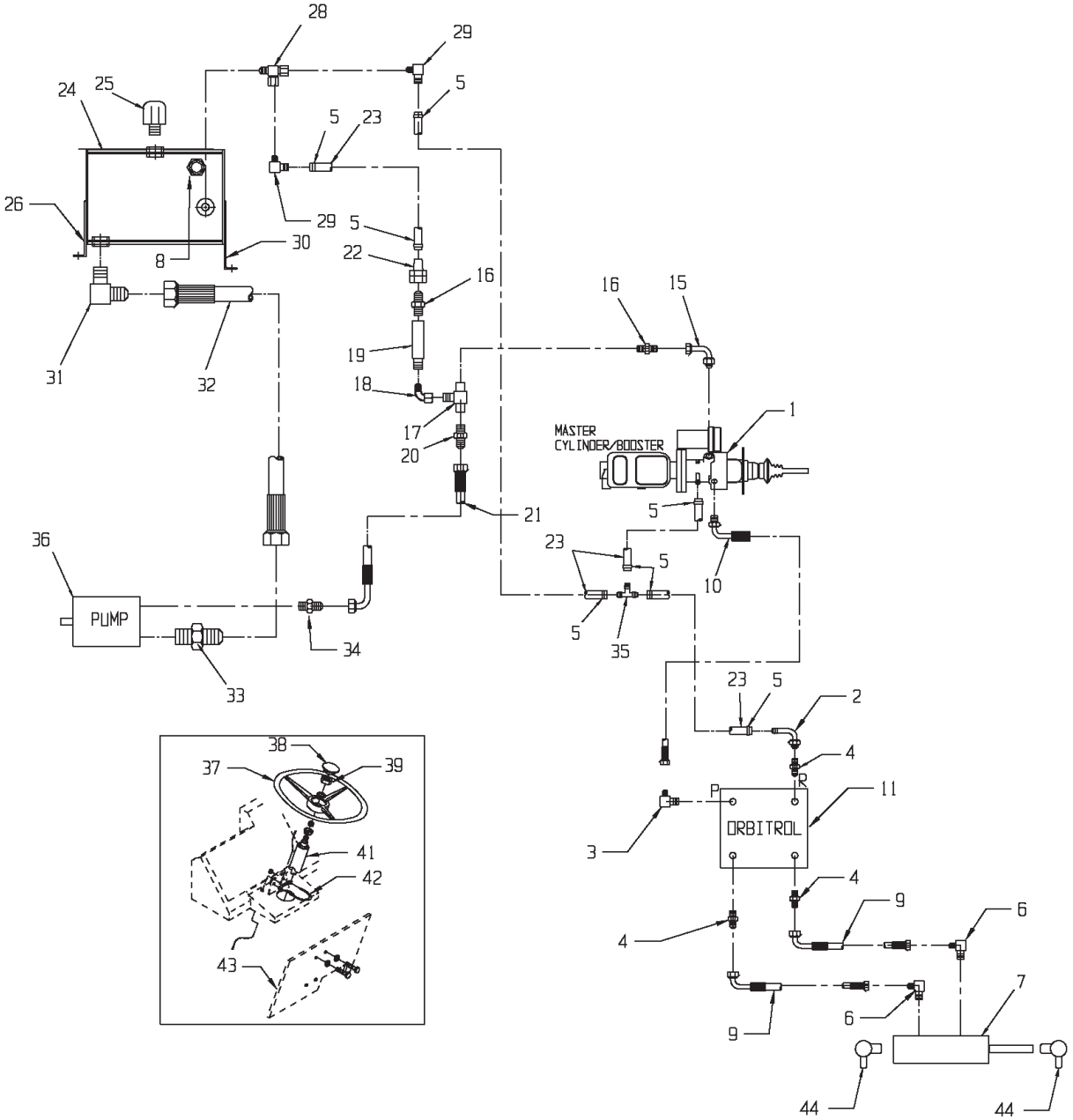


FIGURE 74.

HYDRAULIC SYSTEM, CUMMINS B3.3 TURBO

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
74-	47310-9		HYD ASSY,M140,B3.3 Turbo		1
	47307		PUMP ASSY,GEAR,B3.3 Turbo		1
	46530		STEERING ASSY, M140 HY DRAU LIC		1
	50030-9		HYD ASSY,M140,QSB3.3	H	1
1	46420		MASTER CYLINDER W/BOOSTER		REF
2	F104402		Ftg, 06-06FJX 90		1
3	NW036560		FTG, HYD, 08MB-06MJ90		1
4	3.2519		FTG, HYD, 06MJ-06MB		2
5	F100979	5406	CLAMP,HOSE,#6,.44-.78 (79470)		10
6	3.2143		FTG, 06-06FJX90		2
7	1011081		CYLINDER, STEERING 2B 7.4 ST		1
8	44738	LSP151-05-01	GAUGE,SIGHT PLUG,3/4 NPT (LUBE DEVICES)		1
9	8796.109		HOSE ASSY, #6M 46.63" ST/90		2
10	38828		HOSE ASSY, PS, #6M, 30.5"		1
11	1.7864		STEER UNIT, 5.9 CI		1
15	NW26799	FF5300-0645	FTG, HYD,ELL,PRESSURE (01276)		1
16	3.1572	6/6/2404	FTG,HYD,06MJ-06MP (V00565)		2
17			FTG, TEE		1
18					1
19	NW029020		VALVE,RELIEF,INLINE,ADJ,1100PS (V00534)		1
20	3.1317		FTG, HYD, O8MJ-06MP90 (not as illustrated)		1
21	8797.105		HOSE ASSY #8M 24” ST/90		1
22	46246		FTG,HYD,06H-06JP		1
23	F101679	D13KG61160	HOSE 0.37 ID X 0.66 OD LOW		AR
24	46658		TANK WLDMNT,HYD,1.75 GAL,M140		1
25	202993		BREATHER,3/4 NPT,STL		1
28	3.1391	5602-06-06-06	FTG,HYD,TEE,06MP-06FP-06FP (V00565)		1
29	46247	6/6/4501	FTG,HYD,06H-06MP90 (V00565)		2
31	3.0143	12/12/2501	FTG,HYD,12MJ-12MP90 (V00565)		2
32	8797.11		HOSE ASSY,#8M, 41.32",ST/45		1
33	F101258	6801-12-16-NOW	FTG,HYD,12MJ-16MB90 (V00565)		1
34	91926	6801-08-10-NOW	FTG,HYD,08MJ-10MB90 (V00565)		1
35	F002691		FTG,P,TEE,06 MALL		1
36	304610	26003-LZJ	PUMP,HYD.GEAR,..38CIR,5/8-9TSpline		1
	48473		Pump Assy, Gear, B3.3,M140, T3	I	1
37	202735		STEERING WHEEL, 14"		1
38	202736		BUTTON, HORN FOR VIP WHEEL		1
39	150526		NUT, 13/16-20 HEX		1
41	NW035372		COLUMN, STEERING, 10"		1
42	F103213		CLAMP, 1.75 ID MUF FLER		1
43	46642		COVER PLATE, ORBITROL		1
44	NW034968		TIE ROD END 3/4-16 RH		2
NS	3.1917		Ftg, Hyd, Tee, 06FP-06FP-06FP	H	1
NS	F104418		Ftg, Hyd, Tee Union	H	1
NS	8946.46		Hose, Assy #8M, 50.72”	H	1
NS	46240.14		Hose Assy, #12L, 72.5”	H	1
NS	3.3304		Ftg, Hyd, 08MJ-10MB90	H	1
NS	91938		Ftg, Hyd, 12MJ-12MB90	H	1

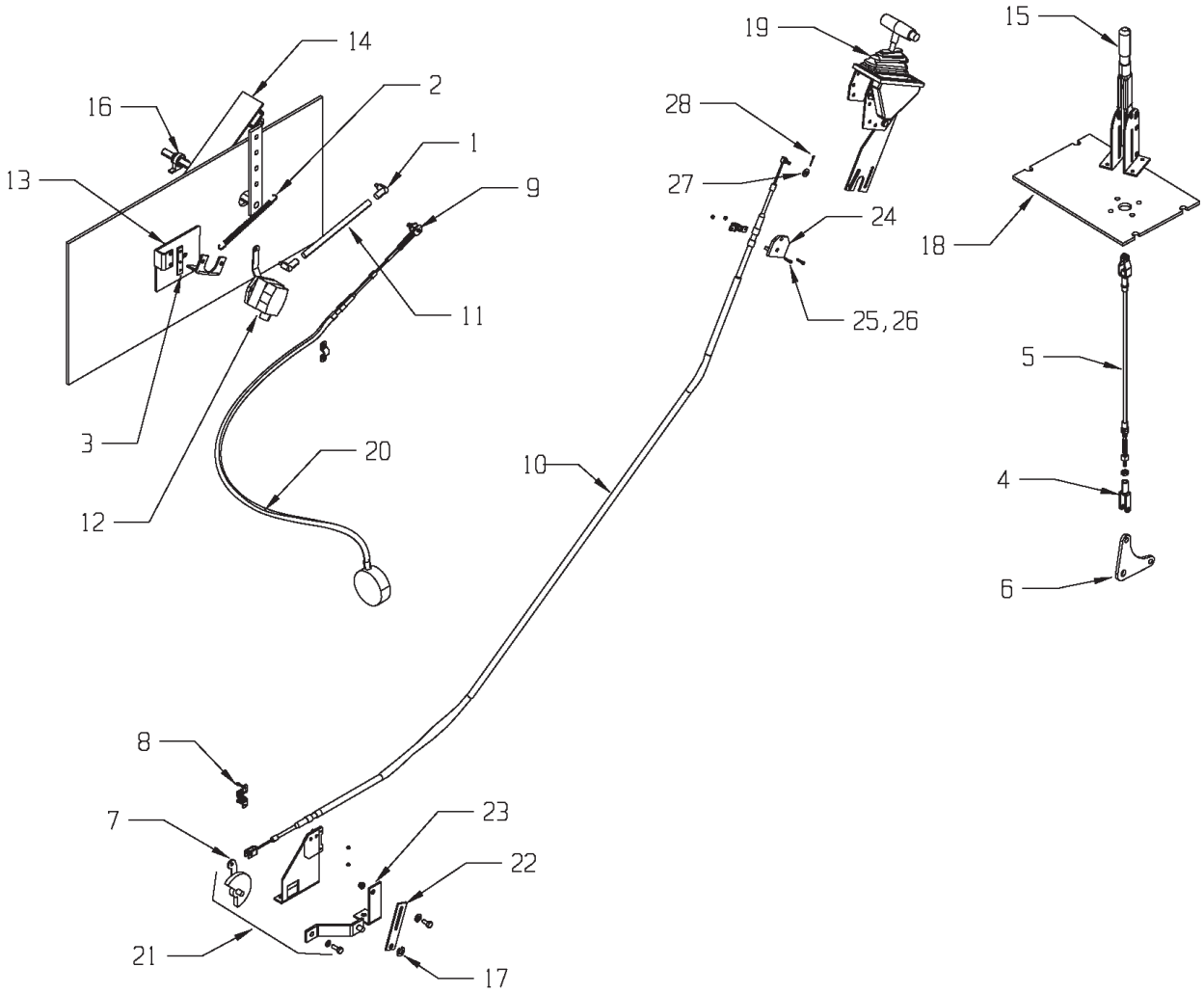


FIGURE 75.
LINKAGE SYSTEM, B3.3 TURBO T3

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
75-	46550-2		LINKAGE SYS,M140,QSB4.5/C6		1
	43953		GRP,TT,SHIFTER,C6,QUADRAST		1
	46685		CON TROLS ASSY,140		1
1	F 101863	R107G	BALL JOINT,ND,1/4-28,1/4-28ST (0NZJ1)		2.0
2	39924		SPRING,MOD U LA TOR RE TURN		1.0
3	39925		BRKT,SPRING RE TURN *B*		1.0
4	90562		CLEVIS, 3/8-24x3/8 PIN (IN CLUDED)		1
5	39457	15787700	CABLE,PRK BRK,50",W/SPRING		1.0
6	NW 033835		PLATE,BRAKE PIV BRKT 140 *B*		1
7	SB489		Neutral Safety Switch		1
8	NW 034731	39001	CLAMP,CABLE MNTG (6S981)		1.0
9	NW 034718	59049-1	KIT,SLIP LINK,FELSTED,60DPC6 (V00546)		1.0
10	NW 031669	307484-3-84	CABLE ASSY,SHIFT,84" (8S377)		1.0
11	406203		CUT,4062, 7.38		1.0
12	45357	TPS001	SENSOR,THROTTLE POSITION,CUMNS		1.0
13	46656		BRKT WLDMNT,ACCEL SEN SOR,M140		1.0
14	46636		PEDAL WLDMT,ACCEL,M140,129"OAL		1.0
15	NW 022767		LEVER,PARK BRAKE-M40/60/100 (92867)		1.0
16	NW 015530		BRG,.50 ID,W/HOUSING		2
17	NW 034551		CLIP,'E'.25 SHAFT,C6/C3 KIKDWN		1.0
18	38675		PLATE, PARK BRAKE LEVER		1
19	NW 036144		LEVER,SHIFT CON TROL,SS NW33909		1.0
20	NW 034717		CABLE,MODULATOR,FELSTED,60DPC6 (V00546)		1.0
21	NW 034343		KIT,CONNECTOR,C6 TRANSMISSIONS		1.0
22	37667		BAR,BRKT,KICKDOWN		1.0
23	NW 034238		BRKT,KICKDOWN ADJ, *B*		1.0
24	39220		Plate, Shift Link		1
25			HHCS, 1/4-20x5/8		1
26	F9536		Nut, 1/4-20 Hex		1
27			Washer, Flat, .328 ID		1

Illustration Not Available At Time Of Publication

FIGURE 76.

ELECTRICAL ASSEMBLY, B3.3 TURBO T3

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
76-	47310-3		ELEC ASSY,M140,B3.3TAA/C6,T3		
2	46580		FTG,HYD,02FP-M14MB		1.0
4	38733		FTG,HYD,02MP-02FP		1.0
6	3.1820	R99JT05500	FTG,HYD,TEE,02MP-02FP-02FP (V00565)		1.0
8	F 100780	A40JT41270	FTG,HYD,08MP-02FP		1.0
10	F 101146	COV2113Z1	CLIP,INSUL,1.25 ID, .41 HOLE		1.0
12	NW 030236	02023-00	SENDER,TEMP,HI-RANGE,1/4 NPT (8S377)		2.0
14	F 101527		SENDER,OIL PRESS,0-100#,1/8NPT (V00542)		1.0
16	F 102160	F498	RELAY,STARTER,12V (V00549)		1.0
18	NW010518FB		STRAP,GROUND,4 GA X 9" (59587)		1.0
20	NW 021649	8647	SWITCH,OIL PRES SURE,HOURMETER (13445)		1.0
22	RF 090896	2” ID ALUMINIZ	SLEEVE ALUM FBRGLS 2.50		40.0
24	46036		CABLE ASSY,GND,CMNS 4B4.5		1.0
26	43145	120-901 STANCO	RELAY,POWER,SPNO,12VDC/100A		1.0
28	305006	AMG-125 BUSSMA	FUSE,125A/48V,MEGA/AMG		1.0
30	46648		HAR NESS,REAR,C6,M140		1.0
32	46625		HARNESS,ENG,QSB4.5,M100,T3		1.0
34	42980		HARNESS,GROUND WIRE,200MB4		1.0
36	46620		HAR NESS,BATTERY B+,M100,T3		1.0
38	45992		HARNESS,INDICATOR LTS,M100		1.0
40	44243		SCHEMATIC,ELEC,CUMMIN,ATC,FUSE		0.0
42	46650		BRKT,FUSE HOLDER,QSB4.5,M100		1.0
44	46601	51204	ISOLATOR,STUD/PLATE MNT		1.0
46	45400		HARNESS,INDICATOR LTS,140		1.0
48	2.3277	36421	TERMINAL,RING,5/16,#1/0 AWG		1.0
50	2.3274	BH146	TERMINAL,RING,3/8,#1/0 AWG		1.0
60	200085	46230	FUSE, 30A/32V,ATC		1.0
62	M257005	46205	FUSE, 5A/32V,ATC		1.0
64	47038		HARNESS,STARTER,CMNS QSB4.5		1.0

Illustration Not Available At Time Of Publication

FIGURE 77.

GRP, M140,ENG,PERKINS 1104D-44T/C6

Fig.-Item	NMC Wollard Part No.	Nomenclature	Eff	Units Per Assy
77-	51225	Grp, M140, Eng,1104D-44T/C6	G	Ref
	51225-1	Eng / Trans / Mount ing Perkins1104D-44T/C6		1
	51225-2	Link age System		1
	51225-3	Elec Sys Engine		1
	51225-4	Cooling System		1
	51225-5	Air Intake System		1
	51225-7	Exhaust System		1
	51225-8	Fuel System		1
	51423	Pump Assy Hydraulic		1
	51225-10	Battery System		1
	51424	Cover, Fender, Hyd Tank		1

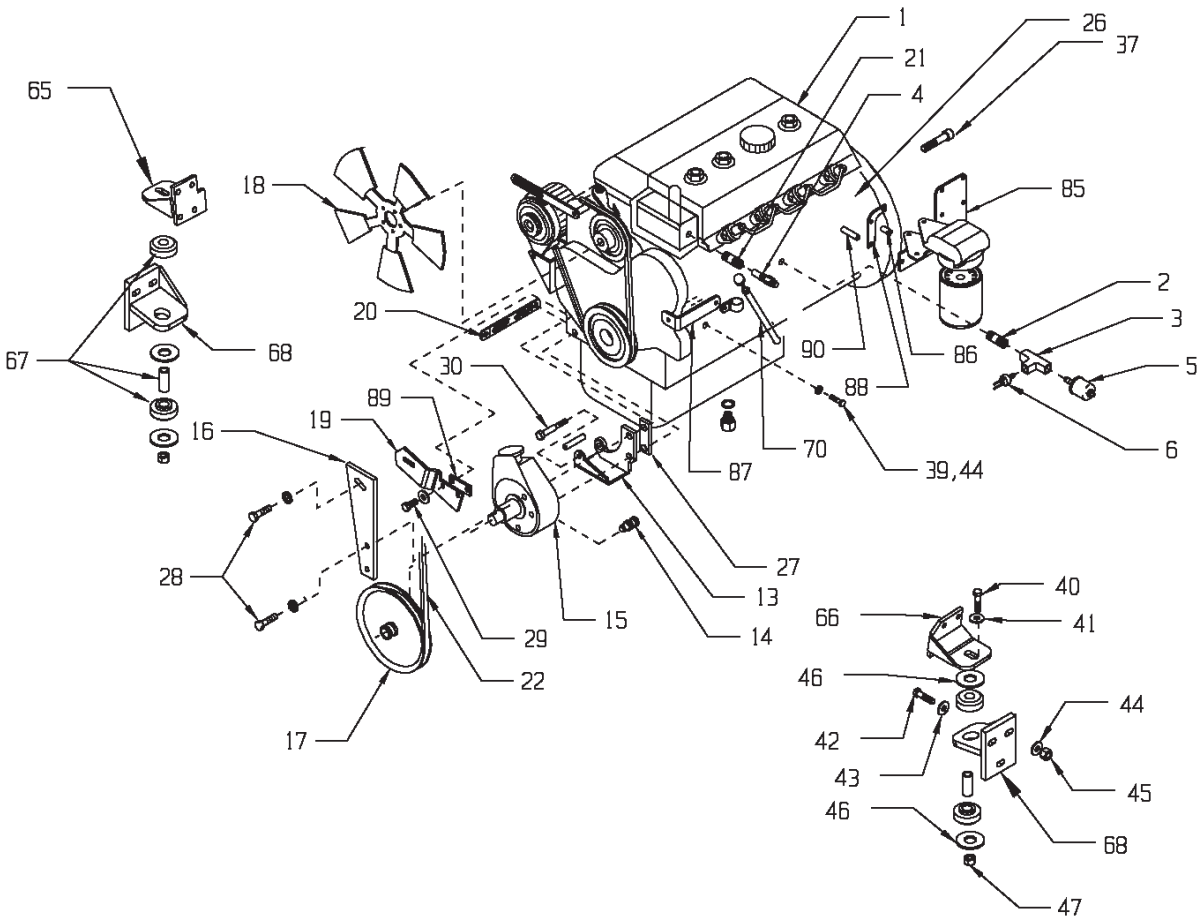


FIGURE 78.

ENGINE/ TRANSMISSION MOUNTING, PERKINS 1104-44T/C6

1 OF 2

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
78-	51225-1		Engine/Transmission, Perkins 1104D-44T/C6, Tier 3	G	REF
	51423		Pump Assy, Hyd, 1104		
1	51235		Engine, Perkins 1104D-44T, C6, TPEM		1
2	38733		Fitting, Pipe, Nipple, 1/8-27 w/Hex		1
3	3.1820		Fitting, Pipe, Tee, 1/8 NPT		1
4	F101526		Sender, Temp		1
5	F101527	02025-00	Sender, Oil Pressure (V00542)		1
6	NW021649	8647	Switch, Pressure (13445)		1
13	43258		Pivot Weldment, PS Pump		1
	F100196		HHCS, 3/8-24 x 1.25		2
	F009665		Lockwasher, 3/8		2
14	45811		Valve, Relief, PS, 800-900 PSI		1
	45812		O-Ring, PS, 800-900 PSI		1
15	F102526		Pump, Power Steering		1
	46229		Cap, Power Steering		1
	F103926		HHCS, M10 x 1.5 x 25mm DN 933		2
	F018486		Lock Washer, 7/16		3
16	38334		Plate, Adjuster, PS Pump		1
17	NW023994	3830967	Pulley, Steering Pump (1HS72)		1
18	48487		Fan, 18" Puller	G	1
19	44941		Adjuster, Power Steer Pump, 1104		1
20	NW010518FB		Strap, Ground		1
21	F100780		Reducer, Bushing, 1/2 NPT to 1/8		1
22	45093	7355	Belt V, G 7355, 3/8 x 36 1/4		1
27	51428		Spacer, PS Pump		1
28	NW031646		HHCS, 10mm x 30mm GR 8		2
29	38321		HHCS, M16 x 40mm		2
30	F103926		HHCS, M10 x 1.5 x 20mm DN 933		2
37	NW03461		Socket Head Bolt		1
39	F104348		HHCS, 12mm x 1.75		12
40	F100405		HHCS, 5/8-11 x 4, GR5		2
41	204714		FW, 5/8 SAE, Hard		2
42	F018701		HHCS, 1/2 x 1-3/4		6
43	F100064		Washer, 1/2 Flat		6
44	F015973		Washer, 1/2 Lock		14
45	F016825		Nut 1/2-13 Hex		6
46	37535		FW, .66 ID, 3.12 OD, .19 thk		4
47	3.0391		Nut, Hex, 5/8-11 Lock, Esna		2
65	51315		Engine Mount, Perkins RH	G	1
66	51320		Engine Mount, Perkins LH	G	1
67	44514		Isolator		2
68	51320		Mnt, Wld,Eng/Frame,LH		1
69	42031-20	4126X091	Tube, Dipstick		1
85	44859		Brkt Wldmnt, Fuel Filter, P1104		1
86	204783		Spacer, Brake Lever, P1104		1
87	44940		Angle, Dipstick Mnt, C6		1
88	44888		Plate, Mnt, fuel Filter, P1104		1
89	44942		Spacer, Power Steer Pump, 1104		1
90	400906		Spacer, Cut, 4009, 1.00		1
91	51315		Mnt, Wld,Eng/Frame,RH	G	1
NS	42265		Heater, Block, Option		1
NS	39981		Brkt, Dipstick		1

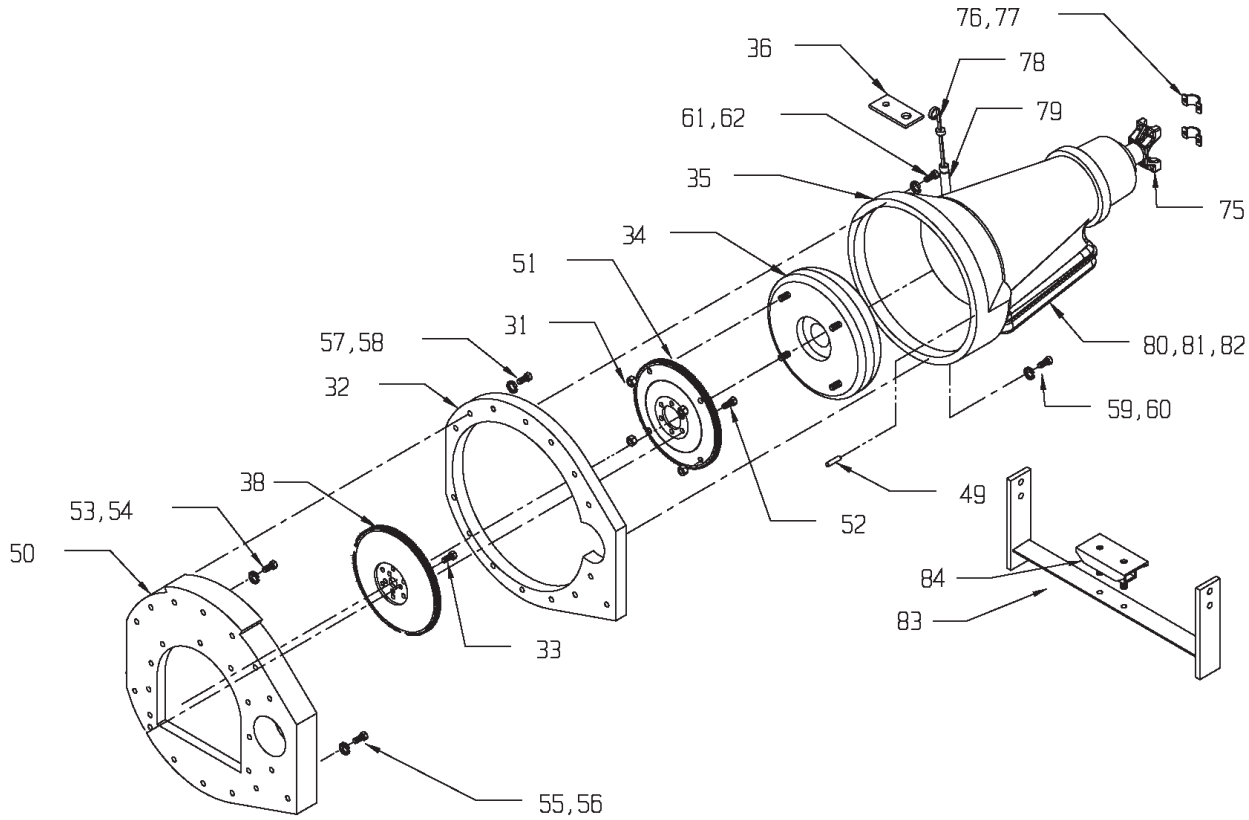


FIGURE 78.
ENGINE/TRANSMISSION MOUNTING, PERKINS 1104-44T/C6
2 of 2

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
78-	51225-1		Perkins Engine Pack 1104-44 T2/C6		Ref
31	F103925		Nut, Hex		4
32	43693	13500038	Plate, Flywheel Assembly (V00517)		1
33	Comm		HHCS 1/2-20 GR 5		6
34	43365	EATP-7902-BBPR	Converter Assembly		1
35	NW034441	XUIL-7000-BAPR	Transmission, C6		1
	NW034678		Ring Gear, 126 Teeth		1
36	43269		Bracket, Dipstick		1
38	43694		Flywheel Assy w/ Ring Gear (V00517)		1
	NW034678		Ring Gear For Flywheel, 126T		1
49	F100444		Pin Dowel		2
50	43695	10500008	Flywheel Housing (V00517)		1
51	43361	6375A	Flywheel, Ford		1
	43362		Reinforcing Plate, Flywheel		1
52	43363		HHCS, 7/16-20 x 13/16		6
53	NW031820		HHCS, M12-1.75 x 38 (at top)		2
54	Comm		Washer, M12 Lock		2
55	204730		HHCS, M10-1.50 x 35		6
56	3.3326		Washer, M10 Lock		6
57	F100403		HHCS, 1/2-13 x 1.5		12
58	F015973		Washer, 1/2 Lock		12
59	F016102		SHCS, 5/16-18 x 1.25 (on inside)		1
	F100308		SHCS, 5/16-18 x 1.50 (bottom center)		3
60	F009704		Washer, 1/4 (for above)		2
61	F100622		HHCS, 7/16-20 x 2.0		6
62	F018486		Washer, 7/16 Lock		6
75	NW036501		Yoke Flange		1
76	41072		Bolts		4
77	41073		Strap		2
78	42856		Dipstick		1
79	44075	EOPZ-7A228-A	Tube, Dipstick C6		1
80	302313		Pan, Oil		1
81	37920		Gasket, Oil Pan, C6		1
82	NW034532		Filter, Transmission		1
83	51312		Support Wldmnt, Trans		1
84	37188		Trans. Mount. C6		1

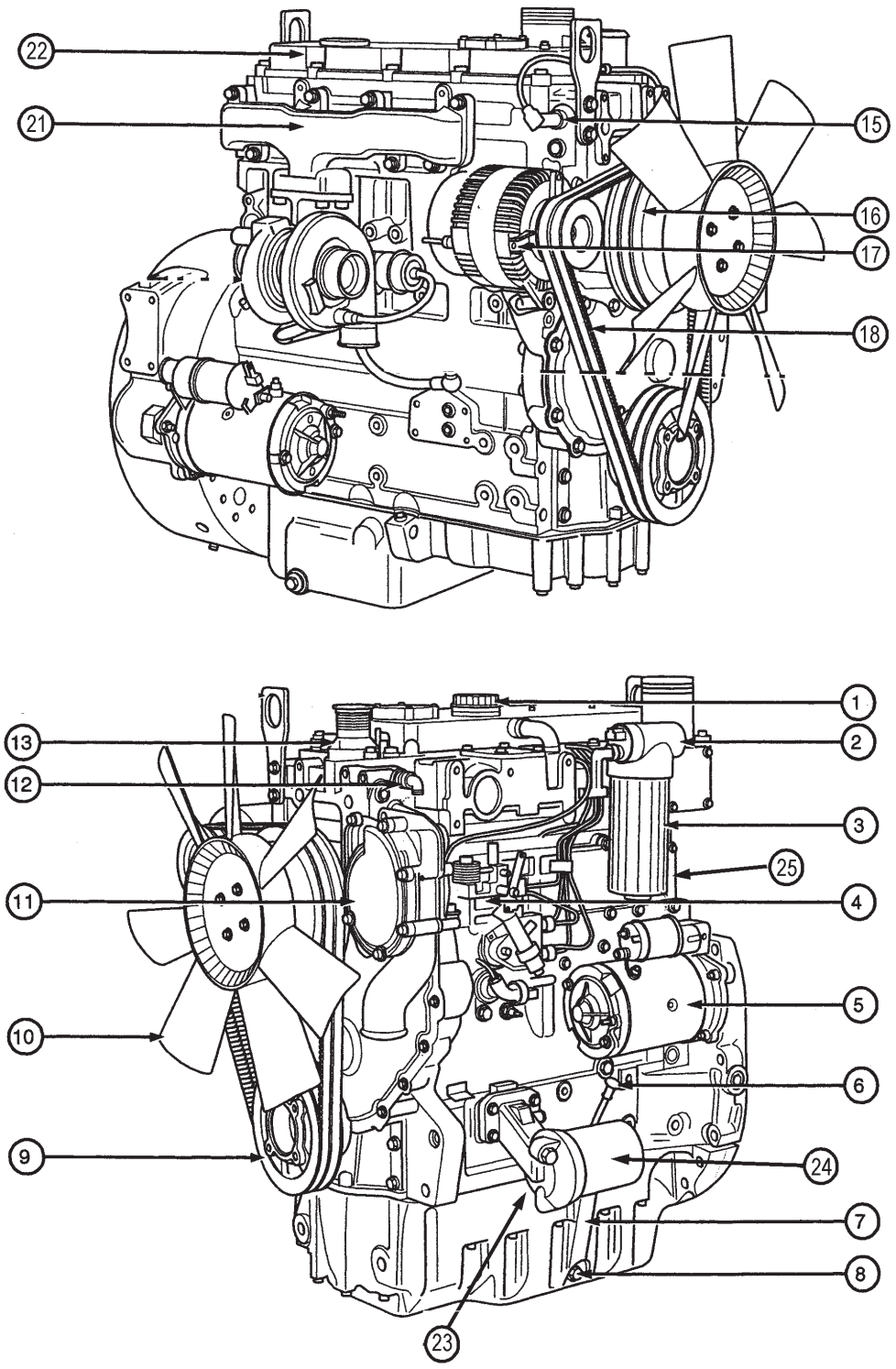


FIGURE 79.

OEM PARTS, PERKINS 1104 C & D

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
79-	51235		Perkins Engine - OEM Parts		Ref
	44827		Perkins En gine - OEM Parts		Ref
1	308809	4142X099	Cap, Lube Oil Filler		1
2		4132A008	Pump, Electric Fuel Lift		1
3	308937	26560201	Filter, Fuel		1
4		2644N203/24RPM	Fuel Injection Pump		1
5	42047	NC873033	Starter Motor		1
6		3178C077	Dipstick, Lubricating Oil		1
7	45820	3717Y061	Oil Pan (Perkins 1104C-44)		1
8	42031-15	32186405	Plug, Oil Pan		1
	42031-16	2415715	O-Ring, Oil Pan Plug		1
9		3115T051	Crankshaft Pulley		1
10			Fan		1
11		U5MW0194	Coolant Pump		1
12			Sender Unit For Start And Advance KSB		1
13		4133L509	Thermostat Housing (ASM)		1
15		2848A127	Sensor, Coolant Temperature		1
16		3115C113	Pulley, Fan		1
17	303831-01	12500217	Alternator		1
18	308938	12000298	Belts, Drive		2
21		3778E232	Exhaust Manifold		1
22		4142X29	Rocker Cover		1
23	M2848062	2848062	Switch, Oil Pressure		1
24		2654403	Filter, Lubricating Oil		1
25		4134W003	Lubricating Oil Cooler		1
NS	42031-1	2666A015	Intake Pre-Heater		1
NS	43246-1	2656F802	Fuel Filter Assembly		1
NS	43246	26560154	Element, Fuel Filter		1

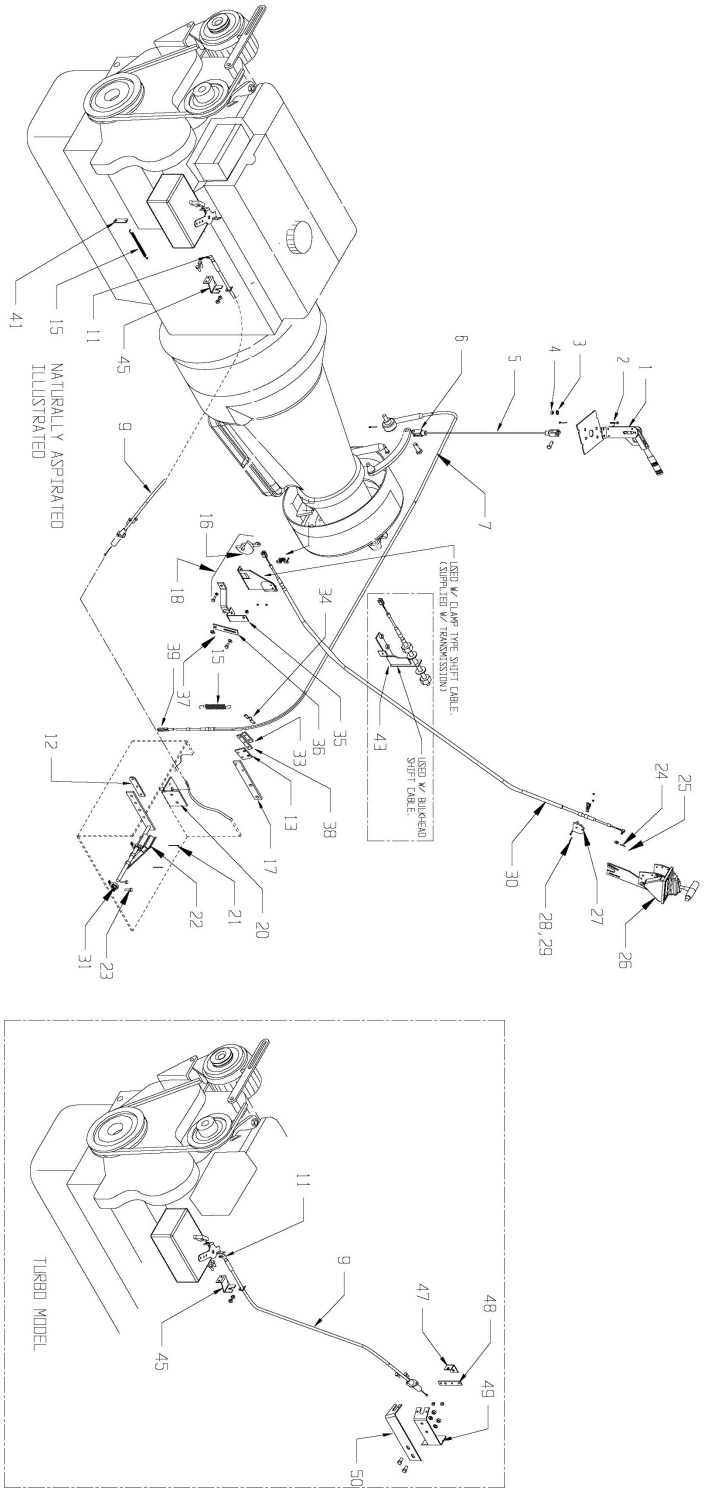


FIGURE 80.
LINKAGE SYSTEM, PERKINS 1104D-44T/C6
(1 OF 2)

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
80-	51225-2		Linkage Sys, M140, Perkins 1104D-44T/C6		Ref
1	NW22767		Lever, Park Brake-M140		1
	NW33835		Plate, Brake Piv Brkt		2
	NW34265		Pivot, Brake Act'r, 140		1
	NW33861		Rod End, 1/2-20 Fem, 140		1
2	F100306		HHCS 5/16-18 X .75		4
3	F009546		Washer, 5/16 Lock		4
4	F009547		Nut Hex, 5/16-18		4
5	39457		Cable, Prk Brk, 50", W/S		1
6	90562		Clevis, 3/8-24 X 3/8 P		1
7	NW34717		Cable, Modulator, Felsted		1
9	NW034298R		Cable, Accel		1
10	F101865		Clip, U-Bolt, Zc Pltd, J		2
11	F101863		Ball Joint,Nd,1/4-28,		2
12	42270		Plate, Throttle Lever		1
13	42381		Brkt, Modulator		1
14	NW21911		Spring, Carb Return		1
15	39924		Spring, Modulator Return		1
16	NW35944		Neutral Safety Switch		1
17	42272		Brkt, Mod Cable Mnt		1
18	NW34343		Kit, Connec tor, C6 Tran		1
19	41457		Brkt Wldmnt, Thrtl Cab		1
20	NW34364		Brkt, Throttle Cable,1		1
21	F001005		Pin Cotter 7/64 X 1		2
22	38307		Pedal Wldmnt, Accel, 14		1
	38461		Pedal Wldmnt, 140 See Fig 11		1
	38487		Brkt Wldmnt, Master Cyl See Fig11		1
	38504		Arm, Brake Shaft, 140dg See Fig 11		1
	F104435		Spring, Ext, .85 OD X 2 See Fig 11		1
23	Comm		HHCS, 1/4-20 X 1.00		4
24	Comm		Flat Washer .328 Id		1
25	Comm		Cotter Pin, 3/32 Dia.		1
26	NW36144		Lever, Shift Control		1
27	39220		Plate, Shift Link		1

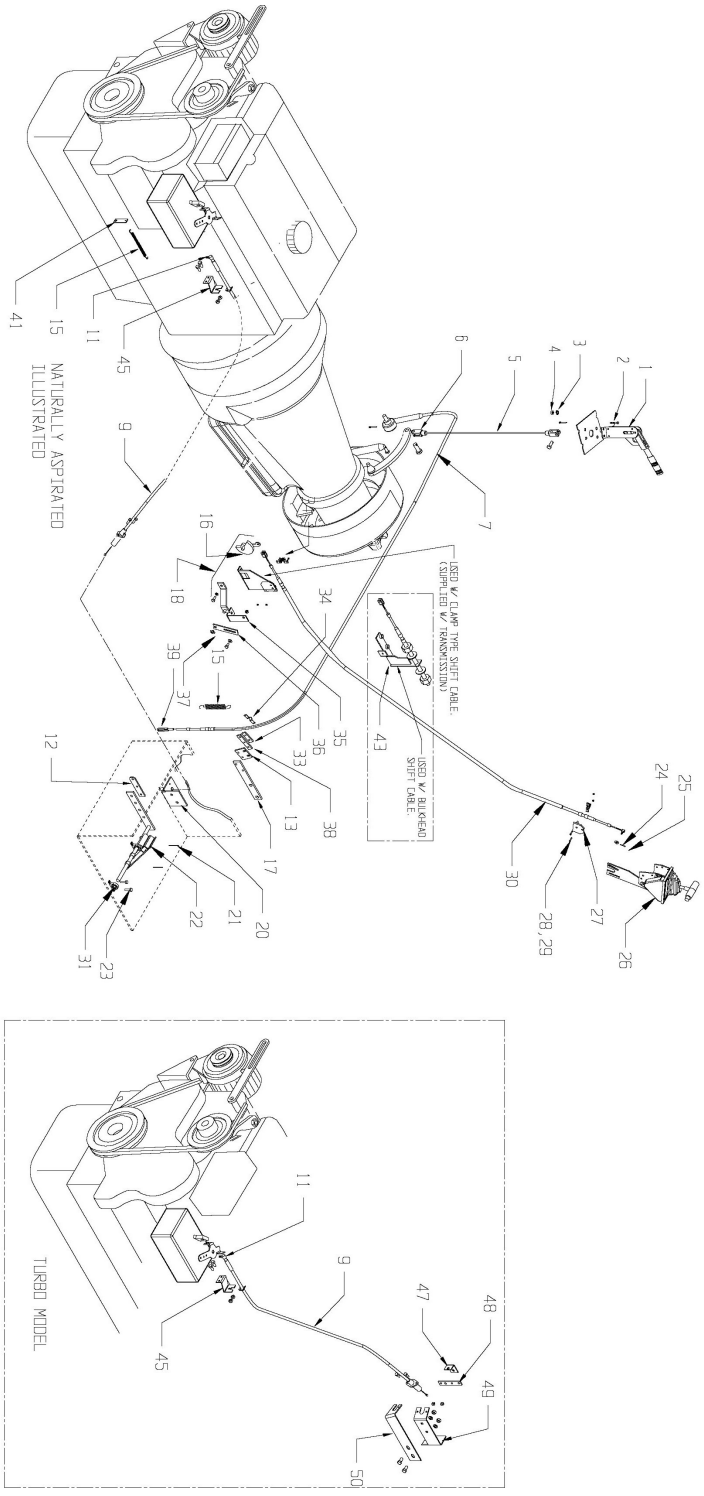


FIGURE 80.
LINKAGE SYSTEM, PERKINS 1104D-44T/C6
(2 OF 2)

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
80-	51225-2		Linkage Sys, M140, Perkins 1104D-44T/C6		Ref
28	Comm		HHCS, 1/4-20 X 5/8		2
29	F9536		Hex Nut, 1/4-20		2
30	NW31669		Ca ble Assy, Shift, 84"		1
31	NW15530		Brg, .50 Id, w/Hous ing		1
33	NW34733		Shim		1
34	NW34731		Clip, Cable Mntg		1
35	37667		Bar, Brkt, Kickdown		1
36	NW34238		Brkt, Kickdown Adj		1
37	NW34551		Clip, 'e' .25 Shaft, C6		1
38	39925		Brkt, Spring Re turn		1
39	NW34718		Kit, Slip Link, Felstad		1
41	41706		Bracket, Return Spring		1
43	44293		Brkt, Shift Cable		1
45	45234		Brkt, Throttle Ca ble Mnt		1
	42271		Brkt, Throttle Cable		1
47	NW034296		Angle, Accel. Cable (Turbo)		1
48	42300		Brkt, Modulator Cable (Turbo)		1
49	41319		Brkt, Accel. Cable (Turbo)		1
50	42301		Brkt, Modulator Cabler Mnt (Turbo)		1
NS	48476		Brkt Weld, Cable Mtg		1
NS	47174		Plate, Eq Valve		1

Illustration Not Available At Time Of Publication

FIGURE 81.

ELEC. SYS, ENG M140,PERKINS 1104D/C6

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
81-	51225-3		Elect Assy,M140,1104D-44T/C6		Ref
	3.3329		Nut,Hex,M6 X 1.0,ZC		1
	37733	COV 1117	Clip,Insul,.62 ID, .53 HOLE		2
	51311		Harness, Wiring (Used on 51225-3)		1
	45745		Schematic,Elec,1104 (See Chap 2)		1
	38733		Ftg,Hyd,02MP-02FP		1
	F016765		F,RHMS,#10-32 X 3/4,ZC		1
	3.0556		Ftg, P, 08MP-02FP, BRASS		2
	F101115	COV 0813	Clip,Insul,.44 ID, .41 HOLE		3
	F101680	COV2913ZI	Clip,Insul,1.75 ID, .41 HOLE		1
	F102160	F498	Relay,Starter,12V (V00549)		1
	F103925	MNC5	F,Nut,Hex,M10X1.5P,GR8.8,ZC*NS		1
	3.3197		F,HHCS,M10 X 1.50 X 30MM,GR8.8		2
	NW031487		F,Nut,Hex,M5 X 0.8,ZC *NS*		1
	NW031776		Harness,Starter		1
	F101527	02505-00	Sender,Oil Press,0-100#,1/8NPT (V00542)		1
	NW021649		Switch,Oil Press,Hourmeter (13445)		1
	NW030236	02023-00	Sender,Temp,Hi-Range,1/4 NPT (8S377)		1
	46648		Harness,Rear,C6		
	F101526	02022-00	Sender,Temp,Hi-Range,1/8 NPT (8S377)		1
	NW010518FB		Strap,Ggound,4 GA X 9" (59587)		1
	3.1820		Ftg,Hyd,Tee,02MP-02FP-02FP (V00565)		1
	NW017269		Cable,Battery,18",2 GA,BLK (6K866)		1
	NW032137		Ccable,Battery,48",1 GA,RED (6K688)		1
	RF090896		Sleeve, Alum Fiberglass		40”
	2.1401		Relay, Power, SPNO		1
	2.3345		Fuse, 30A/32V, FNM		1
	2.3346		Holder, Fuse 30Amp		1
	37540		Plug Assy, Elect		

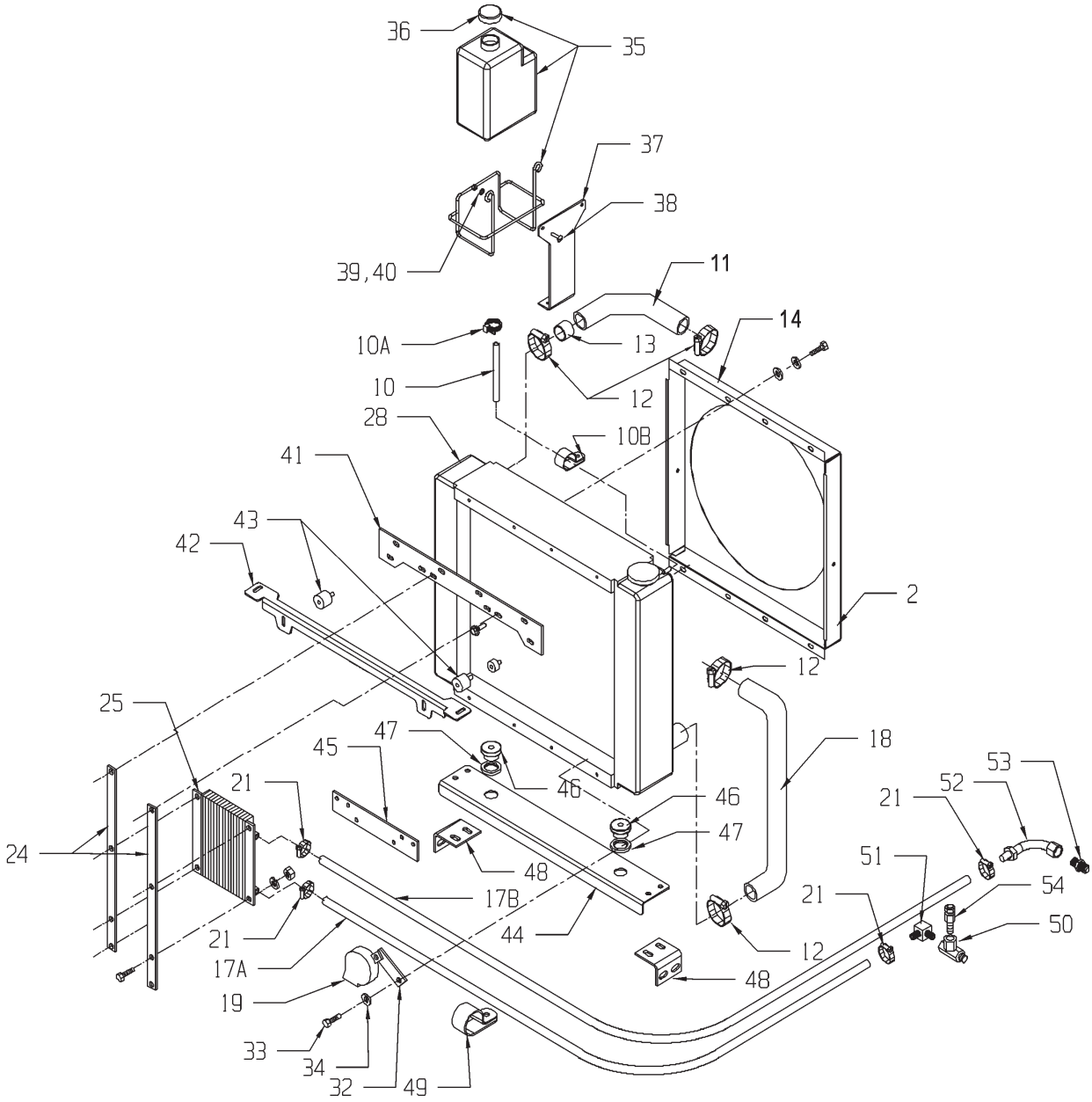


FIGURE 82.

COOLING SYSTEM, PERKINS 1104D-44 T/C6, T3

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
-82	51225-4		Cooling System, Perkins, 1104D-44T/C6, T3		Ref
2	F101603		Trim, Edge, .156 Grip		3.8”
10	NW031849		Hose, Recovery, Vinyl, 55"		1
10A	NW036097		Clip, Retaining, Res Hose		1
11	42151		Hose, Radiator, 2.00x16.5		1
12	F101140		Clamp, Hose, #32		4
13	40340		Hose, Rad, Reducer, 1.75 ID x 2		2
14	48486		Shroud, Fan		1
17A	9.2066		Hose, Coolant		160”
17B	9.2066		Hose, Coolant, (to rear of trans)		
18	38344		Hose, Radiator, 2 x 9.5		1
19	152864	7200021	Horn (V00544)		1
21	F100979		Clamp, Hose, #6, .44-.78		6
24	37676		Strap, Mount, Oil Cooler		2
25	37655		Cooler, Oil, Trans		1
28	37576	11364	Radiator, w/Cap (0J567)		1
	NW017243	3781830	Radiator Cap (1HS72)		Ref
32	43413		Bracket, Horn Mounting		1
33	F100306		HHCS, 5/16-18 x 0.75		1
34	F009546		Lock Washer, 5/16		1
35	44544	BVR-4	Reservoir, Coolant Overflow (ONYTB)		1
36	40164	68	Cap, Reservoir (34669)		1
37	44556		Brkt, Coolant Reservoir		1
38	38615		THMS 5/16-18 x 1		2
39	F009549		Washer, 5/16		2
40	F014476		Nut, 5/16-18 Nylok		2
41	44726		Plate, Upper, Rad Mnt, 60DP		1
42	38077		Mount, Upper Rad Mnt		1
43	44298		Isolator, Ruber, Stud Plt, 5/16		2
44	47800		Brkt Wldmnt, Lower, Rad Mnt		1
45	39484		Plate, Cooler, Mnt		1
46	203566		Isolator, Rubber, Bushing, Center		2
47	NW014597		FW 2 OD x 9/16 ID x 1/4 Thk		2
48	44727		Brkt, Lower, Rad Mnt, Frame, 60DP		2
49	37433		Clip, Insul, 1.25 ID, .53 Hole		2
50	NW034729		Ftg, Hyd, Tee 04MP-04FP-04FP		1
51	NW034736		Ftg, Hyd, 06H-04MP90		1
52	F104402	33982-6-6	Ftg, Hyd, 06H-06FJX90 (01276)		1
53	3.1571		Ftg, Hyd, 06MJ-04MP		1
54	NW030236		Sender, Temp		1

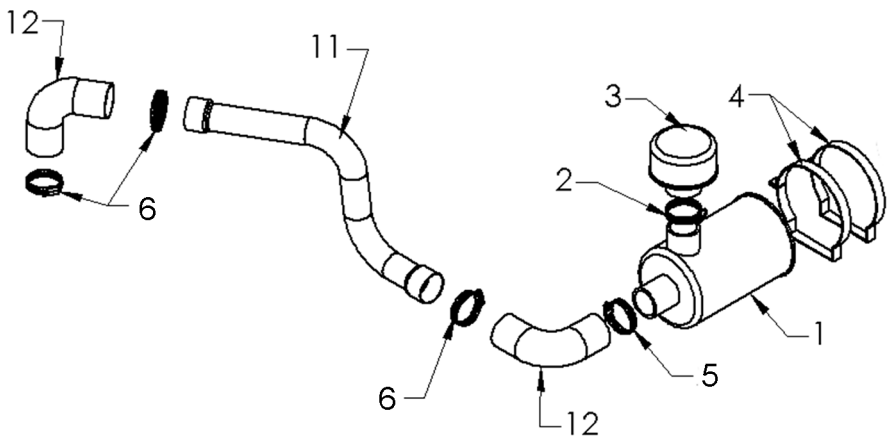


FIGURE 83.
AIR INTAKE SYSTEM, M140, 1104D-44

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
83-	51225-5		Air Intake System, Perkins 1104D-44T/C6		Ref
1	45982		Air Cleaner		1
2	NW033103	P14-8341	T-Bolt Clamp, 3.0 (8S377)		1
3	46604		Cap, Air Cleaner, Plastic		1
4	45983		Band, Mnt, Air Cleaner		2
5	NW035628		Clamp, T-Bolt, 4.31-4.5		1
6	NW033101		Clamp, T-Bolt, 2.5-2.7		3
10	37851		Cup		1
11	51437		Tube, Air Intake, 1104D		1
12	NW035733		Ell, 3 ID, Rubber, 90°		2
NS	46604		Hood, Air Cleaner		1
NS	NW036784		Ell, 2.25 ID Rubber, 45 Degree		1

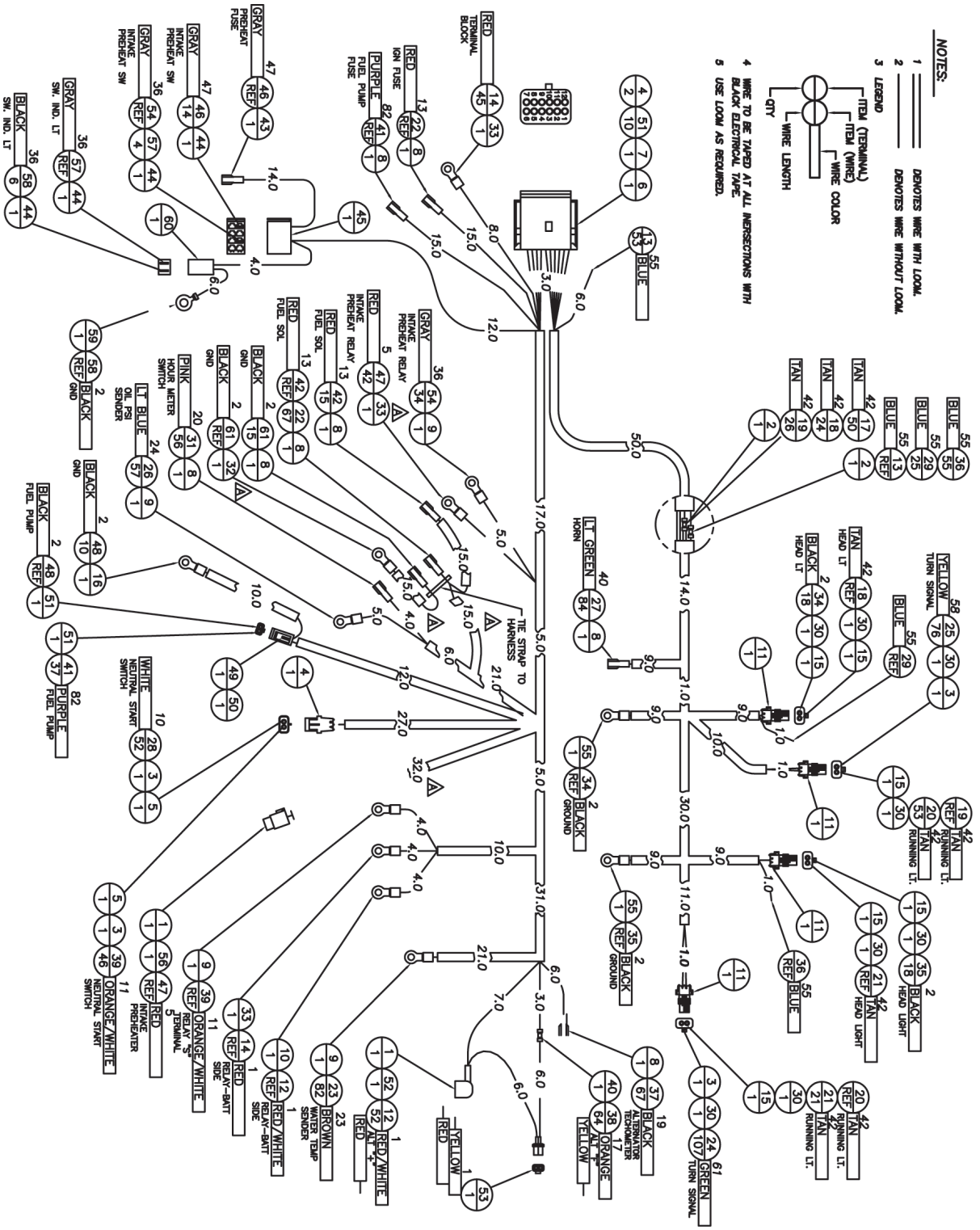


FIGURE 84.

HARNESS WIRING 51311, PERKINS, 1104, M140

(1 OF 2)

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
84-	51311		Harness, Wiring, Perkins 1104D-44T/C6		Ref
1	49672		Conn, El, Deutsch, Plg, Dthd		1
2	F100899	32560	Butt, Conn, 12-10, Waytek		2
3	37309		Conn, EL, W-Pac&280, Seal, 16-18Ga		4
4	206101		Conn, El, Deutsch, Seal Plg,12-16		2
5	37307		Conn, EL, W-Pac, Pin, 14-16 AWG		2
6	45016		Conn, El, Deuts, P, DT06-12SA-P012		1
7	45017		Conn, El, Deutsc, Wedge, W12S-P012		1
8	F102204	31511	1/4 Push-On, Female, 16-14, Waytek		8
9	F100846	31503	#10 Ring Terminal, 16-14, Waytek		4
10	F101854	32504	5/16 Ring Terminal, 12-10, Waytek		1
11	37640	38043	Conn, Tower Half, Waytek		4
12	F101897		Wire, Red/White, 10 Ga		52"
13	F9793		Wire, Blue, 16Ga		50"
14	F104428		Wire, Red, 8 Ga		49"
15	37310	39001	Cable Seal, Waytek		6
16	F101850	31504	1/4 Ring Terminal, 16-14, Waytek		1
17	38031		Wire, Tan, 14Ga		50"
18	38031		Wire, Tan, 14Ga		24"
19	38031		Wire, Tan, 14Ga		26"
20	38031		Wire, Tan, 14Ga		53"
21	38031		Wire, Tan, 14Ga		21"
22	F9794		Wire, Red, 16Ga		70"
23	F100514		Wire, Brown, 14Ga		82"
24	F100933		Wire, Dr Green, 16Ga		107"
25	F9792		Wire, Yellow, 16 Ga		76"
26	F101878		Wire, Lt Blue, 16Ga		57"
27	F104092		Wire, Lt Green, 14Ga		73"
28	F9797		Wire, White, 16Ga		52"
29	F9793		Wire, Blue, 16Ga		25"
30	37308	31035	Terminal, Female, 16-14, Waytek		8
31	F101647		Wire, Pink, 16Ga		56"
32	F100898		3/8 Ring Terminal, 16-14 Ga, Htsk & Sl		1
33	49283		5/16 Ring Terminal, 8 Ga, Htsk & Sl		2
34	F6612		Wire, Black 14Ga		18"
35	F6612		Wire, Black 14Ga		18"
36	F9793		Wire, Blue, 16Ga		55"
37	F2958		Wire, Black 16Ga		67"

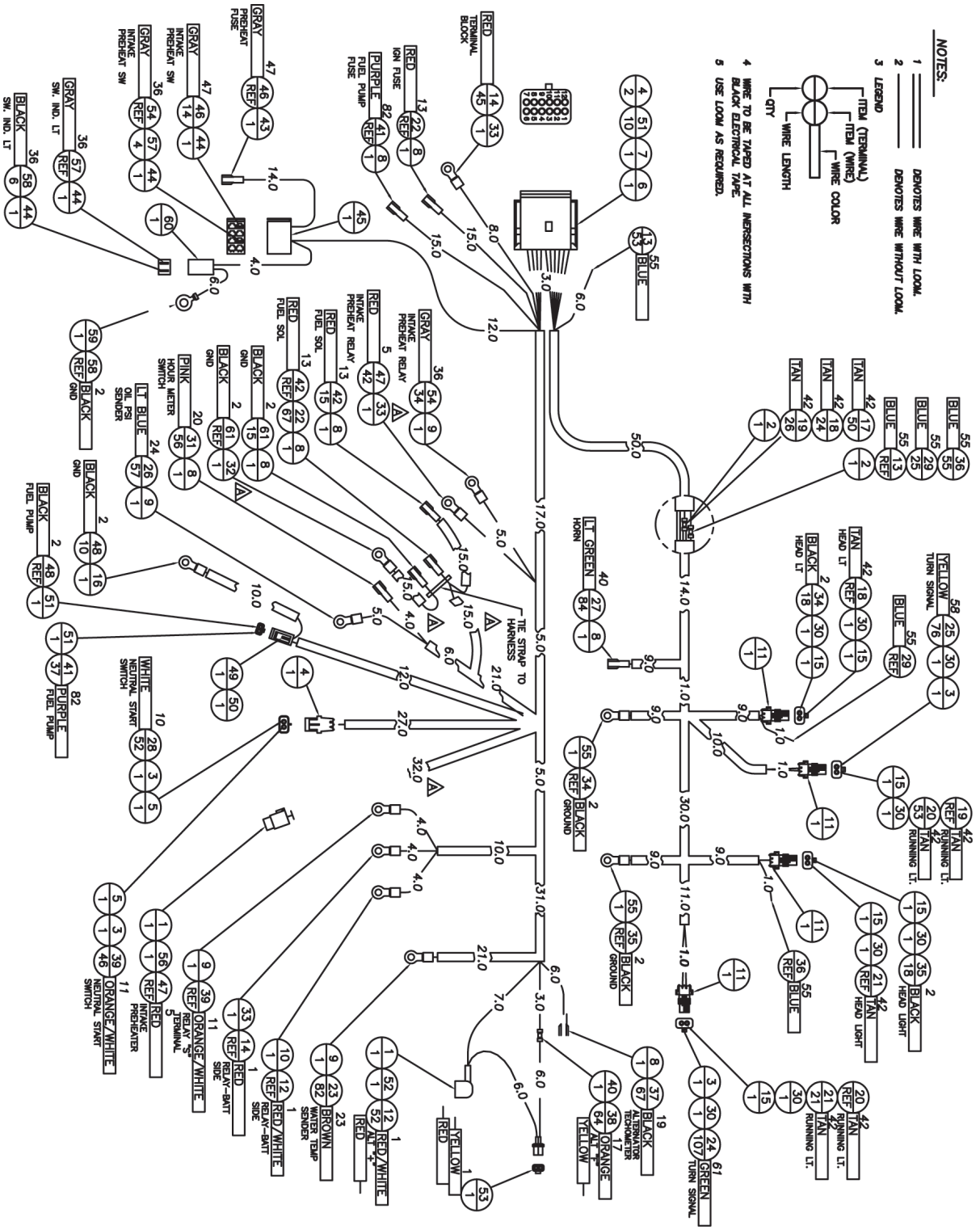


FIGURE 84.

HARNESS WIRING 51311, PERKINS, 1104, M140

(2 OF 2)

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
84-	51311		Harness, Wiring, Perkins 1104D-44T/C6		Ref
38	F101642		Wire, Orange 16Ga		64"
39	F101896		Wire, Orange/ White 16Ga		46"
40	F104341		Conn, Butt Splice, 14-16 Ga		1
41	F101793		Wire, Purple, 16Ga		34"
42	F9794		Wire, Red, 16Ga		15"
43	F102369	32515	Terminal, Male, 12-10, Waytek		1
44	37049		Terminal, Female, Blade		2
45	37408		Conn, Switch		1
46	F101895		Wire, Gray, 16Ga		14"
47	F104428		Wire, Red, 8 Ga		42"
48	F002958		Wire, Black, 16Ga		10"
49	206102		Conn, El, Deutsch,P, DT06-2S-PO12		1
50	206103		Conn, El, Deutsch Wedge, W2S-P02		1
51	206117		Conn, El, Deutsch, SKT, 14-16 AWG		12
52	2.3913		Insulator, Term, #485 (Red)		1
53	44528		Plug, Alternator, 2 Term		1
54	F101895		Wire, Gray, 16Ga		34"
55	F101772		Terminal, Ring, 5/16, #16-14 AWG		2
56	49657		Conn, El, Deutsch, SKT, 8-10 AWG		1
57	F101895		Wire, Gray, 16Ga		4"
58	F002958		Wire, Black, 16Ga		6"
59	204684		Terminal, Ring, #6, 16-14Ga, HTSK		1
60	37409		Conn, Light		1
61	F002958		Wire, Black, 16Ga		15"
62	2.3478		Loom, 0.25 ID Flexguard		188"
63	F101793		Loom, 0.35 ID Flexguard		153"
64	2.3366		Loom, 0.50 ID Flexguard		53"

Illustration Not Available At Time Of Publication

FIGURE 85.

GRP, M140, ENG, 1104C-44/C6 PERKINS

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
85-	52555		Grp, M140, Eng,1104C-44/C6	G	Ref
	51555-1		Eng / Trans / Mount ing Perkins1104C-44/C6		1
	51225-2		Link age System		1
	51225-3		Elec Sys Engine		1
	51225-4		Cool ing System		1
	51225-5		Air In take System		1
	51555-7		Exhaust System		1
	51225-8		Fuel System		1
	51423		Pump Assy Hydraulic		1
	51225-10		Battery System		1
	51424		Cover, Fender, Hyd Tank		1

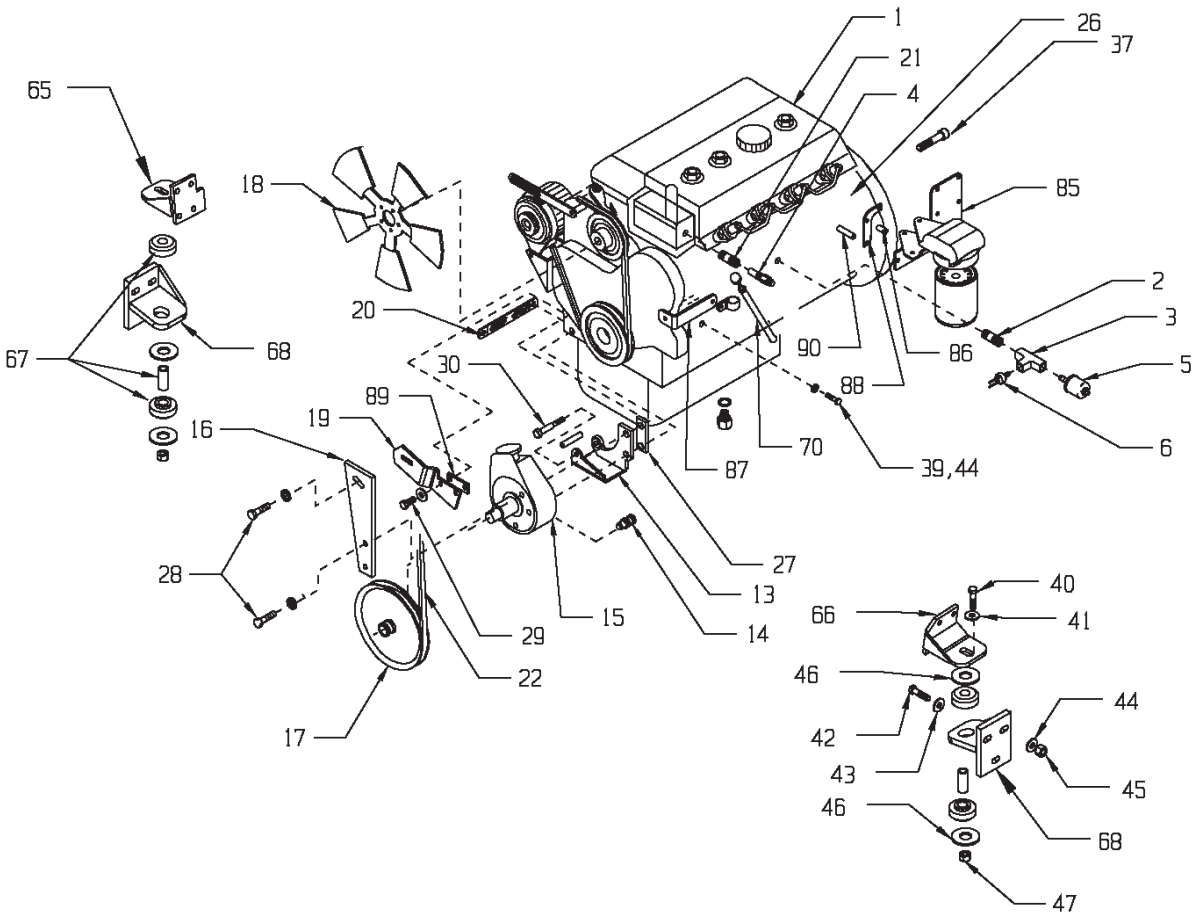


FIGURE 86.
ENGINEERING TRANSMISSION MOUNTING, PERKINS 1104C-44/C6
(1 OF 2)

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
86-	52555-1		Engine/Transmission, Perkins 1104C-44/C6	G	REF
	51423		Pump Assy, Hyd, 1104	G	
1	44827		Engine, Perkins 1104C-44, C6, T2	G	1
2	38733		Fitting, Pipe, Nipple, 1/8-27 w/Hex		1
3	3.1820		Fitting, Pipe, Tee, 1/8 NPT		1
4	F101526		Sender, Temp		1
5	F101527	02025-00	Sender, Oil Pressure (V00542)		1
6	NW021649	8647	Switch, Pressure (13445)		1
13	43258		Pivot Weldment, PS Pump		1
	F100196		HHCS, 3/8-24 x 1.25		2
	F009665		Lockwasher, 3/8		2
14	45811		Valve, Relief, PS, 800-900 PSI		1
	45812		O-Ring, PS, 800-900 PSI		1
15	F102526		Pump, Power Steering		1
	46229		Cap, Power Steering		1
	F103926		HHCS, M10 x 1.5 x 25mm DN 933		2
	F018486		Lock Washer, 7/16		3
16	38334		Plate, Adjuster, PS Pump		1
17	NW023994	3830967	Pulley, Steering Pump (1HS72)		1
18	48487		Fan, 18" Puller	G	1
19	44941		Adjuster, Power Steer Pump, 1104		1
20	NW010518FB		Strap, Ground		1
21	F100780		Reducer, Bushing, 1/2 NPT to 1/8		1
22	45093	7355	Belt V, G 7355, 3/8 x 36 1/4		1
27	51428		Spacer, PS Pump		1
28	NW031646		HHCS, 10mm x 30mm GR 8		2
29	38321		HHCS, M16 x 40mm		2
30	F103926		HHCS, M10 x 1.5 x 20mm DN 933		2
37	NW03461		Socket Head Bolt		1
39	F104348		HHCS, 12mm x 1.75		12
40	F100405		HHCS, 5/8-11 x 4, GR5		2
41	204714		FW, 5/8 SAE, Hard		2
42	F018701		HHCS, 1/2 x 1-3/4		6
43	F100064		Washer, 1/2 Flat		6
44	F015973		Washer, 1/2 Lock		14
45	F016825		Nut 1/2-13 Hex		6
46	37535		FW, .66 ID, 3.12 OD, .19 thk		4
47	3.0391		Nut, Hex, 5/8-11 Lock, Esna		2
65	44631		Engine Mount, Perkins RH	G	1
66	44670		Engine Mount, Perkins LH	G	1
67	44514		Isolator		2
68	51320		Mnt, Wld,Eng/Frame,LH		1
69	42031-20	4126X091	Tube, Dipstick		1
85	44859		Brkt Wldmnt, Fuel Filter, P1104		1
86	204783		Spacer, Brake Lever, P1104		1
87	44940		Angle, Dipstick Mnt, C6		1
88	44888		Plate, Mnt, fuel Filter, P1104		1
89	44942		Spacer, Power Steer Pump, 1104		1
90	400906		Spacer, Cut, 4009, 1.00		1
91	51315		Mnt, Wld,Eng/Frame,RH	G	1
NS	42265		Heater, Block, Op tion		1
NS	39981		Brkt, Dipstick		1

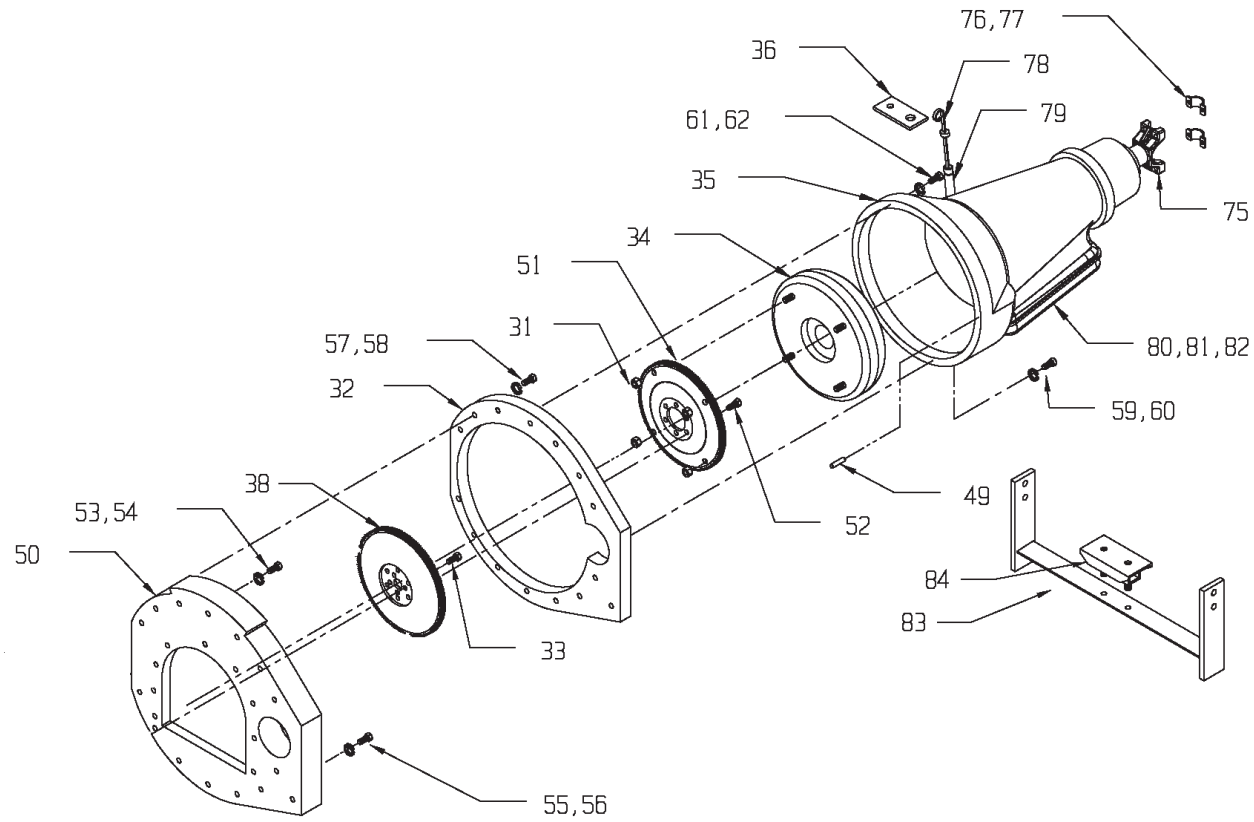


FIGURE 86.
ENGINE TRANSMISSION MOUNTING, PERKINS 1104C-44/C6
(2 OF 2)

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
86-	52555-1		En gine/Trans., Perkins 1104-44/C6, 140	G	Ref
31	F103925		Nut, Hex		4
32	43693		Plate, Flywheel Assembly (V00517)		1
33	Comm		HHCS 1/2-20 GR 5		6
34	43365		Converter Assembly		1
35	NW034441		Transmission, C6		1
	NW034678		Ring Gear, 126 Teeth		1
36	43269		Bracket, Dipstick		1
38	43694		Flywheel Assy w/ Ring Gear (V00517)		1
	NW034678		Ring Gear For Flywheel, 126T		1
49	F100444		Pin Dowel		2
50	43695		Flywheel Housing (V00517)		1
51	43361		Flywheel, Ford		1
	43362		Reinforcing Plate, Flywheel		1
52	43363		HHCS, 7/16-20 x 13/16		6
53	NW031820		HHCS, M12-1.75 x 38 (at top)		2
54	Comm		Washer, M12 Lock		2
55	204730		HHCS, M10-1.50 x 35		6
56	3.3326		Washer, M10 Lock		6
57	F100403		HHCS, 1/2-13 x 1.5		12
58	F015973		Washer, 1/2 Lock		12
59	F016102		SHCS, 5/16-18 x 1.25 (on inside)		1
	F100308		SHCS, 5/16-18 x 1.50 (bottom center)		3
60	F009704		Washer, 1/4 (for above)		2
61	F100622		HHCS, 7/16-20 x 2.0		6
62	F018486		Washer, 7/16 Lock		6
75	NW036501		Yoke Flange		1
76	41072		Bolts		4
77	41073		Strap		2
78	42856		Dipstick		1
79	44075		Tube, Dipstick C6		1
80	302313		Pan, Oil		1
81	37920		Gasket, Oil Pan, C6		1
82	NW034532		Filter, Transmission		1
83	51312		Sup port Wldmnt, Trans		1
84	37188		Trans. Mount. C6		1

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
87-	47310-8		Fuel System, M140, Cummins BT3.3	H	Ref
1	38692		Tank, Fuel W/Cap (See Fig 58)		1
2	F101588		Strip, Chaffing (See Fig 58)		120”
3	NW026327		Strap, Fuel Tank (See Fig 58)		2
4	NW036838		Harness Fuek Tank (See Fig 58)		1
5	NW027824		Support Wldmnt, Tank, LH (See Fig 58)		1
6	NW027825		Support Wldmnt, Tank, RH (See Fig 58)		1
7	NW024702		Gauge, Fuel (See Fig 14)		1
8	F101015		Hose, .031 Fuel		120
9	F101150		Clamp, Hose #4 (See Fig 58)		6
10	153768		Decal, Diesel Fuel (See Fig 16)		1
11	NW036196		Tube, Fuel, Return (See Fig 67)		1
12	42051		Ftg, Hyd, 06H-04MP (See Fig 67)		2
13	NW034736		Ftg, Hyd, 06H-04MP90 (See Fig 67)		1
14	9.2066		Hose, 0.37 ID Low Press (See Fig 58)		108”
15	NW036198		Ftg, Hyd, 05MP-04MP (See Fig 58)		1
16	42051		Ftg, hyd, 06H-04MP (See Fig 58)		1
17	42118		Ftg, Hyd, 14MM-04FP (See Fig 58)		2
18	41472		Decal, Warning (See Fig 16)		1

FIGURE 87.

FUEL SYS, M140 CUMMINS QSB3.3

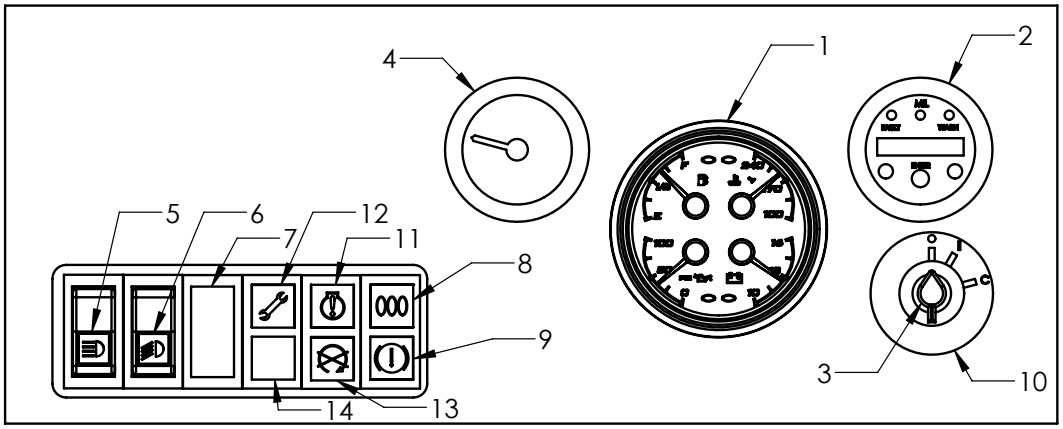


Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
88-			Instrument Panel	H	Ref
	53004		Panel Assy, Instrument	I	Ref
1	52751		Gauge, 3”, 4 in 1		1
2	52752		Gauge, 2”, Engine Malfunction		1
3	F104281		Switch, Ignition		1
	51826		Switch, Ignition, Rot, Lever, Anti RSRT	I	1
4	52753		Gauge, Temperature Transmission		1
5	NW35376	511106	Head/tail Light Switch (56289)		1
	NW35386	596648	Head/tail Light Insert (56289)		
6	NW34176	511005	Work Light Switch (Simms)		1
	NW35383	596315	Work Light Insert (56289)		
7	NW35379	596273	Switch Blank (56289)		1
8	NW035385		Insert, Glo Plug		1
9	NW035388		Insert, Brake Fault		1
10	52487		Placard, Ign Switch		1
11	45164		Insert, Switch, Eng Warning	I	1
12	45165		Insert, Switch, Maintenance, White	I	1`
13	45143		Insert, Switch, Engine Stop, Red	I	1
14	NW035382		Insert, Switch Blank		1
NS	NW035378		Housing, Light Indicator (See Page 31)	I	1

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
88-	53002		Gauge Pkg, Can, SACD	I	Ref
1	52751		Gauge, 3”, 4 in 1		1
2	52752		Gauge, 2”, Engine Malfunction		1
3					
4	52753		Gauge, Temperature Transmission		1
NS	52880		Harness, Dash, 140 CAN		1
NS	52919		Harness, Canbus, ECM, QSB 3.3, M140		1

FIGURE 88.

INSTRUMENT PANEL, M140 CUMMINS QSBT3.3, EFF H,I

Illustration Not Available at Time of Publication

FIGURE 87.
AIR CONDITIONING, M140 CUMMINS QSB3.3

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
89-			Air Conditioning	I	Ref
	210095		Air Cond/Htr, Wall Mnt		1
	53153		Air Conditioner, Headliner		
	F101685		Hose 2.00” ID, Flex		30”
	210307		Adapter, Heater, 2-2.5		1
	206640		Condenser, A/C 2000		1
	41482		Compressor, A/C		1
	42993		Strap, A/C Compressor		1
	9.0027		Hose, 0.62 Heater		96”
	NW034742		Insulation, Firewall		1
	38825		Switch, Pressure,		1
	38768		Receiver, Dryer		1

This Page Intentionally Blank

CHAPTER 5 MANUFACTURER'S INFORMATION

CONTROL CABLES 5-2
BOSTROM SEAT, T-BAR 5-4
AUTOMATIC TRANSMISSION DIAGNOSIS 5-13
C-6 TRANSMISSION SERVICE 5-35
C-6 AUTOMATIC TRANSMISSION SERVICE 5-36
C-6 TRANSMISSION PARTS 5-46
CASE, CONVERTER, AND EXTENSION HOUSING 5-46
INTERMEDIATE SERVO AND BAND 5-49
VALVE BODY ASSEMBLY 5-50
THROTTLE AND MANUAL CONTROL LINKAGE 5-52
CLUTCHES, GEAR AND SHAFTS 5-54
FLYWHEEL AND OIL FILLER 5-59
BRAKE POWER BOOSTER, BENDIX 5-60
SAE DIAGNOSTIC TROUBLE CODES AND CUMMINS FAULT CODES 5-77
NEWAGE AXLE INFORMATION 5-85
CAN DISPLAY MANUAL 5-87
ALLISON 2500 TRANS. INFORMATION 5-130

⚠ WARNING

THE FOLLOWING WARNINGS DESCRIBE IMPORTANT PUSH-PULL CABLE OPERATION AND MAINTENANCE INFORMATION.

1. DO NOT ADJUST THE CONTROL CABLE WITH THE POWER ON OR THE ENGINE RUNNING. SERIOUS INJURY OR DEATH COULD RESULT.

2. A GRADUAL OR SUDDEN INCREASE IN THE NO-LOAD FRICTION (CABLE DISCONNECTED AT BOTH ENDS) OF A CONTROL CABLE IS AN INDICATION OF A PENDING OR PRESENT PERFORMANCE PROBLEM. THE CONTROL CABLE SHOULD BE REPLACED, OTHERWISE SERIOUS INJURY OR DEATH MAY RESULT.

3. A GRADUAL OR SUDDEN DECREASE IN THE USABLE TRAVEL, IS AN INDICATION OF A PENDING OR PRESENT PERFORMANCE PROBLEM. THE CONTROL CABLE SHOULD BE REPLACED, OTHERWISE SERIOUS INJURY OR DEATH MAY RESULT.

4. CONTROL CABLES WHICH HAVE MOISTURE INSIDE OF THEM AND/OR HAVE FROZEN SHOULD BE REPLACED. DO NOT APPLY HEAT TO THAW OR DRY CONTROL CABLES.

5. CABLECRAFT CONTROL CABLES ARE LUBRICATED FOR THE LIFE OF THE CONTROL CABLE. DO NOT REMOVE THE SEALS OR LUBRICATE THE CONTROL CABLE.

6. CABLECRAFT CONTROL CABLES ARE DESIGNED TO BE NON-REPAIRABLE. DO NOT ATTEMPT TO REPAIR THIS CONTROL CABLE.

TUTHILL CORPORATION | Cablecraft Division
4401 South Orchard Street, P.O. Box 11372
Tacoma, Washington USA 98411
Tel 206 475-1080 Fax 206 474-1623

CONTROL CABLES

⚠ CAUTION

THE FOLLOWING CAUTIONS DESCRIBE APPLICATION AND INSTALLATION INFORMATION.

1. DO NOT INSTALL CONTROL CABLES ON ANY APPLICATION WHICH MAY EXCEED ANY OF THE DESIGN PARAMETERS OF THE CONTROL CABLE.

2. CABLECRAFT CONTROL CABLES ARE DESIGNED AND ASSEMBLED TO BE NON-REPAIRABLE. DO NOT ATTEMPT TO MODIFY THIS CONTROL CABLE.

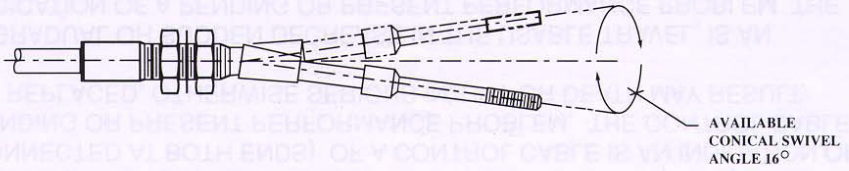
3. CABLECRAFT CABLES ARE DESIGNED TO BE CONTAMINANT RESISTANT; NOT CONTAMINANT PROOF. PROTECT THE CABLE FROM CONTAMINANTS SUCH AS GAS, OIL, DIESEL FUEL, WATER, DIRT AND CHEMICALS WHICH MAY DAMAGE THE CONTROL CABLE.

4. PROTECT THE CONTROL CABLE FROM PHYSICAL DAMAGE BY PAINT, KINKING, VIBRATION, ETC., WHICH MAY DAMAGE THE CONTROL CABLE.

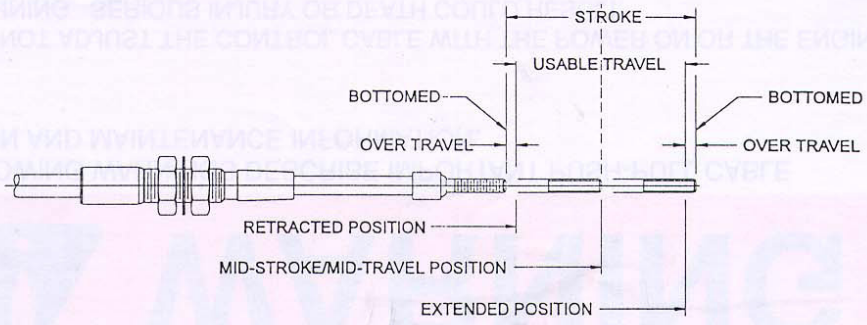
5. CONTROL CABLES HAVE THE BEST LOAD CAPACITY IN THE PULL MODE. ALWAYS INSTALL THE CONTROL CABLE SO IT PULLS THE GREATEST LOAD, AND PUSHES THE SMALLER LOAD; AND PULLS THE ITEM INTO THE NEUTRAL OR OFF POSITION.

6. DO NOT INSTALL THE CONTROL CABLE WITH THE POWER ON OR THE ENGINE RUNNING. SERIOUS INJURY OR DEATH COULD RESULT.

7. THE SWIVEL ANGLE MUST BE CENTERED WITHIN THE AVAILABLE SWIVEL ANGLE;



8. THE USABLE TRAVEL MUST BE CENTERED WITHIN THE AVAILABLE STROKE:



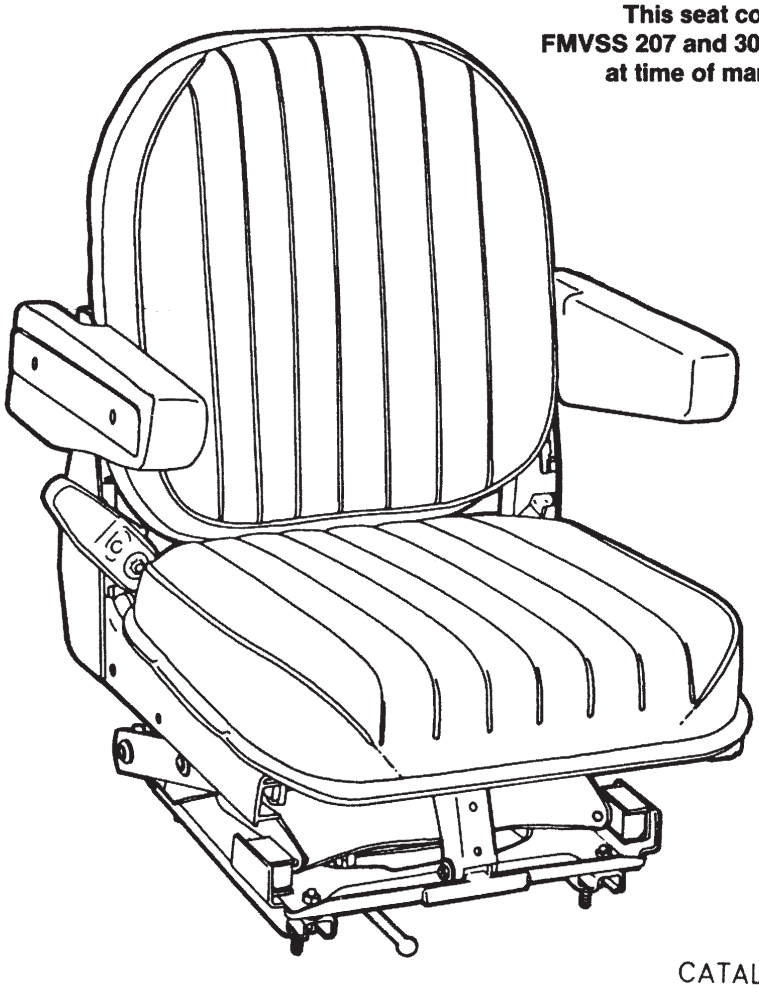
IND-DEC 97

Bostrom® SEATING, INC.

VIKING T-BAR®

OPERATION AND SERVICE PARTS MANUAL

This seat conforms to FMVSS 207 and 302 in effect at time of manufacture.



Seat Shown with Optional Armrests

CATALOG NO.
0112489–001

©1991 BOSTROM
REV B – 7/96

BOSTROM SEAT, T-BAR

OPERATION WARNING

WARNING

SERIOUS INJURY MAY OCCUR IF HEAD CLEARANCE IS NOT ADEQUATE. BEFORE DRIVING OR RIDING IN VEHICLE, ENSURE THAT THERE IS ADEQUATE HEAD CLEARANCE AT MAXIMUM UPWARD TRAVEL OF SEAT. SEE OPERATION MANUAL.

To check for adequate head clearance, sit in the seat and slowly raise it to its maximum upward position by moving the ratchet lever upward (see Comfort Adjustments).

Seat belts should be worn at all times when operating the vehicle.

Federal Motor Vehicle Safety Standard

This seat conforms to Federal Motor Vehicle Safety Standards (FMVSS) 207 and 302 in effect on the date of manufacture.

It is the responsibility of the installer to ensure that proper seat fastening hardware and seat belt anchorages (seat belt and tether belt system) are used in accordance with FMVSS 209 and 210.

To achieve compliance with FMVSS 207, use only high strength fasteners and heavy duty washers when installing seat assembly.

Bostrom

Vigo Road
P. O. Box 566
Piedmont, Alabama 36272
(256) 447-9051

Comfort Adjustments

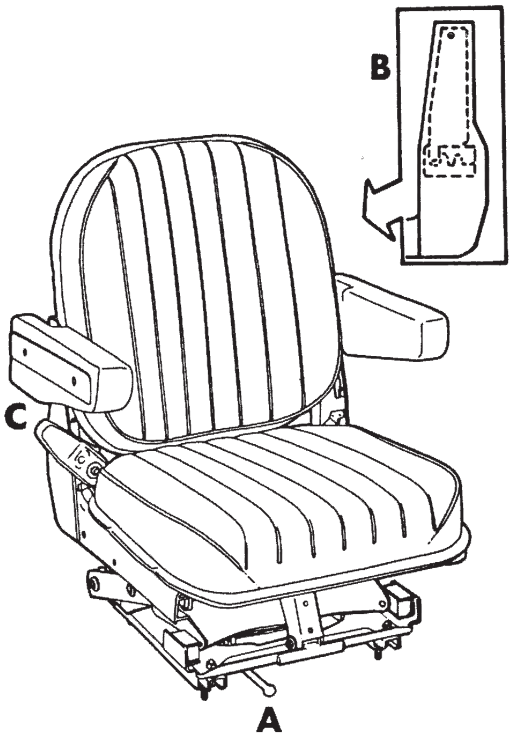
Note: Read operating instructions carefully after installing seat. Proper weight adjustment is essential for a good ride. Seat adjustments should be made to insure seating comfort.

FORE AND AFT SEAT ADJUSTMENT (A)

Seat assembly moves forward or rearward for four (4) inches of total adjustment along ball bearing slides to suit short or long-legged drivers. Move handle (on right hand side under seat) to the left to release slides and adjust.

BACK ANGLE ADJUSTMENT (B)

Back-rest angle has three (3) positions to accommodate driver's preference and comfort. Lift seat back and pivot to the desired position. Be sure seat back locks into rack on side rails.



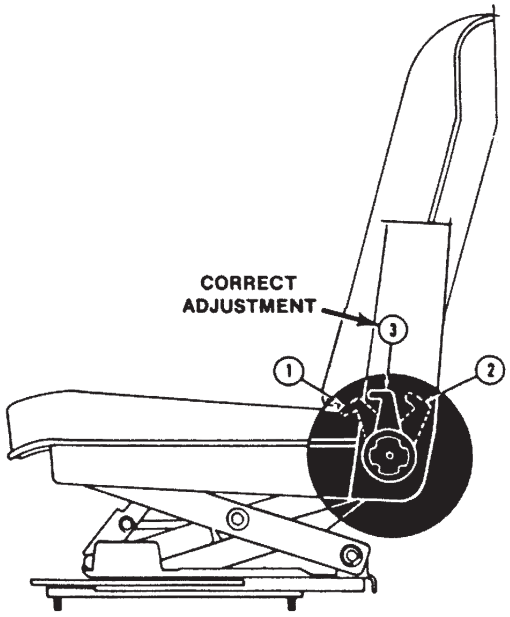
WEIGHT ADJUSTMENT LEVER (C)

This hand-operated lever controls a ratchet mechanism which adjusts the torsion bar to the driver's weight — from 125 to 270 pounds. Lever moves upward (when seated) to raise seat or downward to lower seat to proper position. Proper position is indicated by the RIDE LEVEL INDICATOR.

RIDE LEVEL INDICATOR

The indicator, located inside the left frame upright (see illustration), provides positive assurance that the seat is properly adjusted for the driver's weight. If there is too much preload (seat is too high), the indicator will be forward of the upright (position 1). If there is too little preload (seat is too low), the indication will remain behind the upright (position 2).

Adjust preload (see WEIGHT ADJUSTMENT LEVER (C)) with driver in seat until indicator is even with edge (position 3).



Removal/Reassembly

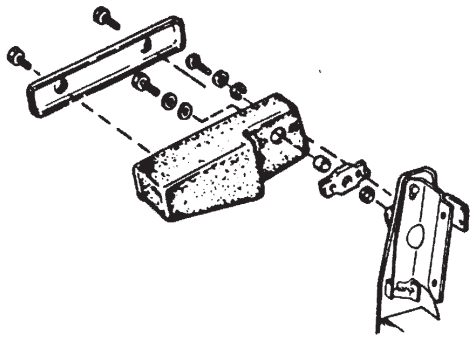
Key: Right hand and left hand are defined as driver's R.H. and L.H. while sitting in the seat. The numbers in parenthesis refer to index numbers on the parts illustration, and parts replace-list.

Arm Rest Removal

1. Take out screws (79) and remove arm channel cover (78).
2. Move mounting plate inside arm rest (68 or 70) to front of seat.
3. Using 1/2" socket wrench remove capscrews (75) and washers (74).

NOTE

If removal of side arm mounting block (72) is desired, take out 3/4" bolt (77), washer (71) and wave washer (76). For assembly, place spacer (73) inside of side arm mounting block (72).



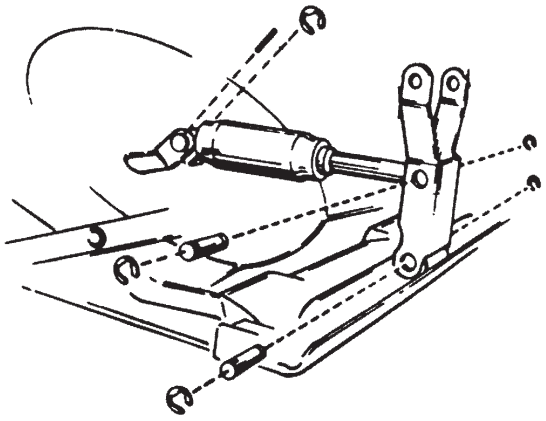
RIGHT HAND ARM SHOWN

Damper Removal

1. Follow same procedure as Torsion Bar Removal instructions 1-6.
2. Wire side panel assemblies (19) and (20) across front seat to retain their position.
3. Remove left hand snap ring (26) from end of hinge shaft (27) at front of damper (22).
4. Remove hinge shaft (27) by tapping out from left hand to right hand side. This operation frees two washers (28).
5. Remove snap ring (26) from hinge shaft (24) at rear of damper.
6. Remove hinge shaft (24) and free damper (22).

Assembly

1. With damper (22) in proper position, replace hinge shaft (24) at rear of damper.
2. Replace snap ring (26) in hinge shaft (24).
3. Replace hinge shaft (27) at front of damper, driving from right hand to left hand side. Serrated end of shaft to enter shock lever (30) last. Drive shaft through two washers (28) and through damper loop.
4. Replace snap ring (26) at end of front hinge shaft (27).
5. Line up right hand and left hand side of panels (20) and (19) retaining the twenty inch dimension over the side panels.
6. Reassemble seat cushion following Torsion Bar Assembly instructions 4-10.



Always Order Replacement Parts by Part Number —

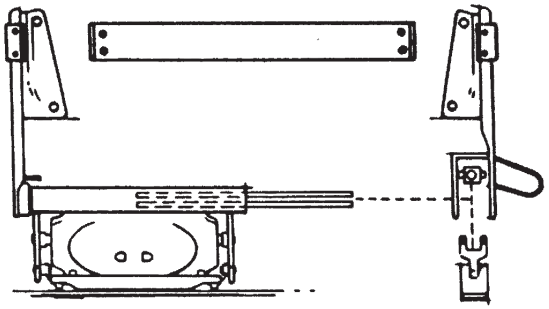
Not Reference Numbers

Removal/Reassembly

Key: Right hand and left hand are defined as driver's R.H. and L.H. while sitting in the seat. The numbers in parenthesis refer to index numbers on the parts illustration, and parts replace-list.

Torsion Bar Removal

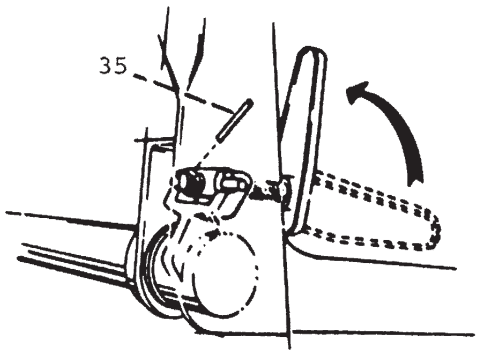
1. Remove strap (80) by taking out four 3/8" cap-screws (81), washers (82) and locknuts (83) (if suspension has armrests).
2. Place wood shim between seat pan and base at front of seat or between torsion bar tube and base at rear of seat. Shim should be no more than 3" high to allow upper seat assembly to drop 1" for seat cushion removal.
3. Remove pin (35).
4. Remove preload on torsion bars by rotating adjuster lever assembly (33) downward until adjuster assembly is disengaged from seat.
5. Remove back cushion assembly by taking out screws (53) and lockwashers (52).
6. Disengage seat cushion assembly by removing nuts (51). (**Note:** Take caution when removing last nut because pan drops onto wood shim.) Move seat cushion forward to free nylon rollers (31) from housing under seat cushion.
7. Remove right hand side panel assembly (20) by tapping out towards side. This allows yoke (42) to drop free.
8. Remove torsion bar set (41) from tube.



REAR VIEW

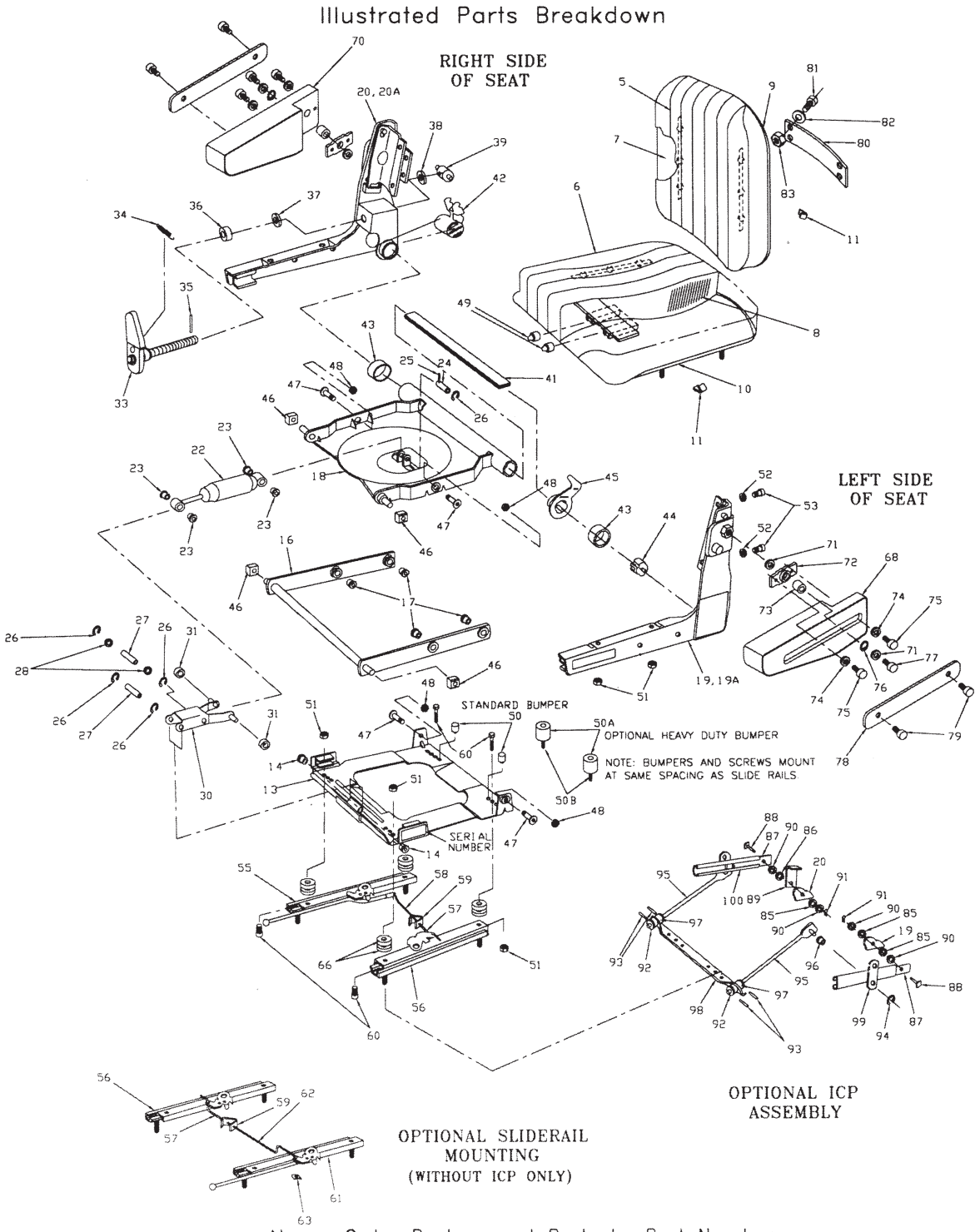
Assembly

1. Insert torsion bar set (41) in tube, being sure that bars are engaged in retainer (44) inside tube at left hand side of seat.
2. Replace right hand side panel assembly (20) with yoke (42) held in position inside housing on side panel. Engage yoke (42) on free end of torsion bar set (41).
3. Line up side panels right hand (20) and left hand (19) retaining the 20" dimension over side panels.
4. Reassemble seat cushion moving from front of seat toward rear in order to engage nylon rollers (31) properly in housing under seat cushion.
5. Reassemble back cushion.
6. Replace preload adjuster assembly being sure that item numbers (36 through 39) are in their proper positions. Engage yoke (42) hooked ends over lugs on adjuster pin (39).
7. Preload torsion bars by rotating adjuster lever assembly (33) upward.
8. Replace pin (35).
9. Remove wood shims.
10. Reassemble back strap (80).
11. For assembly of arm rests reverse removal steps.



Always Order Replacement Parts by Part Number —

Not Reference Numbers


Illustrated Parts Breakdown
RIGHT SIDE OF SEAT
LEFT SIDE OF SEAT
STANDARD BUMPER
50A OPTIONAL HEAVY DUTY BUMPER
NOTE: BUMPERS AND SCREWS MOUNT AT SAME SPACING AS SLIDE RAILS.
SERIAL NUMBER
OPTIONAL ICP ASSEMBLY
OPTIONAL SLIDERAIL MOUNTING (WITHOUT ICP ONLY)
Always Order Replacement Parts by Part Number– Not Reference Numbers

PARTS REPLACEMENT LIST
VIKING T-BAR

ORDERING INSTRUCTIONS: Order by Part Number, NOT Reference Number.

HOW TO USE: Find the corresponding part that you wish to replace on the exploded view illustration and note its reference number. Refer to list below and record part number, quantity required and description. Replaceable components of an assembly are indented under that assembly, indicating that they can be ordered separately or will be included if the assembly is ordered.

ORDER FROM: Your truck dealer or Bostrom Authorized Distributor for your area.

REF NO	PART NO	DESCRIPTION	QTY
1	*	KIT, BACK CUSHION ASSEMBLY (includes items 5, 7, 9 & 11)	
	*	Black Vinyl	1
	*	Black BC/Vinyl	1
2	*	KIT, SEAT CUSHION ASSEMBLY (includes items 6, 8, 10 & 11)	
	*	Black Vinyl	1
	*	Black BC/Vinyl	1
3	*	KIT, BACK COVER AND PAD (includes items 5, 7 & 11)	
	*	Black Vinyl	1
	*	Black BC/Vinyl	1
4	*	KIT, SEAT COVER AND PAD (includes items 6, 8 & 11)	
	*	Black Vinyl	1
	*	Black BC/Vinyl	1
5	*	COVER ASSEMBLY BACK	1
6	*	COVER ASSEMBLY SEAT	1
7	**	PAD, BACK	1
8	**	PAD, SEAT	1
9	**	PAN ASSEMBLY, BACK	1
10	**	PAN ASSEMBLY, SEAT	1
11	**	FASTENER CLIP, COVER	22
12	**6112473-002**	BASE ASSEMBLY W/BEARINGS (includes items 13 & 14)	
13	**	BASE ASSEMBLY	1
14	**	BEARING, Flanged	2
15	**6112485-001**	OUTER LEVER ASSEMBLY (includes items 16 & 17)	
16	**	OUTER LEVER ASSEMBLY	1
17	**	BEARING, Flanged	4
18	**6112471-001**	CENTER LEVER ASSEMBLY	1
19	**6112475-001**	SIDE PANEL ASSEMBLY LH (w/o armrest bracket)	1
19A	**6112481-001**	SIDE PANEL ASSEMBLY LH (w/armrest bracket)	1
20	**6112476-001**	SIDE PANEL ASSEMBLY RH (w/o armrest bracket)	1
20A	**6112482-001**	SIDE PANEL ASSEMBLY RH (w/armrest bracket)	1

REF NO	PART NO	DESCRIPTION	QTY
21	**6222051-001**	KIT, DAMPER ASSEMBLY (includes items 22 thru 28)	
22	**	DAMPER	1
23	**	BEARING, Flanged	4
24	**	SHAFT, Rear	1
25	**	PIN, Roll	1
26	**	RING, Snap	3
27	**	PIN, Hinge Front	1
28	**	WASHER, Flat	2
29	**6222052-001**	KIT, DAMPER LEVER ASSEMBLY (includes items 26, 27, 30 & 31)	
30	**	DAMPER, Lever	1
31	**	ROLLER, Nylon	2
32	**6222053-001**	KIT, WEIGHT ADJUST SCREW & LEVER ASSEMBLY (includes items 33 thru 39)	
33	**	ADJUSTER, Screw & Lever	1
34	**	SPRING, Tension	1
35	**	PIN, Drive	1
36	**	BEARING, Thrust Ball	1
37	**	WASHER, Flat	1
38	**	SPACER, Sintered	1
39	**	PIN, Adjuster	1
40	**6061153-001**	TORSION BAR SET (includes item 41)	
41	**	TORSION BAR	2
42	**6027160-802**	YOKE ADJUSTER CASTING	1
43	**6025775-801**	BEARING, Housing	2
44	**6027159-802**	RETAINER	1
45	**6031015-801**	RISER LEVEL INDICATOR	1
	6222054-001	KIT-SUSPENSION BEARING (T-BAR) (includes items 46, 47 & 48)	
46	**	BLOCK, Slide	4
47	**	BOLT, Shoulder	4
48	**	NUT, Hex Lock M8	4
49	**6027194-801**	BUMPER, Rubber - Top	2
50	**6027194-801**	BUMPER, Rubber - Bottom (Standard)	2
50A	**6049019-002**	BUMPER, Rubber - Bottom Optional Heavy Duty Bumper	2
50B	**6349148-002**	SCREW, Machine .31-18x1.00 (used only with 50A)	2

PARTS REPLACEMENT LIST
VIKING T-BAR
CONTINUED

REF NO	PART NO	DESCRIPTION	QTY
51	**6110153-001**	NUT, Flanged .31-19	8
52	**6353024-801**	WASHER, Flat	4
53	**6351152-801**	SCREW, Cap .31-18x.62	4
54	**6044618-001**	KIT, SLIDE RAIL - STANDARD (includes items 51, 55 thru 60)	
54A	**6042754-001**	KIT, SLIDE RAIL - OPTIONAL (includes items 51, 56, 57, 59, 60, 61 thru 63)	
55	**	SLIDE RAIL ASSEMBLY W/HANDLE	1
56	**	SLIDE RAIL ASSEMBLY	1
57	**	LATCH WIRE, Short	1
58	**	LATCH WIRE, Long	1
59	**	FASTENER, Clip Wires	1
60	**	SCREW, Cap .31-18-1.00	4
61	**	SLIDE RAIL ASSEMBLY W/HANDLE	1
62	**	LATCH WIRE, Long	1
63	**	FASTENER, Clip Wires	1
64	**6042065-041**	KIT, LATCH WIRE - STANDARD (includes items 57, 58 & 59)	
65	**6042378-021**	KIT, LATCH WIRE - OPTIONAL (includes items 57, 59 & 62)	
66	**6353085-003**	WASHER, Flat	8
67	**6046557-013**	KIT, ARMREST ASSEMBLY LH (includes items 68, 71 thru 79)	
68	**	ARMREST ASSEMBLY LH	1
69	**6046557-014**	KIT, ARMREST ASSEMBLY RH (includes items 70, 71 thru 79)	
70	**	ARMREST ASSEMBLY RH	1
71	**	WASHER, Flat	2
72	**	STOP, Side Arm	1
73	**	SPACER	1
74	**	WASHER, Lock .31	2
75	**	SCREW, Cap .31-18 X .50	2
76	**	WASHER, Wave	1
77	**	SCREW, Cap .50 - 13 X 1.25	1
78	**	COVER, Arm Channel	1
79	**	SCREW, Machine .25 - 20 X .75	2
80	**6046373-003**	STRAP, Cross Back	1
81	**6351228-001**	SCREW, Cap .37 - 16 X 1.12	4
82	**6353014-801**	WASHER, Flat	4
83	**6350009-002**	NUT, Hex Lock .37 - 18ZP	4
84	**6044614-001**	KIT, ICP CONVERSATION STANDARD COMPLETE UNIT W/SLIDE RAILS (includes items 55, 58, 85 thru 100)	
85	**	SPACER, Rubber	7
86	**	WASHER, Flat Rubber	1
87	**	GUIDE, Delrin	2
88	**	PIN, Headed .312 X 1.25ZP	4
89	**	BRACKET, Stop	1
90	**	WASHER, Flat	8
91	**	PIN, Cotter .12 X .5	4
92	**	WASHER, Flat	4
93	**	PIN, Drive .120 X 1.0	4
94	**	RING, Snap	2
95	**	ROD, Slide w/Pin	2
96	**	BEARING, Flanged	2
97	**	WASHER, Rubber	4
98	**	STRAP, Front	1
99	**	SLIDE ASSEMBLY LH	1
100	**	SLIDE ASSEMBLY RH	1
101	**6043370-001**	KIT, ICP REPLACEMENT (includes items 85 thru 88, 90 thru 94, 96 & 97)	

* Order by color and material: Black Vinyl, Brown Vinyl, Gray Vinyl, Black Cloth and Vinyl, Brown Cloth and Vinyl, Gray Cloth and Vinyl, Blue Cloth and Vinyl, Red Cloth and Vinyl, Cocoa Cloth and Vinyl, Red Velour and Vinyl, Cocoa Velour and Vinyl.
** Not available separately. Order the kit which includes this part.

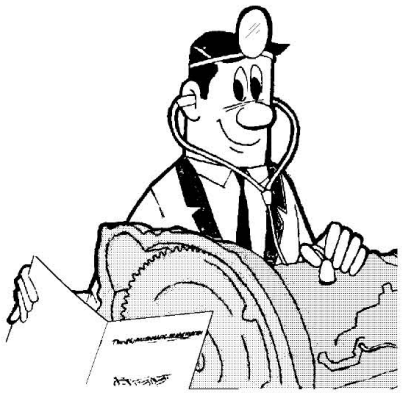
The descriptions and specifications contained in this manual were in effect at the time the book was approved for printing. Bostrom Seating, Inc., whose policy is one of continuous improvement, reserves the right to discontinue models at any time or to change specifications or design, without notice and without incurring obligation.

This Page Intentionally Blank

AUTOMATIC TRANSMISSION DIAGNOSIS

Diagnosis

NOTES



One of the most important things to remember about diagnosing automatic transmissions, is that there is a definite procedure to follow. Don't try to shortcut it.

The following diagnostic checks are in the order they should be taken to cover the likeliest causes of trouble first. This should eliminate every possibility that doesn't require opening the transmission for overhaul:

- Fluid Level Check
- Fluid Condition Check
- Throttle Valve and Diaphragm Check
- Band Quick Check
- Performance Test
- Stall Test
- Line Pressure Test
- Governor Test
- Case Air Pressure Test

4-1 AUTOMATIC TRANSMISSIONS 4-1

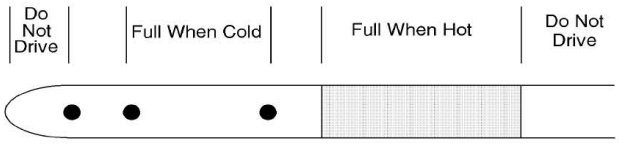
Diagnosis

NOTES

Fluid Level Check

The fluid level should ideally be checked with the following:

- Normal operating temperature.
- Engine at normal curb idle.
- Move shift selector through all the ranges to fill clutch and servo cavities.
- Take reading with shift selector in Park.



A cold fluid level check can be made. The cold fluid level should be between the inner holes. A hot fluid level check is more accurate. After the transmission operates some 20 minutes, the fluid temperature should be 150-170 º F (66-77º C). The hot fluid level reading should always be between the arrows, at operating temperature.

If it's overfilled, the equipment should not operate without removing fluid.
If the level is low, the equipment should not operate without adding fluid. Locate and repair any leaks.

⚠ **CAUTION: Use only fluid as specified on the dipstick. Use of any other fluid can cause damage and will void the warranty.**

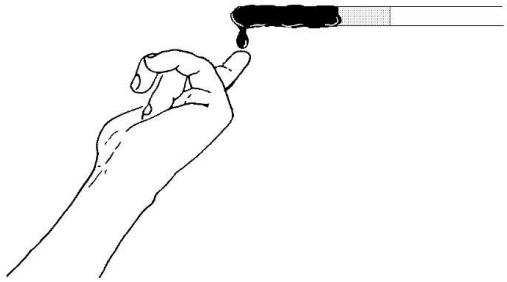
NOTE: Do not overfill. The space between the arrows is less than one pint. Do not fill to the arrows unless the transmission is hot.

Diagnosis

NOTES

Fluid Condition Check

There are certain fluid conditions to watch for that will tell you an overhaul is necessary and further testing is useless.



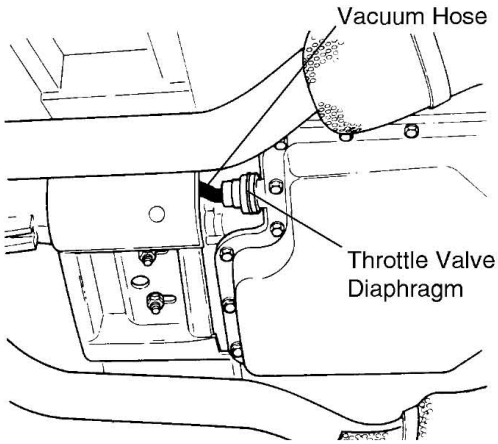
- The fluid should be clean and normally not discolored.
- Some fluid contains a detergent which may result in a dark coloration of the fluid and does not by itself indicate malfunction or need for repair.
- A burnt smell or rotten egg odor indicates a major failure. Overhaul the transmission.
- The presents of a solid residue is most likely clutch or band material. Overhaul the transmission.
- If varnish is present, overhaul transmission and check for engine overheating.
- Oil in the radiator would indicate leakage between radiator core and transmission cooler (if equipped).
- When overhauling transmission, also replace converter and flush the cooler lines (if equipped).

Diagnosis

NOTES

Throttle Valve and Diaphragm Check

Take a quick look at the diaphragm to be sure the vacuum line is connected. If the vacuum isn't there, the upshifts will be delayed and harsh.



Check at the vacuum port of the diaphragm for transmission fluid or water. The presence of transmission fluid means the diaphragm is leaking and should be replaced.

The presence of water means it may have leaked in through the vacuum system, causing the diaphragm to rust or freeze during cold weather, and stick. This also would cause shift problems, and a new diaphragm will fix the condition.

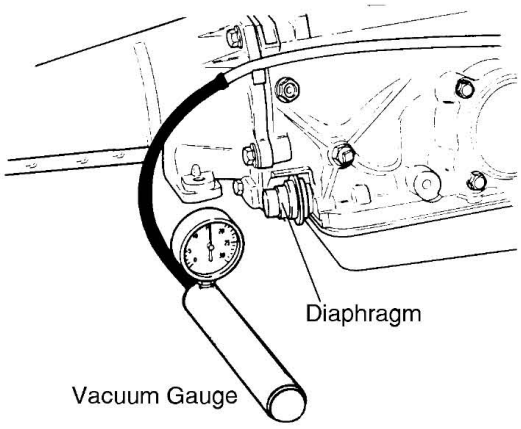
Diagnosis

NOTES

Manifold Vacuum Check

To test the vacuum to the diaphragm:

1. Remove the vacuum hose and connect it to a vacuum gauge.
2. Run the engine at hot curb idle. Check for a steady idle vacuum.
3. "Goose" the engine and let it return to idle. The vacuum should drop; then return to a steady high vacuum.



If there is not any manifold vacuum to the diaphragm, inspect the hoses and check for proper routing with the vacuum schematic.

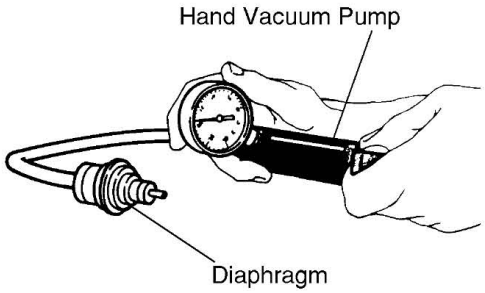
4-5 AUTOMATIC TRANSMISSIONS 4-5

Diagnosis

NOTES

Vacuum Diaphragm Leak Test

Leak test the diaphragm if shift points are delayed and/or shifts are harsh. Also leak test it if the fluid was low or the engine appeared to be burning oil. (The fluid may be getting sucked into the intake manifold through a ruptured vacuum diaphragm.)



The leak test can be done on or off the transmission.

1. Remove the manifold vacuum hose and connect a vacuum source to the diaphragm.
2. Apply 18 inches of vacuum to the diaphragm and see if it holds.

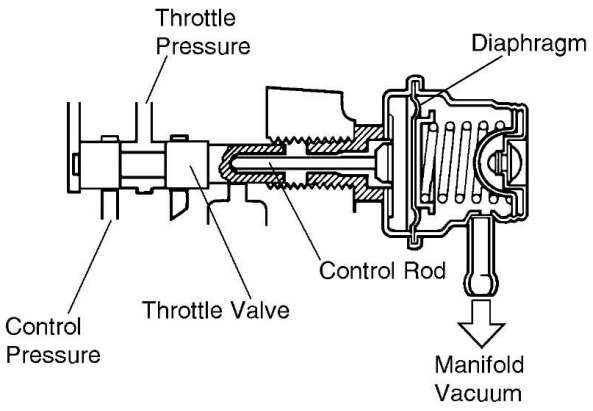
The diaphragm is probably OK if it will hold vacuum. Replace it if it fails to hold vacuum, or if the rod doesn't move with vacuum changes.

Diagnosis

NOTES

Diaphragm Inspection

Check the diaphragm for any binding or sticking. Insert the control rod and push it back and forth. If the diaphragm binds, install a new one. Install a new rod if the rod is bent.

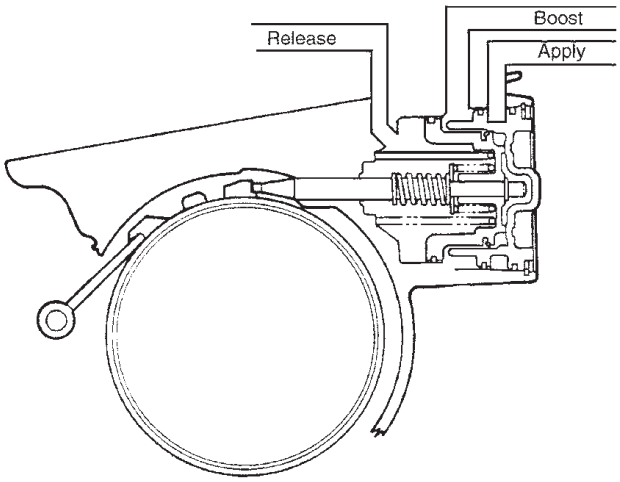


Throttle Valve Inspection

Check the throttle valve for free operation in its bore in the case. If the valve sticks, remove it from the bore and inspect it for burrs. A sticking throttle valve can often be deburred by rolling it on a flat Arkansas Stone. This may quickly correct a shifting problem.

Diagnosis

NOTES



Band Quick Check

1. Be sure the oil level is correct.
2. Shift the selector to reverse and then to second gear.
3. Check for firm engagement.

- If engagement in Reverse is delayed or mushy, adjust the rear (low-reverse) band.
- If engagement in second gear is delayed or mushy, adjust the front (intermediate) band.

Refer to appropriate service manual for band adjustment procedure.

4-8 AUTOMATIC TRANSMISSIONS 4-8

Diagnosis

NOTES

Performance Test

A properly conducted performance test is really your most valuable diagnostic tool if you know your transmission and apply this knowledge. It will tell you if any of the drive train holding members are slipping; and will usually give a clear indication of valve body and governor function. There are specifications published for automatic shift speeds in three operating conditions in Drive gear:

MINIMUM THROTTLE SHIFTS	To check the minimum throttle upshifts, give it just enough gas to barely accelerate the equipment. These shift points will check the operation of the shift valves and governor circuit.
TO-DETENT SHIFTS	The "to-detent" upshifts are heavy throttle shifts, but not wide open throttle. These shift points will check the throttle valve systems delay of upshifts and boost of control pressure.
THROUGH-DETENT SHIFTS	Check the "through-detent" upshifts by pushing the accelerator to wide open throttle and holding it there. These shift points will check the downshift (kick down) system, with the downshift valve actuated.

Diagnosis

NOTES

Shift speed testing can be done in the shop, but will give no indication of shift "feel." A performance test of the equipment as intended is the preferred method. To prepare for the shift speed test:

1. Look up the specifications for shift speeds for the particular engine, transmission and axle combination. Write them on a check sheet.
2. Accelerate a time or two to get the feel for where kick down is actuated. (Put an extra spring or rubber band on the downshift rod to help "feel" when it moves).
3. Record the actual shift speeds during the test for analysis following the test.

4-10 AUTOMATIC TRANSMISSIONS 4-10

Diagnosis

NOTES

Be sure to observe the following procedures and analysis for each of the tests and always pay attention to the "feel" of the shifts as well as the shift speeds.

Reverse Check

Operate the transmission in Reverse and check for:

- Engagement
- No slipping

First Gear Check

Operate the transmission in First gear and check for:

- Engagement
- Should not be a 1-2 upshift
- Engine braking in low gear
- Shifts 3-2 and then 2-1 coming out of Drive at cruise
- No slipping

Second Gear Check

Operate the transmission in Second gear and check for:

- Engagement
- Starts in second gear
- Should not be a 2-3 upshift
- Shifts 3-2 coming out of Drive at cruise
- No slipping

Drive Gear Check

Operate the transmission in Drive and check for:

- Engagement
- Starts in first gear
- Upshifts not mushy or harsh
- *Minimum throttle*, *to-detent*, and *through-detent* upshifts and downshifts are at specified speeds.

Diagnosis

NOTES

Minimum Throttle Shifts

1. To check the minimum throttle upshifts, give it just enough gas to barely accelerate the equipment.
2. As you operate in first gear, if there is an immediate upshift to second, the governor valve may be stuck in the maximum pressure position.
3. When you reach about 10 mph, a smooth 1-2 shift should occur. If you stay in first gear and upshift to third at a higher speed, the servo is not applying the band.
4. Without increasing the throttle setting, check for the 2-3 upshift at the specified speed. If OK, the governor is still doing its job, the clutch circuit is hydraulically tight, and the 2-3 shift valve is free.
5. Let the equipment "coast down" in Drive gear. About 10 MPH it should downshift 3-2 and then 2-1.
6. In first gear, the equipment should be free-wheeling.

To Detent Shifts

- The "to-detent" upshifts are heavy throttle shifts, but not at wide open throttle.
- If the upshift points are within specifications and the shifts are firm, the throttle valve and throttle modulator valve are operating freely. Also, the governor still is doing a good job.
- At about 25 MPH in drive, push the accelerator "to the detent." This should force the 3-2 shift.

Through Detent Shifts

- Check the "through-detent" shift points by pushing the accelerator to wide open throttle in Drive and holding it there.
- Check the kick down shift points by pushing the accelerator through the detent at the appropriate performance speed. These shift points are a check on the downshift valve and on the governor pressure output above 10 MPH.

Diagnosis

NOTES

Test Results/Conclusions

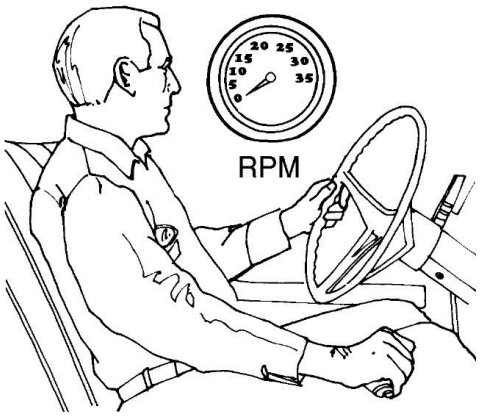
After the performance test, determine what repairs are needed by analyzing what's going on during the problem shift. Here are some tips on performance test analysis.

- If shift speeds are all okay the governor is operating properly. If they aren't, refer to *Governor Test* in this section.
- The problem may be correctable by cleaning the valve body or tightening its bolts to the specified torque.
- If the shifts are early and mushy or harsh and delayed, perform the *Throttle Valve Checks* in this section.
- Further diagnosis can be made by the *Line Pressure Test* and *Case Air Pressure Tests*.

4-13 AUTOMATIC TRANSMISSIONS 4-13

Diagnosis

NOTES



Stall Test

The stall test checks for clutch or band slippage, for engine performance and for torque converter operation. It should be done only with the engine coolant and transmission fluid at proper levels and at operating temperature.

⚠ **WARNING: DURING STALL TEST, APPLY ANY PARKING BRAKES FIRMLY OR BLOCK WHEELS TO PREVENT EQUIPMENT FROM MOVING, WHICH MAY CAUSE PERSONAL HARM OR EQUIPMENT DAMAGE.**

⚠ **CAUTION: Do not operate at stall longer than 5 seconds, doing so may damage transmission. Operate just long enough to get a reading. Operate the engine in neutral at fast idle between tests for cooling.**

1. Look up the specified stall RPM for the application.
2. Use a grease pencil to mark the RPM on the dial of a tachometer.
3. Connect the tachometer to the engine and position it for easy reading from the operator's seat.

Diagnosis

NOTES

4. In each of the following ranges, accelerate to full throttle and hold it just long enough to let the engine get to full RPM.

⚠ **CAUTION: If the needle goes past the mark, something is slipping and may damage transmission. Release the accelerator immediately.**

5. Record the results in each range. Run the engine at fast idle, in neutral, between each test to cool the fluid.

- If stall speeds are *low*, check engine for tune-up. If OK, remove torque converter and check for a one-way clutch slip.
- If stall speeds are *high*, refer to the following chart:

SELECTOR POSITIONS	POSSIBLE CAUSE
High in Drive only	Low planetary one-way clutch
High in Drive, 2 and 1	Forward clutch
High in all driving ranges	Perform line pressure test
High in Reverse only	Reverse-high clutch or low-reverse band or servo

Diagnosis

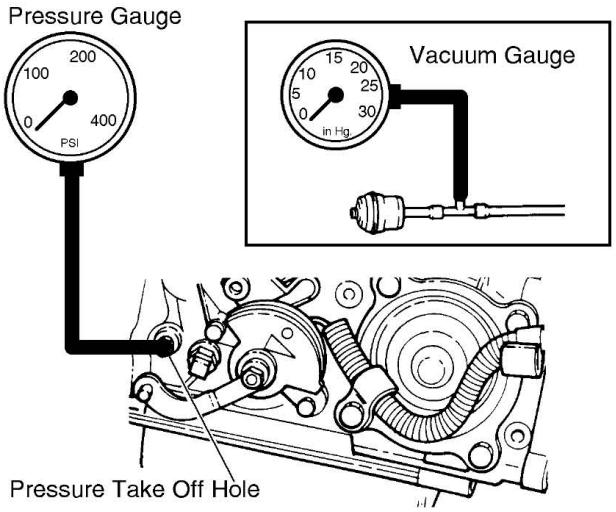
NOTES

Line Pressure Test

Line pressure testing is often called for on shift complaints and may be useful in diagnosing slip conditions. The pressure test will isolate the cause to parts of the transmission, such as the pump or valve body. The stall test can be performed at the same time as the line pressure test.

⚠ **WARNING: APPLY ANY PARKING BRAKES FIRMLY OR BLOCK WHEELS TO PREVENT EQUIPMENT FROM MOVING DURING STALL TEST, WHICH COULD CAUSE PERSONAL INJURY.**

⚠ **CAUTION: Do not operate at stall longer than 5 seconds or transmission may be damaged. Operate just long enough to get a reading. Operate the engine in neutral at fast idle between tests for cooling.**



Diagnosis

NOTES

1. Attach a 400 psi gauge with a long hose to the pressure take off.
2. Put the gauge where you can see it from the operator's seat.
3. Look up the control pressure specifications and write them on a chart.
4. Tee in an ordinary vacuum gauge into the line to the throttle valve diaphragm.
5. At idle, with vacuum above 12 inches, record the control pressure in all selector positions
6. Accelerate to 10 inches of vacuum and perform the test again in just forward ranges and record the results.
7. Perform again at wide open throttle in Drive, 2, 1 and Reverse and record the results.

If a vacuum bleed valve is available, tee it into the diaphragm vacuum line. This will let you simulate heavy throttle conditions without operating at stall. If you use a vacuum bleed, run the engine at 1000 RPM for the 10 inches of vacuum and wide open throttle readings.

4-17 AUTOMATIC TRANSMISSIONS 4-17

Diagnosis

NOTES

Test Results

The following chart shows the likeliest causes of out-of-spec pressure readings in various ranges. In some cases, low pressure can be caused by internal leakage in the clutch or servo circuits. To verify the leakage, remove the valve body and perform an "Case Air Pressure Test" of the circuit(s).

Results	Possible Cause
Low Pressure In Park	• Valve Body
Low Pressure In Reverse	• Reverse-High Clutch • Low-Reverse Servo
Low Pressure In Neutral	• Valve Body
Low Pressure In Drive	• Forward Clutch
Low Pressure in Second Gear	• Forward Clutch • Intermediate Servo
Low Pressure In First Gear	• Forward Clutch • Low-Reverse Servo
Low Pressure At Idle In All Ranges	• Low fluid level • Restricted intake screen • Loose fluid tubes • Loose valve body • Leakage at pump, case or valve body • Pressure regulator valve sticking

Diagnosis

NOTES

High Pressure At Idle In All Ranges	• Throttle valve diaphragm • Manifold vacuum line • Throttle valve control rod • Regulator boost valve(s) sticking
Low At 10 In. Vacuum	• Faulty throttle valve diaphragm or throttle valve stuck
Low At Wide Open Throttle	• Excessive leakage • Low pump capacity • Restricted oil pan screen
High Or Low In All Tests	• Change throttle valve diaphragm and control rod

NOTE: Fluid pressure can be corrected by replacing the Throttle Valve diaphragm control rod with a longer or shorter selective rod. Never change the setting just to soften the shift feel; only to meet pressure specifications. See the service manual for this procedure.

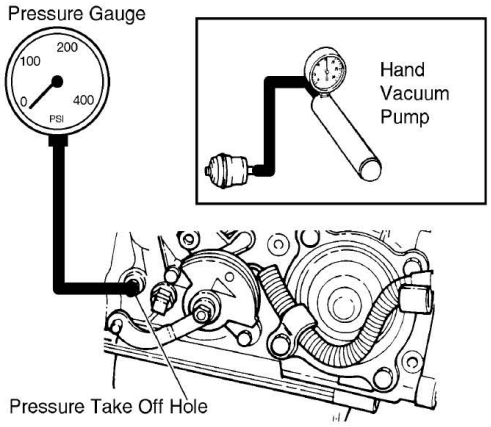
If the fluid level, linkage, shift speeds and pressure tests check out OK, the transmission is OK. Certain "shift feel" conditions then are due to "driveability" characteristics.

No further attempt should be made to diagnose the transmission.

4-19 AUTOMATIC TRANSMISSIONS 4-19

Diagnosis

NOTES



Governor Test

The governor is normally proved OK on the performance test if all the shift points are to specification. If they are not, a governor test can be performed either in the shop or during the performance test to determine if the governor is functioning.

1. Disconnect and plug the throttle valve diaphragm vacuum hose. Attach a hand vacuum tester with a long hose to the diaphragm.
2. Raise and support the equipment as necessary to permit it to free wheel.
3. Look up the cutback "performance speed" specification.
4. Apply 10 inches vacuum.
5. Slowly accelerate in second gear.
6. Watch for a pressure cutback at between 10 and 13 MPH.
7. Record the "speed" at which the cutback occurs.

- If cutback is early or late, inspect governor and screen.
- If OK, check cutback valve in transmission valve body.

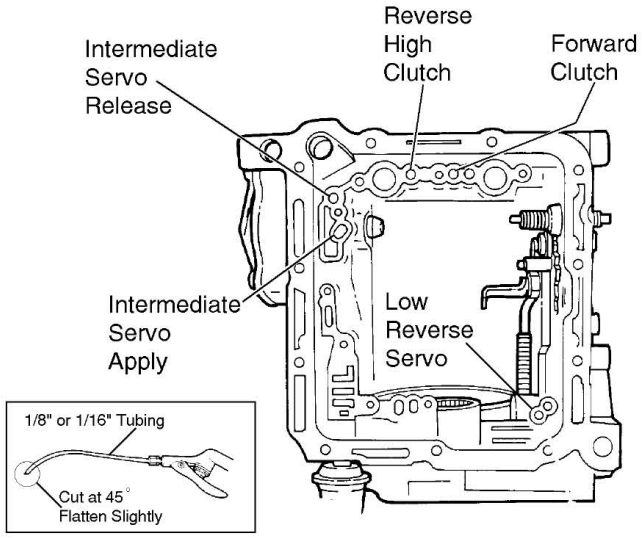
Diagnosis

NOTES

Case Air Pressure Tests

Testing the clutch and servo circuits with air pressure tells you whether slipping is caused by internal leakage or by a mechanical failure. Use 25 psi shop air and a nozzle. Apply pressure to the circuit port. Look up port location in the applicable service manual.

The illustration shown is for a C5 automatic transmission. If the circuit leaks, locate the cause by inspecting the seals during disassembly. The servos may be accessible from the outside of the transmission. Clutches require transmission overhaul. If the circuit doesn't leak, the problem is mechanical and an overhaul is required. Remove the valve body to test. Use rags to prevent splatter when testing.



Diagnosis

NOTES

Forward Clutch Results

- Will make a dull thud sound if OK.
- A hiss sound indicates a leak.
- Feel piston movement with fingertips on input shell if no thud is heard.

Reverse-High Clutch Results

- Will make a dull thud sound if OK.
- A hiss sound indicates a leak.
- Feel piston movement with fingertips at clutch drum if no thud is heard.

Intermediate Apply Servo Results

- Band will tighten if OK.
- A hiss sound or if band does not tighten will indicate a leak.
- Hold while testing release passage.

Intermediate Release Servo Results

- Band will release if OK.
- A hiss sound or if band does not release will indicate a leak.

Low-Reverse Servo Results

- Band will tighten if OK.
- A hiss sound or if band does not tighten will indicate a leak.

Available: Ford C-6 Automatic Transmission Service Manual
Wollard P/N 302157
(Ford P/N PPD 194-296

C-6 TRANSMISSION SERVICE

C-6 AUTOMATIC TRANSMISSION SERVICE

Removal and installation procedures are included in the event the transmission must be replaced or sent to a specialized repair facility.

The Ford C6 transmission combines a torque converter with a two-speed, fully automatic unit for transmitting engine torque to the drive axle via a driveshaft. Maintenance is limited to changing the fluid and filter at the recommended service intervals and adjusting the linkage, intermediate band, and neutral start switch.

Malfunctions

Automatic transmission malfunctions may be caused by poor engine perfor mance or improper transmission adjustments.
You should always begin by checking engine performance, then fluid level and condition, and gearshift cable adjustment.

⚠CAUTION If the problem exists after these checks and adjustments are completed, remove unit from service and refer the transmission to a transmission repair facility.

If you ever notice unusual noises such as gear noise or grinding, a buzz or whine, knocks, scraping, clicking, etc., remove the unit from service and refer it to a transmission repair facility.

Towing the Unit

⚠CAUTION Tow the unit with the rear end picked up or with the drive shaft disconnected or the transmission will be damaged.

IN AN EMERGENCY, the unit may be towed without lifting the wheels or discon necting the drive shaft IF:
• Engine is running AND transmission is in neutral.
• Towing distance must be LESS THAN 1 MILE and travel speed LESS THAN 5 M.P.H.

IMPORTANT! Failure to follow these instructions will void the warranty.

Fluid Level and Condition

1. Bring transmission to normal operating temperature (about 180°OF). Five minutes of driving, including frequent stops and starts, will usually produce normal fluid temperature.
2. Set gear selector to neutral (N) and withdraw transmission dipstick to check oil level.

Always check oil level with unit on a level surface and WITH FLUID AT NORMAL OPERATING TEMPERATURE. DO NOT OVERFILL TRANSMISSION. Overfilling can result in transmission damage. It is easy to overfill the transmission. To avoid overfilling, add oil in small amounts and recheck level frequently.

3. Withdraw dipstick and examine fluid for discoloration and a foul (burned) smell. This would indicate damaged bands or clutches. If oil has a milky look, water has entered the transmission. Air bubbles mean there is an air leak in the suction lines. Report any of these conditions to your supervisor.
4. Check level indicated on dipstick. Add fluid as needed to maintain level between “FULL” and “ADD 1 PINT” marks on the dipstick. Use type Dexron R2.

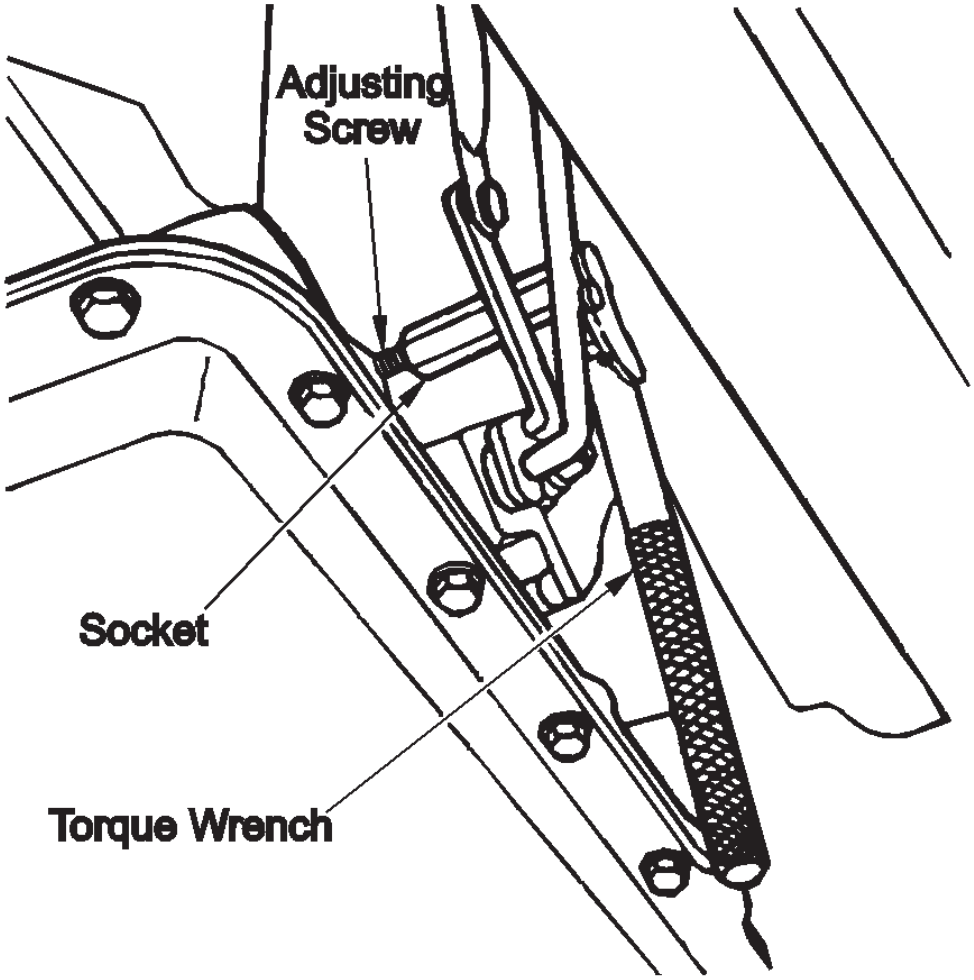
Transmission Adjustments

Most repair facilities can perform intermediate band and neutral start switch adjustments.

Intermediate Band Adjustment

When making band adjustments, FOLLOW SPECIFICATIONS EXACTLY. Failure to do so may cause serious damage to the transmission.

1. Raise unit on jack stands or a hoist.
2. Clean dirt from band adjusting screw. Remove and discard locknut.
3. Install a new locknut and tighten adjusting screw to 10 ft/lbs. torque.
4. Back off adjusting screw exactly 1 1/2 turns.
5. Hold adjusting screw from turning and tighten locknut to 35-40 ft/lbs.
6. Lower the unit.



Neutral Start Switch

The neutral start switch is a safety device that prevents the engine from starting if the transmission is in any shift position other than NEUTRAL.

Adjusting the Neutral Start Switch

NOTE: The neutral start switch may also be checked by attempting to start the engine with the gear shift lever in each shift position.
This switch is a combination unit located on the automatic transmission shifter shaft in the engine package.

1. Remove clevis pin holding shifter arm to cable clevis.
2. Connect a volt-ohm meter (on resistance range) or a continuity tester across both Red/Blue wires coming out of the switch.
3. Loosen hold-down bolts on switch and rotate switch until contact opens for the same throw of shifter arm either side of Neutral.
4. Retighten switch bolts and recheck adjustment.
5. Replace clevis pin.

Replacing the Neutral Start Switch

1. Remove neutral start switch from transmission case. Catch fluid in a clean container.
2. Move control lever to NEUTRAL position. Check to see that the switch operat ing lever finger is centered in switch opening in transmission case.
3. Install switch and tighten to 24 ft./lbs torque. Readjust switch.

IMPORTANT! Be sure the switch packing is properly installed to prevent oil leakage.

4. Add fluid to transmission if needed.

The drive plate (flywheel) will not support a load. None of the weight of the transmission must be allowed to rest on the drive plate during removal or installation.

⚠ CAUTION The transmission and torque converter must be removed and installed as an assembly to prevent damage to the front bushing or front oil seal.

1. Remove the engine/transmission assembly.
2. Shift transmission into NEUTRAL. Place drain pan under transmission fluid pan. Starting at rear of pan and working toward front, loosen attaching bolts and allow fluid to drain. Finally remove all of pan attaching bolts except two at front to allow fluid to further drain. With fluid drained, install two bolts on rear side of pan to temporarily hold it in place.
3. Remove converter drain plug access cover from lower end of converter housing. Matchmark torque converter with drive plate (for easier installation).

⚠ CAUTION Do not attempt to rotate the drive plate or torque converter by prying or using force or you will damage the drive plate.

4. Remove converter-to-flywheel attaching nuts. Place a wrench on crankshaft pulley attaching bolt to turn converter to gain access to bump switch.
5. With wrench on crankshaft pulley attaching bolt, turn converter to gain access to converter drain plug. Place a drain pan under converter to catch fluid and remove plug. After fluid has been drained, re-install plug.
6. Remove capscrew and self-locking nut securing transmission shift cable to shift lever on transmission.
7. Remove all hardware securing transmission shift cable to transmission and free the cable.
8. Disconnect hydraulic lines at transmission.
9. Disconnect park brake cable. Disconnect driveshaft and slide shaft rear ward from transmission. Install a seal installation tool in extension housing to prevent fluid leakage.

10. Remove vacuum hose from vacuum diaphragm unit. Remove vacuum line from retaining clip.
11. Remove transmission rear support and insulator assembly attaching bolts at bottom rear of transmission.

1. Raise transmission with transmission jack to take pressure off rear cross member.
2. Secure transmission to jack with safety chain.
3. Remove converter housing-to-engine attaching bolts.
4. Move transmission away from engine.
5. Lower transmission jack and move transmission and converter assembly from under vehicle.

NOTE: This manual does not cover transmission disassembly. Disassembly must be done by specialized personnel.

Transmission/Torque Converter Installation

The transmission must be installed as an assembly, or the front pump bushing and oil seal will be damaged.

Do not allow the weight of the transmission to rest on the drive plate during installation. The drive plate will not support a load.

1. Tighten converter drain plug to 18-28 ft-lbs.
2. Position converter on transmission, making sure converter drive flats are fully engaged in pump gear.
3. With converter properly installed, place transmission on jack. Secure trans mission to jack with chain and place under tractor.
4. Raise transmission to align with engine.
5. Rotate converter until studs, drain plug and matchmark are in alignment with flywheel.
6. The converter must rest squarely against flywheel. This indicates that con verter pilot is not binding in engine crankshaft. Do not allow converter drive flats to disengage from pump gear. Move converter and transmission assembly forward into position, using care not to damage the flywheel and converter pilot.

7. Install and tighten converter housing-to-engine attaching bolts to 40-50 ft-lbs.
8. Remove transmission jack safety chain from around transmission.
9. Position transmission support crossmember to frame side rails and tighten attaching bolts.
10. Position transmission rear support and insulator assembly above cross member and lower transmission into place. Install mounting bolts and tighten.

1. Remove jack.
2. Connect vacuum line to vacuum diaphragm making sure that line is in retaining clip.
3. Connect oil cooler lines to transmission.
4. Connect downshift and manual linkage rods or cable controls to their respective levers on the transmission.
5. Secure converter-to-flywheel attaching nuts and tighten them to 20-30 ft-lbs.
6. Install converter housing access cover and secure it with attaching bolts.
7. Install new filter and pan gasket, and fill transmission with oil.
8. Connect neutral switch wire to plug connector.
9. Connect temperature sender wire.
10. Connect oil cooler lines to transmission and install oil filler tube.
11. Install dust shield in front of converter assembly.
12. Install engine/transmission assembly into the unit.
13. Connect the battery negative cable.
14. Place gear shift lever in neutral position. Install gear shift cable.
15. Connect wires to neutral starting switch and temperature sending unit.
16. Install park brake cable.
17. Adjust shift cable as required.
18. Start engine and again check for leaks.

Ford C-6 Automatic Transmission Parts Manual
for

C-6 TRANSMISSION PARTS

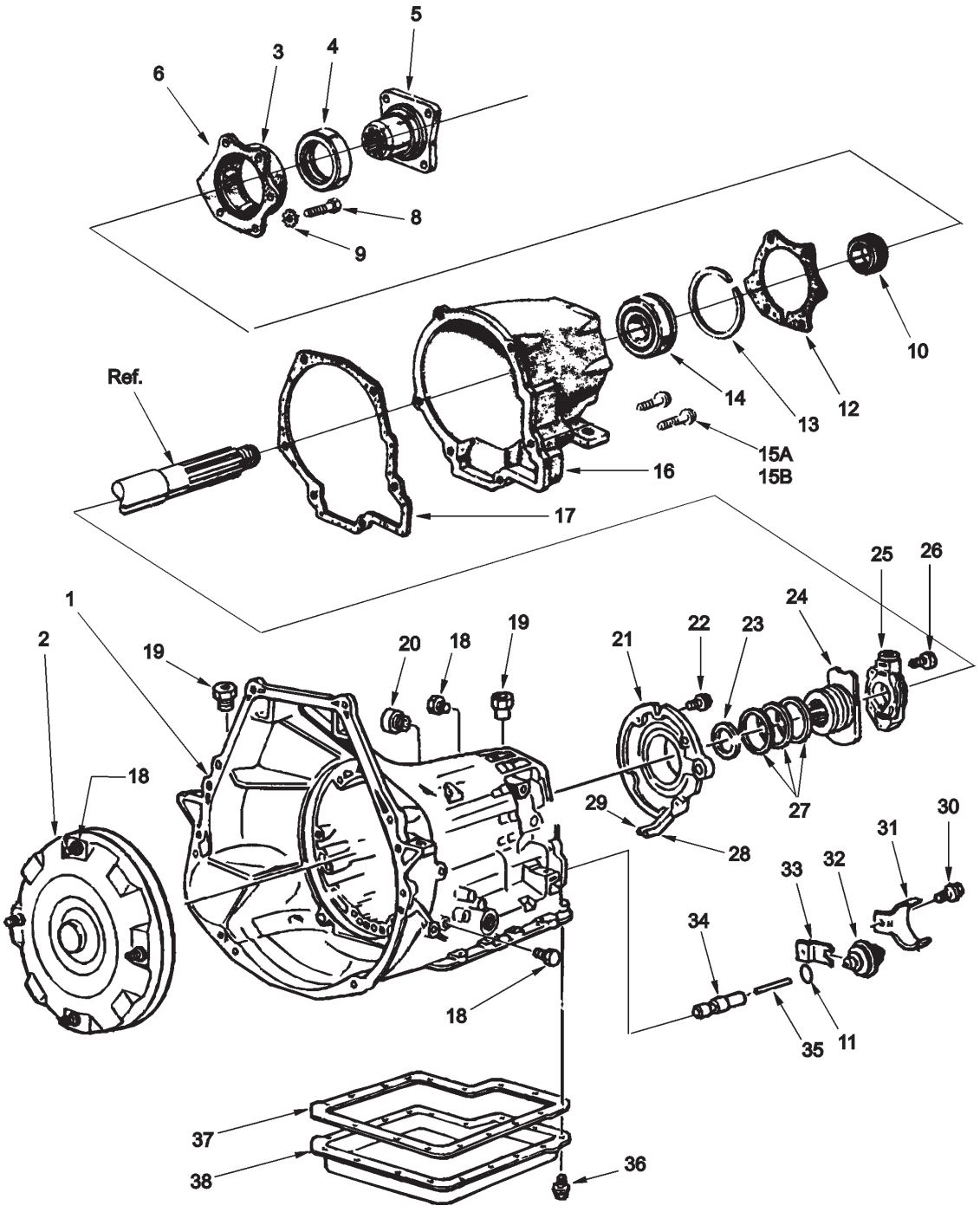


Figure 1

CASE, CONVERTER, AND EXTENSION HOUSING

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
1	302281	E7TP-CA	Case Assembly, Standard Trans.		1
2	38792	E4TP-EA	Converter, Torque (1.87:1) (used with case #E7TP-CA)		1
	43365		Converter, Torque, 2.36:1		
	307413		Converter, Torque, N-W Standard		
3 NS NS	302282 COMM COMM	D0TZ-7085-A 33846-S8 34944	Retainer, Rear Bearing (incl. Item #4) Nut, 1/2-20 Washer, Tooth Lock, 1/2		1 4 4
4	302283	D0TZ-7A011-A	Seal, Output Shaft Oil		1
5	302284	D3TZ-7089-B	Yoke, Output		1
6	302285	C8HZ-7A002-A	Plug, Speedometer Drive Hole		1
7			NOT USED		
8	Comm	20522-S	HHCS		5
9	Comm	351487-S	Washer, Tooth Lock		5
10	302286	D1TZ-17285-A	Gear, Speedometer (used as spacer)		1
11	302287	D2AZ-7B426-A	Gasket, Throttle Control Diaphragm		1
12	302288	D0TZ-7086-A	Gasket, Bearing Retainer		1
13	302289	D5TZ-7070-A	Snap Ring, Rear Bearing		1
14	302290	8D-7065	Bearing, Rear		1
15A 15B	Comm Comm	380209-S 380207-S	HHCS, 3/8-16 x 1.25 HHCS		2 4
16	302291	D0TZ-7A039-B	Extension Assembly (includes studs)		1
17	302292	D0TZ-7086-A	Gasket, Extension Housing		1
18	302293	87650-S	Plug, Dry Seal Tapered Thread, 1/8-27”		3
19	302294 302295	E0UZ-7D273-A or D7AZ-7D273-B	Fitting, Oil, 1/4-18 male x 1/2-20 female Fitting, Oil, 1/8 male x 1/2-20 female		2 2
20	302296	D0AZ-7034-B	Vent, Case		1
21	302297	C6AZ-7C232-A	Sleeve, Oil Distributor		1
22	Comm	58618-S2	HHCS, 5/16-28 x 1.00		4
23	302298	377138-S	Ring, Retainer (copper)		1
24	302299	C7AZ-7D220-A	Body, Governor Oil Collector		1
25	302300	D8AZ-7C063-B	Body Assembly, Governor		1
25A	302301	C4AZ-7D218-B	Retainer, Governor Secondary Valve Spring (not shown)		1

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
26	Comm	20386-S8	HHCS		4
27	302302	C4AZ-7D011-A	Ring, Governor Housing Seal		3
28	302303	C6AZ-7D000-B	Tube, Outlet, Oil Distributor		1
29	302304	C6AZ-7D000-A	Tube, Inlet, Oil Distributor		1
30	Comm	56119-S	Screw, Hex Flange Hd, 5/16-18 x 0.82		1
31	302305	F1TZ-7F013-A	Shield, Modulator Heat		1
32	302307	D4TZ-7A377-A	Diaphragm Assy, Throttle Valve (Black Band-SAD)		1
	302308	D70Z-7A377-A	Diaphragm Assy, Throttle Valve (Green Band-SAD)		
	302309	D8AZ-7A377-A	Diaphragm Assy, Throttle Valve (Altitude Compensating)		
33	302310	D3AZ-7F006-B	Clip, Diaphragm Retainer		1
34	302311	D5AZ-7D080-A	Valve, Transmission, Primary Throttle		1
35	302312	8DAZ-7A380-A	Rod Kit, Throttle Control		1
36	Comm	378782-S	HHCS, 5/16-18 x 9/16		17
37	37920	C6AZ-7A191-B	Gasket, Oil Pan		1
38	302313	E5TZ-7A194-D	Pan, Oil		1

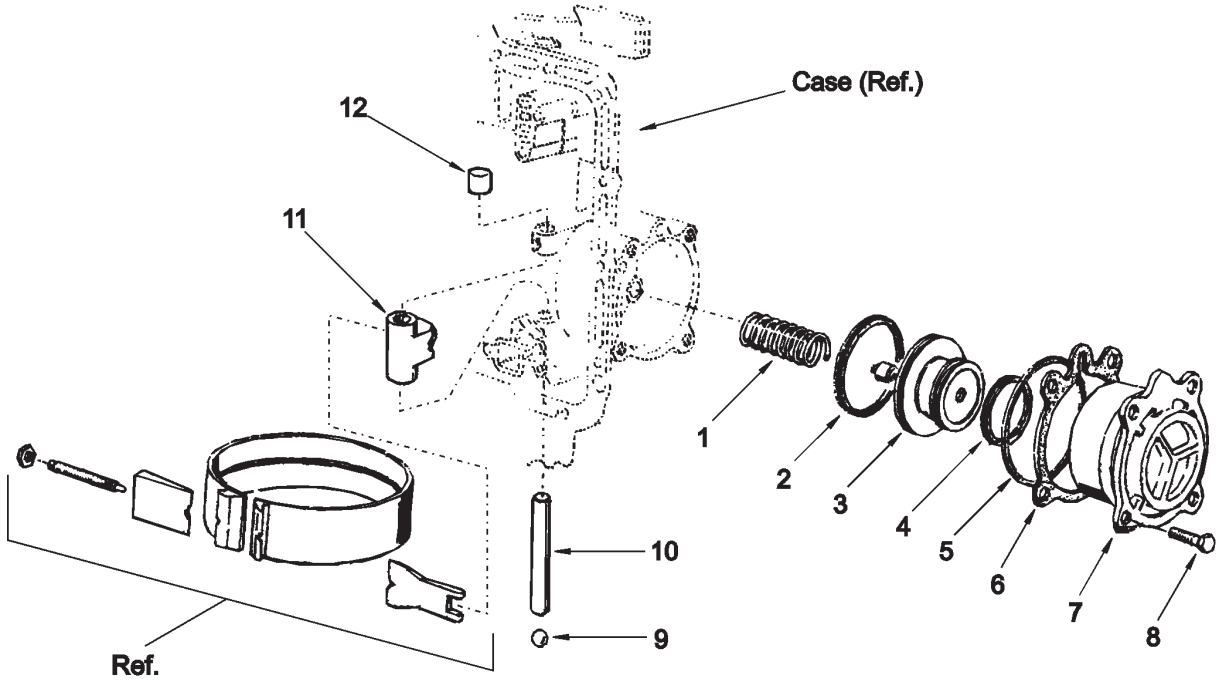


Figure 2
INTERMEDIATE SERVO AND BAND

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
1	302314 302315 302316	C8SZ-TD028-B D1AZ-7D028-A D6OZ-7D028-A	Spring, Inter. Band Servo (Yellow) Spring, Inter. Band Servo (Brown) Spring, Inter. Band Servo (Pink)		1
2	302317	D5TZ-7D024-B	Seal, Intermediate Band Servo Cover		1
3	302318	D5UZ-7D021-B	Piston Assy, Inter. Band Servo		1
4	302319	C6AZ-7D025-A	Seal, Intermediate Brake Drum		1
5	302320	D5TZ-7D024-B	Seal, Inter. Band Servo Cover		1
6	302321	D4AZ-7D026-A	Gasket, Inter. Band Servo Cover		1
7	302322	D3AZ-7D027-A	Cover, Inter. Band Servo		1
8	Comm	57633-S2	HHCS, 5/16-18 x 0.75		4
9	302323	353079-S	Ball, 1/2”		1
10	302324	C6AZ-7D433-A	Shaft, Inter. Band Actuating Lever		1
11	302325	C6AZ-7330-B	Lever, Inter. Band Servo		1
12	302326	C7AZ-7E206-A	Retainer, Inter. Band Servo Lever		1

Figure 3
VALVE BODY ASSEMBLY

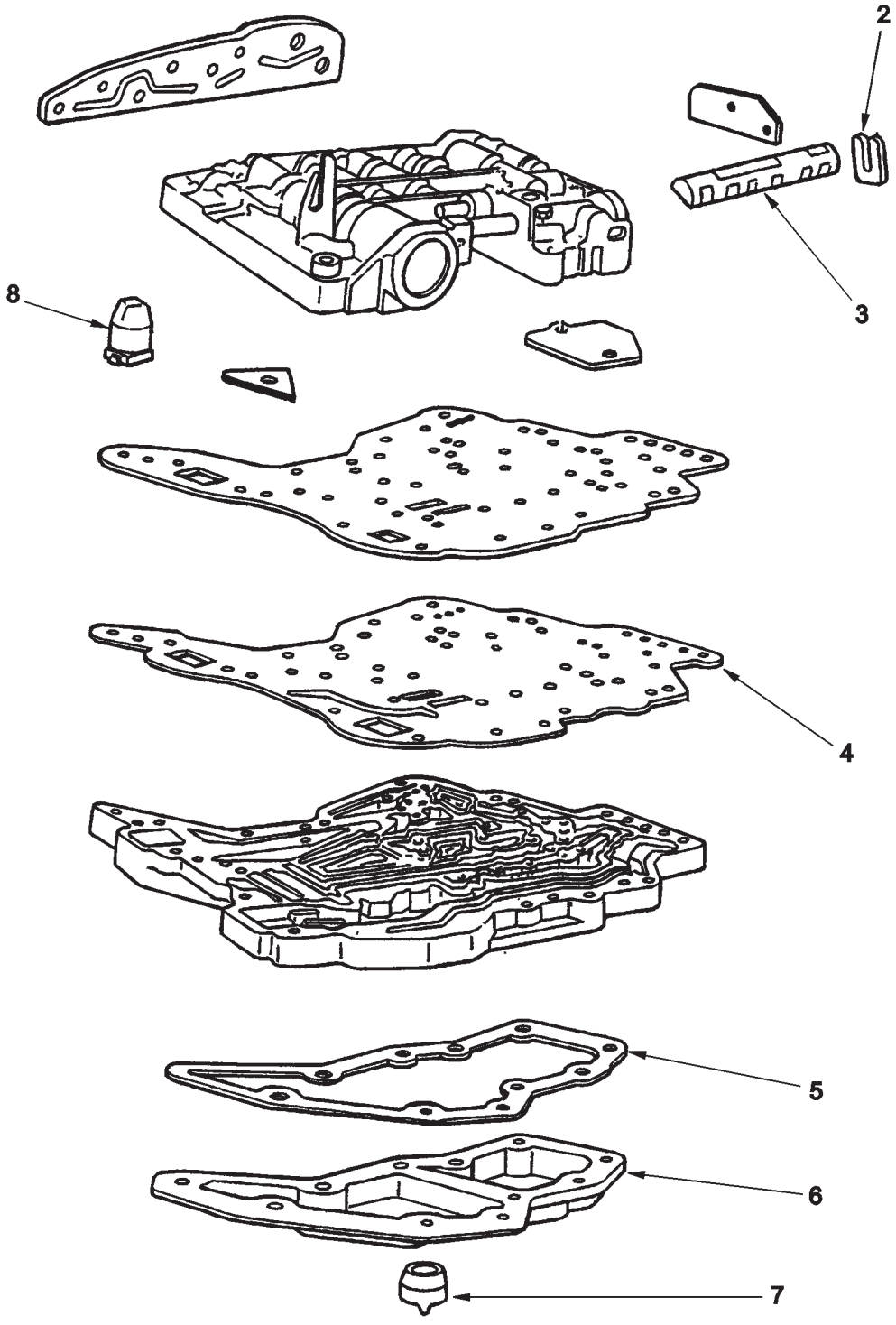


Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
1	302327	E0FP-4A100-BA Or E0FP-4A100-AA	Valve Body, Main Control Assy (2-speed) (Includes items shown but not called out) Valve Body, Main Control Assy (3-speed) (Includes items shown but not called out)		1
2	302328	C4AZ-7D227-A	Spacer, Throttle Pressure Valve		1
3	302329	E0TZ-7326-D	Rod, Gear Selector Valve		1
4	302330	6DAZ-7D100-A	Gasket, Valve Body Separator Plate		1
5	302331	C6AZ-7E062-A	Gasket, Oil Pan Screen		1
6	NW34532	D5AZ-7A098-B	Screen, Oil Pan (includes item #5)		1
7	320332	D3TZ-7A102-A	Tube, Lower Valve Body Suction		1
8	302333	D0AZ-7E387-A	Screen, Main Control Pump Inlet		1

FIGURE 4
THROTTLE AND MANUAL CONTROL LINKAGE

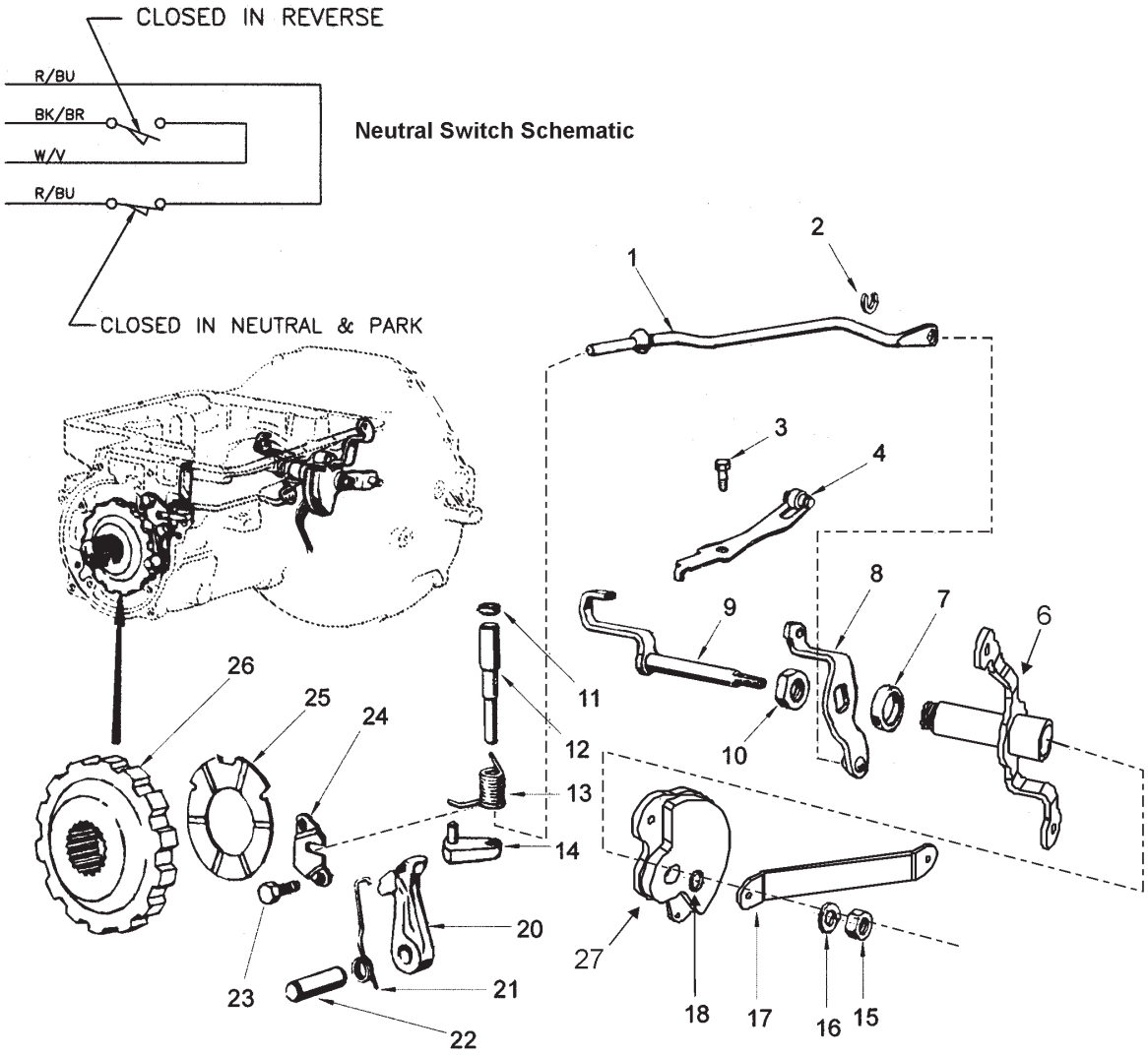
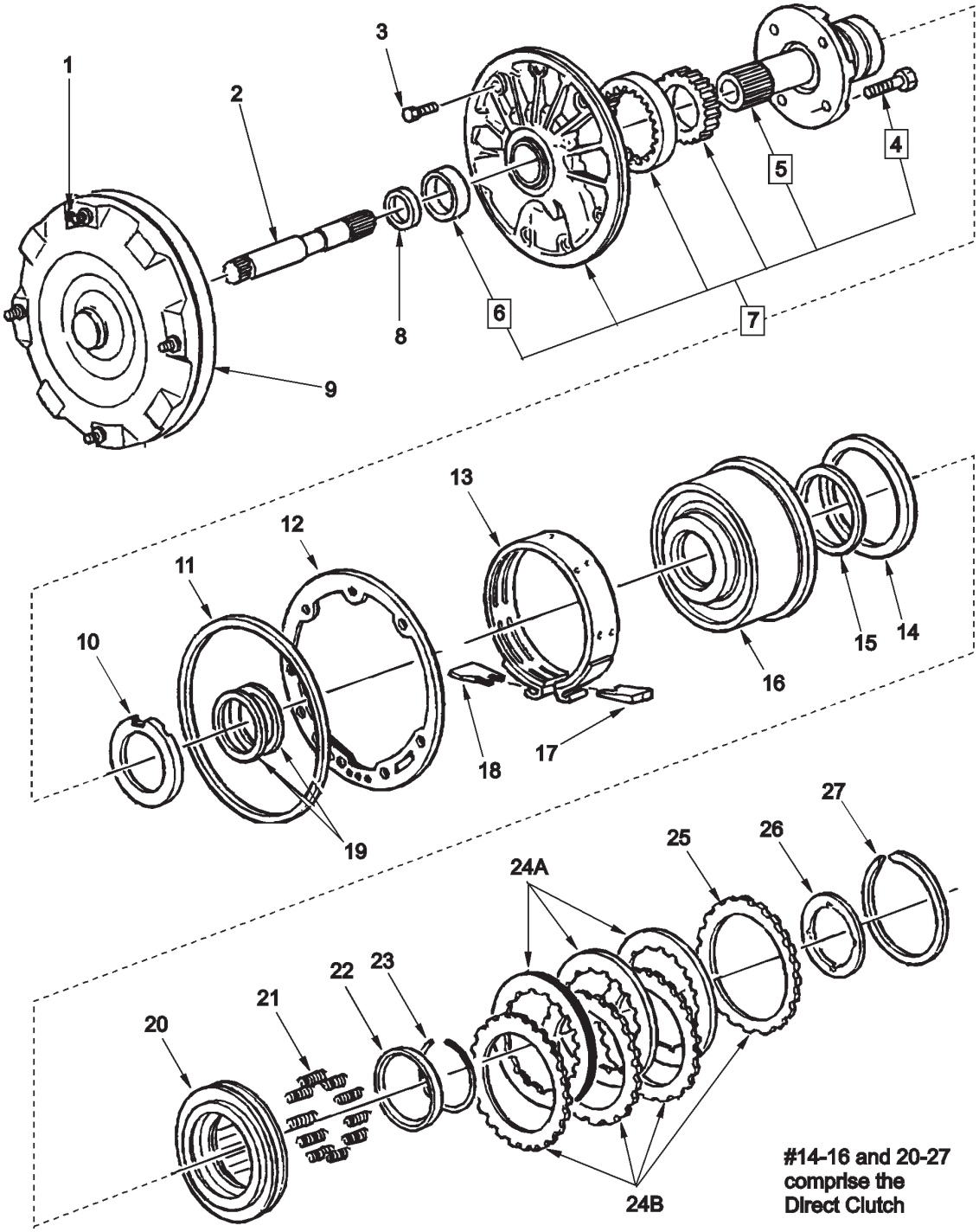


Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
1	302334	F0TZ-7D411-A	Rod, Parking Pawl Actuating (Includes item #24)		1
2	Comm	97411-S	Retainer		1
3	Comm	376562-S	Screw		1
4	302335	E0TZ-7A261-A	Spring, Manual Control Valve Detent Lever		1
6	302336	D2ZP-7A256-AB	Lever Assembly, Manual Control		1
7	302337	D5AZ-7B498-A	Seal Assy, Manual Control Lever		1
8	302338	E0TZ-7A115-A	Lever Assy, Manual Control Valve Detent		1
9	302339	D0AZ-7D261-B	Lever Assy, Downshift Detent Inner		1
10	Comm	33945-S	Nut		1
11	302340	EAA 6572-A	Cup, Parking Plate Shaft		1
12	302341	C6AZ-7D418-A	Shaft, Parking Plate		1
13	302342	C9AZ-7D417-A	Spring, Parking Brake Torsion		1
14	302343	C9AZ-7D414-A	Plate Assy (includes item #13)		1
15	Comm	33798-S	Nut		1
16	Comm	34806-S7	Washer, Lock		1
17	302344	D0OZ-7A394-B	Lever, Downshift Control Outer		1
18	302345	386078-S	Seal		1
20	302346	E0TZ-7A441-A	Pawl, Parking		1
21	302347	C6AZ-7D070-B	Spring, Parking Pawl Return		1
22	302348	C6AZ-7D071-A	Shaft, Parking Pawl Return		1
23	Comm	379058-S7-8	Screw and Washer		1
24	NSS	E0AP-7D419-BA	Plate (see item #1)		1
25	302349	D3TZ-7B368-A	Washer, Output Shaft Thrust Rear		1
26	302350	D6TZ-7A233-A	Gear, Output Shaft (incl item #25)		1
27	NW35944	D2ZZ-7A247-C	Neutral Switch Assembly		1

FIGURE 5
CLUTCHES, GEAR AND SHAFTS



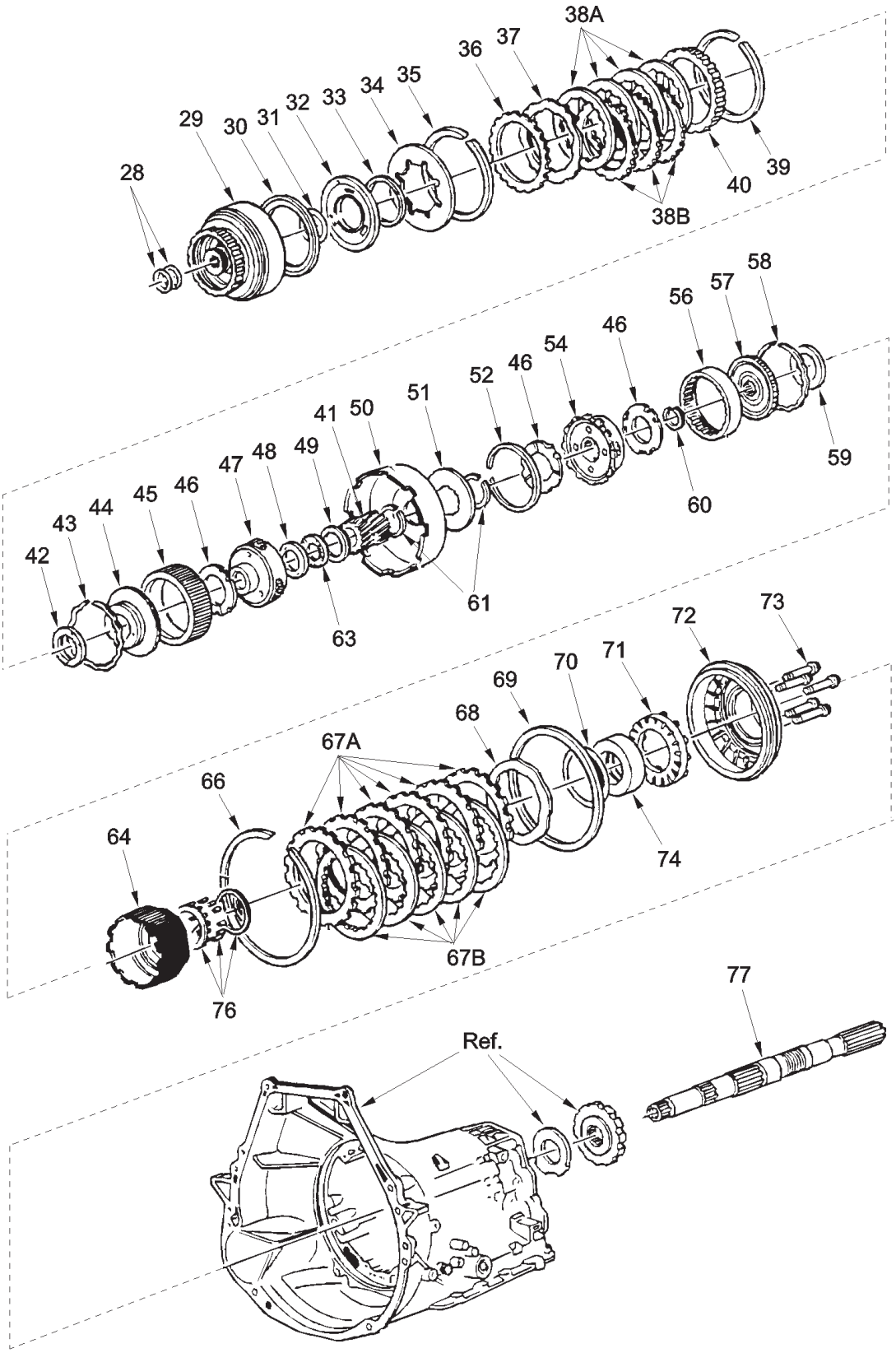

38A
37
36
35
34
33
32
31
30
29
28
39
40
38B
58
57
56
46
54
46
52
51
50
41
49
48
47
46
45
44
43
42
59
60
61
63
73
72
71
70
69
68
67A
66
64
74
67B
76
77
Ref.

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
1	302351	87650-S2	Plug, Dry Seal Tapered Thread,1/8-27		1
2	302352	D2AZ-7017-A	Shaft, Input		1
3	Comm	58619-S2	HHCS, 5/16-18 x 1.25		7
4	Comm	20346-S8	HHCS, 5/16-18 x 0.75		5
5	302353	C9AZ-7A108-A	Support Assy, Front Pump		1
6	302354	C6AZ-7B258-A	Bushing, Front Oil Pump		1
7	302355	C8AZ-7A103-B	Pump Assembly, Front Oil		1
8	302356	C2AZ-7A248-A	Seal Assy, Front Oil Pump, Small		1
9	38792	E4TP-EZ	Torque Converter Assembly		Ref
10	302357	 C6AZ-7D014-A C6AZ-7D014-B C6AZ-7D014-C C6AZ-7D014-D C6AZ-7D014-E	Washer, Front Pump Support Thrust #1, 0.057” thick #2, 5/64” thick #3, 3/32” thick #4, 0.114 thick #5, 0.119 thick		 1 1 1 1 1
11	300134	C6AZ-7A248-B	Seal Assy, Front Oil Pump, Large		1
12	302358	C6AZ-7A136-A	Gasket, Front Oil Pump to Case		1
13	302359	D9AZ-7D034-B	Band Assy, Intermediate Servo		1
14	302360	C8AZ-7A548-C	Seal, Direct Clutch Piston Oil		1
15	302361	C8AZ-7C099-A	Seal, Clutch Piston Oil		1
16	302362	C9AZ-7D044-A	Drum Assembly, Intermediate Brake (includes item #15)		1
17	302363	C6AZ-7D430-C	Strut, Intermediate Band Anchor		1
18	302364	C6AZ-7D029-C	Strut, Intermediate Brake Band		1
19	302319	C6AZ-7D025-A	Seal, Intermediate Band Servo Piston Cover		2
20	302365	C9AZ-7A262-B	Piston Assy, Direct Clutch		1
21	302366	C7ZZ-7B488-A	Spring, Direct Clutch Piston Spring		10
22	302367	C6AZ-7A527-A	Retainer, Direct Clutch Piston Spring		1
23	302368	377136-S	Ring, Retaining		1
24A	302369	D6AZ-7B164-B	Plate, Direct Clutch, Internal		A/R
24B	302370	C6AZ-7B442-A	Plate, Direct Clutch, External		A/R
25	302371	C6AZ-7B066-B	Plate, Clutch Pressure		1
26	302372	C6AZ-7C096-A	Washer, Thrust		1
27	NSS		Ring, Retaining (see item #39)		1
28	302373	E0AZ-7D019-A	Seal, Forward Clutch Cylinder		2

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
29	302374	E9AZ-7A360-A	Cylinder Assy, 8-Plate Clutch Forward (Includes item #34) Note: If replacing a 6-plate clutch, you must use an additional item #24A and B		1
30	302375	D6AZ-7A548-A	Seal, Forward Clutch Piston Oil,Outer		1
31	302376	377130-S94	Seal, Forward Clutch Piston Oil,Inner		1
32	302377	D6AZ-7A262-A	Piston Assembly, Forward Clutch		1
33	302378	C6AZ-7D256-B	Ring, Forward Clutch Piston Spring		1
34	302379	D9AZ-7B070-A	Spring, Forward Clutch Piston Disc		1
35	302380	377127-S	Ring, Retainer, 6-2 1/32” x 0.076” thick		1
36	302381	C6AZ-7B066-A	Plate, Clutch Pressure (has triange depression on front face)		1
37	302382	D6AZ-7E085-B	Spring, Clutch Pressure, Forward (4 teeth in 26-tooth bank)		1
38A	302383	C8AZ-7B164-H	Plate, Front Clutch, Internal (Friction)		A/R
38B	302370	C6AZ-7B442-A	Plate, Front Clutch, External (Steel)		A/R
39	302384	377126-S 377127-S 377128-S 377437-S 377444-S 386841-S 386842-S	Ring, Retaining (Select fit): 6-2 1/32” dia. X .062” thick 6-2 1’32” dia. .076” thick 6-2 1/32” DIA. .090” THICK .058” thick (forward clutch) .094” thick (forward clutch) 7-7/64” dia. X .112” thick 7-7/64” dia. X .130” thick		A/R
40	302385	C6AZ-7D066-B	Washer, Input Shell Thrust, 3-3/4” x 3/64”		1
41	302386	C6AZ-7D063-A	Gear Assembly, Sun (34 teeth)		1
42	302387	C9AZ-7D090-A	Washer, Forward Clutch Hub Thrust		1
43	302388	377132-S	Ring, Retaining, 4-21/32”		1
44	302389	D6AZ-7B067-A	Hub, Clutch, Forward Ring Gear, 4-1/2”		1
45	302390	D6AZ-7D392-A	Gear, Forward Ring		1
46	302391	CDAZ-7A166-A	Thrust Washer, Forward Planet Carrier		1
47	302392	D5AZ-7A398-A	Planet Assy, Forward		1
48	302393	C6AZ-7D236-A	Race, Sun Gear Thrust Bearing (Front)		1

Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
49	302394	C6AZ-7D235-	Race, Sun Gear Thrust Bearing (Rear)		1
50	302395	C6AZ-7D064-	Shell, Input		1
51	302396	C6AZ-7D066-	Washer, Input Sheel Thrust, 3-3/4 x 3/64		1
52	302397	377155-S	Ring, Retaining, 5-7/32”		1
54	302398	C6AZ-7D006-	Planet Assembly, Reverse		1
56	302399	C6AZ-7A153-	Gear Ring (74 teeth)		1
57	302400	C9AZ-7D164-	Hub, Output Shaft		1
58	302388	377132-S	Ring, Retaining, 4-21/32”		1
59	302401	C9AZ-7D422-	Thrust Washer, Output Shaft Hub		1
60	302402	387031-S5	Ring, Retaining, Copper, 5/64” thick		1
61	302403	377300-S	Ring, Retaining, 2”		2
62			NOT USED		
63	302404	C6AZ-7D234-A	Bearing Assembly, Sun Gear Thrust		1
64	302405	C6AZ-7B067-B	Hub, Clutch, Reverse, 5-1/2”		1
65			NOT USED		
66	302406	385044-S	Ring, Retaining, 7-1/8”		1
67A	302407	D6AZ-7B164-A	Plate, Reverse Clutch, Internal (friction)		A/R
67B	302408	C6AZ-7B442-B	Plate, Reverse Clutch, External (steel)		A/R
68	302409	D8AZ-7E085-A	Spring, Clutch Pressure, Reverse, 6-7/8”		1
69	302410	C8AZ-7D403-A	Seal, Outer, Reverse Clutch Piston		1
70	302411	C7AZ-7D404-A	Seal, Inner, Reverse Clutch Piston		1
71	302412	D6AZ-7D406-A	Retainer and Spring, Reverse Clutch		1
72	302413	D8AZ-7D402-A	Piston Assembly, Reverse Clutch (Includes item #68)		1
73	302414	C6AZ-7D167-A	HHCS, Overrunning Clutch Case, 5/16-24 x 2.00		5
74	302415	C9AZ-7D171	Race, Inner, Overrunning Clutch		1
76	302416	D0AZ-7A089-A	Clutch Assembly, Overrunning		1
77	302417	D6TZ-7060-A	Shaft, Output		1

FIGURE 6
FLYWHEEL AND OIL FILLER

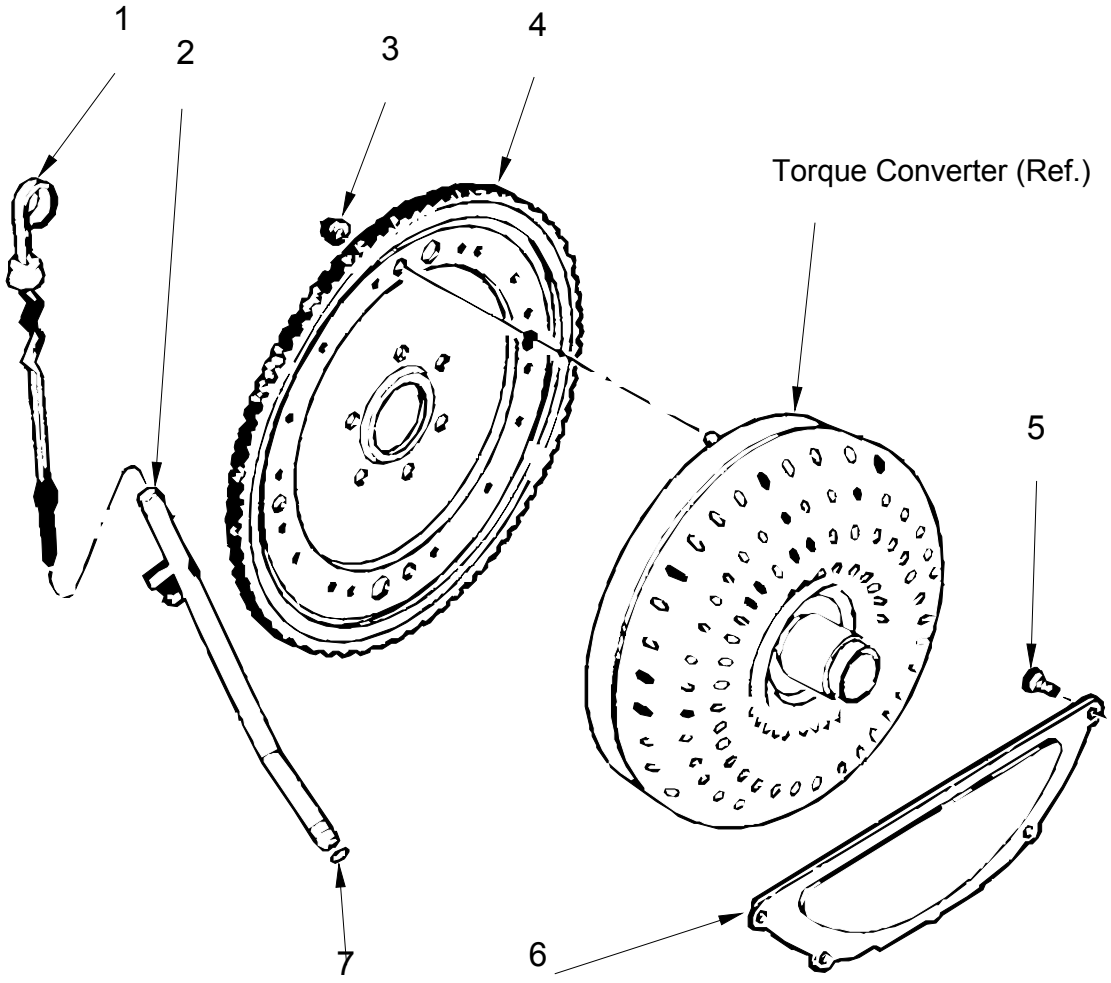
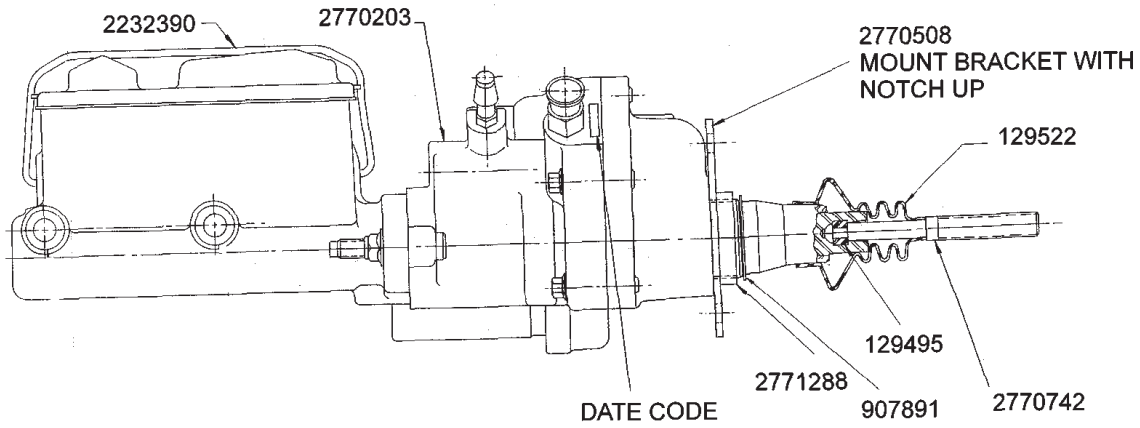
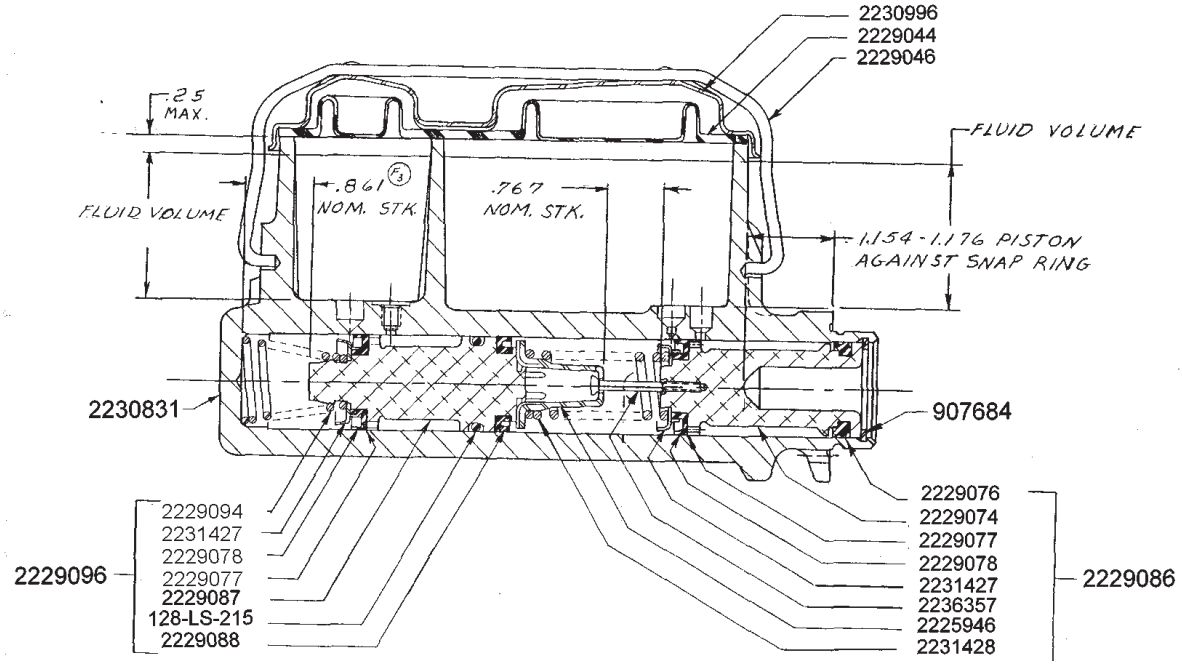


Fig.-Item	NMC Wollard Part No.	Vendor Part No.	Nomenclature	Eff	Units Per Assy
1		Numerous types-Call with description	Indicator, Oil Level		1
2			Tube Assembly, Oil Filler		1
3	Comm	378941-S7-8	Nut, Flywheel		4
4	302418	D5TZ-6375-A	Flywheel		1
5	Comm	57632-S2	HHCS		4
6	302419	D1OZ-7986-A	Cover, Converter Housing		1
7	302420	87034-S94	Seal, Oil Filler Tube		1
8	302296	D0AZ-7034-B	Vent, Case		1





BRAKE POWER BOOSTER, BENDIX

PARTS LIST,
HYDRAULIC POWER SECTION
NOT AVAILABLE AT TIME OF PUBLICATION

This Page Intentionally Blank

II DESCRIPTION OF THE HYDRO-BOOST SYSTEM

The brake system diagram for a Hydro-Boost installation is illustrated in Figure 1. The Hydro-Boost is normally mounted on the engine side of the firewall and used with a suspended brake pedal. The Hydro-Boost is either mounted directly to the firewall or to brackets attached to the firewall.

In addition to mechanical connections to the pedal or input rod, three (3) hydraulic connections also need to be made. One connection is from the supply pump to the booster inlet port. A second connection delivers the hydraulic flow from the booster gear port to the steering gear (if applicable) or to pump reservoir. The third hose returns internal leakage, and fluid from the boost cavity, to the pump reservoir.

The Hydro-Boost unit includes a nitrogen charged pneumatic accumulator. The accumulator provides two or more reserve power assisted brake applications in the event of pressure supply loss, i.e. the engine dies, belt breaks, etc. the number or reserve stops varies with the severity and duration of the applications.

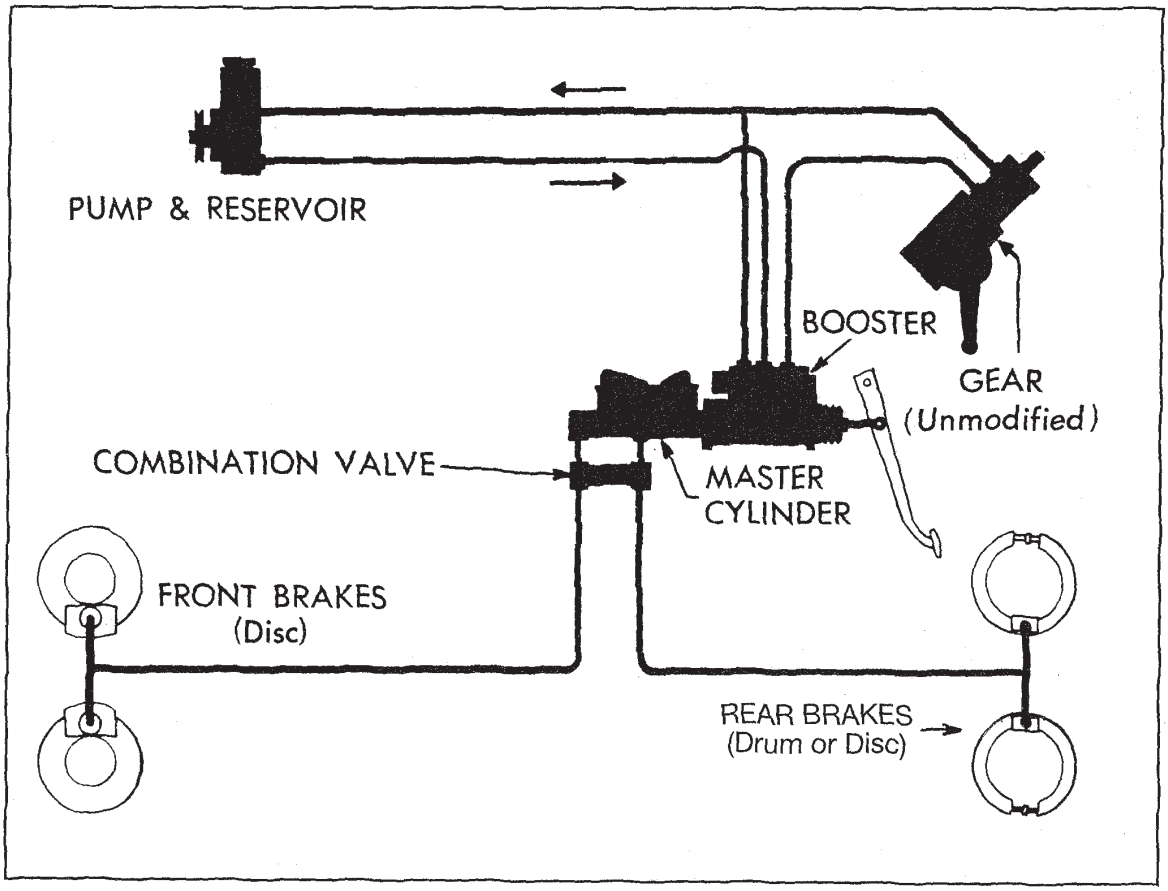


FIGURE 1. Schematic diagram of the Hydro-Boost system

IV PRINCIPLES OF HYDRO-BOOST OPERATION

UNIT AT REST - A sectioned view of the Hydro-Boost unit at rest is shown in figure 2. The major components are labeled with an enlarged view of the ports identifying the ports, lands, laps, and gaps of the valve in the "at rest" position. Oil flows from the inlet or pump port, across the number 3 land and out the gear port. In the position shown, steering pressure created by the steering gear and pump is isolated from the boost cavity by the spool valve and does not affect braking. Lands 2 and 4 block this steering pressure avoiding activation of the unit.

NORMAL POWER OPERATION - With reference to figure 3, the brake pedal is applied as shown by input travel A. The movement of the ratio lever operates the spool valve creating hydraulic pressure due to the restriction at land 3. Fluid traverses land 2 and flows through the center of the spool into the boost cavity. This pressure acts against the power piston to give the power assist and against the reaction rod to provide the effort level of the brake pedal. The reaction and power piston diameters can be varied for different vehicle applications, changing the effort level and power output of the booster.

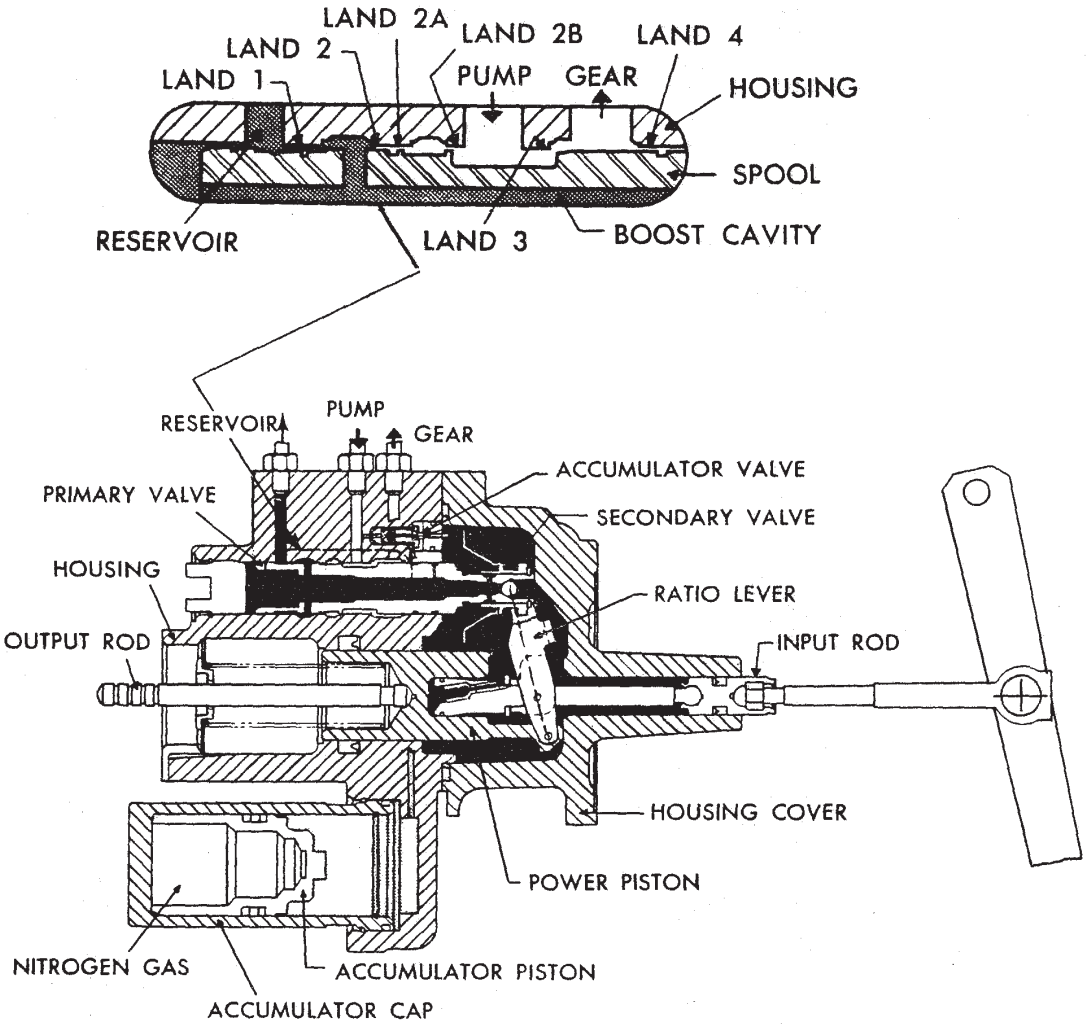
During the normal power operation, the input travel is less than the output travel as indicated by 'A' versus 'B' travel. The ratio lever attaches to the power piston, input rod, and spool valve. The ratio of the distance between the valve pivot and input rod pivot to the distance between the valve pivot and the piston pivot determines the relationship between input travel and output travel.

The lower enlarged view of the spool valve shows the relationship of the valve lands during normal power operation. Land 1 is closed blocking the oil flow to the reservoir. Land 3 meters the flow of oil from the supply pump to the steering gear and generates the hydraulic pressure that is metered across land 2 to apply the brakes.

The upper enlarged view of the valve shows the same operation except pressure is generated by the steering gear and is also being used for braking. During this mode of operation, the spool travel is slightly less than the first case.

It is important to note that braking and steering pressures are not additive and that full pump flow is available to the steering gear at all braking pressures less than power runout.

Figure 2. Unit at Rest



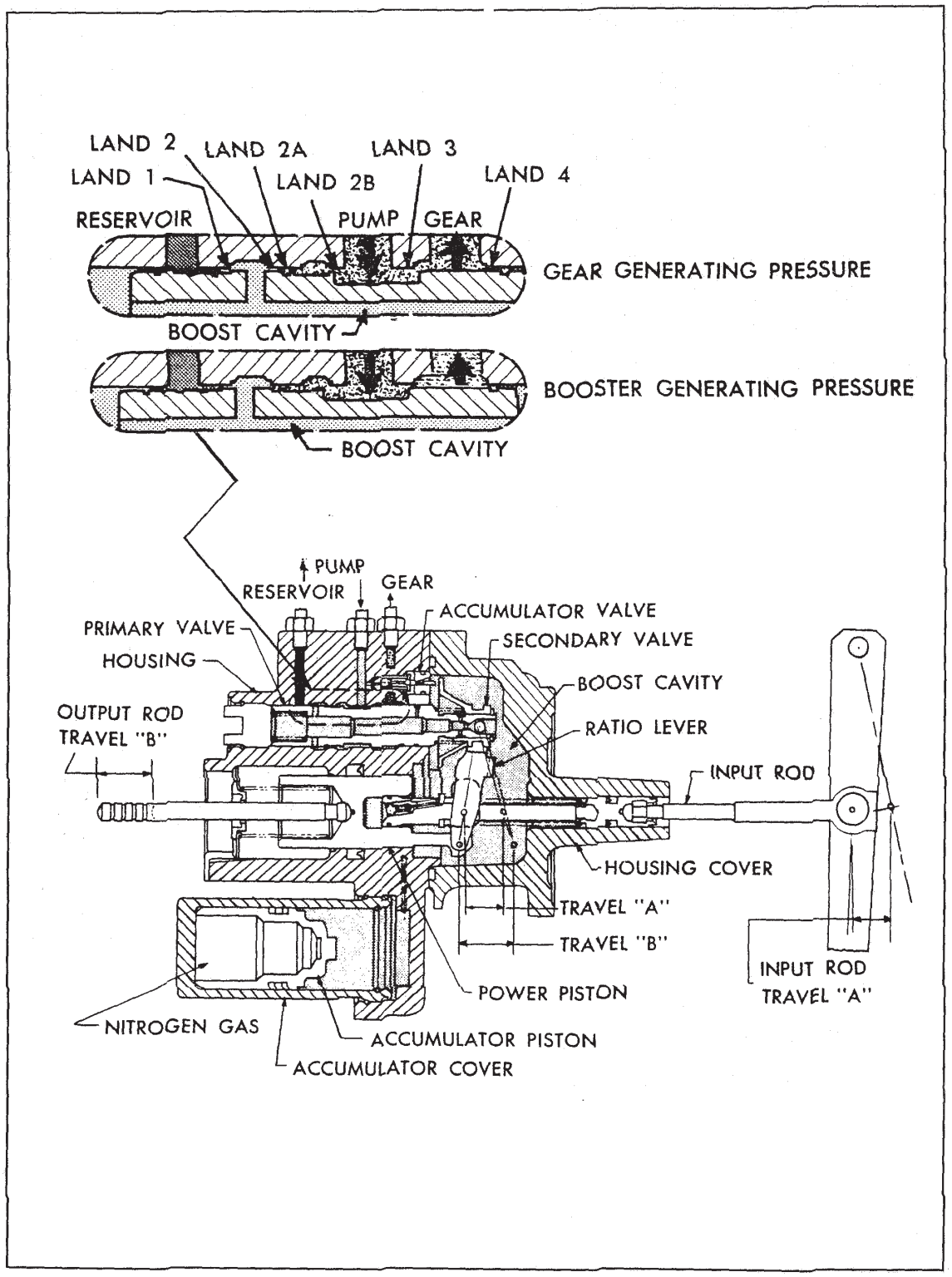


Figure 3. Normal Power Operation

PREVENTATIVE MAINTENANCE

1. Check fluid level of pump every 3 months or more often under severe use.

2. Check for fluid leakage from the Hydro-Boost, Master Cylinder, or hoses every 3 months or more often under severe use.

3. Check for proper tension of pump drive belt and for deterioration of the belt every 3 months or more often under severe use.

4. Check reserve system charge retention occasionally as follows:

   Holding steering on stop or hold brake with 100 lb. minimum brake pedal force for 5 seconds with pump operating. Turn engine off. Eight to twelve hours later depress brake pedal (engine off) and check for some degree of power reserve. If no reserve, repair or replace booster.

GENERAL SERVICE PROCEDURE

REMOVING THE HYDRO-BOOST FROM THE VEHICLE

1. With the engine off, depress the brake pedal several times to discharge the accumulator.
2. Remove Master Cylinder from Hydro-Boost Unit.
   (Do **not** apply Booster with M/CYL. removed.)
3. Disconnect all three(3) hydraulic lines from Booster.
4. Disconnect Pedal or Input Rod.
5. Remove Booster mounting nuts or bolts.

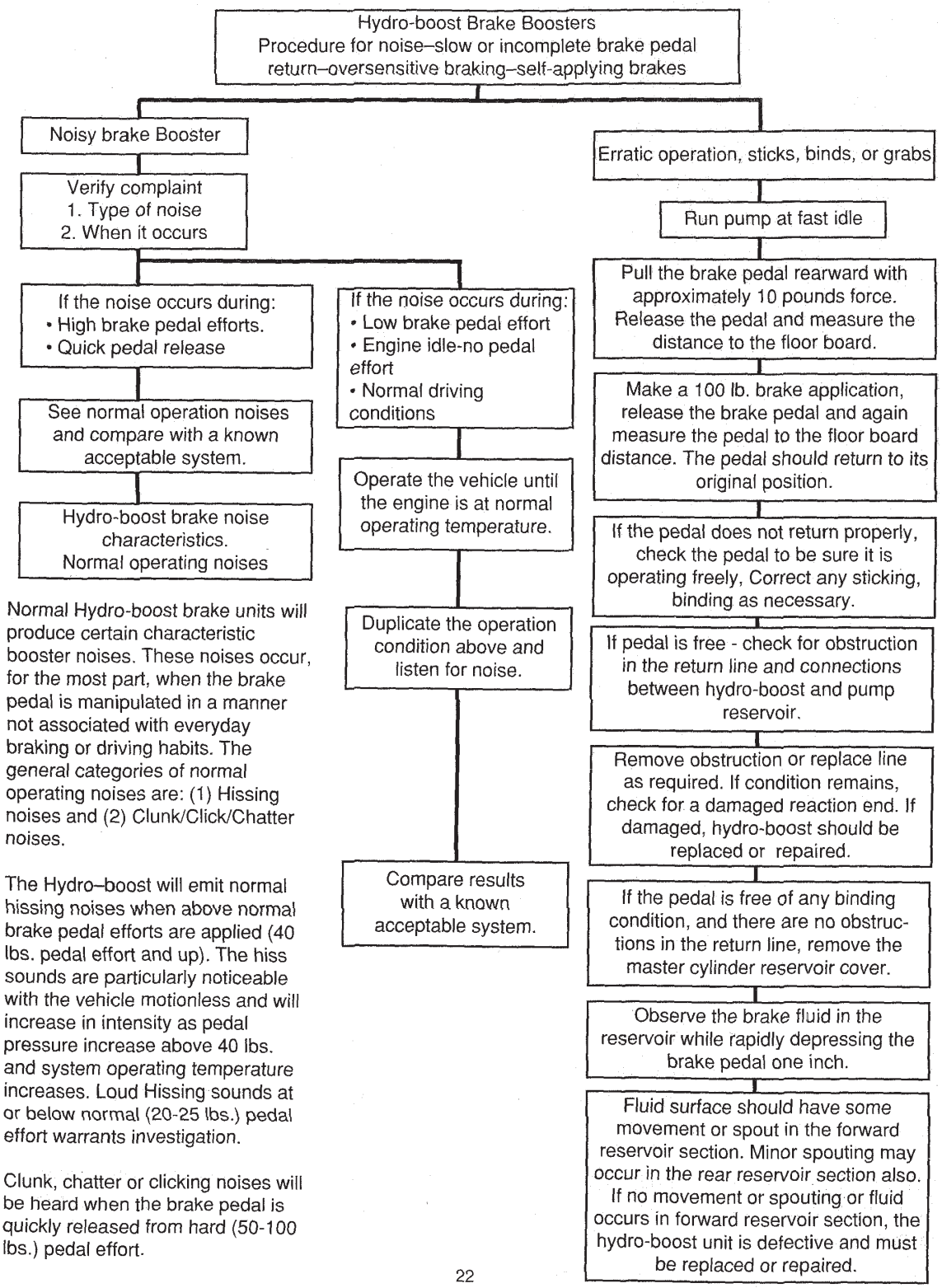
RE-INSTALLING THE HYDRO-BOOST IN THE VEHICLE

1. Install unit on mounting surface.
2. Re-connect Pedal or Input Rod.
3. Install and tighten mounting nuts.
4. Re-connect Master Cylinder.
5. Re-connect all three (3) hoses.
6. Bleed Hydro-Boost unit as follows:

   A) Fill pump reservoir
   B) Crank engine for several seconds, with coil wire disconnected.
   (Do not start engine)
   C) Check fluid level; add if necessary.
   D) Start engine.
   E) Turn wheels lock-to-lock twice.
   F) Stop engine.
   G) Discharge accumulator. (Depress brake pedal 5 times)
   H) Repeat steps D) and E).
   I) If foaming occurs, stop engine and wait for 1 hour for foam to dissipate.
   J) Repeat steps D) and E).

The Hydro-Boost is generally self-bleeding, and the above procedure will normally bleed the air from the booster. Normal driving and operation of the unit will remove any further trapped air.

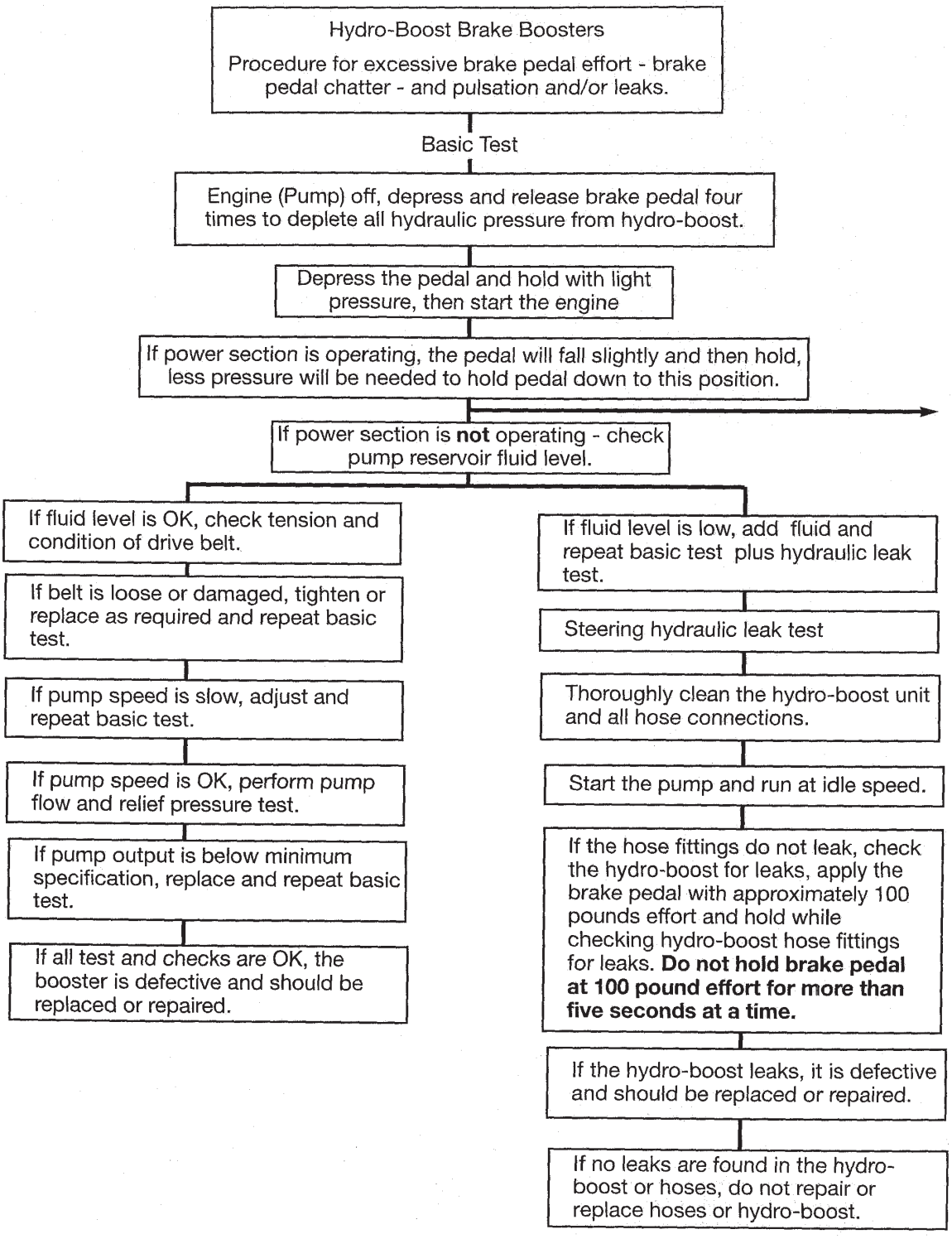
H. HYDRO-BOOST CHECK-OUT PROCEDURE

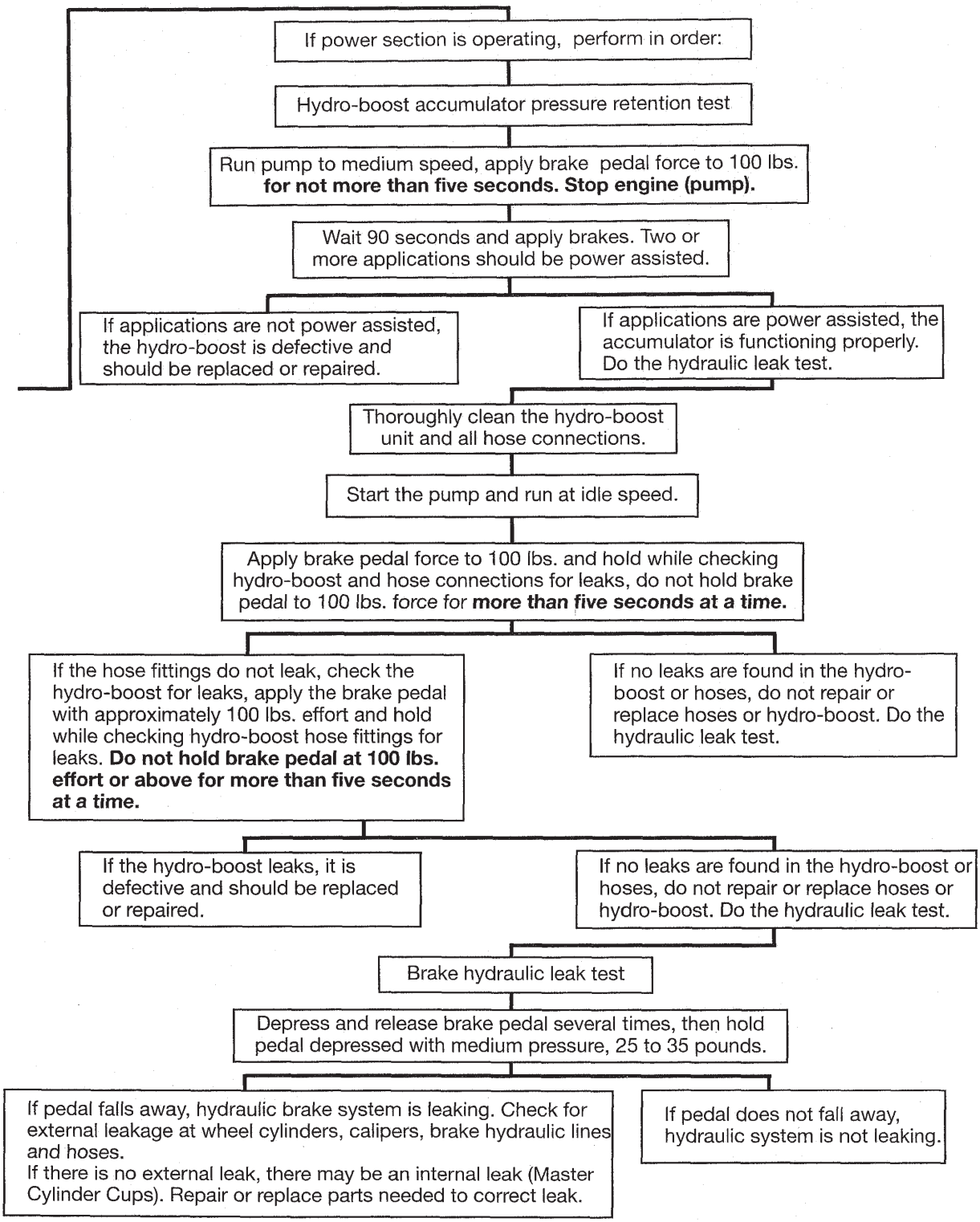


Normal Hydro-boost brake units will produce certain characteristic booster noises. These noises occur, for the most part, when the brake pedal is manipulated in a manner not associated with everyday braking or driving habits. The general categories of normal operating noises are: (1) Hissing noises and (2) Clunk/Click/Chatter noises.

The Hydro–boost will emit normal hissing noises when above normal brake pedal efforts are applied (40 lbs. pedal effort and up). The hiss sounds are particularly noticeable with the vehicle motionless and will increase in intensity as pedal pressure increase above 40 lbs. and system operating temperature increases. Loud Hissing sounds at or below normal (20-25 lbs.) pedal effort warrants investigation.

Clunk, chatter or clicking noises will be heard when the brake pedal is quickly released from hard (50-100 lbs.) pedal effort.


Hydro-Boost Brake Boosters
Procedure for excessive brake pedal effort - brake pedal chatter - and pulsation and/or leaks.
Basic Test
Engine (Pump) off, depress and release brake pedal four times to deplete all hydraulic pressure from hydro-boost.
Depress the pedal and hold with light pressure, then start the engine
If power section is operating, the pedal will fall slightly and then hold, less pressure will be needed to hold pedal down to this position.
If power section is not operating - check pump reservoir fluid level.
If fluid level is OK, check tension and condition of drive belt.
If belt is loose or damaged, tighten or replace as required and repeat basic test.
If pump speed is slow, adjust and repeat basic test.
If pump speed is OK, perform pump flow and relief pressure test.
If pump output is below minimum specification, replace and repeat basic test.
If all test and checks are OK, the booster is defective and should be replaced or repaired.
If fluid level is low, add fluid and repeat basic test plus hydraulic leak test.
Steering hydraulic leak test
Thoroughly clean the hydro-boost unit and all hose connections.
Start the pump and run at idle speed.
If the hose fittings do not leak, check the hydro-boost for leaks, apply the brake pedal with approximately 100 pounds effort and hold while checking hydro-boost hose fittings for leaks. Do not hold brake pedal at 100 pound effort for more than five seconds at a time.
If the hydro-boost leaks, it is defective and should be replaced or repaired.
If no leaks are found in the hydro-boost or hoses, do not repair or replace hoses or hydro-boost.


If power section is operating, perform in order:
Hydro-boost accumulator pressure retention test
Run pump to medium speed, apply brake pedal force to 100 lbs. for not more than five seconds. Stop engine (pump).
Wait 90 seconds and apply brakes. Two or more applications should be power assisted.
If applications are not power assisted, the hydro-boost is defective and should be replaced or repaired.
If applications are power assisted, the accumulator is functioning properly. Do the hydraulic leak test.
Thoroughly clean the hydro-boost unit and all hose connections.
Start the pump and run at idle speed.
Apply brake pedal force to 100 lbs. and hold while checking hydro-boost and hose connections for leaks, do not hold brake pedal to 100 lbs. force for more than five seconds at a time.
If the hose fittings do not leak, check the hydro-boost for leaks, apply the brake pedal with approximately 100 lbs. effort and hold while checking hydro-boost hose fittings for leaks. Do not hold brake pedal at 100 lbs. effort or above for more than five seconds at a time.
If no leaks are found in the hydro-boost or hoses, do not repair or replace hoses or hydro-boost. Do the hydraulic leak test.
If the hydro-boost leaks, it is defective and should be replaced or repaired.
If no leaks are found in the hydro-boost or hoses, do not repair or replace hoses or hydro-boost. Do the hydraulic leak test.
Brake hydraulic leak test
Depress and release brake pedal several times, then hold pedal depressed with medium pressure, 25 to 35 pounds.
If pedal falls away, hydraulic brake system is leaking. Check for external leakage at wheel cylinders, calipers, brake hydraulic lines and hoses.
If there is no external leak, there may be an internal leak (Master Cylinder Cups). Repair or replace parts needed to correct leak.
If pedal does not fall away, hydraulic system is not leaking.

24

PNEUMATIC ACCUMULATOR

The Hydro-Boost unit uses a pneumatically charged accumulator to provide reserve power in case of loss of power, engine dies, belt brakes, etc.

HANDLING

The Booster should not be carried by the accumulator nor should the Booster ever be dropped on the accumulator. The **snap ring** which holds the accumulator into the housing should **be checked** for **proper positioning before the booster** is used. The accumulator contains high pressure gas and with any high pressure gas a certain degree of danger is present if mishandled.

DISPOSAL

The accumulator should not be exposed to excessive heat, fire or incineration. Before discarding accumulator following replacement, drill a 1\16" diameter hole in the end of accumulator can to relieve the pressure. BE SAFE! Protect your eyes. Wear approved safety glasses.

HYDRO-BOOST DIAGNOSIS

CONDITION	CAUSE	CORRECTION
Slow Brake Pedal Return	A. Excessive seal friction in Booster.	Overhaul with New Seal Kit.*
	B. Flared reaction end.	Replace Booster
	C. Broken Piston return spring.	Replace Spring*
	D. Restriction in return from Booster to Pump Reservoir.	Clear or line replace line.
	E. Return line incorrectly connected	Correct plumbing. REF: Fig. 1 & 15
	F. Broken spool return spring.	Replace spring*
	G. Heavy brake pedal.	Reposition pedal or add retracting spring.
Grabbing Brakes	A. Broken spool return spring.	Replace Spring.*
	B. Faulty Spool action due to contamination.	Flush steering while pumping brake pedal.
	C. Low pump flow.	Tighten Belt.
Booster Chatter, Pedal Vibration	A. Slipping pump belt.	Tighten Belt.
	B. Low fluid level in Pump.	Fill reservoir-check for external leaks.
Accumulator leaks down. Reserve system Does not hold charge.	A. Two-function valve is faulty.	Replace valve and valve set.
	B. Accumulator seal is faulty.	Replace O-Ring.
	C. Pneumatic accumulator is faulty.	Replace accumulator*
Excessive brake pedal efforts.	A. Loose, glazed, or broken pump belt.	Tighten or replace belt.
	B. No fluid in pump reservoir	Fill reservoir and check for external leaks.
	C. Leaks in system hoses.	Replace faulty parts
	D. Leaks at tube fittings and connections.	Tighten fittings or replace tube seats or O-Rings.

(Continued)

HYDRO-BOOST DIAGNOSIS - Cont'd

CONDITION	CAUSE	CORRECTION
Excessive Brake Pedal and retaining ring.* Efforts (cont'd)	E. Leakage at pneumatic accumulator seal.	Replace O-Ring
	F. Leakage at piston seal.	Overhaul with new seal kit.*
	G. Leakage at input seal.	Overhaul with new seal kit.*
	H. Leakage at cover-to-housing seal	Overhaul with new seal kit.*
	I. Leakage at spool plug seal.	Overhaul with spool plug seal kit.*
	J. Leakage at expansion plug.	Replace Hydro-Boost.

CONDITION	CAUSE	CORRECTION
Unit self-applies	A. Restriction in Booster return line.	Clear or replace line.
	B. Return line incorrectly connected.	Correct plumbing. REF: Fig. 1 & 15
	C. Dump valve faulty.	Replace dump valve.*

*Some customers may elect to replace Booster rather than make necessary repairs.

SEAL LEAK DIAGNOSIS

A. Input Seal Leak - Fluid leakage from rear (cover) end of Booster near reaction bore.
B. Piston Seal Leak - Fluid leakage from vent at front of unit near Master Cylinder.
C. Housing Seal - Fluid leakage between the housing and housing cover.
D. Spool Valve Seal - Fluid leakage near plug area.
E. Return port fitting seal.

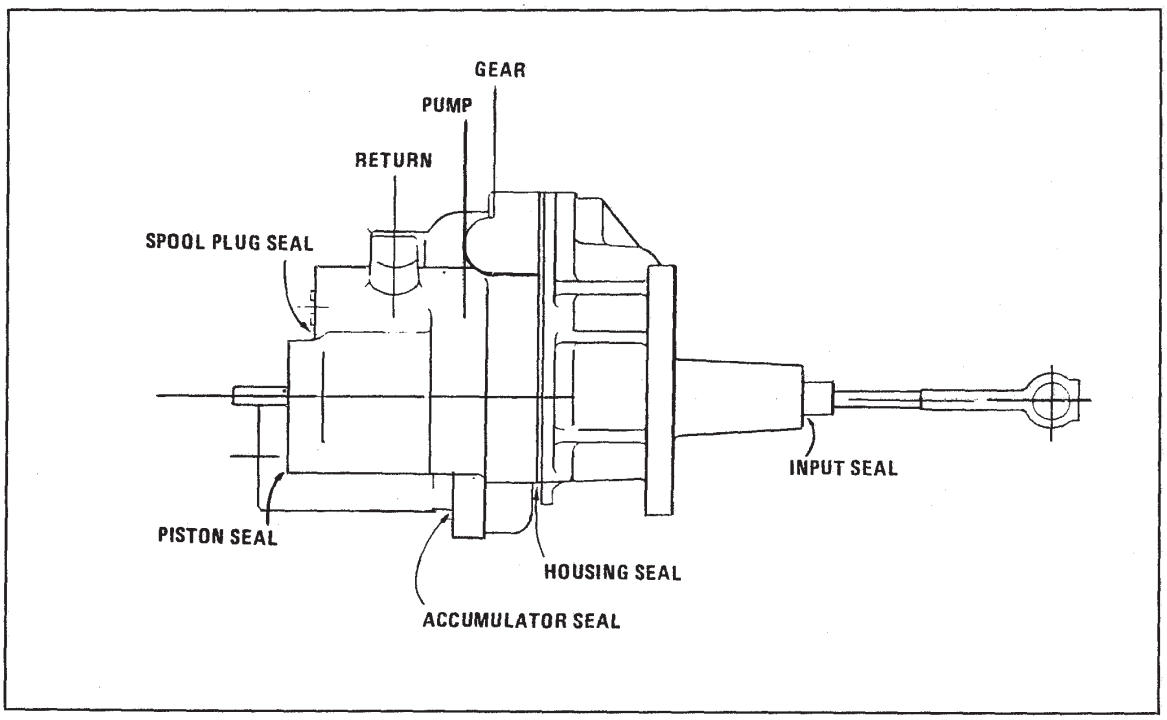
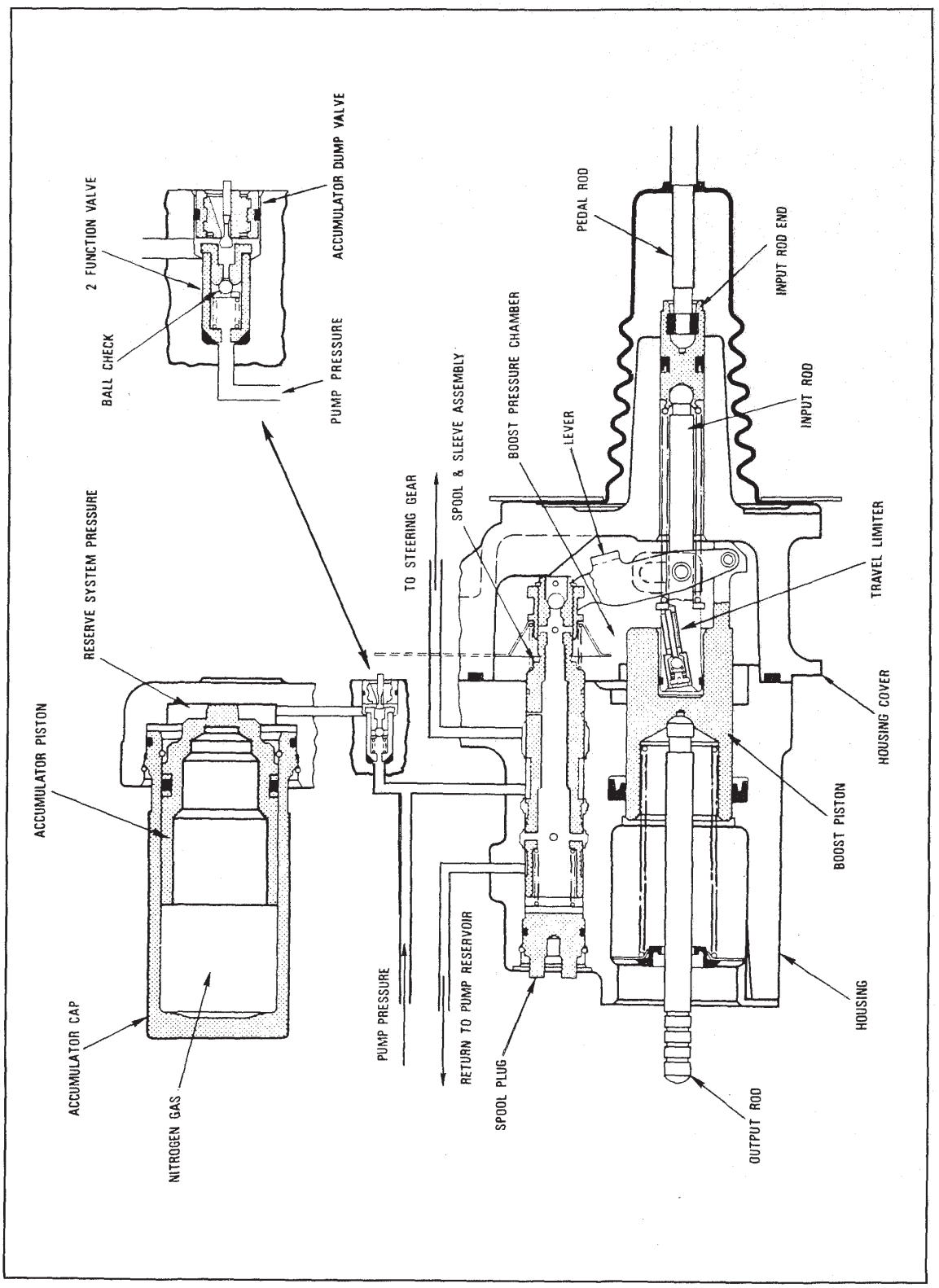


Figure 16. Seal Leak Diagnosis



Hydro-Boost Assembly Schematic

Fault Code	J1939 SPN	J1939 FMI	Lamp Color	J1939 SPN Description	Cummins Description
111	629	12	Red	Controller #1	Engine Control Module Critical internal failure - Bad intelligent Device or Component
115	612	2	Red	System Diagnostic Code # 2	Engine Speed/Position Sensor Circuit lost both of two signals from the magnetic pickup sensor - Data Erratic, Intermittent, or incorrect
122	102	3	Amber	Boost Pressure	Intake Manifold Pressure Sensor Circuit – Voltage Above Normal, or Shorted to High Source
123	102	4	Amber	Boost Pressure	Intake Manifold Pressure Sensor Circuit – Voltage Below Normal, or Shorted to Low Source
124	102	16	Amber	Boost Pressure	Intake Manifold 1 Pressure - Data Valid but Above Normal Operational Range - Moderately Severe Level
131	91	3	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor Circuit - Voltage Above Normal, or Shorted to High Source
132	91	4	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
133	974	3	Red	Remote Accelerator	Remote Accelerator Pedal or Lever Position Sensor Circuit – Voltage Above Normal, or Shorted to High Source
134	974	4	Red	Remote Accelerator	Remote Accelerator Pedal or Lever Position Sensor Circuit – Voltage Below Normal, or Shorted to Low Source
135	100	3	Amber	Engine Oil Pressure	Oil Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
141	100	4	Amber	Engine Oil Pressure	Oil Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
143	100	18	Amber	Engine Oil Pressure	Oil Pressure Low – Data Valid but Below Normal Operational Range - Moderately Severe Level
144	110	3	Amber	Engine Coolant Temperature	Coolant Temperature Sensor Circuit – Voltage Above Normal, or Shorted to High Source
145	110	4	Amber	Engine Coolant Temperature	Coolant Temperature Sensor Circuit – Voltage Below Normal, or Shorted to Low Source
146	110	16	Amber	Engine Coolant Temperature	Coolant Temperature High - Data Valid but Above Normal Operational Range - Moderately Severe Level
147	91	1	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor Circuit – Abnormal Frequency, Pulse Width, or Period
148	91	0	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor Circuit – Abnormal Frequency, Pulse Width, or Period
151	110	0	Red	Engine Coolant Temperature	Coolant Temperature Low - Data Valid but Above Normal Operational Range - Most Severe Level
153	105	3	Amber	Intake Manifold #1 Temp	Intake Manifold Air Temperature Sensor Circuit - Voltage Above Normal, or Shorted to High Source
154	105	4	Amber	Intake Manifold #1 Temp	Intake Manifold Air Temperature Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
155	105	0	Red	Intake Manifold #1 Temp	Intake Manifold Air Temperature High – Data Valid but Above Normal Operational Range - Most Severe Level
187	3510	4	Amber	5 Volts DC Supply	Sensor Supply Voltage #2 Circuit – Voltage Below Normal, or Shorted to Low Source

SAE DIAGNOSTIC TROUBLE CODES AND CUMMINS FAULT CODES

193	520199	3	Amber	Cruise Control	Cruise Control (Resistive) Signal Circuit - Voltage Above Normal, or Shorted to High Source
194	520199	4	Amber	Cruise Control	Cruise Control (Resistive) Signal Circuit - Voltage Below Normal, or Shorted to Low Source
195	111	3	Amber	Coolant Level	Coolant Level Sensor Circuit - Voltage Above Normal, or Shorted to High Source
196	111	4	Amber	Coolant Level	Coolant Level Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
197	111	18	Amber	Coolant Level	Coolant Level - Data Valid but Below Normal Operational Range - Moderately Severe Level
199	1661	4	Amber	Engine Automatic Start Lamp	Engine Automatic Start Lamp Driver Circuit - Voltage Above Normal, or Shorted to High Source
211	1484	31	None	J1939 Error	Additional Auxiliary Diagnostic Codes logged - Condition Exists
212	175	3	Amber	Oil Temperature	Engine Oil Temperature Sensor 1 Circuit - Voltage Above Normal, or Shorted to High Source
213	175	4	Amber	Oil Temperature	Engine Oil Temperature Sensor 1 Circuit - Voltage Below Normal, or Shorted to Low Source
214	175	0	Red	Oil Temperature	Engine Oil Temperature - Data Valid but Above Normal Operational Range - Most Severe Level
221	108	3	Amber	Barometric Pressure	Barometric Pressure Sensor Circuit – Voltage Above Normal, or Shorted to High Source
222	108	4	Amber	Barometric Pressure	Barometric Pressure Sensor Circuit – Voltage Below Normal, or Shorted to Low Source
227	3510	3	Amber	5 Volts DC Supply	Sensor Supply Voltage #2 Circuit – Voltage Above Normal, or Shorted to High Source
231	109	3	Amber	Coolant Pressure	Coolant Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
232	109	4	Amber	Coolant Pressure	Coolant Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
233	109	18	Amber	Coolant Pressure	Coolant Pressure - Data Valid but Below Normal Operational Range - Moderately Severe Level
234	190	0	Red	Engine Speed	Engine Speed High - Data Valid but Above Normal Operational Range - Most Severe Level
235	111	1	Red	Coolant Level	Coolant Level Low - Data Valid but Below Normal Operational Range - Most Severe Level
237	644	2	Amber	External Speed Input	External Speed Input (Multiple Unit Synchronization) - Data Erratic, Intermittent, or Incorrect
238	3511	4	Amber	System Diagnostic code # 1	Sensor Supply Voltage #3 Circuit – Voltage Below Normal, or Shorted to Low Source
239	3511	3	Amber	System Diagnostic code #2	Sensor Supply Voltage #3 Circuit - Voltage Above Normal, or Shorted to High Source
241	84	2	Amber	Wheel-based Vehicle Speed	Vehicle Speed Sensor Circuit - Data Erratic, Intermittent, or Incorrect
242	84	10	Amber	Wheel-based Vehicle Speed	Vehicle Speed Sensor Circuit tampering has been detected – Abnormal Rate of Change
244	623	4	Amber	Red Stop Lamp	Red Stop Lamp Driver Circuit - Voltage Below Normal, or Shorted to Low Source
245	647	4	Amber	Fan Clutch Output Device Driver	Fan Control Circuit - Voltage Below Normal, or Shorted to Low Source
249	171	3	Amber	Ambient Air Temperature	Ambient Air Temperature Sensor Circuit - Voltage Above Normal, or Shorted to High Source
256	171	4	Amber	Ambient Air Temperature	Ambient Air Temperature Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
261	174	16	Amber	Fuel Temperature	Engine Fuel Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level

263	174	3	Amber	Fuel Temperature	Engine Fuel Temperature Sensor 1 Circuit - Voltage Above Normal, or Shorted to High Source
265	174	4	Amber	Fuel Temperature	Engine Fuel Temperature Sensor 1 Circuit - Voltage Below Normal, or Shorted to Low Source
268	94	2	Amber	Fuel Delivery Pressure	Fuel Pressure Sensor Circuit - Data Erratic, Intermittent, or Incorrect
271	1347	4	Amber	Fuel Pump Pressurizing Assembly #1	High Fuel Pressure Solenoid Valve Circuit – Voltage Below Normal, or Shorted to Low Source
272	1347	3	Amber	Fuel Pump Pressurizing Assembly #1	High Fuel Pressure Solenoid Valve Circuit – Voltage Above Normal, or Shorted to High Source
281	1347	7	Amber	Fuel Pump Pressurizing Assembly #1	High Fuel Pressure Solenoid Valve #1 – Mechanical System Not Responding Properly or Out of Adjustment
284	1043	4	Amber	Internal Sensor Voltage Supply	Engine Speed/Position Sensor (Crankshaft) Supply Voltage Circuit - Voltage Below Normal, or Shorted to Low Source
285	639	9	Amber	SAE J1939 Datalink	SAE J1939 Multiplexing PGN Timeout Error - Abnormal Update Rate
286	639	13	Amber	SAE J1939 Datalink	SAE J1939 Multiplexing Configuration Error – Out of Calibration
287	91	19	Red	Accelerator Pedal Position	SAE J1939 Multiplexing Accelerator Pedal or Lever Sensor System Error - Received Network Data In Error
288	974	19	Red	Remote Accelerator	SAE J1939 Multiplexing Remote Accelerator Pedal or Lever Data Error - Received Network Data In Error
292	441	14	Red	Auxiliary Temperature 1	Auxiliary Temperature Sensor Input 1 - Special Instructions
293	441	3	Amber	OEM Temperature	Auxiliary Temperature Sensor Input # 1 Circuit - Voltage Above Normal, or Shorted to High Source
294	441	4	Amber	OEM Temperature	Auxiliary Temperature Sensor Input # 1 Circuit - Voltage Below Normal, or Shorted to Low Source
295	108	2	Amber	Barometric Pressure	Barometric Pressure Sensor Circuit - Data Erratic, Intermittent, or Incorrect
296	1388	14	Red	Auxiliary Pressure	Auxiliary Pressure Sensor Input 1 - Special Instructions
297	1388	3	Amber	Auxiliary Pressure	Auxiliary Pressure Sensor Input # 2 Circuit - Voltage Above Normal, or Shorted to High Source
298	1388	4	Amber	Auxiliary Pressure	Auxiliary Pressure Sensor Input # 2 Circuit - Voltage Below Normal, or Shorted to Low Source
319	251	2	Maint	Real Time Clock Power	Real Time Clock Power Interrupt - Data Erratic, Intermittent, or Incorrect
322	651	5	Amber	Injector Cylinder #01	Injector Solenoid Cylinder #1 Circuit – Current Below Normal, or Open Circuit
323	655	5	Amber	Injector Cylinder #05	Injector Solenoid Cylinder #5 Circuit – Current Below Normal, or Open Circuit
324	653	5	Amber	Injector Cylinder #03	Injector Solenoid Cylinder #3 Circuit – Current Below Normal, or Open Circuit
325	656	5	Amber	Injector Cylinder #06	Injector Solenoid Cylinder #6 Circuit – Current Below Normal, or Open Circuit
331	652	5	Amber	Injector Cylinder #02	Injector Solenoid Cylinder #2 Circuit – Current Below Normal, or Open Circuit
332	654	5	Amber	Injector Cylinder #04	Injector Solenoid Cylinder #4 Circuit – Current Below Normal, or Open Circuit
334	110	2	Amber	Engine Coolant Temperature	Coolant Temperature Sensor Circuit – Data Erratic, Intermittent, or Incorrect

338	1267	3	Amber	Vehicle Accessories Relay Driver	Idle Shutdown Vehicle Accessories Relay Driver Circuit - Voltage Above Normal, or Shorted to High Source
339	1267	4	Amber	Vehicle Accessories Relay Driver	Idle Shutdown Vehicle Accessories Relay Driver Circuit - Voltage Below Normal, or Shorted to Low Source
341	630	2	Amber	Calibration Memory	Engine Control Module data lost - Data Erratic, Intermittent, or Incorrect
342	630	13	Red	Calibration Memory	Electronic Calibration Code Incompatibility - Out of Calibration
343	629	12	Amber	Controller #1	Engine Control Module Warning internal hardware failure - Bad Intelligent Device or Component
349	191	16	Amber	Transmission Output Shaft Speed	Transmission Output Shaft Speed - Data Valid but Above Normal Operational Range - Moderately Severe Level
351	627	12	Amber	Controller #1	Injector Power Supply - Bad Intelligent Device or Component
352	3509	4	Amber	5 Volts DC Supply	Sensor Supply Voltage #1 Circuit – Voltage Below Normal, or Shorted to Low Source
386	3509	3	Amber	5 Volts DC Supply	Sensor Supply Voltage #1 Circuit – Voltage Above Normal, or Shorted to High Source
415	100	1	Red	Engine Oil Pressure	Oil Pressure Low – Data Valid but Below Normal Operational Range - Most Severe Level
418	97	15	Maint.	Water in Fuel Indicator	Water in Fuel Indicator High - Data Valid but Above Normal Operational Range – Least Severe Level
422	111	2	Amber	Coolant Level	Coolant Level - Data Erratic, Intermittent, or Incorrect
425	175	2	Amber	Oil Temperature	Engine Oil Temperature - Data Erratic, Intermittent, or Incorrect
428	97	3	Amber	Water in Fuel Indicator	Water in Fuel Sensor Circuit - Voltage Above Normal, or Shorted to High Source
429	97	4	Amber	Water in Fuel Indicator	Water in Fuel Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
431	558	2	Amber	Accelerator Pedal Low Idle Switch	Accelerator Pedal or Lever Idle Validation Circuit - Data Erratic, Intermittent, or Incorrect
432	558	13	Red	Accelerator Pedal Low Idle Switch	Accelerator Pedal or Lever Idle Validation Circuit - Out of Calibration
435	100	2	Amber	Engine Oil Pressure	Oil Pressure Sensor Circuit - Data Erratic, Intermittent, or Incorrect
441	168	18	Amber	Electrical Potential (Voltage)	Battery #1 Voltage Low - Data Valid but Below Normal Operational Range – Moderately Severe Level
442	168	16	Amber	Electrical Potential (Voltage)	Battery #1 Voltage High - Data Valid but Above Normal Operational Range – Moderately Severe Level
449	157	0	Red	Injector Metering Rail 1 Pressure	Fuel Pressure High - Data Valid but Above Normal Operational Range – Moderately Severe Level
451	157	3	Amber	Injector Metering Rail 1 Pressure	Injector Metering Rail #1 Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
452	157	4	Amber	Injector Metering Rail 1 Pressure	Injector Metering Rail #1 Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
488	105	16	Amber	Intake Manifold	Intake Manifold 1 Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level
489	191	18	Amber	Transmission Output Shaft Speed	Transmission Output Shaft Speed - Data Valid but Below Normal Operational Range - Moderately Severe Level

497	1377	2	Amber	Switch Circuit	Multiple Unit Synchronization Switch Circuit - Data Erratic, Intermittent, or Incorrect
523	611	2	Amber	System Diagnostic code # 1	OEM Intermediate (PTO) Speed switch Validation - Data Erratic, Intermittent, or Incorrect
527	702	3	Amber	Circuit - Voltage	Auxiliary Input/Output 2 Circuit - Voltage Above Normal, or Shorted to High Source
528	93	2	Amber	Switch - Data	Auxiliary Alternate Torque Validation Switch - Data Erratic, Intermittent, or Incorrect
529	703	3	Amber	Circuit - Voltage	Auxiliary Input/Output 3 Circuit - Voltage Above Normal, or Shorted to High Source
546	94	3	Amber	Fuel Delivery Pressure	Fuel Delivery Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
547	94	4	Amber	Fuel Delivery Pressure	Fuel Delivery Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
551	558	4	Amber	Accelerator Pedal Low Idle Switch	Accelerator Pedal or Lever Idle Validation Circuit - Voltage Below Normal, or Shorted to Low Source
553	157	16	Amber	Injector Metering Rail 1 Pressure	Injector Metering Rail #1 Pressure High – Data Valid but Above Normal Operational Range - Moderately Severe Level
554	157	2	Amber	Injector Metering Rail 1 Pressure	Fuel Pressure Sensor Error - Data Erratic, Intermittent, or Incorrect
559	157	18	Amber	Injector Metering Rail 1 Pressure	Injector Metering Rail #1 Pressure Low – Data Valid but Below Normal Operational Range - Moderately Severe Level
584	677	3	Amber	Starter Solenoid Lockout Relay Driver Circuit	Starter Relay Circuit - Voltage Above Normal, or Shorted to High Source
585	677	4	Amber	Starter Solenoid Lockout Relay Driver Circuit	Starter Relay Circuit - Voltage Below Normal, or Shorted to Low Source
595	103	16	Amber	Turbocharger 1 Speed	Turbocharger #1 Speed High - Data Valid but Above Normal Operational Range – Moderately Severe Level
596	167	16	Amber	Alternate Potential (voltage)	Electrical Charging System Voltage High – Data Valid but Above Normal Operational Range - Moderately Severe Level
597	167	18	Amber	Alternate Potential (voltage)	Electrical Charging System Voltage Low – Data Valid but Below Normal Operational Range - Moderately Severe Level
598	167	1	Red	Alternate Potential (voltage)	Electrical Charging System Voltage Low – Data Valid but Below Normal Operational Range - Most Severe Level
599	640	14	Red	Engine External Protection Input	Auxiliary Commanded Dual Output Shutdown - Special Instructions
649	1378	31	Maint	Engine Oil Change Interval	Change Lubricating Oil and Filter – Condition Exists
687	103	18	Amber	Turbocharger 1 Speed	Turbocharger #1 Speed Low - Data Valid but Below Normal Operational Range – Moderately Severe Level
689	190	2	Amber	Engine Speed	Primary Engine Speed Sensor Error – Data Erratic, Intermittent, or Incorrect
691	1172	3	Amber	Turbocharger #1Compressor Inlet Temperature	Turbocharger #1 Compressor Inlet Temperature Sensor Circuit – Voltage Above Normal, or Shorted to High Source
692	1172	4	Amber	Turbocharger #1Compressor Inlet Temperature	Turbocharger #1 Compressor Inlet Temperature Sensor Circuit – Voltage Below Normal, or Shorted to Low Source
697	1136	3	Amber	Sensor Circuit - Voltage	ECM Internal Temperature Sensor Circuit - Voltage Above Normal, or Shorted to High Source
698	1136	4	Amber	Sensor Circuit - Voltage	ECM Internal Temperature Sensor Circuit - Voltage Below Normal, or Shorted to Low Source

719	22	3	Amber	Crankcase Pressure	Extended Crankcase Blow-by Pressure Circuit - Voltage Above Normal, or Shorted to High Source
729	22	4	Amber	Crankcase Pressure	Extended Crankcase Blow-by Pressure Circuit - Voltage Below Normal, or Shorted to Low Source
731	723	7	Amber	Engine Speed Sensor #2	Engine Speed/Position #2 mechanical misalignment between camshaft and crankshaft sensors - Mechanical System Not Responding Properly or Out of Adjustment
~~753~~	~~723~~ 2	–	~~Amber~~	~~Engine Speed Sensor #2~~	~~Engine Speed/Position #2 Camshaft sync error - Data Erratic, Intermittent, or Incorrect~~
757	2802	31	Amber	Electronic Control Module	Electronic Control Module data lost - Condition Exists
778	723	2	Amber	Engine Speed Sensor #2	Engine Speed Sensor (Camshaft) Error – Data Erratic, Intermittent, or Incorrect
779	703	11	Amber	Auxiliary Equipment Sensor Input	Warning Auxiliary Equipment Sensor Input # 3 (OEM Switch) - Root Cause Not Known
951	166	2	None	Cylinder Power	Cylinder Power Imbalance Between Cylinders - Data Erratic, Intermittent, or Incorrect
1117	627	2	None	Power Supply	Power Lost With Ignition On - Data Erratic, Intermittent, or Incorrect
1139	651	7	Amber	Injector Cylinder # 01	Injector Cylinder #1 - Mechanical System Not Responding Properly or Out of Adjustment
1141	652	7	Amber	Injector Cylinder # 02	Injector Cylinder #2 - Mechanical System Not Responding Properly or Out of Adjustment
1142	653	7	Amber	Injector Cylinder # 03	Injector Cylinder #3 - Mechanical System Not Responding Properly or Out of Adjustment
1143	654	7	Amber	Injector Cylinder # 04	Injector Cylinder #4 - Mechanical System Not Responding Properly or Out of Adjustment
1144	655	7	Amber	Injector Cylinder # 05	Injector Cylinder #5 - Mechanical System Not Responding Properly or Out of Adjustment
1145	656	7	Amber	Injector Cylinder # 06	Injector Cylinder #6 - Mechanical System Not Responding Properly or Out of Adjustment
1239	2623	3	Amber	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor 2 Circuit - Voltage Above Normal, or Shorted to High Source
1241	2623	4	Amber	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor 2 Circuit - Voltage Below Normal, or Shorted to Low Source
1242	91	2	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor 1 and 2 - Data Erratic, Intermittent, or Incorrect
1256	1563	2	Amber	Control Module Identification Input State	Control Module Identification Input State Error - Data Erratic, Intermittent, or Incorrect
1257	1563	2	Red	Control Module Identification Input State	Control Module Identification Input State Error - Data Erratic, Intermittent, or Incorrect
1852	97	16	Amber	Water in Fuel Indicator	Water in Fuel Indicator - Data Valid but Above Normal Operational Range - Moderately Severe Level
1911	157	0	Amber	Injector Metering Rail	Injector Metering Rail 1 Pressure - Data Valid but Above Normal Operational Range - Most Severe Level
2111	52	3	Amber	Coolant Temperature	Coolant Temperature 2 Sensor Circuit - Voltage Above Normal, or Shorted to High Source
2112	52	4	Amber	Coolant Temperature	Coolant Temperature 2 Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
2113	52	16	Amber	Coolant Temperature	Coolant Temperature 2 - Data Valid but Above Normal Operational Range - Moderately Severe Level
2114	52	0	Red	Coolant Temperature	Coolant Temperature 2 - Data Valid but Above Normal Operational Range - Most Severe Level

2115	2981	3	Amber	Coolant Pressure	Coolant Pressure 2 Circuit - Voltage Above Normal, or Shorted to High Source
2116	2981	4	Amber	Coolant Pressure	Coolant Pressure 2 Circuit - Voltage Below Normal, or Shorted to Low Source
2117	2981	18	Amber	Coolant Pressure	Coolant Pressure 2 - Data Valid but Below Normal Operational Range - Moderately Severe Level
2182	1072	3	Amber	Engine Brake Output # 1	Engine Brake Actuator Driver 1 Circuit - Voltage Above Normal, or Shorted to High Source
2183	1072	4	Amber	Engine Brake Output # 1	Engine Brake Actuator Driver 1 Circuit - Voltage Below Normal, or Shorted to Low Source
2185	3512	3	Amber	System Diagnostic code # 1	Sensor Supply Voltage #4 Circuit – Voltage Above Normal, or Shorted to High Source
2186	3512	4	Amber	System Diagnostic code # 1	Sensor Supply Voltage #4 Circuit – Voltage Below Normal, or Shorted to Low Source
2195	703	14	Red	Auxiliary Equipment Sensor	Auxiliary Equipment Sensor Input 3 Engine Protection Critical - Special Instructions
2215	94	18	Amber	Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid but Below Normal Operational Range - Moderately Severe Level
2216	94	1	Amber	Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid but Above Normal Operational Range – Moderately Severe Level
2217	630	31	Amber	Calibration Memory	ECM Program Memory (RAM) Corruption - Condition Exists
2249	157	1	Amber	Injector Metering Rail 1 Pressure	Injector Metering Rail 1 Pressure - Data Valid but Below Normal Operational Range - Most Severe Level
2261	94	15	Maint	Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid but Above Normal Operational Range - Least Severe Level
2262	94	17	Maint	Fuel Delivery Pressure	Fuel Pump Delivery Pressure - Data Valid but Below Normal Operational Range - Least Severe Level
2263	1800	16	Amber	Battery Temperature	Battery Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level
2264	1800	18	Amber	Battery Temperature	Battery Temperature - Data Valid but Below Normal Operational Range - Moderately Severe Level
2265	1075	3	Amber	Electric Lift Pump for Engine Fuel	Fuel Priming Pump Control Signal Circuit – Voltage Above Normal, or Shorted to High Source
2266	1075	4	Amber	Electric Lift Pump for Engine Fuel	Fuel Priming Pump Control Signal Circuit – Voltage Below Normal, or Shorted to Low Source
2292	611	16	Amber	Fuel Inlet Meter Device	Fuel Inlet Meter Device - Data Valid but Above Normal Operational Range - Moderately Severe Level
2293	611	18	Amber	Fuel Inlet Meter Device	Fuel Inlet Meter Device flow demand lower than expected - Data Valid but Below Normal Operational Range - Moderately Severe Level
2311	633	31	Amber	Fuel Control Valve #1	Fueling Actuator #1 Circuit Error – Condition Exists
2321	190	2	None	Engine Speed	Engine Speed / Position Sensor #1 - Data Erratic, Intermittent, or Incorrect
2322	723	2	None	Engine Speed Sensor #2	Engine Speed / Position Sensor #2 - Data Erratic, Intermittent, or Incorrect
2345	103	10	Amber	Turbocharger 1 Speed	Turbocharger speed invalid rate of change detected - Abnormal Rate of Change
2346	2789	15	None	System Diagnostic Code #1	Turbocharger Turbine Inlet Temperature (Calculated) - Data Valid but Above Normal Operational Range – Least Severe Level

2347	2790	15	None	System Diagnostic Code #1	Turbocharger Compressor Outlet Temperature (Calculated) - Data Valid but Above Normal Operational Range – Least Severe Level
2363	1073	4	Amber	Engine Compression Brake Output # 2	Engine Brake Actuator Circuit #2 – Voltage Below Normal, or Shorted to Low Source
2365	1112	4	Amber	Engine Brake Output # 3	Engine Brake Actuator Driver Output 3 Circuit - Voltage Below Normal, or Shorted to Low Source
2367	1073	3	Amber	Engine Compression Brake Output # 2	Engine Brake Actuator Circuit #2 – Voltage Above Normal, or Shorted to High Source
2368	1112	3	Amber	Engine Brake Output # 3	Engine Brake Actuator Driver 3 Circuit - Voltage Above Normal, or Shorted to High Source
2372	95	16	Amber	Engine Fuel Filter Differential Pressure	Fuel Filter Differential Pressure - Data Valid but Above Normal Operational Range - Moderately Severe Level
2373	1209	3	Amber	Exhaust Gas Pressure	Exhaust Gas Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source
2374	1209	4	Amber	Exhaust Gas Pressure	Exhaust Gas Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
2375	412	3	Amber	Exhaust Gas Recirculation Temperature	Exhaust Gas Recirculation Temperature Sensor Circuit - Voltage Above Normal, or Shorted to High Source
2376	412	4	Amber	Exhaust Gas Recirculation Temperature	Exhaust Gas Recirculation Temperature Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
2377	647	3	Amber	Fan Clutch Output Device Driver	Fan Control Circuit - Voltage Above Normal, or Shorted to High Source
2425	730	4		Intake Air Heater # 2	Intake Air Heater 2 Circuit - Voltage Below Normal, or Shorted to Low Source
2426	730	3		Intake Air Heater # 2	Intake Air Heater 2 Circuit - Voltage Above Normal, or Shorted to High Source
2555	729	3	Amber	Inlet Air Heater Driver #1	Intake Air Heater #1 Circuit - Voltage Above Normal, or Shorted to High Source
2556	729	4	Amber	Inlet Air Heater Driver #1	Intake Air Heater #1 Circuit - Voltage Below Normal, or Shorted to Low Source
2557	697	3	Amber	Auxiliary PWM Driver #1	Auxiliary PWM Driver #1 - Voltage Above Normal, or Shorted to High Source
2558	697	4	Amber	Auxiliary PWM Driver #1	Auxiliary PWM Driver #1 - Voltage Below Normal, or Shorted to Low Source
2963	110	15	None	Engine Coolant Temperature	Engine Coolant Temperature High - Data Valid but Above Normal Operational Range - Least Severe Level
2973	102	2	Amber	Boost Pressure	Intake Manifold Pressure Sensor Circuit - Data Erratic, Intermittent, or Incorrect

Information Not Available at Time of Publication

NEWAGE AXLE INFORMATION

Information Not Available at Time of Publication

NexSysLink

CAN Instruments Product Family

2" CAN Display Operation Manual

SAE J1939 Edition

Contact Beede
Beede Electrical
Instrument Company, Inc.
88 Village Street
Penacook, NH 03303
(603) 753-6362
Toll-free 800-451-8255
Fax (603) 753-6201

BEEDE INSTRUMENTS Since 1917

WWW.BEEDE.COM

© 2011, Beede Electrical Instrument Co., Inc.

548941 A • 09.13.11

CAN DISPLAY MANUAL

Table of Contents

About iii
Scope iii
Preconfigured Instruments iv
Stand-Alone and Master Node Configurations iv
Product Outline Drawing v
Menu Navigation 1
- Menu/Enter/Reset Switch 1
- Up Switch 1
- Down Switch 1
- Switch Icon Conventions 1
- Selection Arrow Cursor 2
- Menu Scrolling Icons 2
- Blinking Bar Cursor 3

Start-up Routine 4
Default CAN Parameter Screen 4
Viewing CAN Parameters 4
Main Menu 4
- Maintenance Hours or Vehicle Trip 5
- Faults Active 6
- Viewing Active Faults 7
- Warnings Active 8
- Viewing Active Warnings 9
- Faults Stored 10
- Alarms 11
  - Alarms Menu 12
  - Enabling/Disabling Alarms 13
  - Viewing Alarms 14
  - Alarm Configuration 15
  - Adding an Alarm or Alarms 16
  - Editing Alarms 18
  - Deleting Alarms 19
- Mute 20

Setup Menu 21
- Backlight 22
  - Lamp On & Lamp Off 22
- Setting Units 23
- Popups Notification Screens 24
- Setting Popups 25
- Display 26
  - 1 or 2 Parameter Display 27
  - Set Contrast 28
  - Video Mode Formats 29
  - Set Video 30
- Trip Mode 31
- Alarm Output 32
- Firmware Information 33

Implementation of SAE J1939 Parameters 34
Parameter Icons & Descriptions 35
Menu Navigation Icon Descriptions 36

List of Figures

Figure 1-1: Menu Scrolling and Option Selection 2
Figure 1-2: Blinking Bar Cursor 3
Figure 1-3: Accessing the Main Menu 4
Figure 1-4: Accessing and Resetting Maintenance Hours and Vehicle Trip Logs . . . 5
Figure 1-5: Fault Notification and Information Screens 6
Figure 1-6: Viewing Active Faults 7
Figure 1-7: Warning Notification and Information Screens 8
Figure 1-8: Viewing Active Warnings 9
Figure 1-9: Faults Stored Information Screens 10
Figure 1-10: Alarms Menu Functions 12
Figure 1-11: Enabling/Disabling Alarms 13
Figure 1-12: Alarm Screen Details 14
Figure 1-13: Viewing Alarms 14
Figure 1-14: Add & Edit Alarm CAN Parameter Screen Details 15
Figure 1-15: Menu Prompt Sequence with No Configured Alarms 16
Figure 1-16: Menu Prompt Sequence with Previously Configured Alarms 17
Figure 1-17: Editing an Alarm 18
Figure 1-18: Deleting an Alarm 19
Figure 1-19: Muting Faults, Warnings & Alarms 20
Figure 1-20: Setup Menu Functions 21
Figure 1-21: Setting Backlight Intensity 22
Figure 1-22: Setting Units 23
Figure 1-23: Popup Fault, Warning & Alarm Screens 24
Figure 1-24: Setting Popup Status 25
Figure 1-25: Display Menu 26
Figure 1-26: 1 and 2 CAN Parameter Display Formats 27
Figure 1-27: Setting 1 or 2 Parameter Display Lines 27
Figure 1-28: Setting LCD Contrast 28
Figure 1-29: Video Mode Formats 29
Figure 1-30: Setting LCD Background Color Scheme (Video Mode) 30
Figure 1-31: Setting Hours or Miles for Main Menu Display 31
Figure 1-32: Setting Alarm Output Pin Status 32
Figure 1-33: Viewing Firmware Revision 33

• About

The 2" Stand-Alone CAN Display instrument is a member of the Beede NexSysLink® CAN instruments product family.

This instrument directly reads SAE J1939 compliant CAN messages and displays the message information on a sunlight visible, transflective dot-matrix LCD. Like all NexSysLink® instruments, this product eliminates the need for a translation "black box" between an ECM/ECU and the instrument itself making wiring and installation simple and fast.

Three discrete alert LEDs provide users with visual notification of engine/vehicle/vessel parameter faults, warnings and malfunctions.
Built-in, sealed, tactile switches allow users to easily navigate the intuitive menu driven user interface. The integration of the switches also reduces wiring to further reduce installation time and costs; essentially providing a plug-and-play product.

Although designed to "stand-alone", the instrument may be used in conjunction with other NexSysLink® instruments to monitor your equipment.

• Scope

This manual describes how to navigate the LCD interface and use the many features the instrument provides. Although the interface is intuitive and easy to navigate, this operation manual provides users with a resource to realize the full potential and capabilities of the instrument.

Covered in this manual are display options, menu navigation and menu function usage.

Although some wiring connections are noted for easy reference, this manual does not cover complete installation mounting and wiring requirements. Please refer to the installation instruction sheet for proper installation.

• Preconfigured Instruments

Some instruments are preconfigured at the factory to individual OEM specifications to best meet the needs of the application and end user.

Preconfigured features include but may not be limited to alarm configuration, single or dual line display and backlight intensity.

Preconfigured features are easily modified to satisfy personal preferences.

• Stand-Alone and Master Node Configurations

The instrument is primarily designed to "stand-alone" in applications where ease of use, limited space and simple installation are critical criteria in choosing the type of engine/vehicle/vessel monitoring electronics.

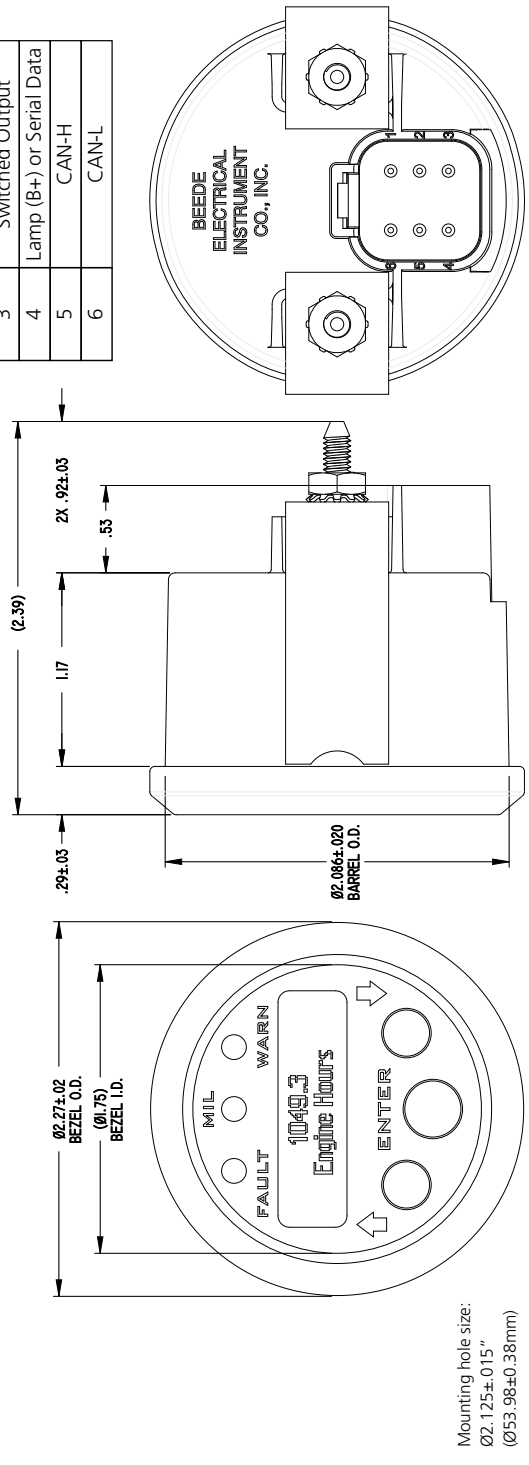
In order to satisfy a wide range of application demands, the hardware of the 2" CAN Display can be factory configured to drive a maximum of 16 Beede NexSysLink® Slave Node Instruments (SNI) or Analog Slave Node Instruments (ASNI).

The ability to connect with ASNI gauges expands the instruments capabilities to display analog inputs such as fuel level or air pressure.

When factory configured to drive Beede NexSysLink® SNI or ASNI gauges, Pin 4 of the 6 pin connector is used for serial data communication among the instruments.

• Product Outline Drawing

6 Pin Connector Wiring Table	
Pin Number	Connection Name
1	Battery +
2	Ground
3	Switched Output
4	Lamp (B+) or Serial Data
5	CAN-H
6	CAN-L



Mounting hole size:
Ø2.125±.015"
(Ø53.98±0.38mm)

Mounting hardware torque:
6 lb-in
(0.68 N-m) max.

Refer to the appropriate Beede installation instruction sheet for complete installation requirements.

Dimensions shown are in inches.

© 2011 Beede Electrical Instrument Co., Inc.

• Menu Navigation

Menu navigation is accomplished through three built-in momentary switches. The switch functions are MENU/ENTER/RESET, UP and DOWN.

• Menu/Enter/Reset Switch

As its name suggests, this switch serves several purposes when navigating the user interface. The function depends upon the context of the menu option but is labeled ENTER on the instrument.

Menu Function: Pressing and holding this switch for approximately three seconds when any parameter screen is displayed brings up the main menu.

Enter Function: Pressing and releasing this switch provides enter functionality when the operator is required to choose a menu item, parameter, or value.

Reset Function: Pressing and holding this switch resets the selected trip miles or maintenance hour value to zero.

• Up Switch

Pressing and releasing the Up switch scrolls up through the CAN parameter list, menu choices or increases a value one item/unit at a time.
Pressing and holding the Up switch continuously scrolls up through the CAN parameter list, menu choices or increases a value until the end of the menu choices or maximum value is reached.

• Down Switch

The Down switch functions identical to the Up switch with the exception that its direction for all lists, menu choices and values is down or decreasing.

• Switch Icon Conventions

Throughout this manual, icons are used to indicate actions required by the user to navigate the menus. Below are descriptions and the corresponding action to be taken when they appear.

Press and release Menu/Enter/Reset switch icon.

The presence of this icon in the manual indicates when to press and release the Menu/Enter/Reset switch.

Press and hold Menu/Enter/Reset switch icon.

The presence of this icon in the manual indicates when to press and hold the Menu/Enter/Reset switch for approximately three seconds.

Press Up switch icon.

The presence of this icon in the manual indicates when to press and release the Up switch. Users may also choose to press and hold the Up switch if necessary.

Press Down switch icon.

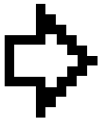
The presence of this icon in the manual indicates when to press and release the Down switch. Users may also choose to press and hold the Down switch if necessary.

© 2011 Beede Electrical Instrument Co., Inc.

• Menu Navigation (Continued)

The user interface contains various icons and indicators to guide users for item selection and/or input while navigating the menus. The selection arrow, menu scrolling icon and blinking bar cursors appear frequently throughout the menus.

• Selection Arrow Cursor



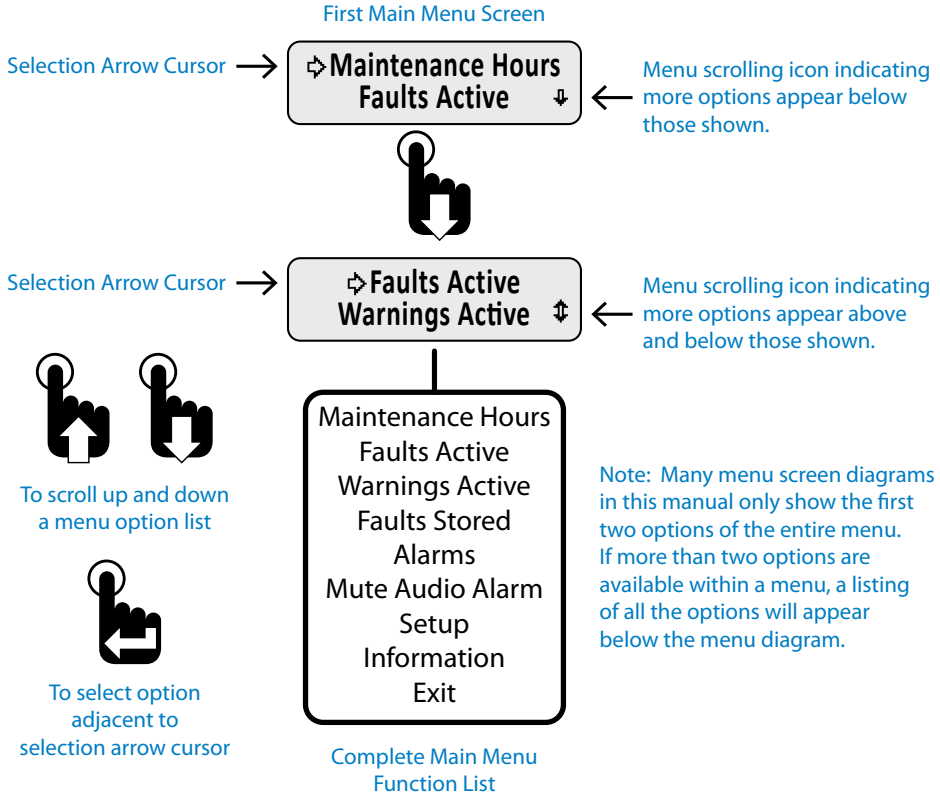
The selection arrow cursor, shown at left, identifies adjacent menu items as the current selection. Pressing the Enter switch selects the menu item/function or value adjacent to the arrow cursor.

Pressing and releasing an Up or Down switch moves the selection arrow up or down a menu list one item at a time until the beginning or end of the list is reached. Pressing and holding the Up or Down switch continuously moves the selection arrow up and down a menu list until the switch is released or the beginning or end of the list is reached.

• Menu Scrolling Icons

A menu scrolling icon appears in the lower right corner of the display to indicate if more menu options appear only above, only below or above and below the menu option or options currently displayed.

Figure 1-1: Menu Scrolling and Option Selection



© 2011 Beede Electrical Instrument Co., Inc.

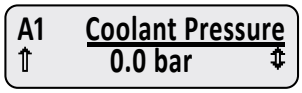
• Blinking Bar Cursor

A blinking bar cursor appearing beneath a numeric value or CAN parameter indicates the item may be changed by pressing or pressing and holding either the Up or Down switches.

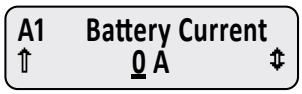
When a numeric value appears above a blinking bar cursor, pressing or pressing and holding the Up or Down switch increases or decreases the value until the maximum value limits are reached.

When a CAN parameter appears above a blinking bar cursor, pressing or pressing and holding either the Up or Down switch scrolls through the list of CAN parameters until the end of the list is reached.

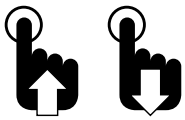
Figure 1-2: Blinking Bar Cursor



Blinking Bar Cursor
located under parameter name



Blinking Bar Cursor
located under amperage value



Pressing the Up or Down switch
changes the CAN parameter or value until the
end of the list or limits of the value range is reached.

Pressing the Enter switch when
the desired parameter or value is
displayed accepts the parameter or value.

© 2011 Beede Electrical Instrument Co., Inc.

• Start-up Routine

Upon Instrument start-up, the three alert LEDs will flash then the Beede logo followed by the SAE logo appear for approximately three seconds.

• Default CAN Parameter Screen

After completion of the start-up routine, the Engine Hours CAN parameter appears. If power was removed from the instrument with a different parameter displayed, Engine Hours will appear when power is reapplied to the instrument.

• Viewing CAN Parameters

All actively broadcast SAE J1939 CAN parameters implemented by the instrument are available for viewing. See "Implementation of SAE J1939 Parameters" on page 34. Press the Up or Down switch to find and view the desired parameter. The displayed parameter will not time out and remains displayed until a different parameter is selected for viewing or power is removed from the instrument.

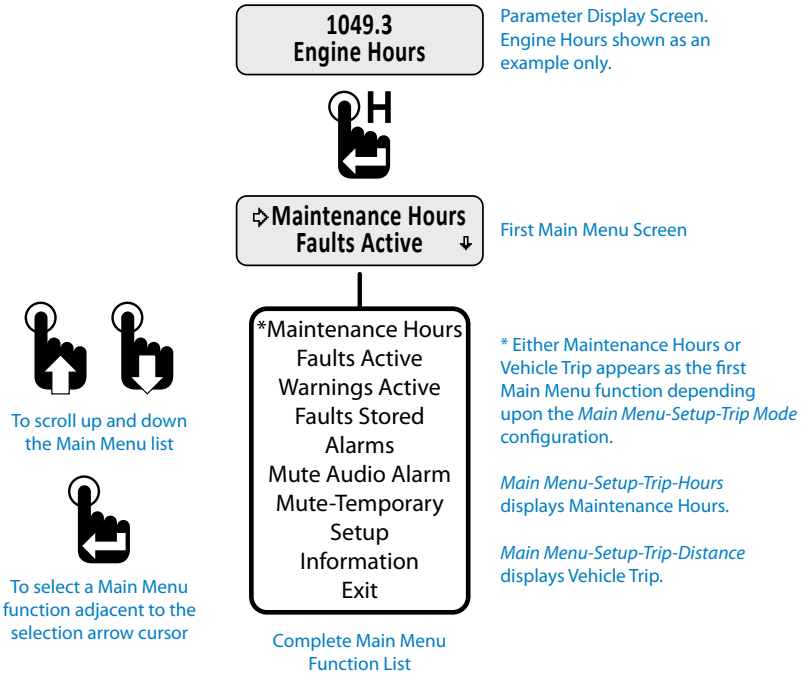
• Main Menu

The Main Menu contains functions to configure the LCD (Liquid Crystal Display), set alarms or view ECM faults and warnings. Access the Main Menu by pressing and holding the Menu/Enter/Reset switch for approximately three seconds while any CAN parameter screen is displayed.

Like all menus with multiple functions/options, only the first two Main Menu functions/options appear on the screen. Access the other functions/options by scrolling down the menu list using the Down switch. Use the Up switch to scroll back up the Main Menu function/option list.

The Main Menu and all the functions within it except Maintenance Hours and Vehicle Trip functions will display for approximately 30 seconds if no user activity is detected. The previously displayed parameter reappears after 30 seconds of inactivity.

Figure 1-3: Accessing the Main Menu



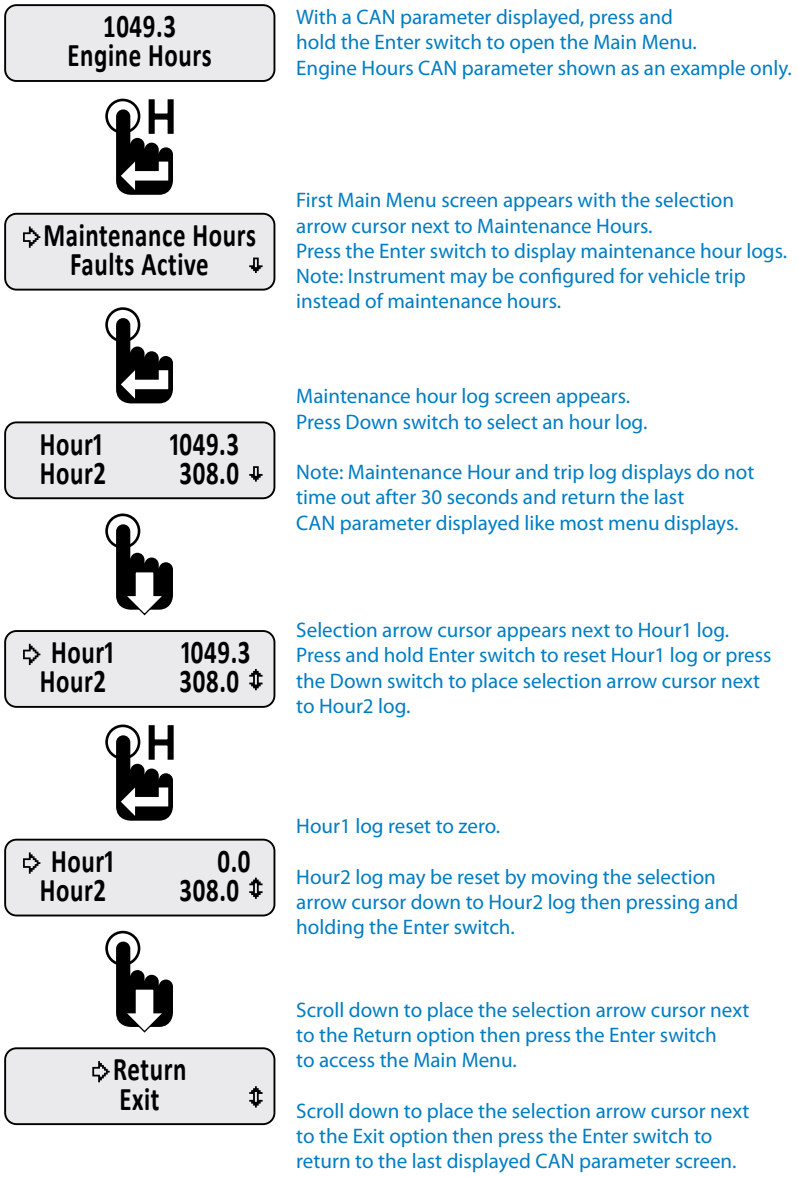
© 2011 Beede Electrical Instrument Co., Inc.

• Maintenance Hours or Vehicle Trip

Depending upon the configuration of the instrument, either Maintenance Hours or Vehicle Trip appears as the first Main Menu function. See "Trip Mode" on page 31 for setting hours or trip as the first Main Menu function.

The instrument provides two resettable maintenance hour and vehicle trip logs. The Maintenance Hours or Vehicle Trip function allows users to view and reset any of the hour or trip logs.

Figure 1-4: Accessing and Resetting Maintenance Hours and Vehicle Trip Logs



© 2011 Beede Electrical Instrument Co., Inc.

• Faults Active

Faults are an indicator of a severe vehicle problem as reported by the ECM/ECU that warrants stopping the engine/vehicle/vessel. Users should consult the owners manual or a service technician to correct the fault condition or conditions.

When a fault condition occurs, the instruments internal audible alarm and Fault LED are activated. The internal audible alarm is temporarily muted by pressing the Enter switch.
An external audible device connected to output pin 3 of the six pin connector will also be muted if the setup option Alarm Output, *Main Menu-Setup-Alarm Output*, is set to Audio. See "Alarm Output" on page 32 to configure alarm output pin.

The *Main Menu-Faults Active* option allows users to view the parameter or parameters causing fault notification. If popups for fault conditions is enabled, a fault notification screen appears. Refer to "Setting Popups" on page 25.

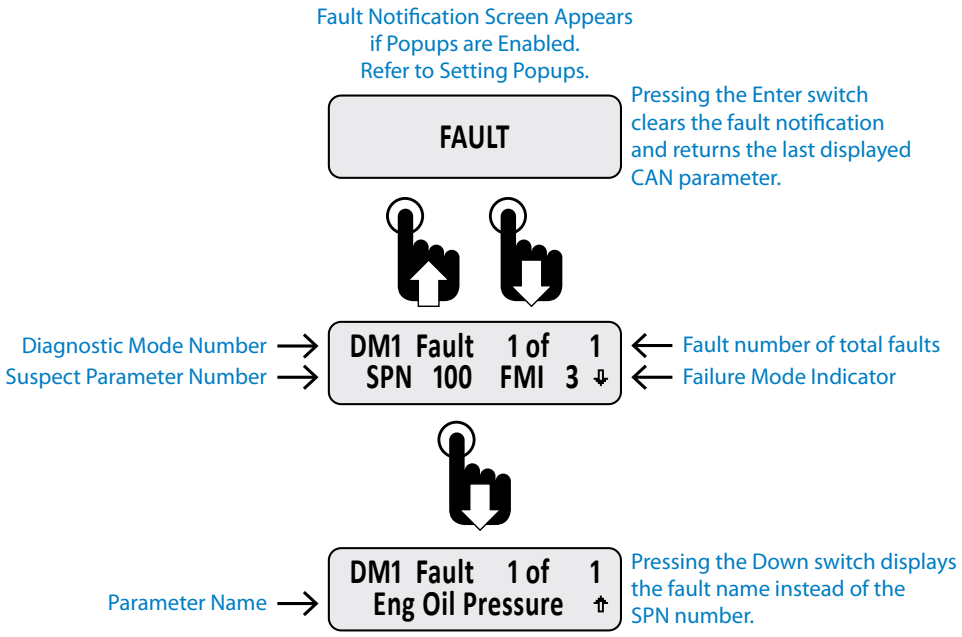
The Faults Active function within the Main Menu allows users to view details for all currently active faults.

Fault information includes the following:

DM1 (Diagnostic Message) for active faults or DM2 for stored faults
Fault number and total fault quantity, e.g., 1 of 3
SPN (Suspect Parameter Number) numerically identifies the parameter per the CAN protocol
FMI (Fault Mode Indicator) number to further identify the faults characteristic
Fault Name. Appears if the CAN parameter is implemented in the instruments firmware.
See"Implementation of SAE J1939 Parameters" on page 34

The active fault display will not time out after 30 seconds. Press the Enter switch to exit viewing faults and return to the Faults Active option of the Main Menu.

Figure 1-5: Fault Notification and Information Screens

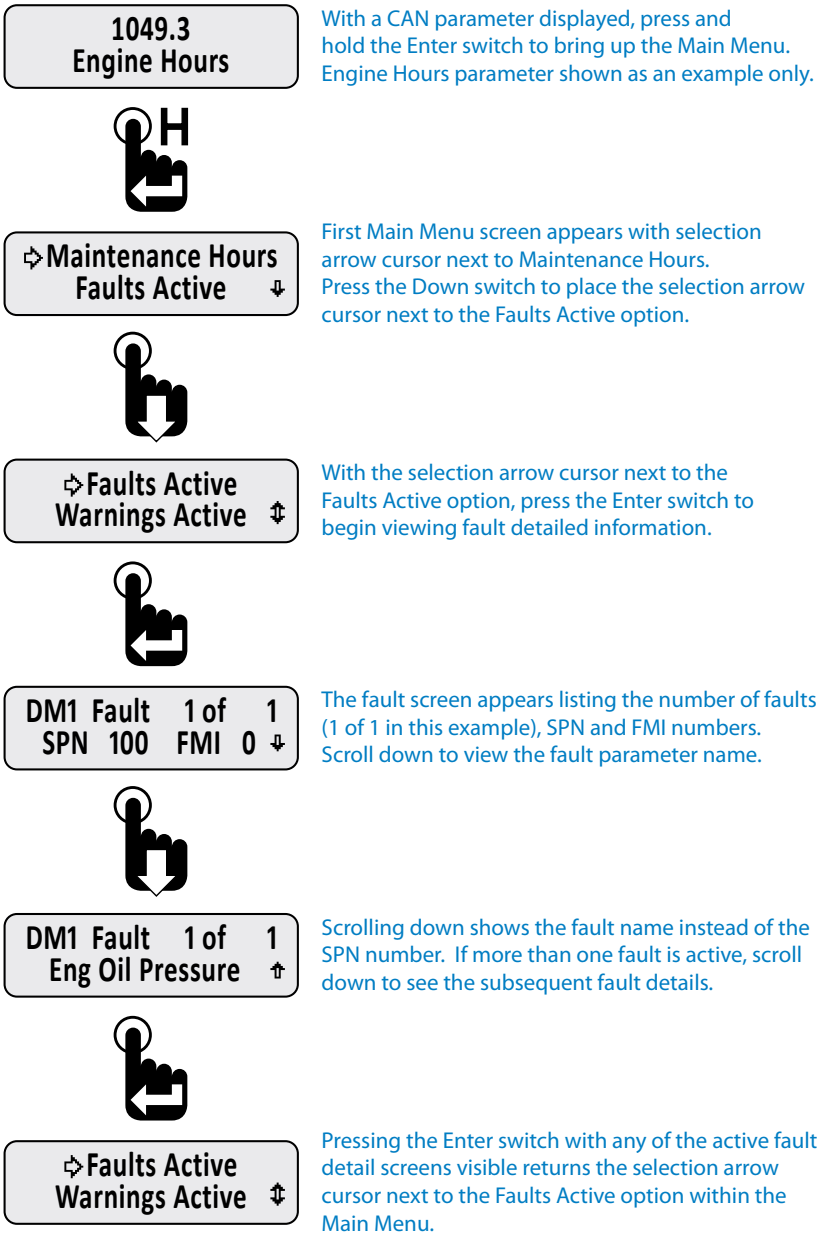


© 2011 Beede Electrical Instrument Co., Inc.

• Viewing Active Faults

If a fault information screen is cleared after it initially appears and the fault is still active, users can view all the active fault information screens by using the Faults Active function of the Main Menu, *Main Menu-Active Faults*.

Figure 1-6: Viewing Active Faults



© 2011 Beede Electrical Instrument Co., Inc.

• Warnings Active

Warnings are an indicator of a vehicle problem as reported by the ECM/ECU that does not warrant immediately stopping the vehicle or vessel. Users should consult the owners manual or a service technician to correct the warning condition or conditions.

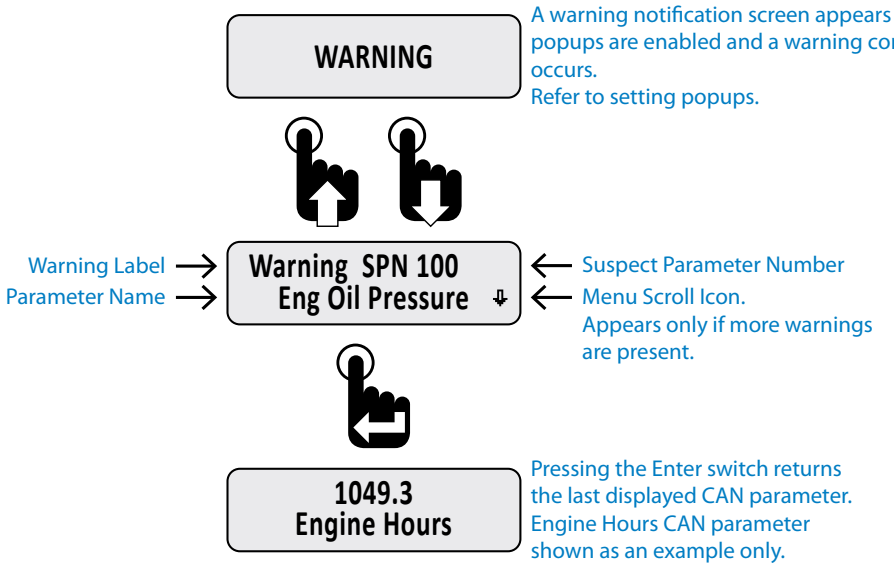
When a warning condition occurs, the instruments internal audible alarm and Warn LED are activated. The internal audible alarm may be temporarily muted by pressing the Enter switch.
An external audible device connected to output pin 3 of the six pin connector will also be muted if the setup option Alarm Output, *Main Menu-Setup-Alarm Output*, is set to Audio. See "Alarm Output" on page 32 to configure alarm output pin.

The *Main Menu-Warnings Active* option allows users to view the parameter or parameters causing the warning. If popups for warning conditions is enabled, a warning notification screen appears. Refer to "Setting Popups" on page 25.

The built-in audible device will sound when a warning condition occurs if the Mute setting, *Main Menu-Mute Audio Alarm*, is not set to Permanent. See "Mute" on page 20 for enabling the internal audible device.

The active warning display will not time out after 30 seconds. Press the Enter switch to exit viewing warnings and return to the Warnings Active option of the Main Menu.

Figure 1-7: Warning Notification and Information Screens

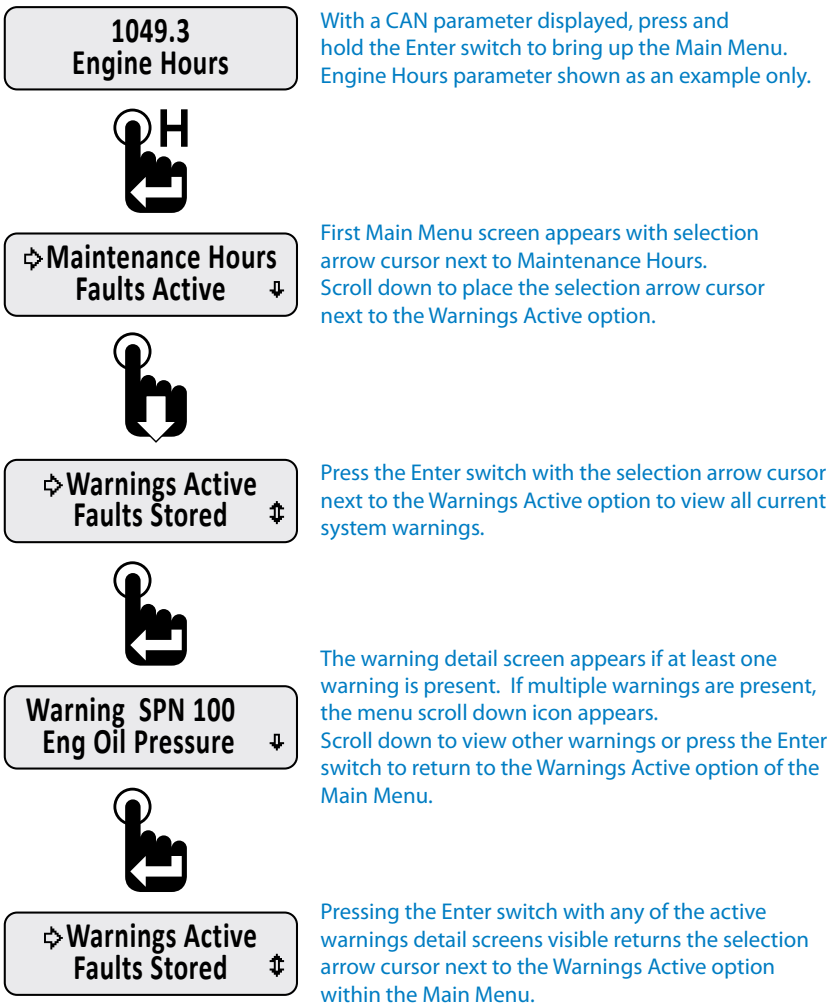


© 2011 Beede Electrical Instrument Co., Inc.

• Viewing Active Warnings

If a warning information screen is cleared after it initially appears and the warning is still active, users can view all the active warning information screens by using the Warnings Active function of the Main Menu, *Main Menu-Warnings Active*.

Figure 1-8: Viewing Active Warnings

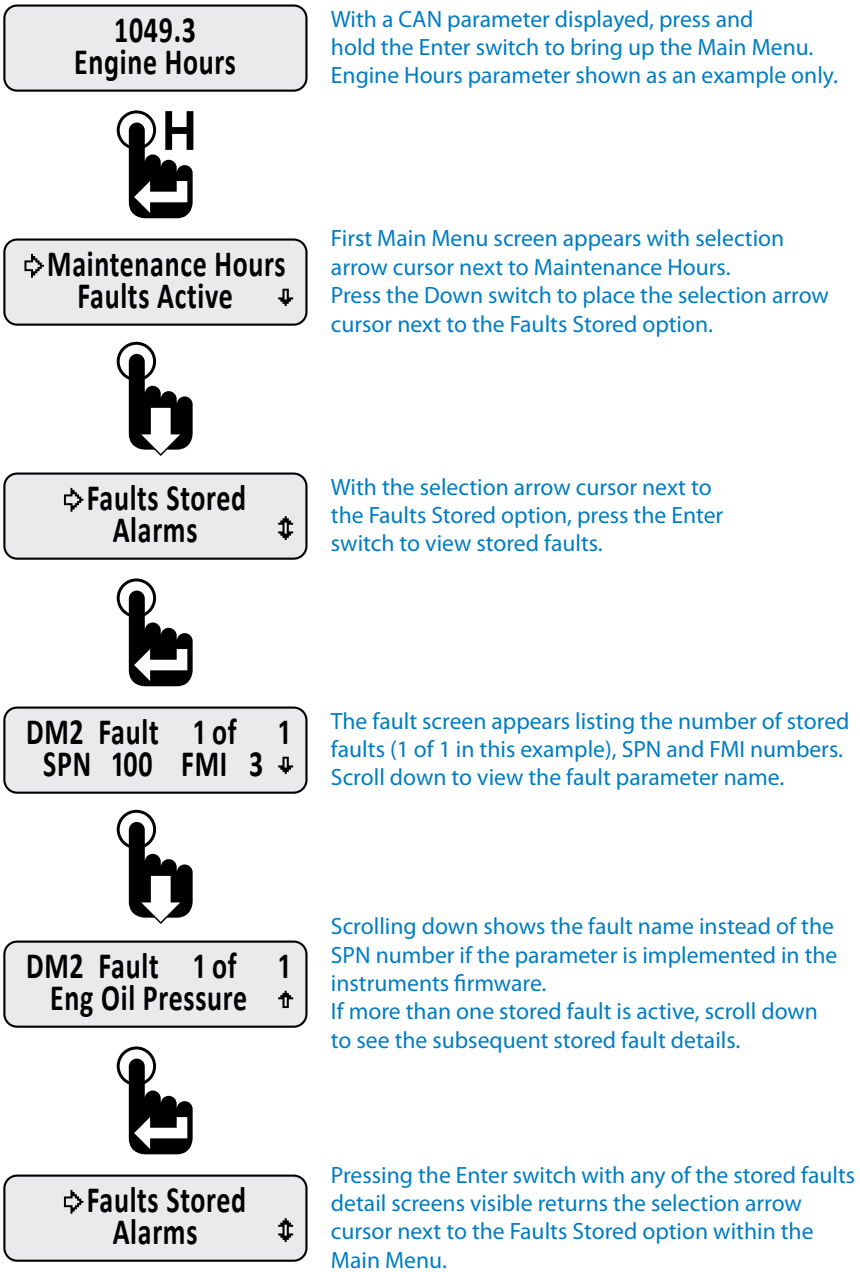


© 2011 Beede Electrical Instrument Co., Inc.

• Faults Stored

The instrument will display all DM2 (Diagnostic Mode) faults stored by the ECU. DM2 faults are previously active diagnostic trouble codes.

Figure 1-9: Faults Stored Information Screens



With a CAN parameter displayed, press and hold the Enter switch to bring up the Main Menu. Engine Hours parameter shown as an example only.

First Main Menu screen appears with selection arrow cursor next to Maintenance Hours. Press the Down switch to place the selection arrow cursor next to the Faults Stored option.

With the selection arrow cursor next to the Faults Stored option, press the Enter switch to view stored faults.

The fault screen appears listing the number of stored faults (1 of 1 in this example), SPN and FMI numbers. Scroll down to view the fault parameter name.

Scrolling down shows the fault name instead of the SPN number if the parameter is implemented in the instruments firmware.
If more than one stored fault is active, scroll down to see the subsequent stored fault details.

Pressing the Enter switch with any of the stored faults detail screens visible returns the selection arrow cursor next to the Faults Stored option within the Main Menu.

© 2011 Beede Electrical Instrument Co., Inc.

• Alarms

Alarms are user configured limits for CAN parameters used to alert operators when the parameter or parameters exceeds those limits. Alarms help users protect a vehicle, vessel or equipment from damage by providing an option to set operating notification limits for CAN parameters critical to the application.

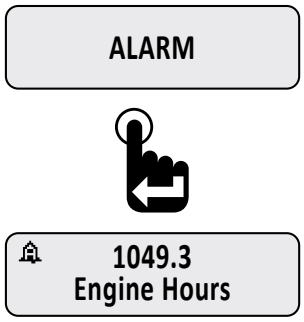
A maximum of 15 parameters may be configured for alarm notification.
Note: Alarms are only a notification feature and do not disable or diminish the operation of a vehicle or equipment.

Alarm settings are written to non-volatile memory and retained when power is removed from the instrument.

If alarms are configured and enabled, a blinking "Bell" icons appears in the upper left corner of the current CAN parameter display screen once a parameter exceeds the set alarm limits. If popups for alarm conditions is enabled, an alarm notification screen appears. Refer to "Setting Popups" on page 25.

The built-in audible device will sound when an alarm occurs if the Mute setting, *Main Menu-Mute Audio Alarm*, is not set to Permanent. See "Mute" on page 20 for enabling the internal audible device.

Parameter Display Screen with Alarm "Bell" Icon



An alarm notification screen appears when popups are enabled and an alarm condition occurs. Refer to setting popups.

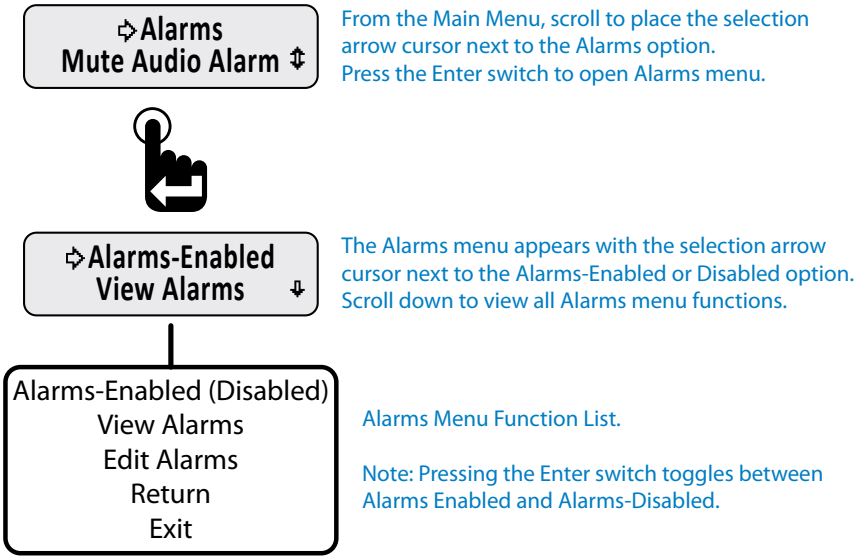
Pressing the Enter switch clears the alarm notification screen and returns the last displayed CAN parameter. A blinking bell icon appears in the upper left corner of the screen to indicate the alarm condition is still active.

© 2011 Beede Electrical Instrument Co., Inc.

• Alarms Menu

The *Main Menu-Alarms* function allows users to enable alarm notification, view the parameter or parameters causing the alarm, edit existing alarms and add new alarms.

Figure 1-10: Alarms Menu Functions



Alarm Menu function Summary:

Alarms-Enabled - Turns on all set alarms.
Alarms-Disabled - Turns off all set alarms.
View Alarms - Allows users to view all set alarm configurations.
Edit Alarms - Allows users to edit existing alarms, add new alarms or delete existing alarms.
Return - Brings users back to the Alarms option of the Main Menu.
Exit - Brings users back to the last displayed CAN parameter screen

© 2011 Beede Electrical Instrument Co., Inc.

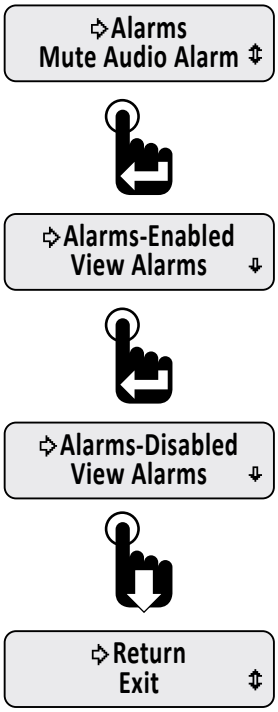
• Enabling/Disabling Alarms

Alarms-Enabled/Disabled turns on or off notification when an alarm condition occurs. This function does not delete alarms or their settings from the alarm list.

Enabling or disabling alarms is a toggle function. When the Alarm menu is opened the current setting, enabled or disabled, is shown. To change the current setting, simply press the Enter switch.

To protect against operating the vehicle unaware of potentially damaging conditions, always use caution when deciding to turn off alarm notification.

Figure 1-11: Enabling/Disabling Alarms



From the Main Menu, scroll to place the selection arrow cursor next to the Alarms option. Press the Enter switch to open the Alarms menu.

Depending upon the previous configuration of the instrument, the Alarms menu appears with either Alarms-Enabled or Alarms-Disabled as the current setting. This screen shows the instrument's current alarm configuration as enabled. Pressing the Enter switch toggles to Alarms-Disabled.

After pressing the enter switch, Alarms-Disabled appears. Pressing the Enter switch a second time will toggle back to Alarms-Enabled.

Scroll down to place the selection arrow cursor next to the Return option then press the Enter switch to leave the Alarms menu and return to the Main Menu.

Scroll down to place the selection arrow cursor next to the Exit option then press the Enter switch to leave the Alarms menu and view the last displayed CAN parameter.

© 2011 Beede Electrical Instrument Co., Inc.

• Viewing Alarms

View Alarms allows users to scroll through all CAN parameters configured for alarm notification.

Users are shown the alarm number, parameter name, measured value for the parameter and the alarm trigger conditions for the parameter.

Figure 1-12: Alarm Screen Details

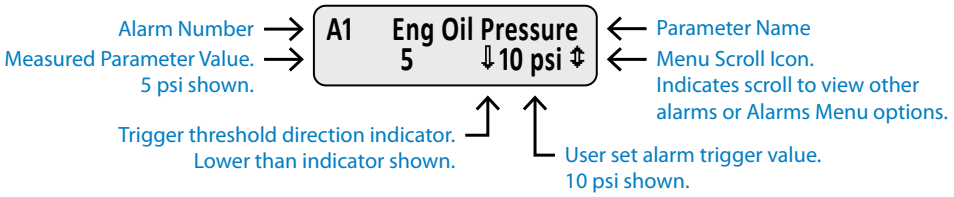
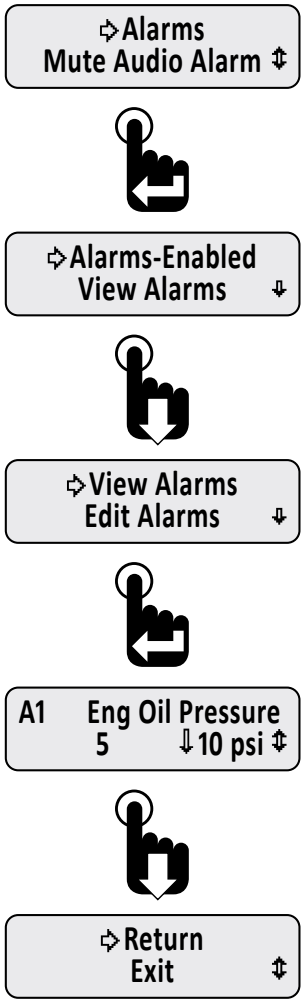


Figure 1-13: Viewing Alarms



From the Main Menu, scroll to place the selection arrow cursor next to the Alarms option.
Press the Enter switch to open the Alarms menu.

Once in the Alarms menu, scroll down to place the selection arrow cursor next to the View Alarms option.

With the selection arrow cursor next to the View Alarms option, press the Enter switch to view any current alarms.

The first configured alarm is displayed.
The display shows the alarm number, CAN parameter name (if implemented), current reading and alarm trigger settings (Below 10 psi in this example).

Scroll down to view any additional alarms.

If no activity is detected for 30 seconds while viewing alarms, the previously displayed CAN parameter appears.
To manually stop viewing alarms, scroll down to place the selection arrow cursor next to the Return option then press the Enter switch to return to the Main Menu or select the Exit option to view the last displayed CAN parameter.

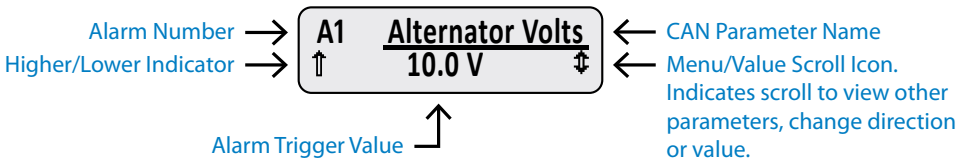
© 2011 Beede Electrical Instrument Co., Inc.

• Alarm Configuration

When adding a new alarm parameter or editing an existing alarm parameter with the Edit Alarms option, users must set the following:

1. The CAN parameter to use.
2. The trigger threshold direction (Higher or Lower than alarm trigger value).
3. The alarm trigger value.

Figure 1-14: Add & Edit Alarm CAN Parameter Screen Details



Higher than threshold indicator. Alarm notification occurs when measured parameter is higher than trigger value.

Lower than threshold indicator. Alarm notification occurs when measured parameter is lower than trigger value.

To select a CAN parameter, scroll through the parameter list with the Up and Down switches until the desired parameter appears. Press the Enter switch to add the parameter to the alarm list.

After selecting a parameter, the blinking bar cursor appears under the Higher/Lower than arrow icon. Users must choose if the alarm notification will occur when the actual parameter value is either higher or lower than the desired trigger value. Pressing either the Up or Down switch toggles the indicator between the higher than arrow (pointing up) and lower than arrow (pointing down). Press the Enter switch to accept direction of the arrow icon.

Once higher or lower is chosen, the blinking bar cursor moves to the alarm notification trigger value. The units of this value change depending on the type of parameter chosen. Use the Up or Down switches to change the value then press the Enter switch to accept the displayed value.

After configuring all the alarm parameters, users can choose to save or discard the alarm configuration.

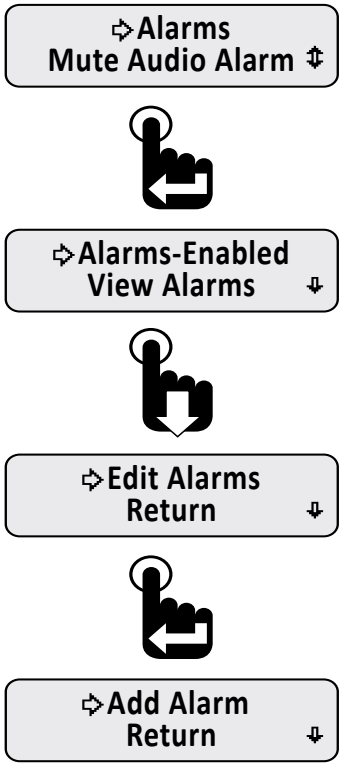
© 2011 Beede Electrical Instrument Co., Inc.

• Adding an Alarm or Alarms

The Edit Alarms function is used to add CAN parameters for alarm notification.
Users may set up to 15 parameters for alarm notification.

The Edit Alarms menu screens differ if no alarms are set as compared to when previously configured alarms exist. If no previously configured alarms exist, the Add Alarm menu option appears after selecting Edit Alarms. If previously configured alarms exist, the configured alarms appear before the Add Alarm menu option. To add an additional alarm when previously alarms exist, users must scroll down thru all the previously configured alarms before reaching the Add Alarm menu option.

Figure 1-15: Menu Prompt Sequence with No Configured Alarms



From the Main Menu, scroll to place the selection arrow cursor next to the Alarms option.
Press the Enter switch to open Alarms Menu.

The Alarms Menu appears with the selection arrow cursor next to the Alarms-Enabled or Disabled option. Scroll down to place selection arrow cursor next to the Edit Alarms option.

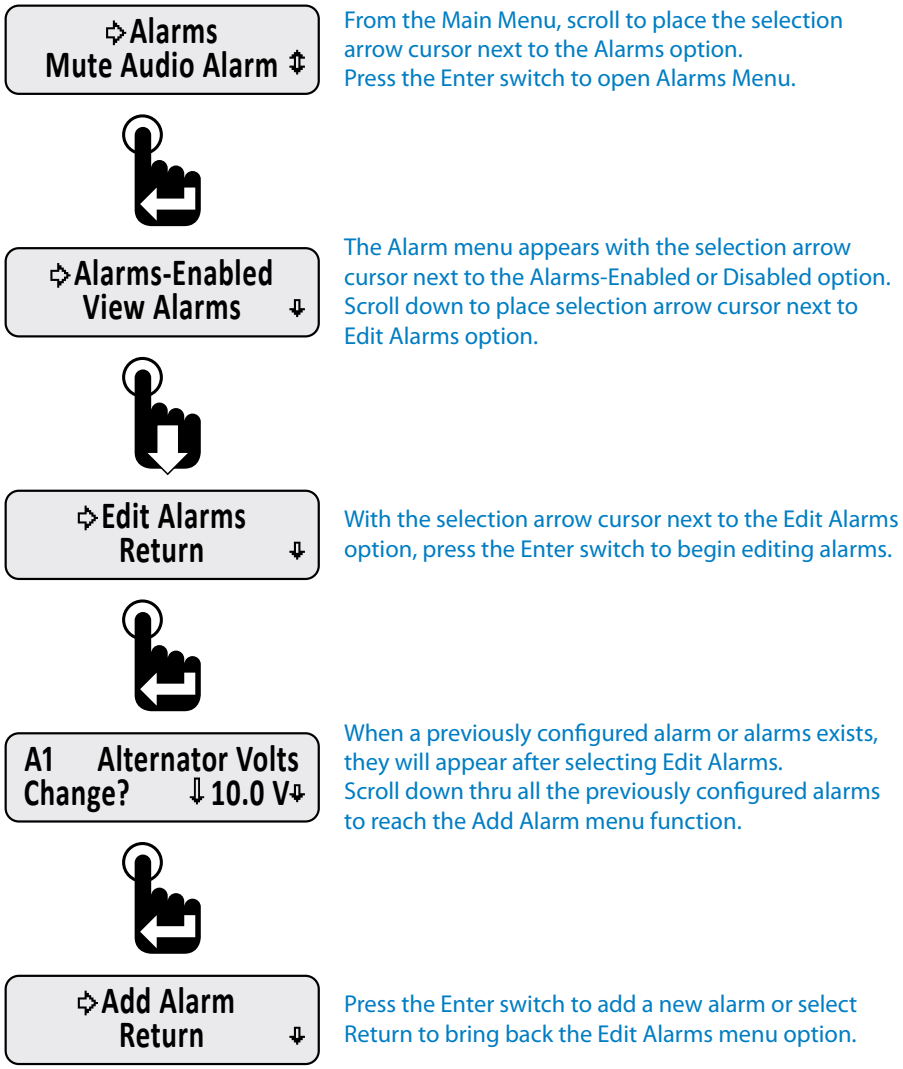
With the selection arrow cursor next to the Edit Alarms option, press the Enter switch to begin editing alarms.

When no alarms exist, selecting Edit Alarms returns two menu options, Add Alarm and Return.

Press the Enter switch to begin adding a CAN parameter for alarm notification or select Return to bring back the Edit Alarms menu option.

© 2011 Beede Electrical Instrument Co., Inc.

Figure 1-16: Menu Prompt Sequence with Previously Configured Alarms

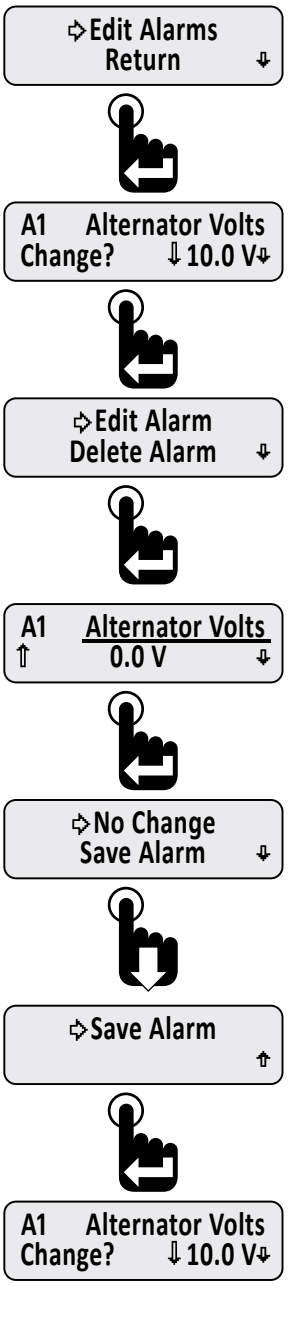


© 2011 Beede Electrical Instrument Co., Inc.

• Editing Alarms

The Edit Alarms function is used to change an alarms existing CAN parameter, higher/lower than threshold indicator or trigger value.

Figure 1-17: Editing an Alarm



From the Alarms Menu place the selection arrow cursor next to the Edit Alarms option, *Main Menu-Alarms-Edit Alarms*, then press the Enter switch to begin editing alarms.

Pressing the Enter switch displays the first previously configured CAN parameter for alarm notification, A1.

The prompt "Change?" appears in the lower left corner of the display. Press the Enter switch to accept the prompt to change/edit the the displayed alarm, A1.

If more than one alarm exists, scroll down to display the desired alarm then press the Enter switch to change/edit it.

After choosing an alarm to change, the selection arrow cursor appears next to the Edit Alarm, option.
Press the Enter switch to begin editing the chosen alarm.

The alarms configuration screen appears with the blinking bar cursor beneath the CAN parameter name.

Step through and edit the parameter name, threshold direction and trigger value as desired using the Up and Down switches. Pressing the Enter switch accepts and sets any changes.

Pressing the Enter switch after accepting the existing or edited trigger value opens the save options menu choices.

To discard changes to the alarm, press the Enter switch to select No Change. Otherwise, scroll down to place the selection arrow cursor next to the Save Alarm option.

With the selection arrow cursor next to the Save Alarm option, press the Enter switch to save alarm changes.

After choosing to either save or discard alarm changes, the same alarm configuration screen appears to allow users to re-edit the alarm if necessary.

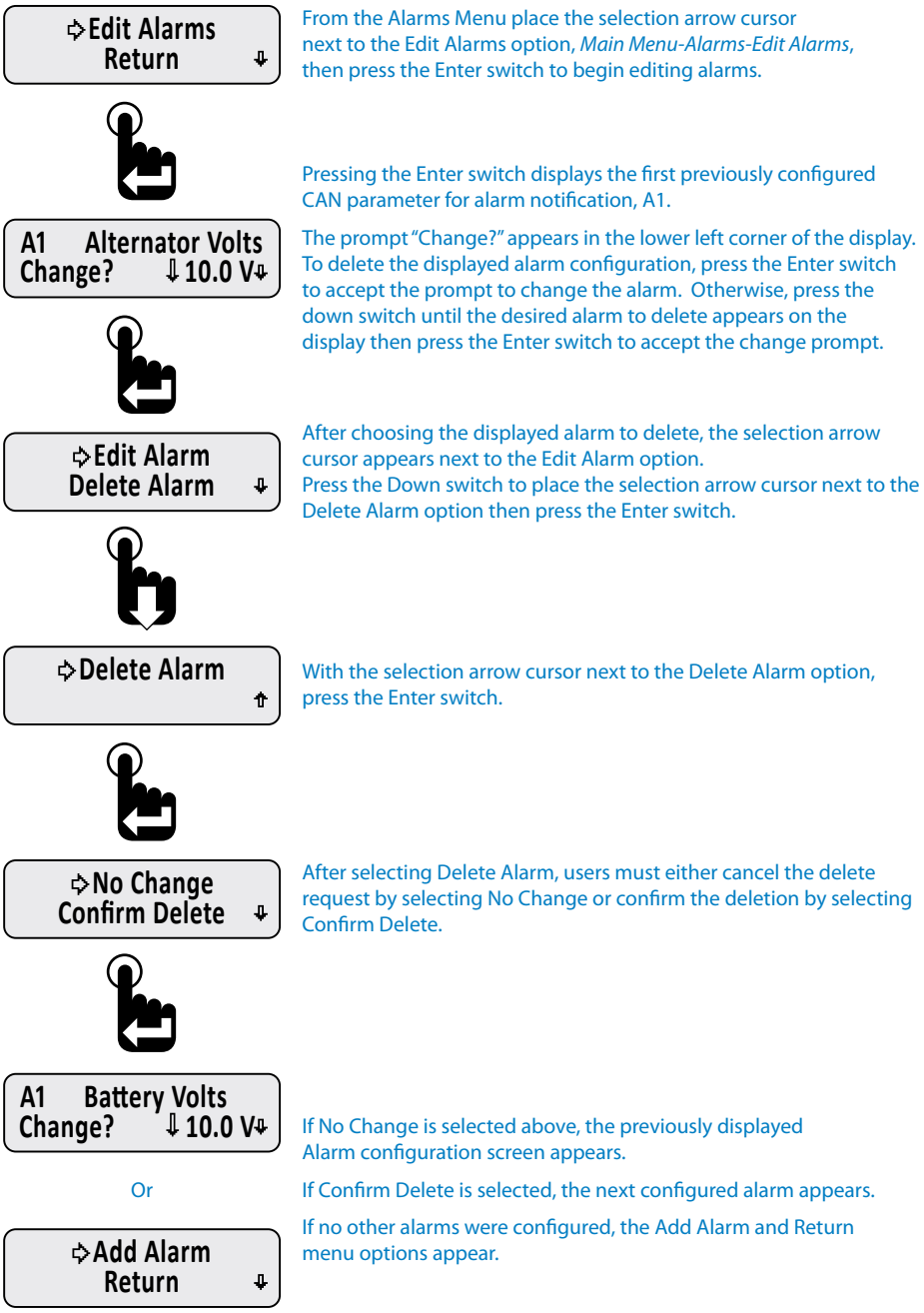
Once the displayed alarm configuration is acceptable, press the Down switch to scroll to the next alarm if one is configured or to the Add Alarm and Return menu options.

© 2011 Beede Electrical Instrument Co., Inc.

• Deleting Alarms

The Edit Alarms function is also used to delete existing alarms.

Figure 1-18: Deleting an Alarm



© 2011 Beede Electrical Instrument Co., Inc.

• Mute

The instrument is equipped with an internal audible device to alert users when a Fault, Warning or Alarm condition occurs. Pressing the Enter switch after a Fault, Warning or Alarm condition occurs either temporarily or permanently mutes the audible device for that condition depending upon the setting of Mute Audio Alarm, *Main Menu-Mute Audio Alarm*.

Note: Regardless of the Mute Audio Alarm setting, the first occurrence of a Fault, Warning or Alarm condition always activates the audio alarm. Subsequent occurrences of the same Fault, Warning or Alarm condition is controlled by the Mute Audio Alarm setting.

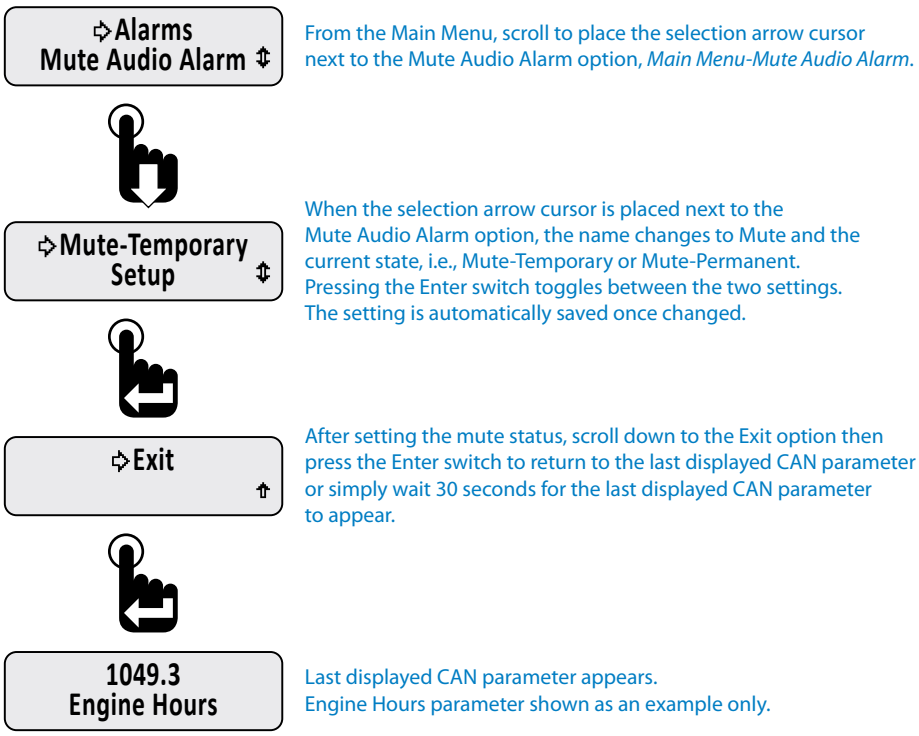
If an external audible device is connected to the switched output pin 3 of the connector, the device is muted as well. For muting external devices, see "Alarm Output" on page 32.

Mute Audio Alarm - Permanent setting turns off the audible device for subsequent occurrences of the specific Fault, Warning or Alarm.

Mute Audio Alarm - Temporary setting disables the audible device for twenty seconds.

Faults are muted for 20 seconds. Warnings and Alarms are muted for 2 minutes. Faults are muted for a shorter period of time because they are considered critical conditions that require immediate attention. A Fault condition sounds a steady audible tone while Warning and Alarms conditions sound an intermittent audible tone.

Figure 1-19: Muting Faults, Warnings & Alarms

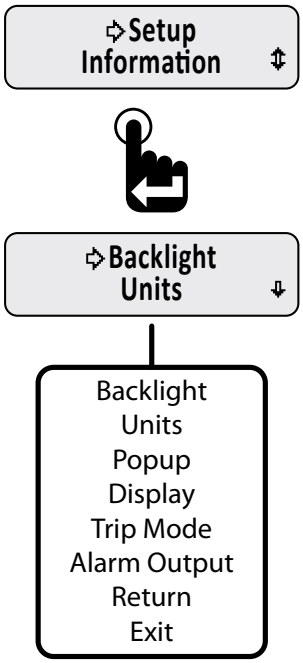


© 2011 Beede Electrical Instrument Co., Inc.

• Setup Menu

The Setup Menu contains all the functions necessary to configure the instrument to satisfy user preferences and application requirements. This section of the manual describes those functions.

Figure 1-20: Setup Menu Functions



From the Main Menu, scroll to place the selection arrow cursor next to the Setup option.
Press the Enter switch to view Setup functions.

The Setup menu appears with the selection arrow cursor next to the Backlight option.
Scroll down to view all Setup menu functions.

Setup Menu Function List.

Setup Menu function summary:

Backlight - Sets intensity of instrument illumination.
Units - Sets display units to English or SI-Metric.
Popup - Activates notification screen for Faults, Warnings and Alarms.
Display - Sets either 1 or 2 parameter display mode, LCD contrast and positive or negative image mode.
Trip Mode - Determines if maintenance hours or trip miles displays as the first item of the Main Menu.
Alarm Output - Turns off (mutes) the output for audible devices.
Return - Brings users back to *Main Menu-Setup*.
Exit - Leaves the menu to show the last displayed CAN parameter.

© 2011 Beede Electrical Instrument Co., Inc.

• Backlight

The instrument offers two levels of illumination control; external lamp switch on and lamp switch off. Backlight intensity is set using the Backlight option from the Setup Menu, *Main Menu-Setup-Backlight*. Backlight intensity values range from 0 or off to 100% or maximum by increments of 10%.

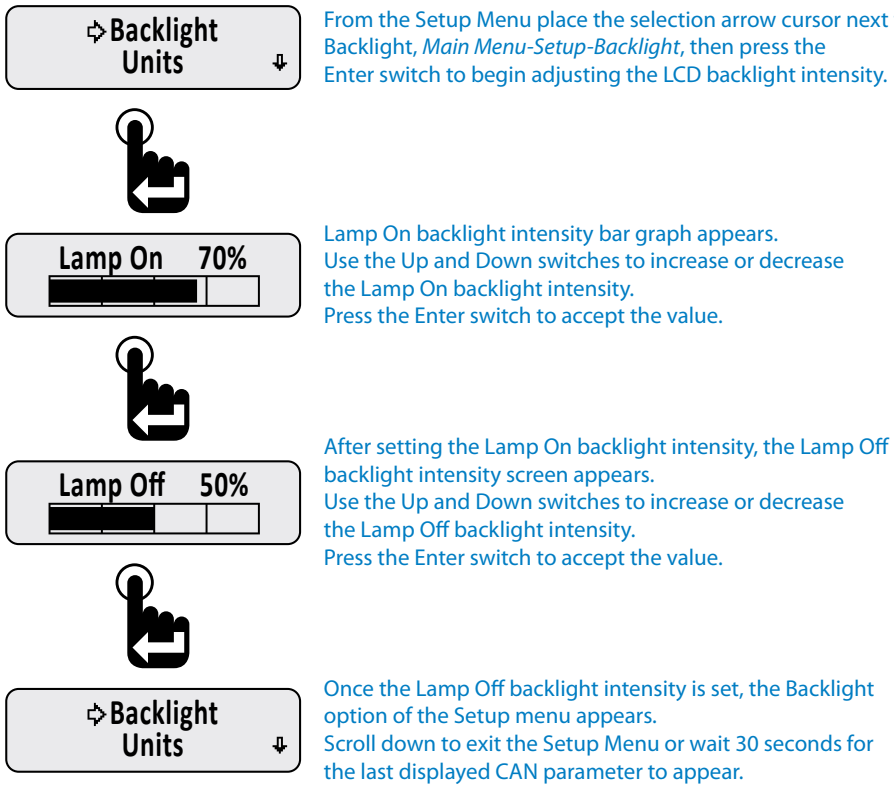
• Lamp On & Lamp Off

Lamp On: The Lamp On function sets the backlight illumination brightness when pin 4 of the instrument's 6 pin connector is wired to an external lamp switch and that switch is turned on.

Lamp Off: The Lamp Off function sets the backlight illumination brightness when no external lamp switch is used or when an external lamp switch is wired to pin 4 of the instruments 6 pin connector and the lamp switch is turned off. This feature allows users to turn on and control the instruments backlighting independent of the vehicle's or equipment's light switch.

Note: Standard factory hardware configuration for the instrument uses Pin 4 of the 6 pin connector to connect to an external lamp switch. Some factory configured instruments use pin 4 for serial data communication to Beede NexSysLink® instruments. See "Stand-Alone and Master Node Configurations" on page iv for more information.

Figure 1-21: Setting Backlight Intensity



From the Setup Menu place the selection arrow cursor next to Backlight, *Main Menu-Setup-Backlight*, then press the Enter switch to begin adjusting the LCD backlight intensity.

Lamp On backlight intensity bar graph appears.
Use the Up and Down switches to increase or decrease the Lamp On backlight intensity.
Press the Enter switch to accept the value.

After setting the Lamp On backlight intensity, the Lamp Off backlight intensity screen appears.
Use the Up and Down switches to increase or decrease the Lamp Off backlight intensity.
Press the Enter switch to accept the value.

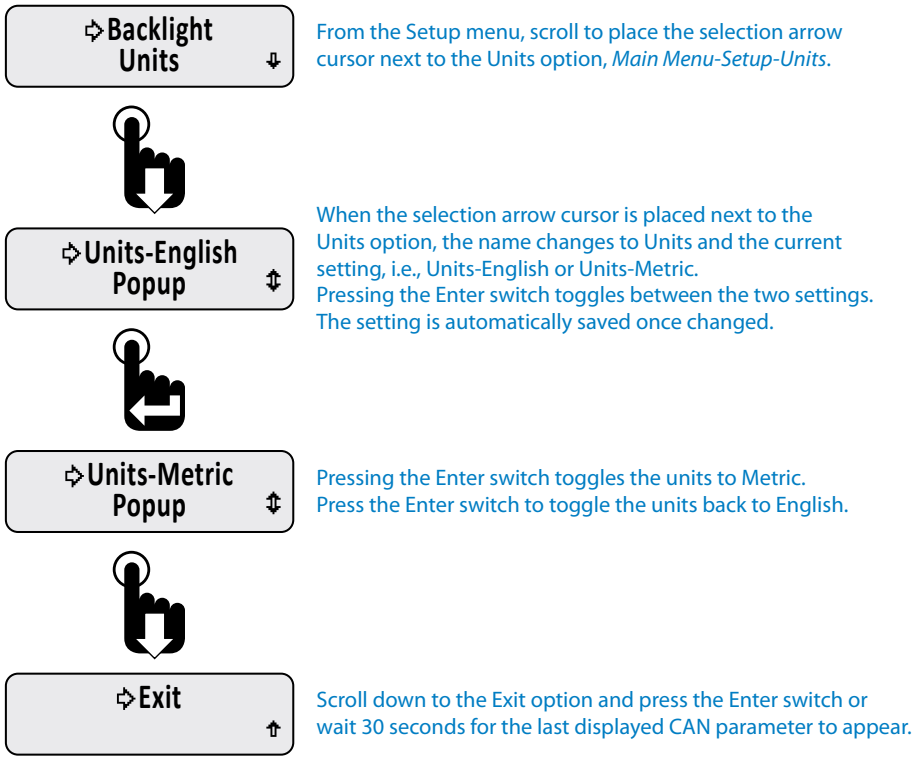
Once the Lamp Off backlight intensity is set, the Backlight option of the Setup menu appears.
Scroll down to exit the Setup Menu or wait 30 seconds for the last displayed CAN parameter to appear.

© 2011 Beede Electrical Instrument Co., Inc.

• Setting Units

Users may select to display CAN parameters in either English or SI-Metric units.

Figure 1-22: Setting Units

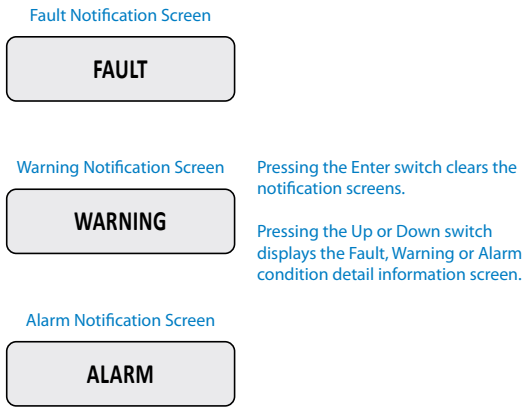


© 2011 Beede Electrical Instrument Co., Inc.

• Popups Notification Screens

Turning on popups provide a highly visible alert screen when a system Fault, Warning or Alarm occurs.

Figure 1-23: Popup Fault, Warning & Alarm Screens



Fault, Warning and Alarm popup screens remain displayed until acknowledged by pressing the Enter switch. Pressing the Enter switch returns the last displayed CAN parameter prior to the occurrence of the Fault, Warning or Alarm condition.

For Faults and Warnings, the Fault LED and Warning LED remain illuminated after pressing the Enter switch to acknowledge and clear the notification screen.

After pressing the Enter switch for Alarms, a blinking "bell" icon appears in the upper left corner of the CAN parameter display screen to indicate an alarm condition exists.

Pressing the Up or Down switch when a notification screen appears brings up the Fault, Warning or Alarm detail information display.

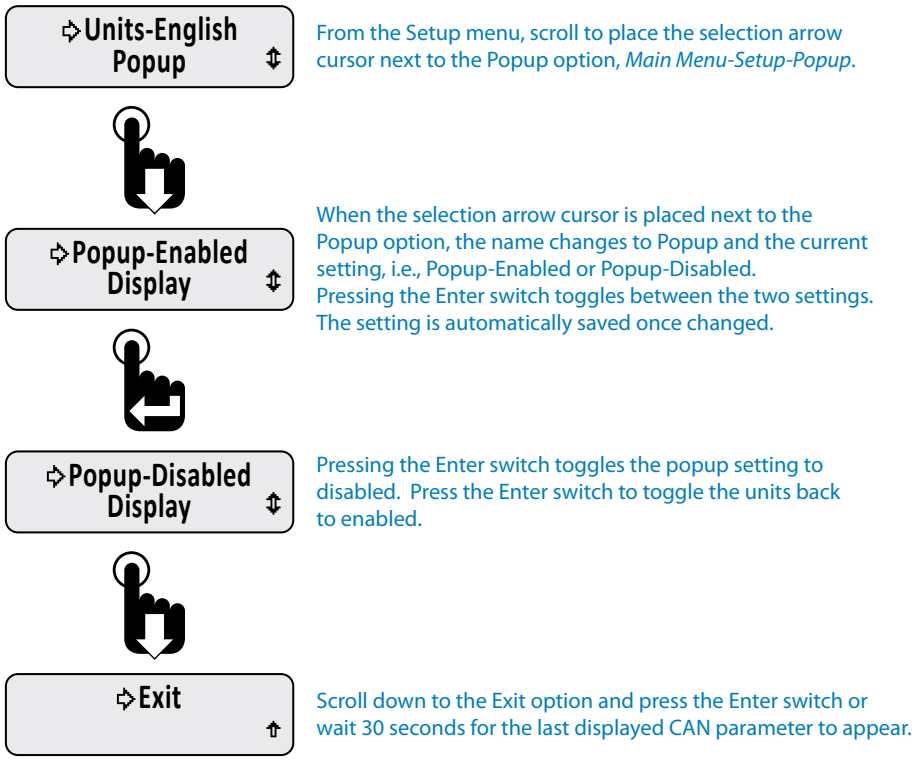
Note: If the condition that caused the Fault, Warning or Alarm clears, the notification screens and bell icon disappears and the alert LEDs turn off.

© 2011 Beede Electrical Instrument Co., Inc.

• Setting Popups

Enabling popups allows the Fault, Warning and Alarm screens to appear when a when a System Fault, Warning or Alarm condition occurs.

Figure 1-24: Setting Popup Status

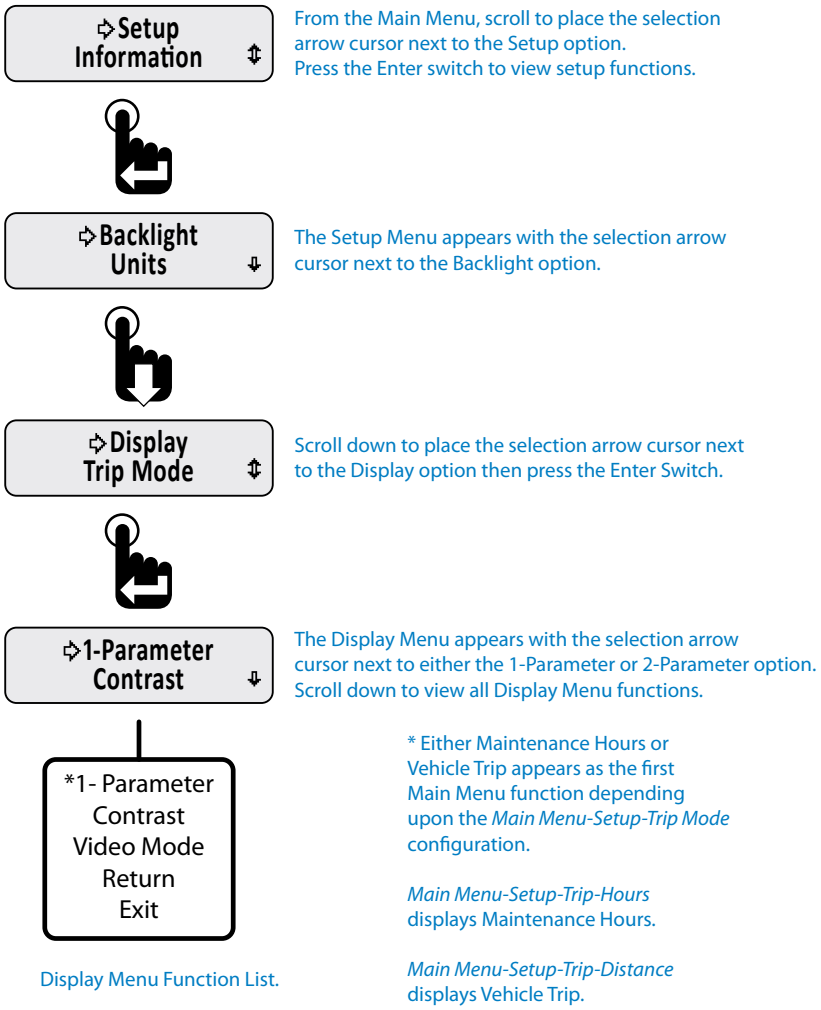


© 2011 Beede Electrical Instrument Co., Inc.

• Display

The Display Menu functions provide users the ability to configure the LCD. Options for configuring the display include either 1 or 2 parameter display mode, LCD contrast and positive or negative image mode. Each function is detailed in the following pages.

Figure 1-25: Display Menu



© 2011 Beede Electrical Instrument Co., Inc.

• 1 or 2 Parameter Display

Users can set whether 1 or 2 CAN parameters appear on the LCD screen.

Figure 1-26: 1 and 2 CAN Parameter Display Formats

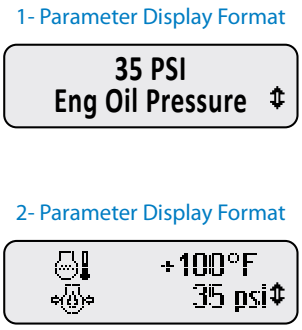
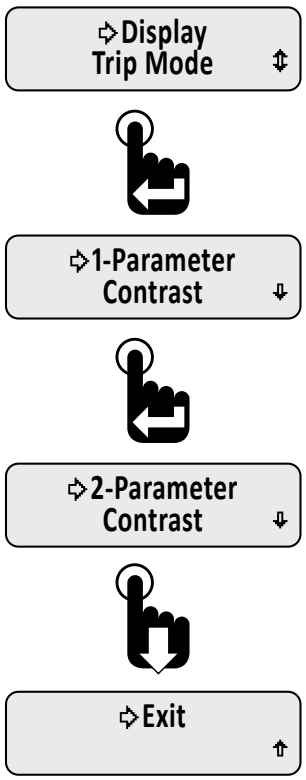


Figure 1-27: Setting 1 or 2 Parameter Display Lines



From the Setup Menu place the selection arrow cursor next to the Display option, *Main Menu-Setup-Display*, then press the Enter switch to view the Display Menu functions.

When the Display Menu opens, the selection arrow appears next to the current parameter display mode setting, i.e., 1-Parameter or 2-Parameter.
Pressing the Enter switch toggles between the two settings. The setting is automatically saved once changed.

Pressing the Enter switch toggles the paramater display mode to two 2-Parameter.

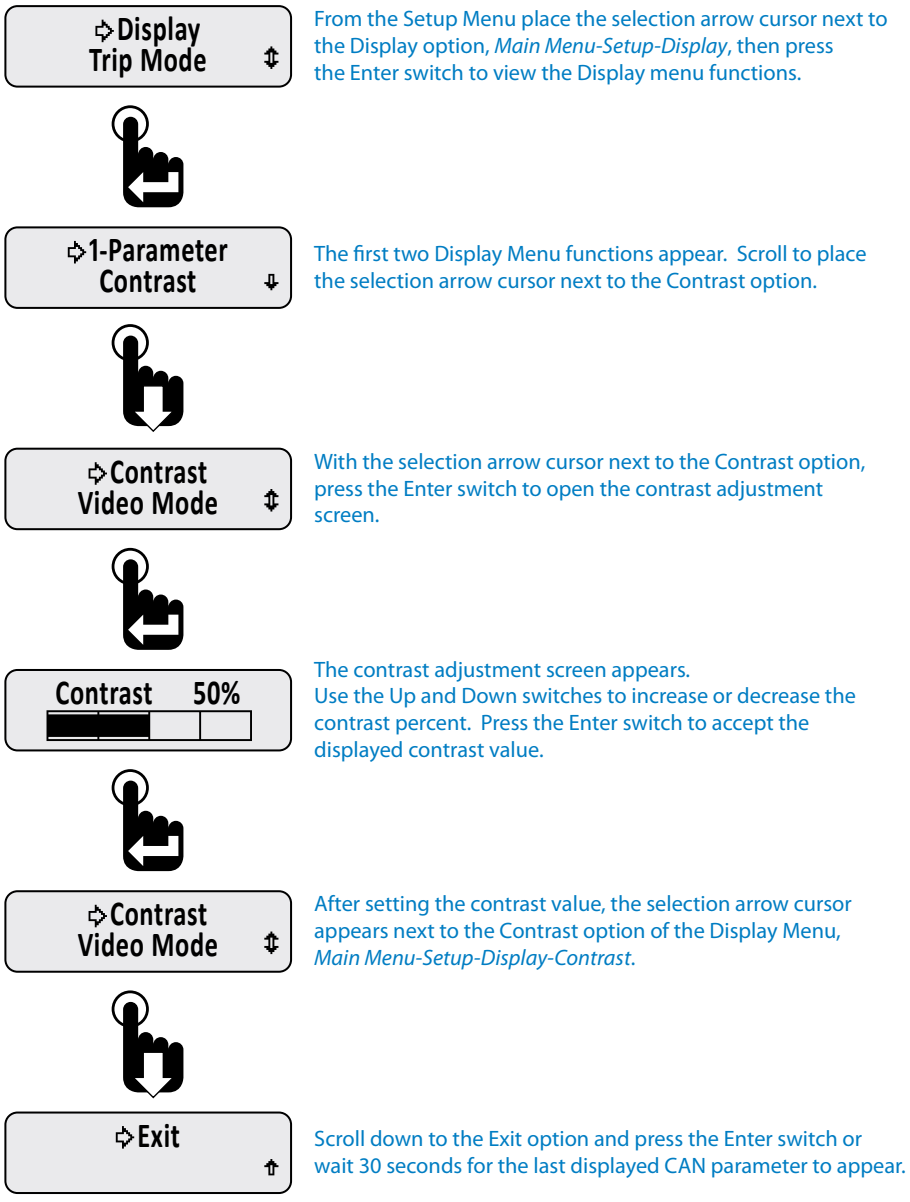
Scroll down to the Exit option and press the Enter switch or wait 30 seconds for last displayed CAN parameter to appear.

© 2011 Beede Electrical Instrument Co., Inc.

• Set Contrast

Contrast sets the difference between the white and black colors of the LCD.

Figure 1-28: Setting LCD Contrast

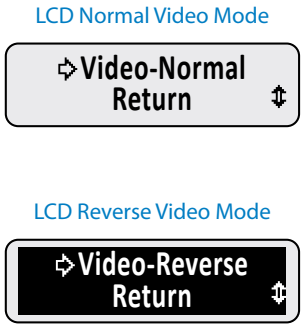


© 2011 Beede Electrical Instrument Co., Inc.

• Video Mode Formats

Setting the video mode changes the color scheme of the LCD from white graphics on a black background (Normal) to black graphics on a white background (Reverse).

Figure 1-29: Video Mode Formats

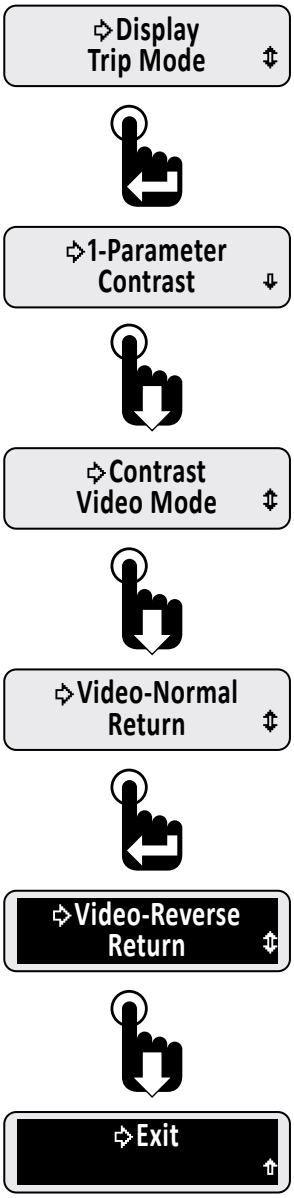


© 2011 Beede Electrical Instrument Co., Inc.

• Set Video

The menu sequence below shows how to set the video mode to either normal or reverse.

Figure 1-30: Setting LCD Background Color Scheme (Video Mode)



From the Setup Menu place the selection arrow cursor next to the Display option, *Main Menu-Setup-Display*, then press the Enter switch to view the Display Menu functions.

The first two Display Menu functions appear. Scroll to place the selection arrow cursor next to the Video Mode option.

Screen shows Video Mode function prior to placing the selection arrow cursor next to the function.
Continue to press the Down switch to place the selection arrow cursor next to the Video Mode function.

When the selection arrow cursor is placed next to the Video-Mode option, the name changes to the current video display mode, i.e., Video-Normal or Video-Reverse.
Pressing the Enter switch toggles between the two settings.
The setting is automatically saved once changed.

Pressing the Enter switch toggled the video mode to the reverse setting.
The setting is automatically saved once changed.

Scroll down to the Exit option and press the Enter switch or wait 30 seconds for the last displayed CAN parameter to appear.

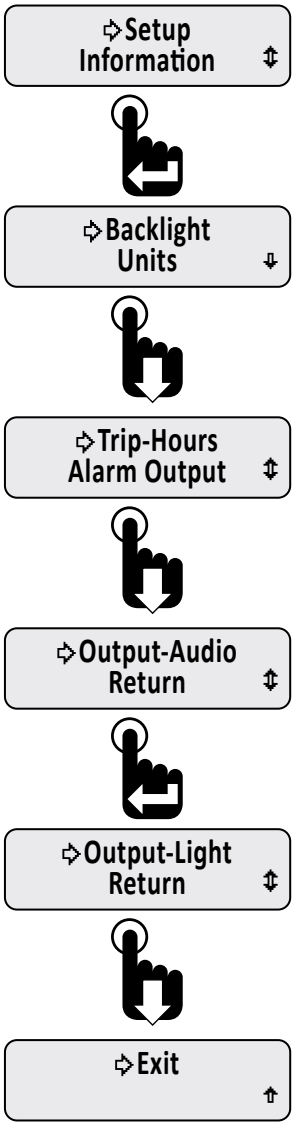
© 2011 Beede Electrical Instrument Co., Inc.

• Alarm Output

The alarm output setting controls whether the alarm output pin is turned off when an alarm condition occurs and the Enter switch is pressed. This function is also dependant upon the Mute setting for the audible output.

If Mute is set to Temporary and Alarm Output is set to Audible, the internal and external audible devices will temporarily turn off. If Mute is set to Permanent and the Alarm Output is set to Audible, the internal and external audible devices will remain off until a new alarm condition occurs.
If Alarm Output is set to light, the output pin remains on regardless of the current mute setting when the Enter switch is pressed.

Figure 1-32: Setting Alarm Output Pin Status



From the Main Menu, scroll to place the selection arrow cursor next to the Setup option.
Press the Enter switch to view the Setup Menu functions.

The Setup Menu appears with the selection arrow cursor next to the Backlight option.
Scroll down to place the selection arrow cursor next to the Alarm Output option.

Screen shows Alarm Output function prior to placing the selection arrow cursor next to the function.
Continue to press the Down switch to place the selection arrow cursor next to the Alarm Output function.

When the selection arrow cursor is placed next to the Alarm Output option, the name changes to the current alarm output mode, i.e., Output-Audio or Output-Light.
The Audio option disables output pin 3 when the Enter switch is pressed to mute an alarm notification.
Pressing the Enter switch toggles between the two settings.
The setting is automatically saved once changed.

Pressing the Enter switch toggled the Alarm Output setting to the light option.
The Output-Light option does not disable output pin 3 when the Enter switch is pressed to mute an alarm notification.

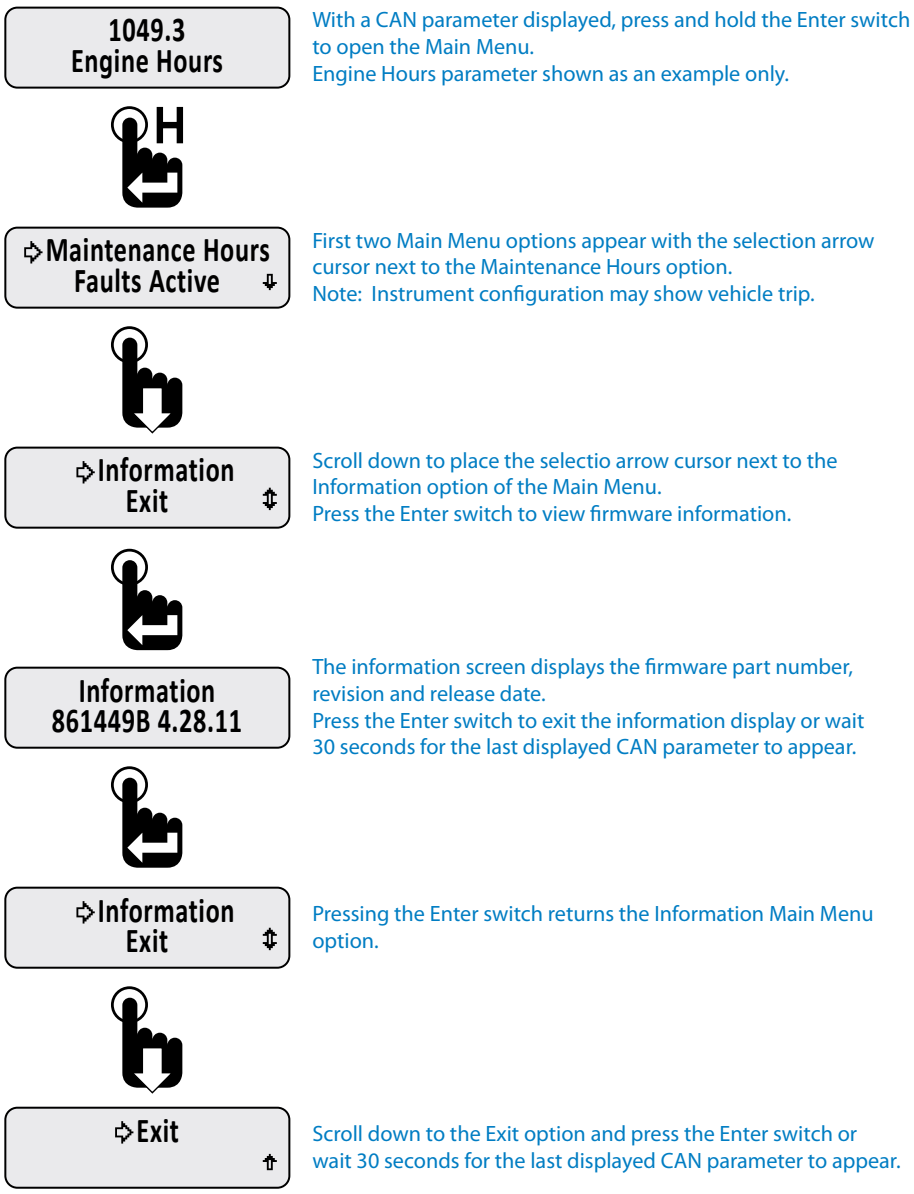
Scroll down to the Exit option and press the Enter switch or wait 30 seconds for last displayed CAN parameter to appear.

© 2011 Beede Electrical Instrument Co., Inc.

• Firmware Information

Firmware part number, revision and release date are available when selecting the Information option from the Main Menu.

Figure 1-33: Viewing Firmware Revision



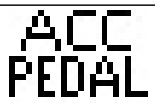
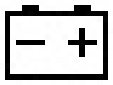
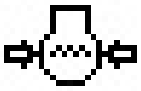
© 2011 Beede Electrical Instrument Co., Inc.

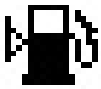
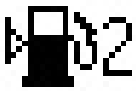
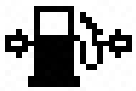
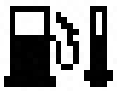
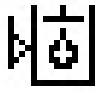
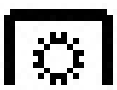
• Implementation of SAE J1939 Parameters

Parameter Name	SPN	PGN	Range	LCD Display Name
Accelerator Pedal Position 1	91	61443	0-100%	Accel Pedal %
Charging System Potential	167	65271	0-50 Volts	Alternator
Engine Average Fuel Economy	185	65266	0-200 MPG	Avg Fuel Econ
Net Battery Current	114	65271	-125 - 125 Amps	Battery Curr
Battery Potential/Power Input 1	168	65271	0-50 Volts	Battery Volt
Engine Intake Manifold #1 Pressure	102	65270	0-72 PSI	Boost Press
Aftertreatment 1 SCR Catalyst Tank Level	1761	65110	0-100%	Cat Tank Lvl
Aftertreatment 1 SCR Catalyst Tank Temperature	3031	65110	-40 - 400 °F	Cat Tank Temp
Engine Coolant Level	111	65263	0-100%	Coolant Level
Engine Coolant Pressure	109	65263	0-72 PSI	Coolant Press
Engine Coolant Temperature	110	65262	0-400 °F	Coolant Temp
Transmission Current Gear	523	61445	-6 - 30 Position	Current Gear
Engine Oil Level	98	65263	0-100%	Eng Oil Level
Engine Oil Pressure	100	65263	0-140 PSI	Eng Oil Press
Engine Oil Temperature 1	175	65262	0-500 °F	Eng Oil Temp
Engine Total Hours of Operation	247	65253	0-999999 Hours	Engine Hours
Engine Speed	190	61444	0-10,000 RPM	Engine Speed
Engine Exhaust Gas Temperature	173	65270	0-3000 °F	Exh Gas Temp
Engine Instantaneous Fuel Economy	184	65266	0-200 MPG	Fuel Economy
Fuel Level 1	96	65276	0-100%	Fuel Level 1
Fuel Level 2	38	65276	0-100%	Fuel Level 2
Engine Fuel Delivery Pressure	94	65263	0-140 PSI	Fuel Pressure
Engine Fuel Rate	183	65266	0-40 GPH	Fuel Rate
Engine Fuel Temperature 1	174	65262	0-400 °F	Fuel Temp
High Resolution Total Vehicle Distance	917	65217	0-999999 Miles	HR Vehicle D
Hydraulic Oil Level	2602	65128	0-100 PSI	Hydr Oil Lvl
Hydraulic Temperature	1638	65128	0-400 °F	Hydraulic Temp
Engine Intercooler Temperature	52	65262	0-400 °F	Intrcoolr Tmp
Engine Intake Manifold 1 Temperature	105	65270	0-400 °F	Manifold Temp
Engine Percent Load At Current Speed	92	61443	0-120%	Percent Load
Power Takeoff Oil Temperature	90	65264	0-400 °F	PTO Oil Temp
Power Takeoff Speed	186	65264	0-8000 RPM	PTO Speed
Wheel-Based Vehicle Speed	84	65265	0-200 MPH	Speed
Engine Throttle Position	51	65266	0-100%	Throttle
Transmission Oil Level	124	65272	0-100%	Trans Oil Lvl
Transmission Oil Pressure	127	65272	0-500 PSI	Trans Oil Prs
Transmission Oil Temperature	177	65272	0-500 °F	Trans Oil Tmp
Total Vehicle Distance	245	65248	0-999999 Miles	Vehicle Dist

© 2011 Beede Electrical Instrument Co., Inc.

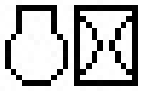
• Parameter Icons & Descriptions

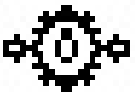
Parameter Icon	Description
	Accelerator Pedal Position
	Alternator Current or Voltage
	Average Fuel Economy
	Battery Voltage or current
	Boost Pressure
	Engine Coolant Level
	Engine Coolant Pressure
	Engine Coolant Temperature
	Engine Exhaust Temperature
	Engine Intercooler Temperature
	Engine Manifold Temperature
	Engine Oil Level
	Engine Oil Pressure
	Engine Oil Temperature

Parameter Icon	Description
	Engine RPM/Speed
	Fuel Level
	Fuel Level 2
	Fuel Pressure
	Fuel Rate/Flow Total
	Fuel Temperature
	Hydraulic Oil Level
	Hydraulic Retarder Oil Temperature
	Instantaneous Fuel Economy
	Percent Load
	Power Takeoff Oil Pressure
	Power Takeoff Oil Temperature
	Power Takeoff Speed
SPEED	Speed, Wheel or Water Based

© 2011 Beede Electrical Instrument Co., Inc.

• Parameter Icons & Descriptions

Parameter Icon	Description
	Throttle Position
	Total Engine Hours
	Total Vehicle Distance

Parameter Icon	Description
	Transmission Gear/ Actual Gear/Current Gear
	Transmission Oil Pressure
	Transmission Oil Temperature

• Menu Navigation Icon Descriptions

Menu Navigation Icon	Description
	Alarm Indicator (Blinks)
	Selection Arrow Cursor
	Blinking Bar Cursor (Shown under number 0, zero)

Menu Navigation Icon	Description
	No CAN Data Present
	Higher Than Alarm Threshold Indicator
	Lower Than Alarm Threshold Indicator

© 2011 Beede Electrical Instrument Co., Inc.

• Notes

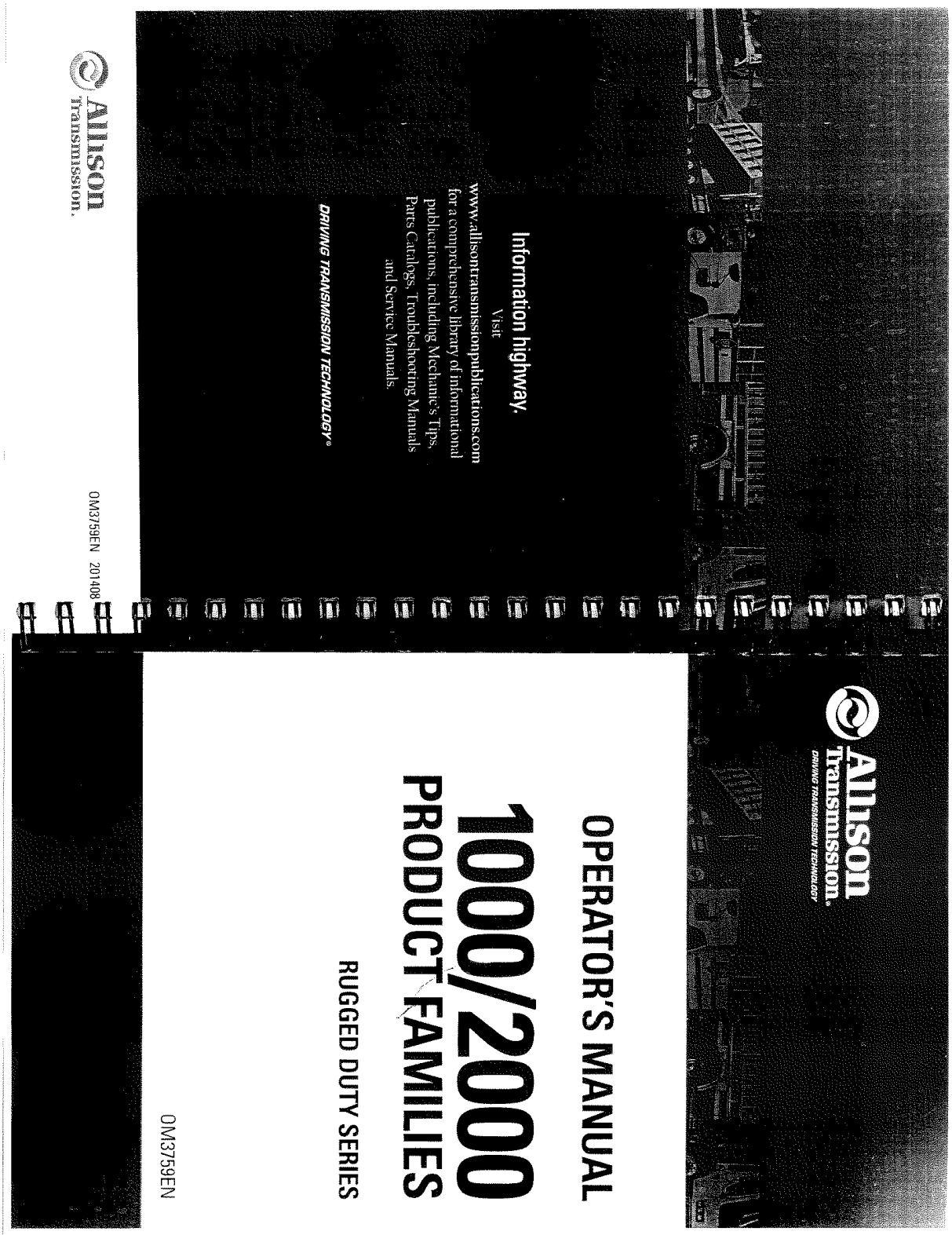
© 2011 Beede Electrical Instrument Co., Inc.

WARRANTY

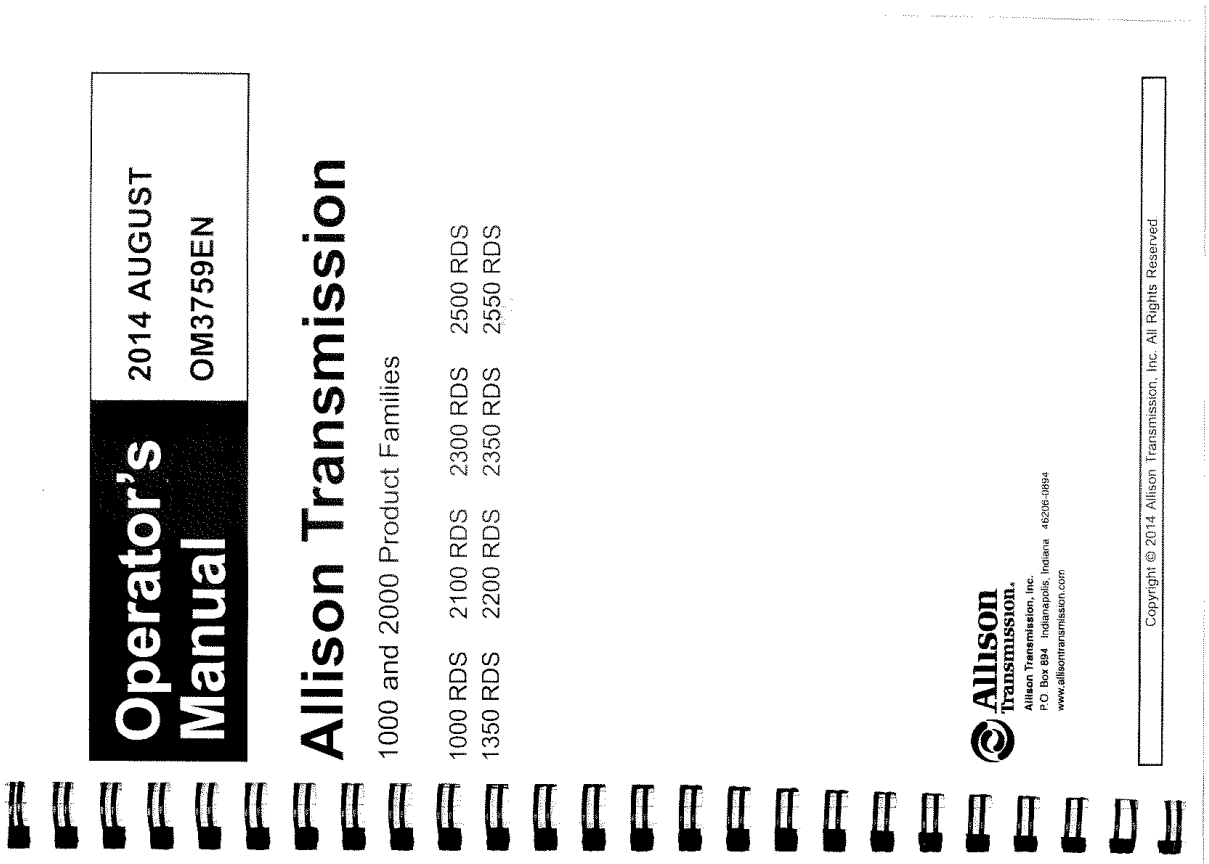
Beede Electrical Instrument Co., Inc warrants all instruments and accessories free from all defects in workmanship and materials on gauges that are less than three (3) years old or have been in service fewer than two (2) years and, at no charge, will replace or repair at Beede's option all instruments that fail.
Contact Beede for complete details.

THANK YOU!

Thank you for purchasing a Beede® Instrument.
Our instruments are designed and manufactured for you in the U.S.A.
Visit our web site at www.beede.com or contact customer service for information on this or other Beede® instruments.



ALLISON 2500 TRANS, INFORMATION


Operator's Manual
2014 AUGUST
OM3759EN
Allison Transmission
1000 and 2000 Product Families
1000 RDS 2100 RDS 2300 RDS 2500 RDS
1350 RDS 2200 RDS 2350 RDS 2550 RDS
Allison Transmission
Allison Transmission, Inc.
P.O. Box 894 Indianapolis, Indiana 46206-0894
www.allisontransmission.com
Copyright © 2014 Allison Transmission, Inc. All Rights Reserved

IMPORTANT SAFETY INFORMATION

IT IS YOUR RESPONSIBILITY to be completely familiar with the warnings and cautions in this manual. These warnings and cautions advise of specific methods or actions that can result in personal injury, equipment damage, or cause the equipment to become unsafe. These warnings and cautions are not exhaustive. Allison Transmission could not possibly know, evaluate, or advise the service trade of all conceivable procedures by which service might be performed or of the possible hazardous consequences of each procedure. Accordingly, ANYONE WHO USES A SERVICE PROCEDURE OR TOOL WHICH IS NOT RECOMMENDED BY ALLISON TRANSMISSION MUST first be thoroughly satisfied that neither personal safety nor equipment safety will be jeopardized by the service methods used.

Vehicle manufacturers integrate Allison transmissions into vehicles used for a variety of vocations and services. The vehicle manufacturer is responsible for identifying the specific operating conditions to which the vehicle will be subjected and to communicate the appropriate means for preventing unintended vehicle movement within those conditions, in order to ensure vehicle and operator safety. The vehicle owner and operator should be aware of and follow the vehicle manufacturer's operating instructions and warnings related to parking and preventing unintended vehicle movement.

Proper service and repair is important to the safe and reliable operation of the equipment. The service procedures recommended by Allison Transmission (or the vehicle manufacturer) and described in this manual are effective methods for performing service and diagnostic operations. Some procedures require using specially designed tools. Use special tools when and in the manner recommended.

The WARNINGS, CAUTIONS, and NOTES in this manual apply only to the Allison transmission and not to other vehicle systems which may interact with the transmission. Be sure to review and observe any vehicle system information provided by the vehicle manufacturer and/or body builder at all times the Allison transmission is being serviced.

WARNINGS, CAUTIONS, NOTES

Three types of headings are used in this manual to attract your attention:

WARNING: A warning is used when an operating procedure, practice, etc., which, if not correctly followed, could result in personal injury or loss of life.

CAUTION: A caution is used when an operating procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment.

NOTE: A note is used when an operating procedure, practice, etc., is essential to highlight.

TRADEMARK USAGE

The following trademarks are the property of the companies indicated

- Allison DOC™ is a Registered Trademark of Allison Transmission, Inc.
- FuelSense® is a Registered Trademark of Allison Transmission, Inc.

ABBREVIATIONS AND ACRONYMS

- ABS — Anti-lock Brake System
- ASCM — Allison Calibration Configuration Tool
- COTP — Converter Over-temp Torque Protection
- DSS — Dynamic Shift Sensing
- DTC — Diagnostic Trouble Code
- DTCs — Diagnostic Trouble Codes
- ECLR — Enhanced Converter Load Release
- IMS — Internal Mode Switch
- KOH — Potassium Hydroxide
- LBSS — Load Based Shift Scheduling
- LRTP — Low Range Torque Protection
- MIL — Malfunction Indicator Lamp
- NSBU — Neutral Start Backup
- OBD II — On Board Diagnostics, second generation.
- OEM — Original Equipment Manufacturer
- PSM — Pressure Switch Manifold
- PTO — Power Takeoff
- RDS — Rugged Duty Series
- RELS — Reduced Engine Load at Stop
- rpm — Revolutions Per Minute
- SEM — Shift Energy Management
- SESS — Super Economy Shift Schedule
- TCM — Transmission Control Module
- TCMS — Transmission Control Modules
- TPS — Throttle Position Sensor
- VAC — Vehicle Acceleration Control
- VETPS — Vehicle Electronic Programming Stations

LIST OF WARNINGS

This manual contains the following warnings--

IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.

- The following steps in this section provide general vehicle guidelines regarding the use and operation of a park pawl. Vehicle manufacturers integrate Allison transmissions into vehicles used for a variety of vocations and services. The vehicle manufacturer is responsible for identifying the specific operating conditions to which the vehicle will be subjected and to communicate the appropriate means for preventing unintended vehicle movement within those conditions, in order to ensure vehicle and operator safety. The vehicle owner and operator should be aware of and follow the vehicle manufacturer's operating instructions and warnings related to parking and preventing unintended vehicle movement.

LIST OF WARNINGS (cont'd)

This manual contains the following warnings--

IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.

- For vehicles containing t000 AND 2000 Product Families Transmissions with P (Park) selector position, follow this procedure each time the operator's station will be unoccupied with the engine running:
  1. Bring the vehicle to a complete stop using the service brake.
  2. Make sure the engine is at low idle rpm or turned off.
  3. Move the gear selector to P (Park), then slowly release the service brake. Releasing the brake too quickly, especially on a steep grade, may prevent the park pawl from engaging. If the vehicle moves, immediately reapply the service brake and repeat the prior steps.
  4. Apply the vehicle's parking/emergency brake and make sure it is properly engaged.
  5. When parked facing downhill, turn the front wheels toward the curb. When parked facing uphill, turn the front wheels away from the curb. When no curb, turn the front wheels away from the street.
  6. If operating the vehicle when not in the operator's seat (such as in a tow truck) or when parking on steep grades, chock the wheels and take any other steps necessary to keep the vehicle from moving and follow any specific vehicle operating manuals or warnings.

  WARNING!Failure to follow this procedure, may result in unintended vehicle movement which could result in death, serious personal injury or property damage.

- R (Reverse) may not be obtained due to an active inhibitor. Check for the illumination of the RANGE INHIBIT(ED) light or CHECK TRANS (MIL) light. See the 3.12 SHIFT INHIBITS section of this manual.

LIST OF WARNINGS (cont'd)

This manual contains the following warnings—

IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.

- To help avoid injury and/or property damage caused by unexpected vehicle movement, do not make shifts from R (Reverse) to N (Neutral) without applying the service brakes, parking brake, or emergency brake. Selecting N (Neutral) does not apply vehicle brakes unless an auxiliary system to apply a parking brake is installed.
- To help avoid injury and/or property damage caused by unexpected vehicle movement, do not make shifts to or from N (Neutral) without manually or automatically applying an appropriate vehicle brake.
- DO NOT allow the vehicle to "coast" in N (Neutral). There is no engine braking in N (Neutral). You could lose control of the vehicle, causing property damage or personal injury. Coasting in neutral can cause severe transmission damage.
- D (Drive) and other forward ranges may not be obtained due to an active inhibitor. The range selected may not be obtained, resulting in unexpected vehicle movement. To help avoid injury and/or property damage, always apply the service brake when selecting D (Drive) or other forward ranges. Check for the RANGE INHIBIT(ED) light or the CHECK TRANS light.
- To help avoid injury and/or property damage caused by unexpected vehicle movement, do not make shifts from a forward range to N (Neutral) without applying the service brakes, parking brake, or emergency brake. Selecting N (Neutral) does not apply vehicle brakes unless an auxiliary system to apply a parking brake is installed.
- The transmission incorporates a hold feature to prohibit upshifting above the range selected during normal driving. For downhill operation, select a lower transmission range. If the engine governed speed is exceeded in the held range, however, the transmission will upshift to the next higher range to prevent engine damage. To help avoid injury and/or property damage due to loss of vehicle control, use the vehicle brakes to prevent exceeding engine governed speed in the held range.

LIST OF WARNINGS (cont'd)

This manual contains the following warnings—

IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.

- To help avoid loss of control, use a combination of downshifting, braking, and other retarding devices. Downshifting to a lower transmission range increases engine braking and can help you maintain control. The transmission has a feature to prevent automatic upshifting above the lower range selected. However, during downhill operation, if engine governed speed is exceeded in the lower range, the transmission will upshift to the next higher range to prevent engine damage. This will reduce engine braking and could cause a loss of control. Apply the vehicle brakes or other retarding device to prevent exceeding engine governed speed in the lower range selected.
- For vehicles containing For vehicles containing 2100 RDS, 2300 RDS, and 2500 RDS transmissions with PB (Auto-Apply Parking Brake) selector position, follow this procedure each time the operator's station will be unoccupied with the engine running.
  1. Bring the vehicle to a complete stop using the service brake.
  2. Make sure the engine is at low idle rpm.
  3. Put the transmission in PB (Auto-Apply Parking Brake). Make sure the parking brake is properly engaged.
  4. Engage the park pawl by slowly releasing the service brake.
  5. Apply the emergency brakes and make sure they are properly engaged.
  6. Chock the wheels and take any other steps necessary to keep the vehicle from moving.

  If this procedure is not followed, the vehicle can move unexpectedly and cause injury and/or property damage.
- R (Reverse) may not be obtained due to an active inhibitor. Check for the illumination of the RANGE INHIBIT(ED) light or CHECK TRANS (MIL) light. See the 3 12 SHIFT INHIBITS section of this manual.

LIST OF WARNINGS (cont'd)

This manual contains the following warnings—

IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.

- For vehicles containing 1000 and 2000 Product Families transmissions without either P (Park) or PB (Auto-Apply Parking Brake) selector positions, each time you park the vehicle or leave the operator's station with the engine running, do the following:
  1. Bring the vehicle to a complete stop using the service brake.
  2. Make sure the engine is at low idle rpm.
  3. Put the transmission in N (Neutral).
  4. Apply the emergency brake and/or parking brake and make sure they are properly engaged.
  5. If the operator's station will be unoccupied with the engine running, chock the wheels and take any other steps necessary to keep the vehicle from moving.

  If the procedure is not followed, the vehicle may move suddenly and cause injury and/or property damage.
- D (Drive) and other forward ranges may not be obtained due to an active inhibitor. The range selected may not be obtained, resulting in unexpected vehicle movement. To help avoid injury and/or property damage, always apply the service brake when selecting D (Drive) or other forward ranges. Check for the RANGE INHIBIT(ED) light or the CHECK TRANS (MIL) light.
- To help avoid injury and/or property damage caused by unexpected vehicle movement, do not make shifts from a forward range to N (Neutral) without applying the service brakes, parking brake, or emergency brake. Selecting N (Neutral) does not apply vehicle brakes unless an auxiliary system to apply a parking brake is installed.

LIST OF WARNINGS (cont'd)

This manual contains the following warnings—

IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.

- Operation with excessive loads can cause transmission damage and unexpected vehicle movement. To help avoid injury, property damage and/or transmission damage, do not exceed the following:
  - For 1000 RDS, 2100 RDS, and 2200 RDS transmissions, do not exceed 26,000 lb (11 800 kg) GCW or the OEM vehicle rating, whichever is less.
  - For 1350 RDS, 2350 RDS and 2550 RDS transmissions, do not exceed 30,000 lb (13 600 kg) GCW or the OEM vehicle rating, whichever is less.
  - For 2300 RDS and 2500 RDS transmissions, do not exceed 33,000 lb (15 000 kg) GCW or the OEM rating, whichever is less.
- To help avoid injury or property damage caused by sudden movement of the vehicle, do not make shifts from N (Neutral) to a forward range or R (Reverse) when the throttle is open. The vehicle will lurch forward or rearward and the transmission can be damaged. Avoid this condition by making shifts from N (Neutral) to a forward range or R (Reverse) only when the throttle is closed and service brakes are applied.
- To help avoid injury or property damage caused by sudden movement of the vehicle, do not make shifts from N (Neutral) to a forward range or R (Reverse) when the throttle is open. The vehicle will lurch forward or rearward and the transmission can be damaged. Avoid this condition by making shifts from N (Neutral) to a forward range or R (Reverse) only when the throttle is closed and service brakes are applied.
- Using the retarder or engine brake on wet or slippery roads may cause loss of traction on the drive wheels—your vehicle may slide out of control. To help avoid injury or property damage, turn the retarder or engine brake enable to OFF when driving on wet or slippery roads.

LIST OF WARNINGS (cont'd)

This manual contains the following warnings—

IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.

- The transmission incorporates a hold feature to prohibit upshifting above the range selected during normal driving. For downhill operation, select a lower transmission range. If the engine governed speed is exceeded in the held range, however, the transmission will upshift to the next higher range to prevent engine damage. To help avoid injury and/or property damage due to loss of vehicle control, use the vehicle brakes to prevent exceeding engine governed speed in the held range.
- To help avoid injury or property damage caused by sudden movement of the vehicle, do not make shifts from N (Neutral) to D (Drive) or R (Reverse) when the throttle is open. The vehicle may lurch forward or rearward and the transmission can be damaged. Avoid this condition by making shifts from N (Neutral) to a forward range or R (Reverse) only when the throttle is closed and the service brakes are applied.
- To help avoid injury and/or property damage caused by unexpected vehicle movement, do not attempt to engage P (Park) with the vehicle in motion (2 km/hr (1 mph) or higher). If you attempt to engage P (Park) with the vehicle in motion (2 km/hr (1 mph) or higher), the park pawl will ratchet, will not engage, and will not hold the vehicle. Repeated park pawl ratcheting can cause transmission damage.
- If the vehicle has four-wheel-drive and the transfer case is in Neutral, the vehicle can be free to roll even if the P (Park) position is selected. To help avoid injury and/or property damage caused by unexpected movement of the vehicle, be certain that the transfer case is in "high" drive range, not Neutral, whenever the vehicle is parked.

12

LIST OF WARNINGS (cont'd)

This manual contains the following warnings—

IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.

- If the vehicle is equipped with a two-speed axle or two-speed transfer case which is engaged in "low", even very low vehicle speeds can produce appreciable transmission output shaft speed. Even the slightest vehicle motion can deter engagement of the park pawl in such cases. To help avoid injury and/or property damage caused by unexpected vehicle movement, be certain that the axle or transfer case is in "high" drive range whenever the vehicle is parked and the park pawl is engaged.
- For vehicles containing 1000 and 2000 Product Families transmissions with P (Park) selector position, follow this procedure each time the operator's station will be unoccupied with the engine running:
  1. Bring the vehicle to a complete stop using the service brake.
  2. Make sure the engine is at low idle rpm or turned off.
  3. Move the gear selector to P (Park), then slowly release the service brake. Releasing the brake too quickly, especially on a steep grade, may prevent the park pawl from engaging. If the vehicle moves, immediately reapply the service brake and repeat the prior steps.
  4. Apply the vehicle's parking/emergency brake and make sure it is properly engaged.
  5. If operating the vehicle when not in the operator's seat (such as in a tow truck) or when parking on steep grades, besides engaging the park pawl and applying the parking brake also chock the wheels and take any other steps necessary to keep the vehicle from moving and follow any specific vehicle operating manuals or warnings.

  If this procedure is not followed, the vehicle can move unexpectedly and cause injury and/or property damage.

13

LIST OF WARNINGS (cont'd)

This manual contains the following warnings—

IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.

- For vehicles containing 1000 and 2000 Product Families transmissions with PB (Auto-Apply Parking Brake) selector position, follow this procedure each time the operator's station will be unoccupied with the engine running:
  1. Bring the vehicle to a complete stop using the service brake.
  2. Make sure the engine is at low idle rpm.
  3. Put the transmission in PB (Auto-Apply Parking Brake).
  4. Apply the emergency brakes and make sure they are properly engaged.
  5. Chock the wheels and take any other steps necessary to keep the vehicle from moving.

  If this procedure is not followed, the vehicle can move unexpectedly and cause injury and/or property damage.
- For vehicles containing 1000 and 2000 Product Families transmissions without either P (Park) or PB (Auto-Apply Parking Brake) selector positions, each time you park the vehicle or leave the operator's station with the engine running, do the following:
  1. Bring the vehicle to a complete stop using the service brake.
  2. Make sure the engine is at low idle rpm.
  3. Put the transmission in N (Neutral).
  4. Apply the emergency brakes and/or parking brake and make sure they are properly engaged.
  5. If the operator's station will be unoccupied with the engine running, chock the wheels and take any other steps necessary to keep the vehicle from moving.

  If this procedure is not followed, the vehicle can move unexpectedly and cause injury and/or property damage.

LIST OF WARNINGS (cont'd)

This manual contains the following warnings—

IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.

- If you leave the vehicle and the engine is running, the vehicle can move unexpectedly and you or others could be injured. DO NOT leave the vehicle with the engine running unless you have taken all of the following precautions:
  - Shift the transmission to N (Neutral), P (Park), or PB (Auto-Apply Parking Brake).
  - Make sure that the engine is at low idle (500–800 rpm).
  - Apply the park brake or emergency brake and make sure it is properly engaged.
  - Chock the wheels and take any other steps necessary to keep the vehicle from moving.
- For vehicles containing 1000 RDS, 2200 RDS, 2350 RDS, and 2550 RDS transmissions with P (Park) selector position, follow this procedure each time the operator's station will be unoccupied with the engine running:
  1. Bring the vehicle to a complete stop using the service brake.
  2. Make sure the engine is at low idle rpm.
  3. Put the transmission in P (Park).
  4. Engage the park pawl by slowly releasing the service brake.
  5. If a parking brake is present, apply the parking brake. Make sure the parking brake is properly engaged.
  6. Apply the emergency brakes and make sure they are properly engaged.
  7. Chock the wheels and take any other steps necessary to keep the vehicle from moving.

  If this procedure is not followed, the vehicle can move unexpectedly and cause injury and/or property damage.

LIST OF WARNINGS (cont'd)

This manual contains the following warnings—

IT IS YOUR RESPONSIBILITY TO BE FAMILIAR WITH ALL OF THEM.

- For vehicles containing 2100 RDS, 2300 RDS, and 2500 RDS transmissions with PB (Auto-Apply Parking Brake) selector position, follow this procedure each time the operator's station will be unoccupied with the engine running:
  1. Bring the vehicle to a complete stop using the service brake.
  2. Make sure the engine is at low idle rpm.
  3. Put the transmission in PB (Auto-Apply Parking Brake). Make sure the parking brake is properly engaged.
  4. Apply the emergency brakes and make sure they are properly engaged.
  5. Chock the wheels and take any other steps necessary to keep the vehicle from moving.

  If this procedure is not followed, the vehicle can move unexpectedly and cause injury and/or property damage.
- For vehicles containing 1000 and 2000 Product Families transmissions without either P (Park) or PB (Auto-Apply Parking Brake) selector positions, each time you park the vehicle or leave the operator's station with the engine running, do the following:
  1. Bring the vehicle to a complete stop using the service brake.
  2. Make sure the engine is at low idle rpm.
  3. Put the transmission in N (Neutral).
  4. Apply the emergency brakes and/or parking brake and make sure they are properly engaged.
  5. If the operator's station will be unoccupied with the engine running, chock the wheels and take any other steps necessary to keep the vehicle from moving.

  If this procedure is not followed, the vehicle can move unexpectedly and cause injury and/or property damage.

TABLE OF CONTENTS

IMPORTANT SAFETY INFORMATION . . . 3
ABBREVIATIONS AND ACRONYMS . . . 4
TRADEMARK USAGE . . . 5
LIST OF WARNINGS . . . 6

1.0 INTRODUCTION
1.1 KEEPING THAT ALLISON ADVANTAGE . . . 20
1.2 A BRIEF DESCRIPTION OF THE ALLISON 1000 AND 2000 PRODUCT FAMILIES TRANSMISSIONS . . . 25
1.3 ELECTRONIC CONTROL SYSTEM . . . 25
1.4 TORQUE CONVERTER . . . 26
1.5 PLANETARY GEARS AND CLUTCHES . . . 27
1.6 COOLER CIRCUIT . . . 27

2.0 SHIFT SELECTORS
2.1 DESCRIPTION OF AVAILABLE TYPES . . . 28
2.2 OPERATION OF THE SHIFT SELECTOR . . . 28
2.3 RANGE SELECTION—ALL 1000 AND 2000 PRODUCT FAMILIES TRANSMISSIONS WITH P (Park) POSITION . . . 31
2.4 RANGE SELECTION—ALL 2000 PRODUCT FAMILY TRANSMISSIONS WITH PB (Auto-Apply Parking Brake) POSITION . . . 36
2.5 RANGE SELECTION—ALL 1000 AND 2000 PRODUCT FAMILIES TRANSMISSIONS WITHOUT EITHER P (PARK) OR PB (AUTO-APPLY PARKING BRAKE) POSITIONS . . . 39

3.0 DRIVING TIPS
3.1 MAXIMUM VEHICLE LOADING . . . 43
3.2 PREVENT MAJOR PROBLEMS . . . 43
3.3 TURNING THE VEHICLE ON/OFF . . . 44
3.4 ACCELERATOR CONTROL . . . 44
3.5 PRIMARY/SECONDARY SHIFT SCHEDULES . . . 45
3.5.1 Shift Schedules . . . 45
3.5.2 Dynamic Shift Sensing (DSS) . . . 45
3.5.3 Allison Transmission FuelSense® . . . 46
3.5.3.1 FuelSense® Terminology Descriptions . . . 47
3.5.3.2 FuelSense® Driver Indicator (with FuelSense® Package) . . . 48
3.6 KICKDOWN . . . 48
3.7 OUTPUT SPEED INDICATOR . . . 49
3.8 DIAGNOSTIC CODES . . . 49
3.9 RANGE INHIBIT(ED) LIGHT . . . 49
3.9.1 Range Inhibited Warning Light . . . 49
3.9.1.1 Converter Over-temp Torque Protection COTP . . . 49
3.10 CHECK TRANS OR MALFUNCTION INDICATOR LIGHT (MIL) . . . 51
3.11 DIAGNOSTIC CODES OVERVIEW . . . 51

3.12 SHIFT INHIBITS 51
3.12.1 Above-Idle Neutral-to-Range Shifts 52
3.12.2 Forward/Reverse Directional Shifts 52
3.12.3 Transmission Problems 52
3.12.4 Auxiliary Equipment Operation 53
3.13 USING THE ENGINE TO SLOW THE VEHICLE 53
3.14 RANGE PRESELECTION 54
3.14.1 Hold Upshift 55
3.14.2 Preselect Downshift 55
3.15 REVERSE 55
3.16 REFUSE PACKER STEP SWITCH 55
3.17 TWO-SPEED AXLE (Some Rugged Duty Series Transmission Applications) 56
3.18 DRIVING ON SNOW OR ICE 56
3.19 ROCKING OUT 56
3.20 OPERATING TEMPERATURES 57
3.21 HIGH FLUID TEMPERATURE 57
3.22 PARKING BRAKE 58
3.23 PARK PAWL 59
3.23.1 Torque Lock 60
3.24 PARKING/LEAVING VEHICLE WITH ENGINE RUNNING 61
3.25 TOWING OR PUSHING 62
3.26 SURGING NATURAL GAS ENGINES 62

4.0 POWER TAKEOFF OPERATION

4.1 POWER TAKEOFF (PTO) SYSTEMS 63
4.2 TURBINE-DRIVEN POWER TAKEOFF (PTO) 63
4.2.1 PTO Configuration 63
4.2.2 PTO Engagement—Slide Engagement Internal to PTO 64
4.2.3 PTO Engagement—Clutch Driven 65
4.2.4 PTO Operation 65
4.2.5 PTO Overspeed Protection 66
4.3 SPLIT-SHAFT POWER TAKEOFF (PTO) 67

5.0 PROGNOSTICS

5.1 1000 AND 2000 PRODUCT FAMILIES SERVICE PROGNOSTICS 68
5.2 OIL LIFE MONITOR 69
5.3 FILTER LIFE MONITOR 69
5.4 TRANSMISSION HEALTH MONITOR 70

6.0 CARE AND MAINTENANCE

6.1 PERIODIC INSPECTIONS AND CARE 71
6.1.1 Transmission Inspection 71
6.1.2 Vehicle Inspection 71
6.1.3 Welding 72
6.2 IMPORTANCE OF PROPER TRANSMISSION FLUID LEVEL 72
6.3 TRANSMISSION FLUID CHECK 73
6.3.1 Fluid Check Procedure 74
6.3.2 Cold Check Procedure 74
6.3.3 Hot Check Procedure 75
6.3.4 Consistency of Readings 77
6.4 KEEPING FLUID CLEAN 77
6.5 FLUID RECOMMENDATIONS 77
6.6 TRANSMISSION FLUID AND FILTER CHANGE INTERVALS 78
6.6.1 Frequency 78
6.6.2 Abnormal Conditions 81
6.6.3 Fluid Analysis 81
6.7 TRANSMISSION FLUID CONTAMINATION 82
6.7.1 Fluid Examination 82
6.7.2 Water 82
6.7.3 Engine Coolant 82
6.7.4 Metal 83
6.8 TRANSMISSION FLUID AND FILTER CHANGE PROCEDURE 83
6.8.1 Drain Fluid 83
6.8.2 Replace Control Main Filter 83
6.8.3 Refill Transmission 85
6.9 BREATHER 86
6.9.1 Location and Purpose 86
6.9.2 Maintenance 86

7.0 DIAGNOSTICS

7.1 DIAGNOSTIC CODES AND TOOLS 87

8.0 CUSTOMER SERVICE

8.1 OWNER ASSISTANCE 88
8.2 SERVICE LITERATURE 89
8.3 ALLISON TRANSMISSION DISTRIBUTORS 90

The **Rugged Duty Series (RDS)** transmissions are rugged and designed to provide long, trouble-free service. This manual will help you gain maximum benefits from your Allison-equipped vehicle.

21

1.0 INTRODUCTION

1.1 KEEPING THAT ALLISON ADVANTAGE

Allison **Rugged Duty Series (RDS)** transmissions provide many advantages for the driver who must "stop and go" or change speeds frequently. Driving is easier, safer, and more efficient.

20

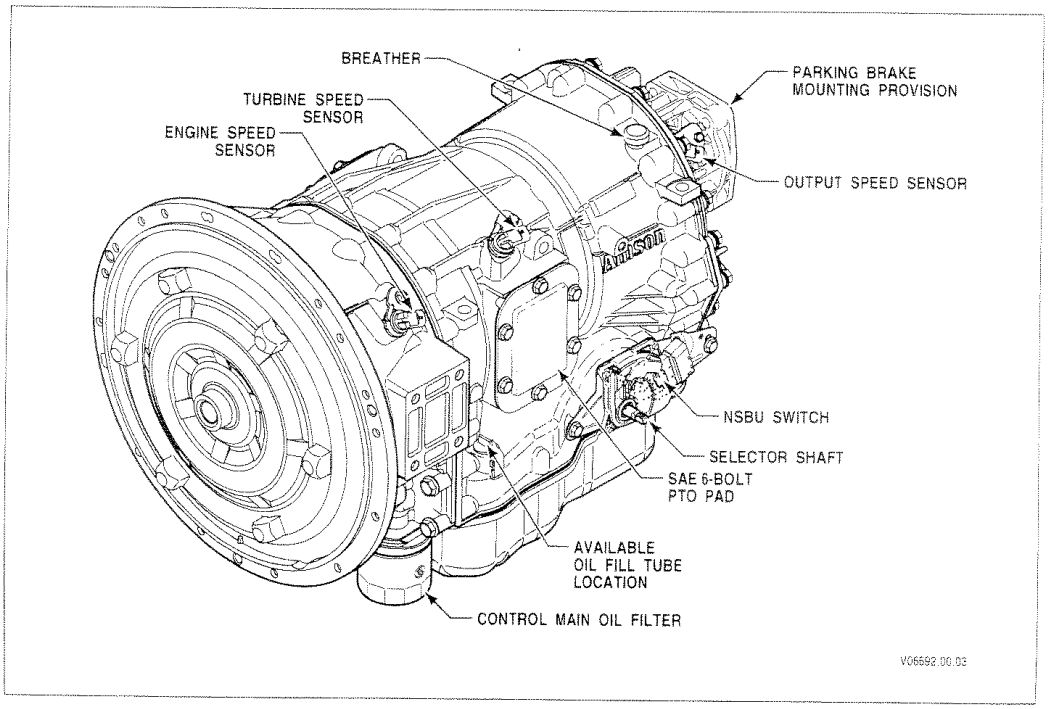


Figure 1–1. Rugged Duty Series — Left-Front View (Prior to Allison 4th Generation Controls)

22

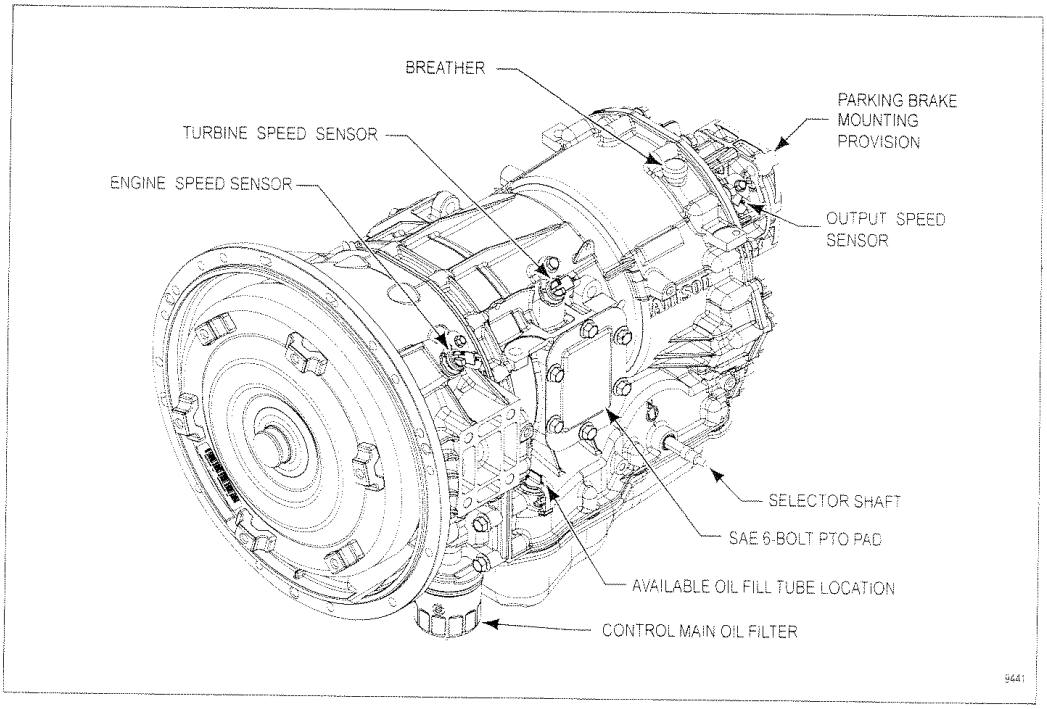


Figure 1–2. Rugged Duty Series — Left-Front View (Allison 4th and 5th Generation Controls)

23

1.2 A BRIEF DESCRIPTION OF THE ALLISON 1000 AND 2000 PRODUCT FAMILIES TRANSMISSIONS

The Rugged Duty Series (RDS) transmissions are fully automatic, torque-converter driven, electronically controlled transmissions best suited for light-medium duty, on-highway applications. Each transmission series contains features which have been designed for specific vocational needs.

- **1000 Product Family**– This transmission is best suited for light duty on-highway applications. The 1000 RDSand 1350 RDS transmissions have a park pawl.
- **2000 Product Family**– These transmissions are best suited for single-axle medium duty on-highway applications. The 2200 RDS, 2350 RDS, and 2550 RDS transmissions have a park pawl; the 2100 RDS, 2300 RDS, and 2500 RDStransmissions do not have park pawls.

The park pawl exists but cannot be engaged in some vehicle configurations using 1000 RDS, 1350 RDS, 2200 RDS, 2350 RDS, and 2550 RDS transmissions (e.g., some rear engine vehicles with air brakes). For these configurations, the **P** (Park) position is not used.

A provision to mount a PTO is available on all transmissions. The PTO drive gear is optional.

All transmissions have up to five forward ranges (six forward ranges available in 2350 RDS and 2550 RDS) and one reverse. All clutches are hydraulically-actuated, spring-released, and have automatic compensation for wear. Gearing is helical type, arranged in planetary sets. Electronic controls provide automatic gear selection in each drive range and automatic engagement of the torque converter (lockup) clutch.

1.3 ELECTRONIC CONTROL SYSTEM

The Rugged Duty Series control system consists of five major components connected by customer-furnished wiring harnesses. The five major components are:

- Transmission Control Module (TCM)
- Engine Throttle Position Sensor (TPS) or direct electronic communication of throttle information
- Engine, turbine, and output speed sensors
- Neutral Start Backup NSBU switch or Internal Mode Switch
- Control valve body

The control valve body contains solenoids and a pressure switch manifold to position and monitor control valve operation. The pressure switch manifold

Figure 1–3. Rugged Duty Series — Right-Rear View (Allison 4th and 5th Generation Controls)

also contains a thermistor to monitor sump fluid temperature. The TPS (or engine-to-transmission communication link), speed sensors, pressure switch manifold, and NSBU switch or internal mode switch communicate information to the TCM. The TCM processes this information and then sends signals to actuate specific solenoids located within the control valve body in the transmission. These solenoids control both oncoming and off-going clutch pressures to provide closed-loop shift control by matching engine rpm during a shift to a previously established desired profile that is programmed into the TCM.

The TCM processes this information and then sends signals to actuate specific solenoids located within the control valve body in the transmission. These solenoids control both oncoming and off-going clutch pressures to provide closed-loop shift control by matching engine rpm during a shift to a previously established desired profile that is programmed into the TCM.

The Rugged Duty Series electronic control system has an "adaptive shifting" feature. Adaptive shifting helps optimize shift quality by monitoring critical characteristics of clutch engagement and making on-going adjustments to improve subsequent shifts. The transmission shift calibration is based on several different types of shifts, e.g., full throttle, part throttle, closed throttle—upshifts, downshifts, etc. Each shift is associated with specific speed and throttle position parameters. In order to optimize each type of shift for normal driving, shift controls must experience operation and shifting in a wide variety of operating conditions.

A "drive in" period under varied driving conditions is required before the adaptive controls can be expected to optimize each and every shift. In general, shift quality will begin to converge to their "adapted" level following several shifts of a particular shift type.

1.4 TORQUE CONVERTER

The torque converter consists of four elements -- pump, turbine, stator, and torque converter (lockup) clutch. The pump is the input element and is driven directly by the engine. The turbine is the output element and is hydraulically driven by the pump. The stator is the reaction (torque multiplying) element. When the pump turns faster than the turbine, the torque converter is multiplying torque. When the turbine approaches the speed of the pump, the stator starts to rotate with the pump and turbine. When this occurs, torque multiplication stops and the torque converter functions as a fluid coupling.

All Rugged Duty Series torque converters contain a torque converter (lockup) clutch. When engaged, this clutch causes the torque converter pump and turbine to be locked together, enabling them to rotate in unison at engine speed. This condition, commonly referred to as "torque converter clutch

operation," provides direct drive through the transmission. This type of operation maximizes engine braking and enhances fuel economy. The torque converter (lockup) clutch is regulated by the shift controls to engage automatically. The torque converter clutch releases at lower speeds or when the TCM detects conditions requiring it to be released. The torque converter clutch contains a damping mechanism which reduces the transmittal of engine-induced torsional vibrations into and beyond the transmission.

1.5 PLANETARY GEARS AND CLUTCHES

A series of three helical, constant mesh planetary gear sets and shafts provides the mechanical gear ratios and direction of travel for the vehicle. The planetary gear sets are controlled by five multiplate clutches that work in pairs to produce up to five forward speeds and one reverse speed. The clutches are applied and released hydraulically in response to electronic signals from the TCM to the appropriate solenoids.

1.6 COOLER CIRCUIT

The transmission fluid is cooled by a remote-mounted oil cooler. The bottom of the transmission torque converter housing provides for the direct mounting of a control main filter and includes two ports to facilitate the attachment of the oil cooler lines.

2.0 SHIFT SELECTORS

2.1 DESCRIPTION OF AVAILABLE TYPES

The Rugged Duty Series transmissions use lever-type shift selectors. The shift positions on the shift selector can vary according to the shift selector installed.

2.2 OPERATION OF THE SHIFT SELECTOR

The shift selector is used by the operator to select the following ranges:

- **P** (Park) for transmissions with park pawls
- **PB** (Auto-Apply Parking Brake) for vehicles with automatically engaged parking brakes
- **R** (Reverse)
- **N** (Neutral)
- **D** (Drive)*
- **4** (Fourth Range) **
- **3** (Third Range) **
- **2** (Second Range)**
- **1** (First Range)

Ranges are selected by moving the lever to the desired selector position (**P**, **PB**, **R**, **N**, **D**, **4**, **3**, **2**, or **1**). Six speed transmission models have six forward ranges, first through sixth. Five speed transmission models have five forward ranges, first through fifth. Four speed models have four forward ranges, first through fourth. When a forward range has been selected, the transmission automatically upshifts through each range. As the vehicle slows, the transmission will downshift automatically through each range.

*The shift selector position representing this gear range may be labeled "5" or "6" (for the highest gear in the range), "OD" (for Overdrive), "D" (for the normal Drive position), "1–5" or "1–6" (for the complete gear range).

** In calibrations with five forward ranges, one of these selector positions will not be available. In calibrations with six forward ranges, two of these selector positions will not be available.

The following tables list the shift selector positions and corresponding ranges for all Rugged Duty Series transmissions.

Table 2–1. All 1000 RDS, 1350 RDS, 2200 RDS, 2350 RDS, and 2550 RDS Transmissions With P (Park) Position

Shift Selector Position	Range	Shift Selector Position	Range	Shift Selector Position	Range
P (Park)	(Neutral) *	**P** (Park)	Neutral*	**P** (Park)	Neutral*
R (Reverse)	Reverse	**R** (Reverse)	Reverse	**R** (Reverse)	Reverse
N (Neutral)	Neutral	**N** (Neutral)	Neutral	**N** (Neutral)	Neutral
D (Drive) **	1–5 (1–6)***	**D** (Drive)**	1–5 (1–6)***	**D** (Drive)**	1–5 (1–4)†
4 (Fourth Range)	1–4	**4** (Fourth Range)	1–4	**3** (Third Range)	1–3
3 (Third Range)	1–3	**2** (Second Range)	1–2	**2** (Second Range)	1–2
1 (First Range)	1	**1** (First Range)	1	**1** (First Range)	1

* With Park Pawl engaged.
** The shift selector position representing this gear range may be labeled "5" or "6" (for the highest gear in the range), "OD" (for Overdrive), "D" (for the normal Drive position), or "1–5" or "1–6" (for the complete gear range).
***Calibration dependent.
†1–4 in Trailering Mode or 4-Speed Calibration.

Table 2–2. All 2100 RDS, 2300 RDS, and 2500 RDS Transmissions With PB (Auto-Apply Parking Brake) Position

Shift Selector Position	Range	Shift Selector Position	Range	Shift Selector Position	Range
PB (Auto-Apply Parking Brake)	Neutral*	**PB** (Auto-Apply Parking Brake)	Neutral*	**PB** (Auto-Apply Parking Brake)	Neutral*
R (Reverse)	Reverse	**R** (Reverse)	Reverse	**R** (Reverse)	Reverse
N (Neutral)	Neutral	**N** (Neutral)	Neutral	**N** (Neutral)	Neutral
D (Drive)**	1–5	**D** (Drive)**	1–5	**D** (Drive)**	1–5 (1–4)***

Table 2–2. All 2100 RDS, 2300 RDS, and 2500 RDS Transmissions With PB (Auto-Apply Parking Brake) Position *(cont'd)*

Shift Selector Position	Range	Shift Selector Position	Range	Shift Selector Position	Range
4 (Fourth Range)	1–4	**4** (Fourth Range)	1–4	**3** (Third Range)	1–3
3 (Third Range)	1–3	**2** (Second Range)	1–2	**2** (Second Range)	1–2
1 (First Range)	1	**1** (First Range)	1	**1** (First Range)	1

* With Auto-Apply Parking Brake engaged
** The shift selector position representing this gear range may be labeled "5" (for the highest gear in the range), "OD" (for Overdrive), "D" (for the normal Drive position), or "1–5" (for the complete gear range).
***1–4 in Trailering Mode or 4-Speed Calibration.

Table 2–3. All 1000 and 2000 Product Families Transmissions Without Either P (Park) or PB (Auto-Apply Parking Brake) Positions

Shift Selector Position	Range	Shift Selector Position	Range	Shift Selector Position	Range
R (Reverse)	Reverse	**R** (Reverse)	Reverse	**R** (Reverse)	Reverse
N (Neutral)	Neutral	**N** (Neutral)	Neutral	**N** (Neutral)	Neutral
D (Drive) **	1–5 (1–6) ***	**D** (Drive)**	1–5 (1–6) ***	**D** (Drive)**	1–5 (1–4)†
4 (Fourth Range)	1–4	**4** (Fourth Range)	1–4	**3** (Third Range)	1–3
3 (Third Range)	1–3	**2** (Second Range)	1–2	**2** (Second Range)	1–2
1 (First Range)	1	**1** (First Range)	1	**1** (First Range)	1

** The shift selector position representing this gear range may be labeled "5" or "6" (for the highest gear in the range), "OD" (for Overdrive), "D" (for the normal Drive position), or "1–5" or "1–6" (for the complete gear range).
*** Calibration dependent.
†1–4 in Trailering Mode or 4-Speed Calibration.

There are several features of the Rugged Duty Series transmissions that can inhibit transmission shifting. See the 3.12 SHIFT INHIBITS section of this manual.

With an Allison-equipped vehicle, selecting the right moment to upshift or downshift during changing road and traffic conditions is not necessary. The Allison Rugged Duty Series transmission does it for you. However, knowledge of the ranges and when to select them will make vehicle control and your job even easier.

2.3 RANGE SELECTION—ALL 1000 AND 2000 PRODUCT FAMILIES TRANSMISSIONS WITH P (Park) POSITION

Table 2–4. ALL 1000 AND 2000 PRODUCT FAMILIES TRANSMISSIONS WITH P (Park) POSITION

PARK
WARNING: The following steps in this section provide general vehicle guidelines regarding the use and operation of a park pawl. Vehicle manufacturers integrate Allison transmissions into vehicles used for a variety of vocations and services. The vehicle manufacturer is responsible for identifying the specific operating conditions to which the vehicle will be subjected and to communicate the appropriate means for preventing unintended vehicle movement within those conditions, in order to ensure vehicle and operator safety. The vehicle owner and operator should be aware of and follow the vehicle manufacturer's operating instructions and warnings related to parking and preventing unintended vehicle movement.

Table 2–4. ALL 1000 AND 2000 PRODUCT FAMILIES TRANSMISSIONS WITH P (Park) POSITION *(cont'd)*

	WARNING: For vehicles containing 1000 AND 2000 Product Families Transmissions with **P** (Park) selector position, follow this procedure each time the operator's station will be unoccupied with the engine running: 1. Bring the vehicle to a complete stop using the service brake. 2. Make sure the engine is at low idle rpm or turned off. 3. Move the gear selector to **P** (Park), then slowly release the service brake. Releasing the brake too quickly, especially on a steep grade, may prevent the park pawl from engaging. If the vehicle moves, immediately reapply the service brake and repeat the prior steps. 4. Apply the vehicle's parking/emergency brake and make sure it is properly engaged. 5. When parked facing downhill, turn the front wheels toward the curb. When parked facing uphill, turn the front wheels away from the curb. When no curb, turn the front wheels away from the street. 6. If operating the vehicle when not in the operator's seat (such as in a tow truck) or when parking on steep grades, chock the wheels and take any other steps necessary to keep the vehicle from moving and follow any specific vehicle operating manuals or warnings. **WARNING!** Failure to follow this procedure, may result in unintended vehicle movement which could result in death, serious personal injury or property damage. **CAUTION:** Attempting to engage **P** (Park) with the vehicle in motion (approximately 1.6 km/hr [1 mph] or higher) will result in ratcheting of the engagement mechanism and lack of engagement of the park pawl. The transmission may sustain damage as a result. **CAUTION:** If the vehicle has four-wheel-drive and the transfer case is in NEUTRAL, the vehicle may be free to roll even if the PARK position is selected. Be certain that the transfer case is in "high" drive range, not in NEUTRAL, whenever the vehicle is parked. If the vehicle is equipped with a two-speed axle or two-speed transfer case which is engaged in "low", even very slow vehicle speeds may produce appreciable transmission output shaft speed. Engagement of the park pawl in such cases may be deterred by even the slightest vehicle motion. Be certain that the axle or transfer case is in "high" drive range whenever the vehicle is parked and the park pawl is engaged.

Table 2–4. ALL 1000 AND 2000 PRODUCT FAMILIES TRANSMISSIONS WITH P (Park) POSITION *(cont'd)*

P	Use **P** (Park) for the following: • To turn the engine on or off • To check vehicle accessories • To operate the engine at idle for longer than five minutes • For stationary operation of the Power Takeoff (PTO) (if your vehicle is equipped with a PTO) This position places the transmission in **N** (Neutral) and engages the park pawl.
	REVERSE
	WARNING: R (Reverse) may not be obtained due to an active inhibitor. Check for the illumination of the **RANGE INHIBIT(ED)** light or **CHECK TRANS (MIL)** light. See the 3.12 SHIFT INHIBITS section of this manual.
	WARNING: To help avoid injury and/or property damage caused by unexpected vehicle movement, do not make shifts from **R** (Reverse) to **N** (Neutral) without applying the service brakes, parking brake, or emergency brake. Selecting **N** (Neutral) does not apply vehicle brakes unless an auxiliary system to apply a parking brake is installed.
	CAUTION: Do not idle in **R** (Reverse) for more than five minutes. Extended idling in **R** (Reverse) can cause transmission overheating and damage. Always select **P** (Park) whenever time at idle exceeds five minutes.
R	**R** (Reverse) is used to back up the vehicle. Completely stop the vehicle and let the engine return to idle before shifting from a forward range to **R** (Reverse) or from **R** (Reverse) to a forward range. The reverse warning signal is activated when the shift selector is in this position.
	NEUTRAL
	WARNING: To help avoid injury and/or property damage caused by unexpected vehicle movement, do not make shifts to or from **N** (Neutral) without manually or automatically applying an appropriate vehicle brake.
	WARNING: DO NOT allow the vehicle to "coast" in **N** (Neutral). There is no engine braking in **N** (Neutral). You could lose control of the vehicle, causing property damage or personal injury. Coasting in neutral can cause severe transmission damage.

Table 2–4. ALL 1000 AND 2000 PRODUCT FAMILIES TRANSMISSIONS WITH P (Park) POSITION *(cont'd)*

N	This position places the transmission in **N** (Neutral). Used for starting the engine and stationary operation.
	DRIVE
!	**WARNING:** D (Drive) and other forward ranges may not be obtained due to an active inhibitor. The range selected may not be obtained, resulting in unexpected vehicle movement. To help avoid injury and/or property damage, always apply the service brake when selecting **D** (Drive) or other forward ranges. Check for the **RANGE INHIBIT(ED)** light or the **CHECK TRANS** light.
!	**WARNING:** To help avoid injury and/or property damage caused by unexpected vehicle movement, do not make shifts from a forward range to **N** (Neutral) without applying the service brakes, parking brake, or emergency brake. Selecting **N** (Neutral) does not apply vehicle brakes unless an auxiliary system to apply a parking brake is installed.
	CAUTION: Do not idle in **D** (Drive) or any forward range for more than five minutes. Extended idling in **D** (Drive) can cause transmission overheating and damage. Always select **P** (Park) whenever time at idle exceeds five minutes.
	NOTE: Turn off the vehicle HIGH IDLE switch, if present, before shifting from **N** (Neutral) to **D** (Drive) or **R** (Reverse). **D** (Drive) or **R** (Reverse) will not be attained unless the shift is made with the engine at idle.
D*	Use **D** (Drive) for normal driving. The transmission will initially attain first range when **D** (Drive) is selected. As vehicle speed increases, the transmission will upshift automatically through each available range up to **4** (Fourth Range) or **5** (Fifth Range). As the vehicle slows, the transmission will downshift automatically.
	MANUAL SELECT
!	**WARNING:** The transmission incorporates a hold feature to prohibit upshifting above the range selected during normal driving. For downhill operation, select a lower transmission range. If the engine governed speed is exceeded in the held range, however, the transmission will upshift to the next higher range to prevent engine damage. To help avoid injury and/or property damage due to loss of vehicle control, use the vehicle brakes to prevent exceeding engine governed speed in the held range.

Table 2–4. ALL 1000 AND 2000 PRODUCT FAMILIES TRANSMISSIONS WITH P (Park) POSITION *(cont'd)*

!	**WARNING:** To help avoid loss of control, use a combination of downshifting, braking, and other retarding devices. Downshifting to a lower transmission range increases engine braking and can help you maintain control. The transmission has a feature to prevent automatic upshifting above the lower range selected. However, during downhill operation, if engine governed speed is exceeded in the lower range, the transmission will upshift to the next higher range to prevent engine damage. This will reduce engine braking and could cause a loss of control. Apply the vehicle brakes or other retarding device to prevent exceeding engine governed speed in the lower range selected.
4** **3****	Use **4** (Fourth Range) or **3** (Third Range) for city traffic and braking on steep downgrades. Actual ranges available depend on programming by vehicle manufacturer.
3*** **2*****	Use **3** (Third Range) or **2** (Second Range) for heavy city traffic and braking on steeper downgrades. Actual ranges available depend on programming by vehicle manufacturer.
1	Use **1** (First Range) for the following: • When pulling through mud and deep snow • When maneuvering in tight spaces • While driving up or down very steep grades **1** (First Range) provides the vehicle with its maximum driving torque and maximum engine braking effect.

* The shift selector position representing this gear range may be labeled "5" or "6" (for the highest gear in the range), "OD" (for Overdrive), "D" (for the normal Drive position), "1–5" or "1–6" (for the complete gear range)
** **3** for shift selectors with **P, R, N, D, 3, 2, 1**
*** **3** for shift selectors with **P, R, N, D, 4, 3, 1**

2.4 RANGE SELECTION—ALL 2000 PRODUCT FAMILY TRANSMISSIONS WITH PB (Auto-Apply Parking Brake) POSITION

ALL 2000 PRODUCT FAMILY TRANSMISSIONS WITH PB (Auto-Apply Parking Brake) POSITION	
	PARKING BRAKE
!	**WARNING:** For vehicles containing For vehicles containing 2100 RDS, 2300 RDS, and 2500 RDS transmissions with **PB** (Auto-Apply Parking Brake) selector position, follow this procedure each time the operator's station will be unoccupied with the engine running. 1. Bring the vehicle to a complete stop using the service brake. 2. Make sure the engine is at low idle rpm. 3. Put the transmission in **PB** (Auto-Apply Parking Brake). Make sure the parking brake is properly engaged. 4. Engage the park pawl by slowly releasing the service brake. 5. Apply the emergency brakes and make sure they are properly engaged. 6. Chock the wheels and take any other steps necessary to keep the vehicle from moving. If this procedure is not followed, the vehicle can move unexpectedly and cause injury and/or property damage.
PB	Use **PB** (Auto-Apply Parking Brake) for the following: • To turn on or turn off the engine • To check vehicle accessories • To operate the engine at idle for longer than five minutes • For stationary operation of the power takeoff (if your vehicle is equipped with a PTO) This position places the transmission in **N** (Neutral) and engages the park pawl.
	REVERSE
!	**WARNING:** **R** (Reverse) may not be obtained due to an active inhibitor. Check for the illumination of the **RANGE INHIBIT(ED)** light or **CHECK TRANS (MIL)** light. See the 3.12 SHIFT INHIBITS section of this manual.

ALL 2000 PRODUCT FAMILY TRANSMISSIONS WITH PB (Auto-Apply Parking Brake) POSITION	
!	**WARNING:** To help avoid injury and/or property damage caused by unexpected vehicle movement, do not make shifts from **R** (Reverse) to **N** (Neutral) without applying the service brakes, parking brake, or emergency brake. Selecting **N** (Neutral) does not apply vehicle brakes unless an auxiliary system to apply a parking brake is installed.
	CAUTION: Do not idle in **R** (Reverse) for more than five minutes. Extended idling in **R** (Reverse) can cause transmission overheating and damage. Always select **P** (Park) whenever time at idle exceeds five minutes.
R	**R** (Reverse) is used to back the vehicle. Completely stop the vehicle and let the engine return to idle before shifting from a forward range to **R** (Reverse) or from **R** (Reverse) to a forward range. The reverse warning signal is activated when the shift selector is in this position.
	NEUTRAL
!	**WARNING:** To help avoid injury and/or property damage caused by unexpected vehicle movement, do not make shifts to or from **N** (Neutral) without manually or automatically applying an appropriate vehicle brake.
!	**WARNING:** DO NOT allow the vehicle to "coast" in **N** (Neutral). There is no engine braking in **N** (Neutral). You could lose control of the vehicle, causing property damage or personal injury. Coasting in neutral can cause severe transmission damage.
N	This position places the transmission in **N** (Neutral). Used for starting the engine and stationary operation.
	DRIVE
!	**WARNING:** **D** (Drive) and other forward ranges may not be obtained due to an active inhibitor. The range selected may not be obtained, resulting in unexpected vehicle movement. To help avoid injury and/or property damage, always apply the service brake when selecting **D** (Drive) or other forward ranges. Check for the **RANGE INHIBIT(ED)** light or the **CHECK TRANS** light.
!	**WARNING:** To help avoid injury and/or property damage caused by unexpected vehicle movement, do not make shifts from a forward range to **N** (Neutral) without applying the service brakes, parking brake, or emergency brake. Selecting **N** (Neutral) does not apply vehicle brakes unless an auxiliary system to apply a parking brake is installed.

ALL 2000 PRODUCT FAMILY TRANSMISSIONS WITH PB (Auto-Apply Parking Brake) POSITION	
	CAUTION: Do not idle in **D** (Drive) or any forward range for more than five minutes. Extended idling in **D** (Drive) can cause transmission overheating and damage. Always select **P** (Park) whenever time at idle exceeds five minutes.
	NOTE: Turn off the vehicle HIGH IDLE switch, if present, before shifting from **N** (Neutral) to **D** (Drive) or **R** (Reverse). **D** (Drive) or **R** (Reverse) will not be attained unless the shift is made with the engine at idle.
D*	Use **D** (Drive) for normal driving. The transmission will initially attain first range when **D** (Drive) is selected. As vehicle speed increases, the transmission will upshift automatically through each available range up to **4** (Fourth Range) or **5** (Fifth Range). As the vehicle slows, the transmission will downshift automatically. * The shift selector position representing this gear range may be labeled "5" or "6" (for the highest gear in the range), "OD" (for Overdrive), "D" (for the normal Drive position), "1–5" or "1–6" (for the complete gear range).
MANUAL SELECT	
	WARNING: The transmission incorporates a hold feature to prohibit upshifting above the range selected during normal driving. For downhill operation, select a lower transmission range. If the engine governed speed is exceeded in the held range, however, the transmission will upshift to the next higher range to prevent engine damage. To help avoid injury and/or property damage due to loss of vehicle control, use the vehicle brakes to prevent exceeding engine governed speed in the held range.
	WARNING: To help avoid loss of control, use a combination of downshifting, braking, and other retarding devices. Downshifting to a lower transmission range increases engine braking and can help you maintain control. The transmission has a feature to prevent automatic upshifting above the lower range selected. However, during downhill operation, if engine governed speed is exceeded in the lower range, the transmission will upshift to the next higher range to prevent engine damage. This will reduce engine braking and could cause a loss of control. Apply the vehicle brakes or other retarding device to prevent exceeding engine governed speed in the lower range selected.
4* 3*	Use **4** (Fourth Range) or **3** (Third Range) for city traffic and braking on steep downgrades. * **3** for shift selectors with **P, R, N, D, 3, 2, 1** Actual ranges available depend on programming by vehicle manufacturer.

ALL 2000 PRODUCT FAMILY TRANSMISSIONS WITH PB (Auto-Apply Parking Brake) POSITION	
3* 2*	Use **3** (Third Range) or **2** (Second Range) for heavy city traffic and braking on steeper downgrades * **3** for shift selectors with **P, R, N, D, 4, 3, 1** Actual ranges available depend on programming by vehicle manufacturer.
1	Use **1** (First Range) range for the following: • When pulling through mud and deep snow • When maneuvering in tight spaces • While driving up or down very steep grades First range provides the vehicle with its maximum driving torque and maximum engine braking effect.

2.5 RANGE SELECTION—ALL 1000 AND 2000 PRODUCT FAMILIES TRANSMISSIONS WITHOUT EITHER P (PARK) OR PB (AUTO-APPLY PARKING BRAKE) POSITIONS

ALL 1000 AND 2000 PRODUCT FAMILIES TRANSMISSIONS WITHOUT EITHER P (PARK) OR PB (AUTO-APPLY PARKING BRAKE) POSITIONS	
PARKING	
	WARNING: For vehicles containing 1000 and 2000 Product Families transmissions without either P (Park) or PB (Auto-Apply Parking Brake) selector positions, each time you park the vehicle or leave the operator's station with the engine running, do the following: 1. Bring the vehicle to a complete stop using the service brake. 2. Make sure the engine is at low idle rpm. 3. Put the transmission in **N** (Neutral). 4. Apply the emergency brake and/or parking brake and make sure they are properly engaged. 5. If the operator's station will be unoccupied with the engine running, chock the wheels and take any other steps necessary to keep the vehicle from moving. If the procedure is not followed, the vehicle may move suddenly and cause injury and/or property damage.

ALL 1000 AND 2000 PRODUCT FAMILIES TRANSMISSIONS WITHOUT EITHER P (PARK) OR PB (AUTO-APPLY PARKING BRAKE) POSITIONS	
REVERSE	
	WARNING: R (Reverse) may not be obtained due to an active inhibitor. Check for the illumination of the **RANGE INHIBIT(ED)** light or **CHECK TRANS (MIL)** light. See the 3.12 SHIFT INHIBITS section of this manual.
	WARNING: To help avoid injury and/or property damage caused by unexpected vehicle movement, do not make shifts from **R** (Reverse) to **N** (Neutral) without applying the service brakes, parking brake, or emergency brake. Selecting **N** (Neutral) does not apply vehicle brakes unless an auxiliary system to apply a parking brake is installed.
	CAUTION: Do not idle in **R** (Reverse) for more than five minutes. Extended idling in **R** (Reverse) can cause transmission overheating and damage. Always select **P** (Park) whenever time at idle exceeds five minutes.
R	**R** (Reverse) is used to back the vehicle. Completely stop the vehicle and let the engine return to idle before shifting from a forward range to **R** (Reverse) or from **R** (Reverse) to a forward range. The reverse warning signal is activated when the shift selector is in this position.
NEUTRAL	
	WARNING: To help avoid injury and/or property damage caused by unexpected vehicle movement, do not make shifts to or from **N** (Neutral) without manually or automatically applying an appropriate vehicle brake.
	WARNING: DO NOT allow the vehicle to "coast" in **N** (Neutral). There is no engine braking in **N** (Neutral). You could lose control of the vehicle, causing property damage or personal injury. Coasting in neutral can cause severe transmission damage.
N	Use **N** (Neutral) for the following: • To turn on or turn off the engine • To check vehicle accessories • To operate the engine at idle for longer than five minutes • For stationary operation of the power takeoff (if your vehicle is equipped with a PTO
DRIVE	

ALL 1000 AND 2000 PRODUCT FAMILIES TRANSMISSIONS WITHOUT EITHER P (PARK) OR PB (AUTO-APPLY PARKING BRAKE) POSITIONS	
	WARNING: D (Drive) and other forward ranges may not be obtained due to an active inhibitor. The range selected may not be obtained, resulting in unexpected vehicle movement. To help avoid injury and/or property damage, always apply the service brake when selecting **D** (Drive) or other forward ranges. Check for the **RANGE INHIBIT(ED)** light or the **CHECK TRANS** (MIL) light.
	WARNING: To help avoid injury and/or property damage caused by unexpected vehicle movement, do not make shifts from a forward range to **N** (Neutral) without applying the service brakes, parking brake, or emergency brake. Selecting **N** (Neutral) does not apply vehicle brakes unless an auxiliary system to apply a parking brake is installed.
	CAUTION: Do not idle in **D** (Drive) or any forward range for more than five minutes. Extended idling in **D** (Drive) can cause transmission overheating and damage. Always select **P** (Park) whenever time at idle exceeds five minutes.
	NOTE: Turn off the vehicle HIGH IDLE switch, if present, before shifting from **N** (Neutral) to **D** (Drive) or **R** (Reverse). **D** (Drive) or **R** (Reverse) will not be attained unless the shift is made with the engine at idle.
D*	Use **D** (Drive) for normal driving. The transmission will initially attain first range when **D** (Drive) is selected. As vehicle speed increases, the transmission will upshift automatically through each available range up to **4** (Fourth Range) or **5** (Fifth Range). As the vehicle slows, the transmission will downshift automatically. The shift selector position representing this gear range may be labeled "5" or "6" (for the highest gear in the range), "OD" (for Overdrive), "D" (for the normal Drive position), "1–5" or "1–6" (for the complete gear range).
MANUAL SELECT	
	WARNING: The transmission incorporates a hold feature to prohibit upshifting above the range selected during normal driving. For downhill operation, select a lower transmission range. If the engine governed speed is exceeded in the held range, however, the transmission will upshift to the next higher range to prevent engine damage. To help avoid injury and/or property damage due to loss of vehicle control, use the vehicle brakes to prevent exceeding engine governed speed in the held range.

ALL 1000 AND 2000 PRODUCT FAMILIES TRANSMISSIONS WITHOUT EITHER P (PARK) OR PB (AUTO-APPLY PARKING BRAKE) POSITIONS	
!	**WARNING:** To help avoid loss of control, use a combination of downshifting, braking, and other retarding devices. Downshifting to a lower transmission range increases engine braking and can help you maintain control. The transmission has a feature to prevent automatic upshifting above the lower range selected. However, during downhill operation, if engine governed speed is exceeded in the lower range, the transmission will upshift to the next higher range to prevent engine damage. This will reduce engine braking and could cause a loss of control. Apply the vehicle brakes or other retarding device to prevent exceeding engine governed speed in the lower range selected.
4* 3*	Use **4** (Fourth Range) or **3** (Third Range) for city traffic and braking on steep downgrades. *3 for shift selectors with **R, N, D, 3, 2, 1** Actual ranges available depend on programming by vehicle manufacturer.
3* 2*	Use **3** (Third Range) or **2** (Second Range) for heavy city traffic and braking on steeper downgrades. *3 for shift selectors with **R, N, D, 4, 3, 1** Actual ranges available depend on programming by vehicle manufacturer.
1	Use **1** (First Range) range for the following: • When pulling through mud and deep snow • When maneuvering in tight spaces • While driving up or down very steep grades First range provides the vehicle with its maximum driving torque and maximum engine braking effect.

3.0 DRIVING TIPS

3.1 MAXIMUM VEHICLE LOADING

! **WARNING:** Operation with excessive loads can cause transmission damage and unexpected vehicle movement. To help avoid injury, property damage and/or transmission damage, do not exceed the following:

- For 1000 RDS, 2100 RDS, and 2200 RDS transmissions, do not exceed 26,000 lb (11 800 kg) GCW or the OEM vehicle rating, whichever is less.
- For 1350 RDS, 2350 RDS and 2550 RDS transmissions, do not exceed 30,000 lb (13 600 kg) GCW or the OEM vehicle rating, whichever is less.
- For 2300 RDS and 2500 RDS transmissions, do not exceed 33,000 lb (15 000 kg) GCW or the OEM rating, whichever is less.

3.2 PREVENT MAJOR PROBLEMS

Minor problems can be kept from becoming major problems if you notify an Allison Transmission distributor or dealer when any of these conditions occur.

- Shifting feels abnormal.
- Transmission leaks fluid.
- Unusual transmission-related sounds (changes in sound caused by normal engine thermostatic fan cycling, while climbing a long grade with a heavy load, have been mistaken for transmission-related sounds).
- **CHECK TRANS** light or **RANGE INHIBIT(ED)** light comes on frequently.
- **SERVICE TRANS** light remains illuminated, if present.

3.3 TURNING THE VEHICLE ON/OFF

Before turning on or off the engine, the driver must verify that the service brake is engaged and one of the following selector positions has been selected and engaged:

- **P** (Park)
- **PB** (Auto-Apply Parking Brake)
- **N** (Neutral) if **P** (Park) or **PB** (Auto-Apply Parking Brake) is not available

NOTE: The vehicle should not start unless one of these selector positions has been selected. If the vehicle starts in any other selector position, seek service immediately.

Transmission operation at cold ambient temperatures may require preheating or the use of a lower viscosity transmission fluid. See the 6.5 FLUID RECOMMENDATIONS section in this manual.

Even when the engine is warm and capable of full-throttle output, the transmission should not be taken out of **P** (Park), **PB** (Auto-Apply Parking Brake), or **N** (Neutral) for at least thirty seconds to allow for buildup of transmission fluid pressure.

3.4 ACCELERATOR CONTROL

WARNING: To help avoid injury or property damage caused by sudden movement of the vehicle, do not make shifts from **N** (Neutral) to a forward range or **R** (Reverse) when the throttle is open. The vehicle will lurch forward or rearward and the transmission can be damaged. Avoid this condition by making shifts from **N** (Neutral) to a forward range or **R** (Reverse) only when the throttle is closed and service brakes are applied.

The position of the accelerator pedal influences when automatic shifting occurs. When the pedal is fully depressed, upshifts will occur automatically at higher engine speeds. A partially depressed position of the pedal will cause upshifts to occur at lower engine speeds. An electronic throttle position signal tells the TCM how much the operator has pressed the pedal. Excessive throttle position may inhibit a directional shift.

3.5 PRIMARY/SECONDARY SHIFT SCHEDULES

3.5.1 Shift Schedules.

The points at which shifts occur depend upon predetermined speeds and other operating conditions. A transmission "shift calibration" includes several sets of shift points which may be used according to current or anticipated operating conditions. Some shift schedules may be inhibited as a result of operating conditions, such as engine or transmission fluid temperature. Shift schedules may be changed through selection of a remote (usually dash-mounted) switch—which is typically associated with a change in anticipated vehicle operation.

The TCM includes the capacity for two separate and distinct shift calibrations (customer-selectable), one for use in "Primary Mode" of operation and one in "Secondary Mode."

- **Primary**—This shift schedule is typically used for all normal vehicle operations.
- **Secondary**—This is an alternate shift schedule that the TCM uses upon request. Not all vehicles will be equipped with a secondary shift schedule. The request can be interlocked with a vehicle component, or be operator-controlled via a dash-mounted switch.

Your vehicle may have a dash-mounted light that illuminates when the secondary mode is active.

3.5.2 Dynamic Shift Sensing (DSS).

NOTE: DSS was known as Load-Based Shift Scheduling (LBSS) prior to July 2014.

Vehicles equipped with DSS do not require the operator to change selection of primary and secondary shift schedules manually and no longer require a dash-mounted OEM-installed switch or Mode button for shift schedule selection. This is because DSS *automatically* selects the appropriate shift schedule based on vehicle load and operating conditions.

DSS selects between Economy and Performance shift schedules based on the vehicle's current estimated payload (determined by acceleration rate and requested power) and the grade on which the vehicle is operating. This optimizes fuel economy while maintaining performance on vehicles so equipped.

DSS has been optimized and now includes a Super Economy Shift Schedule (SESS). This enhancement allows earlier up-shift under cruising conditions

to further improve fuel economy. Cruise is defined as driving with low to no acceleration at a given road speed.

With Allison 5th Generation Controls equipped vehicles, fuel economy enhancement features previously available with 4th Generation Controls are improved. DSS performance is enhanced due to an inclinometer (a device that senses road grade) contained in the 5th Generation TCM.

3.5.3 Allison Transmission FuelSense®.

Vehicles equipped with an Allison Transmission and a FuelSense® package will save fuel when compared to vehicles without the package, depending on the duty cycle.

FuelSense® is an initiative that groups software and calibration fuel economy features into packages that can be easily selected when specifying a TCM calibration in the Allison Calibration Configuration Tool (ACCT).

With the introduction of FuelSense® packages, more descriptive feature designations have been created. Refer to Table 3–1 for FuelSense® features and package designations.

Table 3–1. FuelSense® Features and Package Designations

Former Terminology	FuelSense® Terminology	FuelSense®	FuelSense® Plus	FuelSense® Max
	5th Generation Controls	X	X	X
Low Speed Shift Calibrations	EcoCal	X	X	X
Load-Based Shift Scheduling (LBSS)	Dynamic Shift Sensing (DSS)	X	X	X
Acceleration Based Mode Switch (ABMS)				
Super Economy Shift Schedule (SESS)				
Reduced Engine Load at Stop (RELS) or Enhanced Converter Load Release (ECLR)	Neutral at Stop Standard or Neutral at Stop Premium		X	X
Vehicle Acceleration Control (VAC)	Acceleration Rate Management			X

3.5.3.1 FuelSense® Terminology Descriptions

- **EcoCal:** EcoCal describes lower engine speed shift schedules designed to match the engine and duty cycle, maintain optimum engine speed, perform torque converter lockup as soon as possible, and provide necessary performance without shift cycling.
- **Dynamic Shift Sensing:** Dynamic Shift Sensing is a feature that automatically selects between EcoCal and higher speed shift schedules based on the vehicle's actual payload and the grade on which it's operating.
- **Neutral at Stop:** Neutral at Stop is a feature that reduces or eliminates the load on the engine while the vehicle is stopped, thus reducing fuel usage and emissions.

- **Acceleration Rate Management:** Acceleration Rate Management is a feature that alleviates aggressive driving practices by controlling engine torque based on the vehicle's grade and load.

3.5.3.2 FuelSense® Driver Indicator (with FuelSense® Package)

NOTE: The TCM software must be configured to enable FuelSense® in order for the FuelSense® driver indicator initialization screen to appear. A New Parameter Option is provided in ACCT/Vehicle Electronic Programming Stations (VEPS) Programming Guides that must be answered in order to configure FuelSense®.

Vehicles equipped with a FuelSense® package will include a display of the FuelSense® logo. At the discretion of the OEM, vehicles not equipped with an Allison shift selector display can provide the FuelSense® message on a dash display. The Allison shift selector will display the "Allison Transmission" initialization screen followed by a "FuelSense®" screen upon vehicle startup (refer to Figure 3–1).

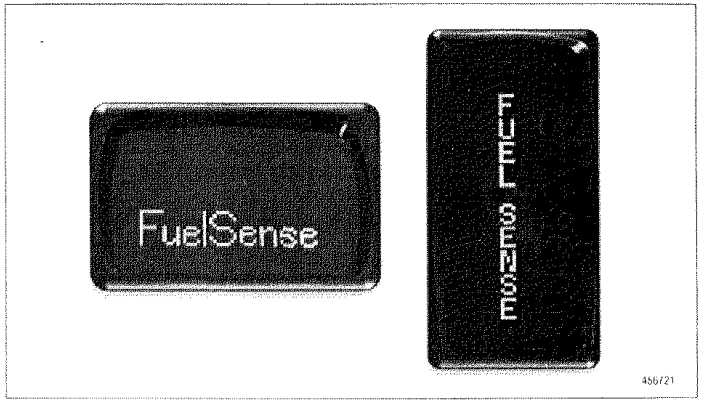


Figure 3–1. FuelSense® Display

3.6 KICKDOWN

Some vehicles have a "kickdown" feature that allows the operator to choose between an "Economy" primary shift schedule and "Performance" secondary shift schedule. The throttle pedal will have a detent feel when full-throttle is

achieved using "Economy" shift points. When the operator "steps through" this detent, the function is activated and "Performance" shift points are achieved.

3.7 OUTPUT SPEED INDICATOR

Your vehicle may contain a light or other indicator that is activated when a preset output speed has been exceeded in the vehicle, transmission, or auxiliary equipment. The output speed may occur in either the forward or reverse direction. This indicator may be used to alert the operator that a specific overspeed condition has occurred or to indicate that a minimum or maximum operating speed was attained.

3.8 DIAGNOSTIC CODES

See detailed information in the 7.0 DIAGNOSTICS section.

3.9 RANGE INHIBIT(ED) LIGHT

3.9.1 Range Inhibited Warning Light. The red or amber **RANGE INHIBIT(ED)** warning light is located on or near the shift selector. The purpose of this indicator is to alert the operator that transmission operation is being inhibited and that range shifts being requested by the operator may not occur. When certain operating conditions are detected by the TCM, the controls will command the transmission to be locked in the range currently in use. If the torque converter clutch is applied when the condition is detected, the clutch will be disengaged concurrently with the activation of the **RANGE INHIBIT(ED)** light.

Each time the engine is started, the **RANGE INHIBIT(ED)** light will illuminate, then turn off after two seconds. If the light does not illuminate during ignition, or if the light remains on after ignition, the transmission system should be checked immediately.

For the conditions under which shift inhibits occur, see the SHIFT INHIBITS 3.12 SHIFT INHIBITS section in this manual.

NOTE: If the **RANGE INHIBIT(ED)** warning light flashes, it may indicate that COTP is active.

3.9.1.1 Converter Over-temp Torque Protection COTP

- Purpose
  - Alerts the driver to a torque converter over-temperature condition.

- Limits the time that the torque converter can be stalled at full power to prevent torque converter damage *(if the vehicle is equipped to limit engine rpm* by SEM or LRTP) while maintaining an acceptable level of driver control during normal operation.

  Engine rpm cannot be controlled for non-SEM applications. Only SEM or LRTP equipped vehicles will be able to offer torque limits. On vehicles without SEM or LRTP, only the **RANGE INHIBIT(ED)** light will be flashed.

- Functionality
  - Converter slip speed is controlled via engine torque limiting to regulate converter temperatures to acceptable levels.
  - **RANGE INHIBIT(ED)** light flashes 1 second before and during torque reduction.
- Criteria for activating COTP
  - First level of COTP (**RANGE INHIBIT(ED)** light flashes)
    - Difference of at least 1400 rpm or greater between engine speed and transmission input speed
    - 25% throttle or greater
    - Less than 100 rpm transmission output speed
    - All conditions above must be maintained for at least sixteen seconds to activate first level of COTP (less if initial converter temp predicted hot)
  - Second level of COTP (Engine Speed will be limited to 900 rpm and **RANGE INHIBIT(ED)** light flashes)
    - Difference of at least 1400 rpm or greater between engine speed and transmission input speed
    - 25% throttle or greater
    - Less than 100 rpm transmission output speed
    - Twenty-Three seconds total of throttle and output conditions being met

Once you exit the COTP condition, a software counter will count back sixteen seconds before full engine rpm is available.

NOTE: (Only SEM or LRTP equipped vehicles will be able to offer torque limits. Otherwise, only the range inhibit light will be flashed.)

3.10 CHECK TRANS OR MALFUNCTION INDICATOR LIGHT (MIL)

The red or amber **CHECK TRANS** indicator or Malfunction Indicator Light (MIL) is located on the dash panel. A MIL is present on vehicles that meet industry On-Board Diagnostics II (OBD II) requirements. A **CHECK TRANS** indicator is present on vehicles not subject to industry OBD II requirements.

Each time the engine is started, the **CHECK TRANS** indicator or MIL will illuminate, then turn off after two seconds. If the indicator does not illuminate during ignition, or if the indicator remains on after ignition, the transmission system should be checked immediately.

Illumination of the MIL or **CHECK TRANS** indicator at any time after start-up indicates that a problem has been detected. The TCM will register a DTC and shifts may be restricted. Depending upon the severity of the problem, operation may continue in order to reach service assistance. The TCM may not respond to shift selector requests since upshifts and downshifts may be restricted and direction changes may not occur.

Illumination of the MIL or **CHECK TRANS** indicator at any time after start-up may indicate a problem with the engine or transmission, refer to the DIAGNOSTICS section for more information on diagnostic codes.

CAUTION: Do not drive the vehicle for any longer than one-half hour after the MIL or **CHECK TRANS** indicator illuminates. Continued operation of the vehicle for more than thirty minutes after the Check Trans or Malfunction Indicator Light illuminates is not recommended. This thirty-minute window is intended to allow the operator to reach service assistance.

3.11 DIAGNOSTIC CODES OVERVIEW

Refer to detailed information in the 7.0 DIAGNOSTICS section.

3.12 SHIFT INHIBITS

The transmission control system will inhibit shifting to protect the transmission from some types of abusive operation, in response to diagnostic trouble codes, and to satisfy transmission feature/option requirements. These shift inhibits fall within the following types:

- Above-idle neutral-to-range shifts
- Forward/reverse directional shifts
- Transmission problems

- Auxiliary equipment operation

3.12.1 Above-Idle Neutral-to-Range Shifts.

Above-idle (greater than 900 rpm in Allison 4th and 5th Generation transmissions, and greater than 1000 rpm in previous transmissions) shifts from **N** (Neutral) to **R** (Reverse) or **N** (Neutral) to a forward range are normally inhibited (except in emergency vehicles or some other type of specialized equipment).

WARNING: To help avoid injury or property damage caused by sudden movement of the vehicle, do not make shifts from **N** (Neutral) to a forward range or **R** (Reverse) when the throttle is open. The vehicle will lurch forward or rearward and the transmission can be damaged. Avoid this condition by making shifts from **N** (Neutral) to a forward range or **R** (Reverse) only when the throttle is closed and service brakes are applied.

When these shifts are inhibited, the **RANGE INHIBIT(ED)** light illuminates. See the 3.9 RANGE INHIBIT(ED) LIGHT section in this manual for further information.

3.12.2 Forward/Reverse Directional Shifts.

Forward/reverse directional changes are typically not permitted if appreciable output shaft speed is detected.

WARNING: To help avoid injury or property damage caused by sudden movement of the vehicle, do not make shifts from **N** (Neutral) to a forward range or **R** (Reverse) when the throttle is open. The vehicle will lurch forward or rearward and the transmission can be damaged. Avoid this condition by making shifts from **N** (Neutral) to a forward range or **R** (Reverse) only when the throttle is closed and service brakes are applied.

When these shifts are inhibited, the **RANGE INHIBIT(ED)** light illuminates. See the 3.9 RANGE INHIBIT(ED) LIGHT section in this manual for further information.

3.12.3 Transmission Problems. Lights such as the **RANGE INHIBIT(ED)**, **CHECK TRANS.** or **MIL**, and a flashing **PRNDL** display are illuminated when the transmission detects a functional concern.

An illuminated **RANGE INHIBIT(ED)** light or a flashing **PRNDL** display indicates the TCM has detected a condition in which directional shifts are

not allowed to be made. This inhibited state can be a self-clearing or lasting condition depending on the amount of time the condition is present.

The following conditions may cause an inhibited state:

- Engine speed too high
- Throttle percentage incorrect
- Output speed movement

See the 3.9 RANGE INHIBIT(ED) LIGHT or 3.10 CHECK TRANS OR MALFUNCTION INDICATOR LIGHT (MIL) section in this manual for further information.

Depending on the severity of the DTC, the transmission may default to an operating state predefined by the TCM such as Limp Home. Limp Home mode temporarily limits normal transmission operation until the vehicle can be driven to a service location and the severity of the problem is determined. The transmission remains in the Limp Home mode until the problem has been corrected. Following an engine restart, the transmission may obtain **3** (Third Range),**N** (Neutral), or **R** (Reverse).. Refer to the Sales and Service Directory (SA2229EN) for the current listing of Allison Transmission authorized distributor and service dealers.

3.12.4 Auxiliary Equipment Operation. The TCM prevents shifts from **P** (Park), **PB** (Auto-Apply Parking Brake), or **N** (Neutral)-to-range when auxiliary equipment is in operation (such as a wheelchair lift). For some vehicles, such as buses, shifts from **P** (Park), **PB** (Auto-Apply Parking Brake), or **N** (Neutral)-to-range are prevented unless the brake pedal is pressed.

3.13 USING THE ENGINE TO SLOW THE VEHICLE

WARNING: The transmission incorporates a hold feature to prohibit upshifting above the range selected during normal driving. For downhill operation, select a lower transmission range. If the engine governed speed is exceeded in the held range, however, the transmission will upshift to the next higher range to prevent engine damage. To help avoid injury and/or property damage due to loss of vehicle control, use the vehicle brakes to prevent exceeding engine governed speed in the held range.

WARNING: To help avoid loss of control, use a combination of downshifting, braking, and other retarding devices. Downshifting to a lower transmission range increases engine braking and can help you maintain control. The transmission has a feature to prevent automatic upshifting above the lower range selected. However, during downhill operation, if engine governed speed is exceeded in the lower range, the transmission will upshift to the next higher range to prevent engine damage. This will reduce engine braking and could cause a loss of control. Apply the vehicle brakes or other retarding device to prevent exceeding engine governed speed in the lower range selected.

To use the engine as a braking force, select the next lower range. If the vehicle is exceeding the maximum speed for this range, use the service brakes and/or other retarding devices to slow the vehicle. When a lower speed is reached, the TCM will automatically downshift the transmission. Engine braking provides good speed control for going down grades. When the vehicle is heavily loaded, or the grade is steep, it may be desirable to preselect a lower range before reaching the grade. If the engine-governed speed is exceeded, the transmission will upshift automatically to the next range.

WARNING: Using the retarder or engine brake on wet or slippery roads may cause loss of traction on the drive wheels—your vehicle may slide out of control. To help avoid injury or property damage, turn the retarder or engine brake enable to OFF when driving on wet or slippery roads.

3.14 RANGE PRESELECTION

Range preselection means selecting a lower range to match driving conditions encountered or expect to be encountered. Learning to take advantage of preselected shifts will give you better control on slick or icy roads and on downgrades.

Downshifting to a lower range increases engine braking. The selection of a lower range often prevents cycling between that range and the next higher range on a series of short up-and-down hills.

NOTE: Preselecting during normal operation may result in reduced fuel economy.

Manual range downshifts will not occur until a calibration value of output speed is reached. When a range downshift is manually selected and the transmission output speed is above the calibration value, the transmission will stay in the range it was in even though a lower range was requested. Apply the vehicle service brakes or some retarding device to reduce the transmission output speed to the calibration value and then the shift to the lower range will occur.

Two shift schedules are used with range preselection: hold upshift and preselect downshift.

3.14.1 Hold Upshift. This shift schedule keeps the transmission from shifting above the selected range. This shift schedule permits upshifts to occur if an engine overspeed condition could result by the transmission remaining (by operator selection) in a range lower than its highest range. When the hold feature is activated, transmission upshift points occur at engine speeds which are higher than normal upshifts in order to "hold" the transmission from upshifting beyond the current range.

WARNING: The transmission incorporates a hold feature to prohibit upshifting above the range selected during normal driving. For downhill operation, select a lower transmission range. If the engine governed speed is exceeded in the held range, however, the transmission will upshift to the next higher range to prevent engine damage. To help avoid injury and/or property damage due to loss of vehicle control, use the vehicle brakes to prevent exceeding engine governed speed in the held range.

3.14.2 Preselect Downshift. This shift schedule is used when the driver preselects a lower range. The operator may preselect any range below **D** (Drive) on the shift selector at any time. When a range has been "preselected" in this manner, shift points to and from ranges above the preselected range are higher than the normal shift points. The transmission will downshift when an engine overspeed condition will not result after the shift. Shifts below the preselected range are not affected.

3.15 REVERSE

Putting the transmission into **R** (Reverse) may activate vehicle backup lights and/or reverse warning devices.

3.16 REFUSE PACKER STEP SWITCH

When personnel are on the rear step of a refuse packer, the transmission will operate in **FIRST** and **NEUTRAL** only.

- An operator request to upshift beyond **FIRST** or to shift to **REVERSE** is ignored by the TCM.
- If the transmission is in **REVERSE**, the TCM will cause the transmission to shift to **NEUTRAL**.
- If the transmission is in a forward range higher than **FIRST**, the TCM will invoke "preselect downshifts" until **FIRST** is attained.

3.17 TWO-SPEED AXLE (Some Rugged Duty Series Transmission Applications)

The two-speed axle may be shifted while the vehicle is moving. However, the axle or vehicle manufacturer's recommendations should be followed for shifting the axle. It is recommended that axle shifts be made with the transmission in the highest range, or vehicle stopped, to prevent a transmission shift from coinciding with an axle shift.

3.18 DRIVING ON SNOW OR ICE

If possible, reduce your vehicle speed and select a lower range before losing traction. Select the range that will not exceed the speed expected to be maintained. Accelerate or decelerate very gradually to prevent the loss of traction. It is very important to decelerate gradually when a lower range is selected. It is important that you reach the selected lower range before attempting to accelerate. This will avoid an unexpected downshift during acceleration.

NOTE: If ABS is activated, the lockup clutch is automatically disengaged.

3.19 ROCKING OUT

WARNING: To help avoid injury or property damage caused by sudden movement of the vehicle, do not make shifts from **N** (Neutral) to **D** (Drive) or **R** (Reverse) when the throttle is open. The vehicle may lurch forward or rearward and the transmission can be damaged. Avoid this condition by making shifts from **N** (Neutral) to a forward range or **R** (Reverse) only when the throttle is closed and the service brakes are applied.

CAUTION: If the wheels are stuck and not turning, do not apply full power for more than 10 seconds in either **D** (Drive) or **R** (Reverse). Full power for more than 10 seconds under these conditions will cause the transmission to overheat. If the transmission overheats, shift to **N** (Neutral) and operate the engine at 1200–1500 rpm until it cools (2–3 minutes).

If the vehicle is stuck in deep sand, snow, or mud, it may be possible to rock it out. Shift to **D** (Drive) and apply steady, light throttle (never full throttle). When the vehicle has rocked forward as far as it will go, apply and hold the vehicle service brakes. Allow the engine to return to idle; then select **R** (Reverse). Release the brakes and apply a steady, light throttle allowing the vehicle to rock in **R** (Reverse) as far as it will go. Again, apply and hold the service brakes and allow the engine to return to idle. This procedure may be repeated in **D** (Drive) and **R** (Reverse) if each directional shift continues to move the vehicle a greater distance. Never make **N** (Neutral)-to-**D** (Drive) or directional shift changes when the engine rpm is above idle.

3.20 OPERATING TEMPERATURES

To properly operate the transmission, adhere to the following minimum and maximum transmission operating temperatures:

Sump, minimum continuous	40°C (100°F)
Sump, maximum intermittent	121°C (250°F)
To cooler, maximum intermittent	149°C (300°F)

Your transmission may have a converter-out transmission temperature gauge near the "to-cooler" port on the transmission converter housing.

3.21 HIGH FLUID TEMPERATURE

CAUTION: Always select **P** (Park), **PB** (Auto-Apply Parking Brake), or **N** (Neutral) whenever time at idle exceeds five minutes. Extended idling in any other ranges can cause transmission overheating and damage.

CAUTION: Sustained use of the parking brake with the engine running and the transmission in range can cause an overheating failure of the transmission. The vehicle can contain a buzzer or dash-mounted light to alert the operator when the ignition switch is "ON", the parking brake is applied, and the transmission selector is in range.

CAUTION: The engine should never be operated for more than 10 seconds at full throttle with the transmission in range and the output stalled. Prolonged operation of this type will cause the transmission fluid temperature to become excessively high and will cause severe overheat damage to the transmission.

Your vehicle may have a dash indicator or other alarm that turns on when the transmission sump temperature or to-cooler temperature exceeds specified limits.

If the transmission overheats during normal operations, do the following:

- Check the fluid level in the transmission. See the 6.0 CARE AND MAINTENANCE section of this manual.
- Safely stop the vehicle and check the cooling system. If it appears to be functioning properly, run the engine at 1200-1500 rpm with the transmission in **N** (Neutral). This should reduce the transmission and engine temperatures to normal operating levels in 2 or 3 minutes. If temperatures do not decrease, reduce the engine rpm.
- If high temperature in either the engine or transmission persists, stop the engine and have the overheating condition investigated by service management.

3.22 PARKING BRAKE

For shift selectors with a **PB** (Auto-Apply Parking Brake) position, selecting **PB** (Auto-Apply Parking Brake) places the transmission in **N** (Neutral) and automatically engages the parking brake. For shift selectors without a **PB** (Auto-Apply Parking Brake) position, the parking brake must be manually engaged. Your vehicle may have an indicator light that illuminates when the parking brake is applied.

CAUTION: Do not apply the transmission-mounted parking brake with the vehicle in motion. Transmission and/or driveline damage can result. In the event of a dynamic brake apply, recheck the torque of all brake mounting bolts to verify the integrity of the mount.

CAUTION: Sustained use of the parking brake with the engine running and the transmission in range can cause an overheating failure of the transmission. The vehicle can contain a buzzer or dash-mounted light to alert the operator when the ignition switch is "ON", the parking brake is applied, and the transmission selector is in range.

3.23 PARK PAWL

A park pawl is standard on 1000 RDS, 1350 RDS, 2200 RDS, 2350 RDS, and 2550 RDS transmissions and is not available on 2100 RDS, 2300 RDS, and 2500 RDS transmissions. The park pawl effectively grounds the transmission output shaft, thereby preventing rotation of the driveline. Provided the vehicle is stationary, selecting **P** (Park) on the shift selector places the transmission in **NEUTRAL** and engages the park pawl. The park pawl exists but cannot be engaged in some vehicle configurations using 1000 RDS, 2200 RDS, 2350 RDS, and 2550 RDS transmissions (e.g., some rear engine vehicles with air brakes). For these configurations, the **P** (Park) position is not used.

WARNING: To help avoid injury and/or property damage caused by unexpected vehicle movement, do not attempt to engage **P** (Park) with the vehicle in motion (2 km/hr (1 mph) or higher). If you attempt to engage **P** (Park) with the vehicle in motion (2 km/hr (1 mph) or higher), the park pawl will ratchet, will not engage, and will not hold the vehicle. Repeated park pawl ratcheting can cause transmission damage.

WARNING: If the vehicle has four-wheel-drive and the transfer case is in Neutral, the vehicle can be free to roll even if the **P** (Park) position is selected. To help avoid injury and/or property damage caused by unexpected movement of the vehicle, be certain that the transfer case is in "high" drive range, not Neutral, whenever the vehicle is parked.

WARNING: If the vehicle is equipped with a two-speed axle or two-speed transfer case which is engaged in "low", even very low vehicle speeds can produce appreciable transmission output shaft speed. Even the slightest vehicle motion can deter engagement of the park pawl in such cases. To help avoid injury and/or property damage caused by unexpected vehicle movement, be certain that the axle or transfer case is in "high" drive range whenever the vehicle is parked and the park pawl is engaged.

3.23.1 Torque Lock. If the vehicle is parked on an incline and **P** (Park) is properly engaged, the weight of the vehicle may generate an excessive amount of torque on the park pawl in the transmission. In this situation, it may be difficult to shift the transmission out of the **P** (Park) position. This condition is commonly called "torque lock." To alleviate torque lock, do the following:

1. Taking the vehicle's weight into consideration, push the vehicle uphill a small amount to release the pressure on the park pawl and permit a shift out of **P** (Park).
2. Shift the transmission out of **P** (Park) while applying the service brakes.
3. Release the parking brake.

3.24 PARKING/LEAVING VEHICLE WITH ENGINE RUNNING

WARNING: For vehicles containing 1000 and 2000 Product Families transmissions with **P** (Park) selector position, follow this procedure each time the operator's station will be unoccupied with the engine running:

1. Bring the vehicle to a complete stop using the service brake.
2. Make sure the engine is at low idle rpm or turned off.
3. Move the gear selector to **P** (Park), then slowly release the service brake. Releasing the brake too quickly, especially on a steep grade, may prevent the park pawl from engaging. If the vehicle moves, immediately reapply the service brake and repeat the prior steps.
4. Apply the vehicle's parking/emergency brake and make sure it is properly engaged.
5. If operating the vehicle when not in the operator's seat (such as in a tow truck) or when parking on steep grades, besides engaging the park pawl and applying the parking brake also chock the wheels and take any other steps necessary to keep the vehicle from moving and follow any specific vehicle operating manuals or warnings.

If this procedure is not followed, the vehicle can move unexpectedly and cause injury and/or property damage.

WARNING: For vehicles containing 1000 and 2000 Product Families transmissions with **PB** (Auto-Apply Parking Brake) selector position, follow this procedure each time the operator's station will be unoccupied with the engine running:

1. Bring the vehicle to a complete stop using the service brake.
2. Make sure the engine is at low idle rpm.
3. Put the transmission in **PB** (Auto-Apply Parking Brake).
4. Apply the emergency brakes and make sure they are properly engaged.
5. Chock the wheels and take any other steps necessary to keep the vehicle from moving.

If this procedure is not followed, the vehicle can move unexpectedly and cause injury and/or property damage.

WARNING: For vehicles containing 1000 and 2000 Product Families transmissions without either **P** (Park) or **PB** (Auto-Apply Parking Brake) selector positions, each time you park the vehicle or leave the operator's station with the engine running, do the following:

1. Bring the vehicle to a complete stop using the service brake.
2. Make sure the engine is at low idle rpm.
3. Put the transmission in **N** (Neutral).
4. Apply the emergency brakes and/or parking brake and make sure they are properly engaged.
5. If the operator's station will be unoccupied with the engine running, chock the wheels and take any other steps necessary to keep the vehicle from moving.

If this procedure is not followed, the vehicle can move unexpectedly and cause injury and/or property damage.

3.25 TOWING OR PUSHING

CAUTION: Failure to lift the drive wheels off the road, disconnect the driveline or remove the axle shafts before towing or pushing can cause serious transmission damage.

The engine cannot be started by pushing or towing. Before pushing or towing a vehicle, lift the drive wheels off the road, disconnect the driveline, or remove the axle shafts from the drive wheels. When the axle shafts are removed, be sure to cover the wheel openings to prevent loss of lubricant and entry of dust and dirt. An auxiliary air supply will usually be required to release the vehicle brake system.

3.26 SURGING NATURAL GAS ENGINES

NOTE: Engine surging or engine speed cycling may occur on natural gas powered equipment. This condition typically occurs when the transmission is being operated in a hold position with throttle applied and the engine speed above full load engine governed speed. Surging may also occur at closed and part throttle. This condition is an engine characteristic and NOT a transmission concern.

4.0 POWER TAKEOFF OPERATION

4.1 POWER TAKEOFF (PTO) SYSTEMS

Three types of PTOsystems may be used with the Rugged Duty Series transmissions:

- **Transmission-Mounted Turbine-Driven PTO** — A transmission-mounted turbine-driven PTO drive provides both an infinitely-variable PTO drive ratio and a protective hydraulic cushion against abrupt loading/unloading (during "converter mode" operation) and engine-driven PTO speed control (during "torque converter clutch mode" operation).
- **Split-Shaft PTO** — A split-shaft PTO, a chassis-mounted component, is typically used in applications which require full engine power being available to either propel the vehicle or to power auxiliary equipment through the PTO drive—but not both simultaneously. In both cases, the transmission output shaft delivers power to the split-shaft transfer case. The split-shaft transfer case is then shifted to deliver this power to either the driveline or PTO drive.
- **Flywheel-Driven PTO** — A flywheel-driven PTO, often called a "sandwich PTO," mounts between the engine and transmission. The PTO is normally driven directly by the engine.

4.2 TURBINE-DRIVEN POWER TAKEOFF (PTO)

The following pertains only to Transmission-Mounted Turbine-Driven PTOs.

4.2.1 PTO Configuration. The PTO is mounted on the left and/or right side of the transmission housing. The PTO drivetrain consists of a large drive gear in the transmission, an idler gear arrangement, and a smaller driven gear in the PTO. The drive gear is integral to the transmission rotating clutch housing, which rotates at the same speed as the torque converter turbine. With this drive configuration, the PTO rotates in the same direction as the engine.

Two types of transmission-mounted PTOs may be used with these transmission models.

- **Constant-drive PTO** — Used in applications which require full-time PTO operation. The PTO driven gear is in constant mesh with the drive gear and cannot be disengaged.
- **Clutch shift PTO**— Used in applications which require only part-time operation of the PTO or the capability to engage or disengage the driven equipment. Clutch shift PTO engagement/disengagement provision is accomplished by a hydraulic clutch mechanism in the PTO assembly. The PTO can be engaged or disengaged at any time (except when the PTO is controlled by the TCM).

4.2.2 PTO Engagement—Slide Engagement Internal to PTO.

CAUTION: Only use "constant-mesh" PTOs. DO NOT use "manual shift" PTOs which engage/disengage with the PTO drive gear in the transmission or the transmission may be damaged. Only use PTOs where the sliding gear is within the PTO.

WARNING: If you leave the vehicle and the engine is running, the vehicle can move unexpectedly and you or others could be injured. DO NOT leave the vehicle with the engine running unless you have taken all of the following precautions:

- Shift the transmission to **N** (Neutral), **P** (Park), or **PB** (Auto-Apply Parking Brake).
- Make sure that the engine is at low idle (500–800 rpm).
- Apply the park brake or emergency brake and make sure it is properly engaged.
- Chock the wheels and take any other steps necessary to keep the vehicle from moving.

Engage the PTO drivetrain as follows:

1. With the vehicle stopped, put the shift selector in a forward range while keeping the service brakes applied.
2. Set the engine speed at idle.
3. Engage the PTO. If gears do not engage, release the brakes momentarily to allow slight vehicle movement. Engage the PTO. Repeat as needed until the PTO is engaged.
4. Shift to **N** (Neutral) and operate the PTO as needed.

Disengage the PTO drivetrain as follows:

1. Idle the engine

2. Set the brake.
3. Place the shift selector in a drive range, stopping the PTO-driven equipment.
4. Disengage the PTO.
5. Operate the vehicle in the normal manner.

4.2.3 PTO Engagement—Clutch Driven. The PTO will engage only when the PTO switch is on, the throttle position is low, and engine speed and output speed are within user-specified limits. If the PTO is controlled by the TCM, your vehicle may have a light on the dash that illuminates when the PTO is engaged.

CAUTION: Some vehicles "creep" in range at low vehicle speeds while maintaining a specified engine speed for PTO operation (e.g., paint stripers and feedlot trucks). DO NOT use the vehicle brakes to control vehicle speed during PTO operation. Use ONLY throttle to control both engine and vehicle speed when the transmission is in reverse or a forward range. Applying BOTH brakes and throttle will cause the transmission to overheat. Extended operation at elevated temperatures will damage the transmission.

CAUTION: Do not exceed the engagement and operational speed limits imposed on the driven equipment during the operation of the PTO. Exceeding the speed limits produces high hydraulic pressure in the PTO that can damage the PTO components. Consult the vehicle manufacturer's literature for these speed limits.

4.2.4 PTO Operation. The transmission operates in either converter mode or torque converter clutch mode. In converter mode, the torque converter (lockup) clutch is not engaged and the PTO is driven through the torque converter, producing a torque at the PTO drive gear that is always greater than the input torque, but less than engine rpm. In torque converter clutch mode, the torque converter (lockup) clutch is engaged, the PTO drivetrain is driven at engine rpm.

The PTO drive is normally in continuous converter mode operation when the transmission is in **P** (Park), **PB** (Auto-Apply Parking Brake), **R** (Reverse), **N** (Neutral), and **D** (Drive). Torque converter clutch operation in **N** (Neutral) is available for some applications. If the PTO is used with the transmission in **D** (Drive) or another forward range, transmission shifts (both converter/torque converter clutch mode shifts and shifts between gears) are based on the

automatic shift sequence of the transmission shift controls. PTO drive gear speed will be affected each time a shift occurs.

With the vehicle stopped and the engine at idle, PTO output speed is dependent upon the transmission gear selection:

- If the transmission is in **D** (Drive) or **R** (Reverse), the PTO output speed is zero.
- If the transmission is in **N** (Neutral), **P** (Park), or **PB** (Auto-Apply Parking Brake), the PTO output will rotate.

In some vehicles, the transmission shifts into **N** (Neutral) regardless of the shift selector position under the following conditions:

- The PTO is requested
- The transmission output speed is near zero
- The throttle position is near zero

To reselect a range after the PTO is turned off, the operator must shift into **N** (Neutral), then shift to the desired range.

CAUTION: Do not exceed the engagement and operational speed limits imposed on the driven equipment during the operation of the PTO. Exceeding the speed limits produces high hydraulic pressure in the that can damage the PTO components. Consult the vehicle manufacturer's literature for these speed limits.

CAUTION: When PTO disengagement occurs due to an overspeed condition, the PTO will automatically re-engage at a lower, user-specified speed. Re-engaging the PTO at a high speed can cause re-engagement shock that could damage a high-inertia PTO-driven system. PTO re-engagement speed parameters must be set by qualified, Allison trained personnel.

4.2.5 PTO Overspeed Protection. All 1000 and 2000 Product Families-equipped vehicles with PTO request have engagement and operational speed limits programmed into the TCM to help protect PTO equipment. The PTO deactivates when operational speeds (either engine or transmission output) are exceeded. When the PTO is disengaged due to overspeed, the PTO will be automatically re-engaged at a user specified speed, which is relatively low.

4.3 SPLIT-SHAFT POWER TAKEOFF (PTO)

For many split-shaft PTOs, holding the transmission in direct drive at all engine speeds is desirable. In this manner, the automatic range shifts are eliminated, thereby eliminating rapid torque changes which would occur at the driven equipment during a shift in the transmission. Such a condition, for instance, could create an undesirable pressure surge (and directional control problem) at the nozzle-end of a fire hose.

NOTE: Beginning with Allison 4th Generation Controls, the Rugged Duty Series transmission models have a control provision that supports a split-shaft PTO application. This function will allow for **THIRD** range lockup operation only. Consult your Allison distributor for additional requirements and operational information associated with this feature.

5.0 PROGNOSTICS

5.1 1000 AND 2000 PRODUCT FAMILIES SERVICE PROGNOSTICS

Prognostics are used to predict the need for transmission maintenance. Service prognostics were introduced with MY09 vehicles and require the use of Allison-approved TES 295 fluids and Control Main Filter P/N 29539579. MY09 Prognostics were offered as a package to Original Equipment Manufacturers (OEMs) as an option (refer to the following caution for vehicles not equipped for Prognostics). Starting in January 2010, the Service Prognostics package requires the use of Allison-approved TES 295 or TES 389* fluids and Control Main Filter P/N 29539579. Transmission operating parameters monitored by the prognostics feature are:

1. Oil Life Monitor
2. Filter Life Monitor
3. Transmission Health Monitor

NOTE: If you are unable to determine whether your vehicle has Prognostics enabled, consult with your OEM service department or an authorized Allison distributor or dealer.

When a specified service threshold is detected for one of these parameters, the **TRANS SERVICE** indicator is illuminated to alert the operator to the need for action. Failure to attend to the service condition and reset the **TRANS SERVICE** indicator within a defined operating period will result in the illumination of the **CHECK TRANS** indicator (in addition to the **TRANS SERVICE** light), indicating the increased probability that the service condition may/will develop into a more serious condition.

The process for resetting the **TRANS SERVICE** indicator varies for each feature and is described in each of the following sections. Use the Universal Allison DOC® to review the current status of any of these features and a history of indicator resets.

* TES 389 fluids can only be used with Prognostics on January 2010 (or later) transmissions and calibrated TCMs.

CAUTION: Transmission Prognostics features may be turned **ON** or **OFF** by a special transmission calibration and **REQUIRES** the use of Allison approved TES 295 and TES 389 fluids. If any other fluids are used, prognostic features must be turned **OFF**. Prognostic information will not be accurate with the use of any other transmission fluids and could result in improper maintenance activities resulting in transmission damage. If Prognostics is not programmed or is turned **OFF**, the kilometers (miles)/hours/months method of determining fluid and filter change intervals will apply. See charts in the CARE AND MAINTENANCE section of your Operator's Manual or visit *www.allisontransmission.com* for a list of Allison -approved TES fluids or read Service Tips 1099 (current revision) for details.

5.2 OIL LIFE MONITOR

The **TRANS SERVICE** indicator will be illuminated, denoting a required change of the transmission fluid, when the remaining fluid life reaches approximately 2 percent (the parameter begins at 100 percent moving downward towards the lowest threshold). The **TRANS SERVICE** indicator will be lit steadily upon each initialization of the TCM, and will remain on steady for approximately two minutes after the initial selection of a drive range, until service is performed and the indicator is reset.

The **TRANS SERVICE** indicator can be reset with the Universal Allison DOC®. It may also be reset by selecting **N-D-N-D-N-R-N** on the shift selector, pausing briefly (less than 3 seconds) between each selector movement, with the ignition on and the engine not running. More details are provided in applicable Allison service literature for your specific transmission model.

Failure to perform maintenance and reset the **TRANS SERVICE** indicator within the next 100 hours of transmission operation will result in the illumination of the **CHECK TRANS** indicator (in addition to the **TRANS SERVICE** light). Any time this light is illuminated, the TCM will register a diagnostic code, which will require the use ofUniversal Allison DOC® to clear the code.

In addition to viewing diagnostic codes, the Universal Allison DOC® may also be used to display the amount of transmission operation from the initial service indication until the service reset.

5.3 FILTER LIFE MONITOR

The **TRANS SERVICE** indicator flashes beginning with the first TCM initialization after reaching the time and mileage parameters, indicating that the filter has reached the end of its designed life. The indicator continues

NMC-WOLLARD 2021Truax Blvd., Eau Claire, WI 54703, Phone (715) 835-3151, Fax (715) 835-6625
M1140 Tow Tractor Manual No. 46054

to flash for two minutes after **D** (Drive) has been selected. Thereafter, the indicator illuminates and flashes upon each TCM initialization, continuing to flash for two minutes after the selection of **D** (Drive) each time, until service is performed and the indicator is reset.

The **TRANS SERVICE** indicator can be reset with the Universal Allison DOC®. It may also be reset by selecting **N-D-N-D-N-R-N** on the shift selector, pausing briefly (less than 3 seconds) between each selector movement, with the ignition on and the engine not running. More details are provided in applicable Allison service literature for your specific transmission model.

Failure to perform maintenance and reset the **TRANS SERVICE** indicator after an additional 100 hours of transmission operation will result in the illumination of the **CHECK TRANS** indicator (in addition to the **TRANS SERVICE** light). Any time this light is illuminated, the TCM will register a DTC, which requires the use ofUniversal Allison DOC® to clear the code.

In addition to viewing diagnostic codes, theUniversal Allison DOC® may also be used to display the amount of transmission operation from the initial service indication until the service reset.

5.4 TRANSMISSION HEALTH MONITOR

The **TRANS SERVICE** indicator will be illuminated, indicating the need for clutch maintenance, when the remaining clutch life reaches approximately 10 percent, or if the running clearance exceeds a maximum value which may indicate a non-wear-related issue. The indicator will be lit steadily upon initialization of the TCM, and will remain on steady at all times, continuing to operate in this manner until service is performed and the indicator is reset. If reset does not occur within 100 hours, the **CHECK TRANS** indicator will be illuminated (in addition to the **TRANS SERVICE** light) and the TCM will register a DTC.

The indicator will reset automatically upon elimination of the clutch clearance condition which initiated it. The indicator can also be reset using theUniversal Allison DOC® if necessary.

TheUniversal Allison DOC® may be used to display the amount of transmission operation from the initial service indication until the service reset.

6.0 CARE AND MAINTENANCE

6.1 PERIODIC INSPECTIONS AND CARE

6.1.1 Transmission Inspection.

CAUTION: Do not spray steam, water, or cleaning solution directly at electrical connectors or the breather. Fluids forced into electrical connectors can cause false codes and cross-talk. Steam, water, or cleaning solution forced into the breather will contaminate the transmission fluid. Seal all openings, the breather, and electrical connections before spraying steam, water, or cleaning solution on the transmission.

Clean and inspect the exterior of the transmission at regular intervals. Severity of service and operating conditions determine the frequency of these inspections. Inspect the transmission for the following:

- Loose bolts—transmission and mounting components
- Fluid leaks—repair immediately
- Loose, dirty, or improperly adjusted throttle sensor or shift selector linkage
- Damaged or loose hoses
- Worn, frayed, or improperly routed electrical harnesses
- Worn or damaged electrical connectors
- Worn or out-of-phase driveline U-joints and slip fittings
- Clogged or dirty breather

6.1.2 Vehicle Inspection. Check the vehicle cooling system occasionally for evidence of transmission fluid (which would indicate a faulty oil cooler) and for blocked or restricted air flow through the radiator or transmission cooler.

6.1.3 Welding.

CAUTION: When welding on the vehicle:

- DO NOT WELD on the vehicle without disconnecting all control system wiring harness connectors from the TCM.
- DO NOT WELD on the vehicle without disconnecting TCM battery power and ground leads.
- DO NOT WELD on any control components.
- DO NOT CONNECT welding cables to any control components.
- PROTECT CONTROL COMPONENTS FROM SPARKS AND HEAT DURING WELDING.

A label describing on-vehicle welding precautions (ST2067EN) is available from your authorized Allison service dealer and should be installed in a conspicuous place. A vehicle used in a vocation that requires frequent modifications or repairs involving welding **must** have an on-vehicle warning label.

6.2 IMPORTANCE OF PROPER TRANSMISSION FLUID LEVEL

Transmission fluid cools, lubricates, and transmits hydraulic power. Always maintain proper fluid level. If fluid level is too low, the torque converter and clutches do not receive an adequate supply of fluid and the transmission overheats. If the fluid level is too high, the fluid aerates—causing the transmission to shift erratically and overheat. Fluid may be expelled through the breather or dipstick tube when the fluid level is too high.

6.3 TRANSMISSION FLUID CHECK

WARNING: For vehicles containing 1000 RDS, 2200 RDS, 2350 RDS, and 2550 RDS transmissions with **P** (Park) selector position, follow this procedure each time the operator's station will be unoccupied with the engine running:

1. Bring the vehicle to a complete stop using the service brake.
2. Make sure the engine is at low idle rpm.
3. Put the transmission in **P** (Park).
4. Engage the park pawl by slowly releasing the service brake.
5. If a parking brake is present, apply the parking brake. Make sure the parking brake is properly engaged.
6. Apply the emergency brakes and make sure they are properly engaged.
7. Chock the wheels and take any other steps necessary to keep the vehicle from moving.

If this procedure is not followed, the vehicle can move unexpectedly and cause injury and/or property damage.

WARNING: For vehicles containing 2100 RDS, 2300 RDS, and 2500 RDS transmissions with **PB** (Auto-Apply Parking Brake) selector position, follow this procedure each time the operator's station will be unoccupied with the engine running:

1. Bring the vehicle to a complete stop using the service brake.
2. Make sure the engine is at low idle rpm.
3. Put the transmission in **PB** (Auto-Apply Parking Brake). Make sure the parking brake is properly engaged.
4. Apply the emergency brakes and make sure they are properly engaged.
5. Chock the wheels and take any other steps necessary to keep the vehicle from moving.

If this procedure is not followed, the vehicle can move unexpectedly and cause injury and/or property damage.

WARNING: For vehicles containing 1000 and 2000 Product Families transmissions without either **P** (Park) or **PB** (Auto-Apply Parking Brake) selector positions, each time you park the vehicle or leave the operator's station with the engine running, do the following:

1. Bring the vehicle to a complete stop using the service brake.
2. Make sure the engine is at low idle rpm.
3. Put the transmission in **N** (Neutral).
4. Apply the emergency brakes and/or parking brake and make sure they are properly engaged.
5. If the operator's station will be unoccupied with the engine running, chock the wheels and take any other steps necessary to keep the vehicle from moving.

If this procedure is not followed, the vehicle can move unexpectedly and cause injury and/or property damage.

6.3.1 Fluid Check Procedure. Clean all dirt from around the end of the fluid fill tube before removing the dipstick. Do not allow dirt or foreign matter to enter the transmission. Dirt or foreign matter in the hydraulic system may cause undue wear of transmission parts, make valves stick, and clog passages. Check the fluid level using the following procedure and report any abnormal fluid levels to your service management.

6.3.2 Cold Check Procedure. The purpose of the cold check is to determine if the transmission has enough fluid to be operated safely until a hot check can be made.

CAUTION: The fluid level rises as fluid temperature rises. DO NOT fill the transmission above the COLD CHECK band if the transmission fluid is below normal operating temperatures. During operation, an overfull transmission can become overheated, leading to transmission damage.

Check the fluid level as follows:

1. Bring the vehicle to a complete stop on a level surface using the service brake.
2. Make sure the engine is at low idle rpm (with fast idle disabled).
3. Put the transmission in **P** (Park), **PB** (Auto-Apply Parking Brake), or **N** (Neutral).

4. Apply any other parking brake, if present, and make sure it is properly engaged.
5. Chock the wheels and take any other steps necessary to keep the vehicle from moving.
6. Run the engine at 1000–1500 rpm for at least one minute to purge air from the system. Apply the service brakes and shift to **D** (Drive), then to **N** (Neutral), and then shift to **R** (Reverse) to fill the hydraulic system. Finally, shift to **P** (Park) or **PB** (Auto-Apply Parking Brake), if available, or **N** (Neutral) and allow the engine to idle (500-800 rpm). Slowly release the service brakes.
7. With the engine running, remove the dipstick from the tube and wipe the dipstick clean.
8. Insert the dipstick into the tube and remove. Check the fluid level reading. Repeat the check procedure to verify the reading.
9. If the fluid level is within the "COLD CHECK" band (refer to Figure 6–1), the transmission may be operated until the fluid is hot enough to perform a "HOT RUN" check. If the fluid level is not within the COLD CHECK"" band, add or drain as necessary to bring it to the middle of the "COLD CHECK" band.
10. Perform a hot check at the first opportunity after the normal operating sump temperature of 71°C–93°C (160°F–200°F) is reached.

6.3.3 Hot Check Procedure.

CAUTION: When performing the Hot Check procedure, the fluid must be at operating temperature to be sure of an accurate check and help prevent transmission damage. The fluid rises as temperature increases. During operation, an overfull transmission can become overheated, leading to transmission damage.

NOTE: If a transmission temperature gauge is not present, check fluid level when the engine water temperature gauge has stabilized and the transmission has been operated under load for at least one hour.

Operate the transmission in **D** (Drive) until the following normal operating temperatures are reached:

- **Sump temperature**—71°C–93°C (160°F–200°F)
- **Converter-out temperature**—82°C–104°C (180°F–220°F)

Figure 6–1. Typical Dipstick Markings

Check the fluid level as follows:

1. Bring the vehicle to a complete stop on a level surface using the service brake.
2. Make sure the engine is at low idle rpm (with fast idle disabled).
3. Put the transmission in **P** (Park), **PB** (Auto-Apply Parking Brake), or **N** (Neutral).
4. Apply any other parking brake, if present, and make sure it is properly engaged.
5. Chock the wheels and take any other steps necessary to keep the vehicle from moving.
6. With the engine running, remove the dipstick from the tube and wipe the dipstick clean.
7. Insert the dipstick into the tube and remove. Check the fluid level reading. Repeat the check procedure to verify the reading.

NOTE: Safe operating level is within the "HOT RUN" band on the dipstick (refer to Figure 6–1). The width of the "HOT RUN" band represents approximately 1.0 liter (1.06 quart) of fluid at normal operating sump temperature.

8. If the fluid level is not within the "HOT RUN" band, add or drain as necessary to bring the fluid level to within the "HOT RUN" band.

6.3.4 Consistency of Readings. Always check the fluid level at least twice using the procedure described above. Consistency (repeatable readings) is important to maintaining proper fluid level. If inconsistent readings persist, check the transmission breather to be sure it is clean and unclogged. If readings are still inconsistent, contact your nearest Allison distributor or dealer.

6.4 KEEPING FLUID CLEAN

Prevent foreign material from entering the transmission by using clean containers, fillers, etc. Lay the dipstick in a clean place while filling the transmission.

CAUTION: Containers or fillers that have been used for antifreeze solution or engine coolant must NEVER be used for transmission fluid. Antifreeze and coolant solutions contain ethylene glycol which, if put into the transmission, can cause the clutch plates and some seals to fail.

6.5 FLUID RECOMMENDATIONS

Hydraulic fluids (oils) used in the transmission are important influences on transmission performance, reliability, and durability. Any fluids meeting Schedule 1 TES 389 or TES 295 specifications are acceptable for use in the 1000 and 2000 Product Families transmissions.

To make sure the fluid is qualified for use in Allison transmissions, check for a Schedule 1 TES 389 or TES 295 fluid license or approval numbers on the container, or consult the lubricant manufacturer. Consult your Allison Transmission dealer or distributor before using other fluid types.

CAUTION: Disregarding minimum fluid temperature limits can result in transmission malfunction or reduced transmission life.

When choosing the optimum viscosity grade of fluid to use, duty cycle, preheat capabilities, and/or geographic location must be taken into consideration. The table below lists the minimum fluid temperatures at which the transmission may be safely operated without preheating the fluid. Preheat with auxiliary heating equipment or by running the equipment or vehicle with the transmission in **P** (Park) or **PB** (Auto-Apply Parking Brake), if available, or **N** (Neutral) for a minimum of 20 minutes before attempting range operation.

Table 6–1. Transmission Fluid Operating Temperature Requirements

	Ambient Temperature Below Which Preheat is Required	
Viscosity Grade	Celsius	Fahrenheit
TES 389	–25°	–13°
Allison approved TES 295	–35°	–31°

Shifting is inhibited and torque converter clutch mode is not reached until the transmission fluid operating temperature requirements have been met. Refer to Table 6–1. As the transmission reaches normal operating temperature, all shift ranges and the torque converter clutch mode begin to function.

6.6 TRANSMISSION FLUID AND FILTER CHANGE INTERVALS

CAUTION: Transmission fluid and filter change frequency is determined by the severity of transmission service. To help avoid transmission damage, more frequent changes can be necessary than recommended in the general guidelines when operating conditions create high levels of contamination or overheating.

6.6.1 Frequency.

NOTE: Fluid Exchanging Machines are not recommended or recognized due to variation and inconsistencies that may not guarantee removal of 100 percent of the used fluid.

NOTE: Change filters/fluid at or before recommended mileage, months, or hours have elapsed, whichever occurs first.

NOTE: Local conditions, severity of operation or duty cycle may require more or less frequent fluid change intervals that differ from the published recommended fluid change intervals of Allison Transmission. Allison Transmission recommends that customers use fluid analysis as the primary method for determining fluid change intervals. In the absence of a fluid analysis program the fluid change intervals listed in the charts should be used.

Severe Vocations are defined as vehicles experiencing duty cycles that require stopping more than once in a mile. General Vocations include all other vocations. Local conditions, severity of operation, or duty cycle may require more or less frequent fluid change intervals that differ from the published recommended fluid change intervals of Allison Transmission.

The following tables are given only as a general guide for fluid and filter change intervals.

Table 6–2. *Schedule 1.* Recommended Fluid and Filter Change Intervals using Allison Approved TES 389 Fluids †) *

Vocation	Fluid	Filters		
		Control Main	Internal	Lube/Auxiliary
General	80 000 km (50,000 Miles) 24 Months 2000 Hours	80 000 km (50,000 Miles) 24 Months 2000 hours	Overhaul	80 000 km (50,000 Miles) 24 Months 2000 hours
Severe	20 000 km (12,000 Miles) 6 Months 500 hours	20 000 km (12,000 Miles) 6 Months 500 hours	Overhaul	20 000 km (12,000 Miles) 6 Months 500 hours

†See *www.allisontransmission.com* for a list of Allison Approved TES 389 fluids.
*Filter Change Intervals, No Prognostics or when Prognostics is NOT Enabled/Turned OFF

Table 6–3. *Schedule 2.* Recommended Fluid and Filter Change Intervals using 100 Percent Concentration of Allison Approved TES 295 or TES 468 Fluids *

Vocation	Fluid	Filters		
		Control Main	Internal	Lube/Auxiliary
General	240 000 km (150,000 Miles) 48 Months 4000 hours	80 000 km (50,000 Miles) 24 Months 2000 hours	Overhaul	80 000 km (50,000 Miles) 24 Months 2000 hours
Severe	120 000 km (75,000 Miles) 36 Months 3000 hours	80 000 km (50,000 Miles) 24 Months 2000 hours	Overhaul	80 000 km (50,000 Miles) 24 Months 2000 hours

*Filter Change Intervals, No Prognostics or when Prognostics is NOT Enabled/Turned OFF

Table 6–4. *Schedule 3.* Recommended Fluid and Filter Change Intervals (Allison Prognostics "ON" with *MY2009 TCM Calibrations* Using 100 Percent Concentration of Allison Approved TES 295 or TES 468 Fluids) †

Vocation	Fluid*	Filters		
		Control Main**	Internal	Lube/Auxiliary
General or Severe	Change fluid when indicated by controller or 48 months, whichever occurs first.***	Change filter when indicated by controller or 48 months, whichever occurs first.	Overhaul	Change filter when indicated by controller or 48 months, whichever occurs first.

†REQUIRED - 100 Percent Concentration Allison Approved TES 295 or TES 468 Fluids and Allison Control Main Filter (P/N 29539579) - REQUIRED
*MY09 Allison Prognostics must only be used with Allison approved TES 295 or TES 468 fluid.
**Allison Prognostics must only be used with Allison Control Main Spin-on Filter P/N 29539579.
***If Prognostics is turned "OFF" or NOT calibrated in TCM, refer to Schedule 1 or 2 for fluid change intervals. Less than 100 percent concentration of TES 295 or TES 468 Allison approved fluids is considered a mixture and shall not be used with Prognostics or this change schedule.

Table 6–5. *Schedule 4.* Recommended Filter Change/Fluid Change Intervals — Prognostics "ON" in *MY2010 TCM Calibrations using TES 389 fluids* †

Vocation	Fluid*	Filters		
		Control Main**	Internal	Lube/Auxiliary
General or Severe	Change fluid when indicated by controller or 24 months, whichever occurs first.***	Change filter when indicated by controller or 24 months, whichever occurs first.	Overhaul	Change filter when indicated by controller or 24 months, whichever occurs first.

†This schedule to be used with MY2010 1000/2000 Product Family Transmissions and TES 389 fluids
*Allison Prognostics must only be used with Allison Control Main Spin-on Filter P/N 29539579.
**If Prognostics is turned "OFF" or NOT calibrated in TCM, refer to Schedule 1 for fluid change intervals.

Table 6–6. *Schedule 5.* Recommended Filter Change/Fluid Change Intervals — Prognostics "ON" in *MY2010 TCM Calibrations using TES 295 or TES 468 fluids* †

Vocation	Fluid	Filters		
		Control Main*	Internal	Lube/Auxiliary
General or Severe	Change fluid when indicated by controller or 48 months, whichever occurs first.**	Change filter when indicated by controller or 48 months, whichever occurs first.	Overhaul	Change filter when indicated by controller or 48 months, whichever occurs first.

†This schedule to be used with MY2010 1000/2000 Product Family Transmissions and TES 295 or TES 468 fluids.
*Allison Prognostics must only be used with Allison Control Main Spin-on Filter P/N 29539579.
**If Prognostics is turned "OFF" or NOT calibrated in TCM, refer to Schedule 2 for fluid change intervals.

6.6.2 Abnormal Conditions. Transmissions used in high cycle rate applications should use fluid analysis to be certain that a proper fluid change interval is established. Transmission fluid must be changed whenever there is evidence of dirt or a high temperature condition. A high temperature condition is indicated by the transmission fluid being discolored or having a strong odor, or by fluid analysis. Local conditions, severity of operation, or duty cycle may require more or less frequent fluid or filter change intervals.

6.6.3 Fluid Analysis. Transmission protection and fluid change intervals can be optimized by monitoring fluid oxidation according to the tests and limits shown in the following table. Fluid oxidation can be monitored through a fluid analysis firm and/or by using an oil analysis kit. Allison Transmission recommends that customers use fluid analysis as the primary method for determining fluid and filter change intervals. In the absence of a fluid analysis program the fluid change intervals listed in Schedules 1, 2, 3 or 4 should be followed.

- Fluid analysis firms—Consult your local telephone directory for fluid analysis firms. To make sure fluid analysis is consistent and accurate, use only one fluid analysis firm. Refer to the Technician's Guide for Automatic Transmission Fluid, GN2055EN, for additional information.
- Oil analysis kits, P/N 29537805, are available through your normal Allison Transmission parts source.

Refer to the Technician's Guide for Automatic Transmission Fluid, GN2055EN, for additional information.

Table 6–7. Fluid Oxidation Measurement Limits

Test	Limit
Viscosity	±25 percent change from new fluid
Total Acid Number	+3.0 * change from new fluid

*mg of KOH required to neutralize a gram of fluid.

6.7 TRANSMISSION FLUID CONTAMINATION

6.7.1 Fluid Examination. At each fluid change, examine the drained fluid for evidence of dirt or water. A normal amount of condensation (not to exceed 0.2 percent maximum) will appear in the fluid during operation.

6.7.2 Water. Obvious water contamination of the transmission fluid or transmission fluid in the cooler water (in heat exchanger) indicates a leak between the water and fluid areas of the cooler. Inspect and pressure test the cooler to confirm the leak. Replace leaking coolers.

NOTE: Cooler water can also be contaminated by engine oil; be sure to locate the correct source of cooler water contamination.

6.7.3 Engine Coolant.

CAUTION: If the transmission fluid is contaminated by water, not to exceed 0.2 percent maximum by volume, or any trace of ethylene glycol, disassemble the transmission and replace the following:

- Seals
- Gaskets
- Clutch/Friction plates
- Bearings
- Torque converters that cannot be disassembled
- Components that have rusted
- Solenoids that do not meet resistance specifications
- Pressure switch manifold (PSM)
- Internal Mode Switch (IMS)

Remove all traces of ethylene glycol and varnish deposits. Failure to follow this procedure decreases transmission reliability and durability.

6.7.4 Metal. Metal particles in the fluid (except for the minute particles normally trapped in the oil filter) indicate internal transmission damage. If these particles are found in the sump, the transmission must be disassembled and closely inspected to find their source. Metal contamination requires complete transmission disassembly. Clean all internal and external hydraulic circuits, cooler, and all other areas where the particles could lodge.

CAUTION: After flushing the cooler, be sure to check cooler circuit restriction. If circuit pressure drop is above specification, the cooler has excessive trapped particles and must be replaced. Excessive pressure drop impedes transmission cooling which can cause overheating and transmission damage.

NOTE: When equipment to flush the oil cooler is not available, install a filter in the cooler line between the oil cooler and the transmission "from cooler" port. The cooler circuit pressure drop specifications must still be met (see AS64–072 in the Allison Tech Data book). Frequent initial changes of this filter element may be required as debris is flushed out of the oil cooler circuit. Closely monitoring change in cooler circuit pressure drop will indicate when a filter change is needed.

6.8 TRANSMISSION FLUID AND FILTER CHANGE PROCEDURE

6.8.1 Drain Fluid.

1. Drain the fluid when the transmission is at normal operating sump temperature of 71–93°C (160–200°F). Hot fluid flows quicker and drains more completely.
2. Remove the drain plug from the oil pan and allow the fluid to drain into a suitable container.
3. Examine the fluid as described in the 6.3 TRANSMISSION FLUID CHECK paragraph in this Section.

6.8.2 Replace Control Main Filter.

1. Using a standard strap-type filter wrench or the J–45023 Filter Wrench tool, remove the control main filter (Figure 6–2) by rotating it in the counterclockwise direction.
2. Remove the magnet from the filter attachment tube or from the top of the filter element.

3. Clean any metal debris from the magnet. Report any metal pieces larger than dust to your maintenance personnel.
4. Reinstall the magnet onto the filter attachment tube.
5. Lubricate the gasket on the control-main filter with transmission fluid.
6. Install, by hand, the control-main filter until the gasket on the control-main filter touches the converter housing or cooler manifold.
7. Using the J-45023 Filter Wrench tool or by hand, turn the filter ONE FULL TURN ONLY after gasket contact.

CAUTION: Turning the control-main filter more than ONE FULL TURN after gasket contact will damage the filter.

8. Reinstall the drain plug and sealing washer. Tighten the drain plug to 30–40 N·m (22–30 lb ft).

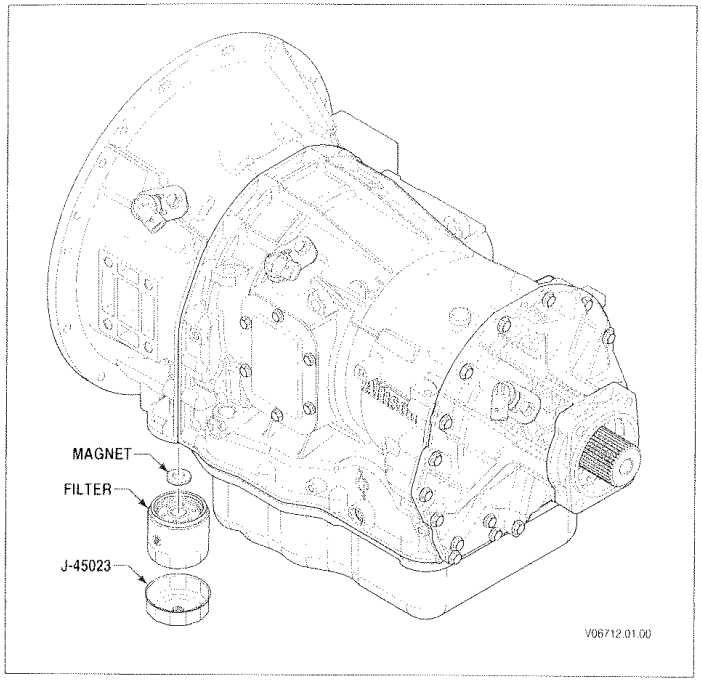


Figure 6–2. Replacing the Control Main Filter

6.8.3 Refill Transmission. The amount of refill fluid is less than the amount used for the initial fill. Fluid remains in the external circuits and transmission cavities after draining the transmission.

After refill, check the fluid level using the 6.3 TRANSMISSION FLUID CHECK paragraph of this Manual.

NOTE: Quantities listed are approximations and do not include external lines and cooler hose.

Table 6–8. Transmission Fluid Capacity

Transmission	Sump	Initial Fill		Refill	
		Liters	Quarts	Liters	Quarts
Rugged Duty Series	Standard	14	14.8	10	10.6

6.9 BREATHER

6.9.1 Location and Purpose. The vent assembly is located at the top left-rear of the transmission main housing (refer to Figure 1–3). The vent assembly prevents air pressure buildup within the transmission and its passage must be kept clean and open.

CAUTION: Do not spray steam, water, or cleaning solution directly at the vent assembly (breather). Spraying steam, water, or cleaning solution at the vent assembly can force the water or cleaning solution into the transmission and contaminate the transmission fluid. Seal all openings and the vent assembly (breather) before spraying steam, water, or cleaning solutions on the transmission.

6.9.2 Maintenance. The amount of dust and dirt encountered determines the frequency of vent assembly cleaning. Use care when cleaning the transmission.

7.0 DIAGNOSTICS

7.1 DIAGNOSTIC CODES AND TOOLS

The illumination of the **CHECK TRANS** indicator or **MIL** any time after start-up indicates that the TCM has registered a DTC. DTCs are used to identify the nature of a malfunction.

Use any Allison DOC® diagnostic tool to access DTCs and troubleshoot transmission complaints.

The following Allison DOC® diagnostic tools are available:

- Universal Allison DOC® – full feature service tool.
- Allison DOC® For Fleets–Service Tool – diagnostic only.

For more information regarding Allison DOC® diagnostic tools, please visit *www.allisontransmission.com*– Click on "Service" and then click on "Diagnostic Tools".

For additional help, **contact an authorized Allison Transmission distributor or service dealer or the Allison Technical Assistance Center at 800-252-5283.** Refer to the Sales and Service Directory (SA2229EN) or use the Allison Transmission Sales and Service Locator Tool on the Allison Transmission web site at *www.allisontransmission.com* for current Allison Transmission authorized distributors and service dealers.

8.0 CUSTOMER SERVICE

8.1 OWNER ASSISTANCE

The satisfaction and goodwill of the owners of Allison transmissions are of primary concern to Allison Transmission, Inc., its distributors, and their dealers.

As an owner of an Allison transmission, you have service locations throughout the world that are eager to meet your parts and service needs with:

- Expert service by trained personnel.
- Emergency service 24 hours a day in many areas.
- Complete parts support.
- Sales teams to help determine your transmission requirements.
- Product information and literature.

Normally, any situation that arises in connection with the sale, operation, or service of your transmission will be handled by the distributor or dealer in your area. Check the telephone directory for the Allison Transmission service outlet nearest you or use Allison Transmission's Sales and Service Locator tool on the Allison Transmission website at *www.allisontransmission.com*. You may also refer to Allison Transmission's Worldwide Sales and Service Directory (SA2229EN).

We recognize, however, that despite the best intentions of everyone concerned, misunderstandings may occur. To further assure your complete satisfaction, we have developed the following three-step procedure to be followed in the event a problem has not been handled satisfactorily.

Step One—Discuss your problem with a member of management from the distributorship or dealership. Frequently, complaints are the result of a breakdown in communication and can be resolved quickly by a member of management. If you have already discussed the problem with the Sales or Service Manager, contact the General Manager. All Allison Transmission, Inc. dealers are associated with an Allison Transmission, Inc. distributor. If the problem originates with a dealer, explain the matter to a management member of the distributorship with whom the dealer has his service agreement. The

dealer will provide his Allison Transmission distributor's name, address, and telephone number on request.

Step Two—When it appears the problem cannot be readily resolved at the distributor level without additional assistance, **contact the Allison Technical Assistance Center at 800-252-5283.** They will place you in contact with the Regional Customer Support Manager for your area.

For prompt assistance, please have the following information available:

- Name and location of authorized distributor or dealer.
- Type and make of vehicle/equipment.
- Transmission model number, serial number, and assembly number (if equipped with electronic controls, also provide the TCM assembly number).
- Transmission delivery date and accumulated miles and/or hours of operation.
- Nature of problem.
- Chronological summary of your transmission's history.

Step Three—If you are still not satisfied after contacting the Regional Customer Support Manager, **present the entire matter to the Home Office by writing to the following address:**

Allison Transmission
Attn: Manager, Warranty Administration
PO Box 894, Mail Code PF9
Indianapolis, IN 46206-0894

The inclusion of all pertinent information will assist the Home Office in expediting the matter.

When contacting the Home Office, please keep in mind that ultimately the problem will likely be resolved at the distributorship or dealership using their facilities, equipment, and personnel. Therefore, it is suggested that **Step One** be followed when experiencing a problem.

Your purchase of an Allison Transmission product is greatly appreciated, and it is our sincere desire to assure complete satisfaction.

8.2 SERVICE LITERATURE

Allison Transmission, Inc. service literature provides fully illustrated instructions for operation, maintenance, troubleshooting, service, overhaul, and parts support for your transmission. For maximum performance and

service life from your unit, you may order additional publications via fax, phone or web.

FAX: 317-471-4996
TOLL FREE: 888-666-5799
INTERNATIONAL: 317-471-4995
www.allisontransmissionpublications.com

NOTE: Surcharge will be applied for orders placed via phone or FAX

For more information about Allison products please visit *www.allisontransmission.com*.

8.3 ALLISON TRANSMISSION DISTRIBUTORS

NOTE: For a complete and up-to-date listing of Allison Transmission Service Centers, go to *www.allisontransmission.com/sales-service-locator*

EASTERN REGION

Atlantic Detroit Diesel-Allison, LLC
19 C Chapin Road
Pine Brook, NJ 07058
973-575-0309

Clarke Power Services, Inc.
8015 Piedmont Triad Parkway
Greensboro, NC 27409
336-292-9240

Detroit Diesel-Allison Canada East Div. of Integrated Power Systems Corp.
2997 Avenue (rue) Watt
Quebec, Quebec G1X 3W1
418-651-5371

Florida Detroit Diesel-Allison, Inc.
2277 N.W. 14th Street
Miami, FL 33125-0068
305-638-5300

Harper Power Products, Inc.
10 Diesel Drive
Toronto, Ontario M8W 2T8
416-259-3281

Johnson & Towers, Inc.
2021 Briggs Road
Mount Laurel, NJ 08054
856-234-6990

New England Detroit Diesel-Allison, Inc.
90 Bay State Road
Wakefield, MA 01880-1095
781-246-1810

Penn Detroit Diesel-Allison, LLC
8330 State Road
Philadelphia, PA 19136-2986
215-335-0500

Western Branch Diesel, Inc.
3504 Shipwright Street
Portsmouth, VA 23703
757-673-7000

CENTRAL REGION

Central Power Systems & Services, Inc.
9200 Liberty Drive
Liberty, MO 64068
816-781-8070

Clarke Power Services, Inc.
3133 East Kemper Road
Cincinnati, OH 45241
513-771-2200

Inland Power Group, Inc.
13015 West Custer Avenue
Butler, WI 53007-0916
262-781-7100

Interstate Power Systems, Inc.
2501 American Boulevard, East
Minneapolis, MN 55425
952-854-5511

Stewart & Stevenson Power Products, LLC
1000 Louisiana, Suite 5900
Houston, TX 77002
713-751-2600

United Engines, LLC
5555 West Reno Street
Oklahoma City, OK 73127
405-947-3321

Waterous Power Systems (A Division of Integrated Power Systems Corp.)
10025 – 51 Avenue
Edmonton, Alberta T6E OA8
780-437-8200

W.W. Williams M.W., Inc.
1176 Industrial Parkway, North
Brunswick, OH 44212-2342
330-225-7751

W.W. Williams S.E., Inc.
3077 Moreland Avenue
Conley, GA 30288
404-366-1070

NOTES

MEXICO REGION

Detroit Diesel-Allison de Mexico S.A.de C.V.
Av. Santa Rosa No. 58 Col.
Ampliacion Norte
San Juan Ixtacala, Tlalnepantla C.P.
54160, Estado de Mexico
525-5-5333-1800

WESTERN REGION

ABC Transmissions, Ltd
9357 – 193rd Street
Surrey, British Columbia V4N 4E7
604-888-1211

Allison West
14775 Wicks Boulevard
San Leandro, CA 94577-6779
510-351-6101

Pacific Power Products Company
7215 South 228th Street
Kent, WA 98032
253-854-0505

Smith Power Products, Inc.
3065 West California Avenue
Salt Lake City, UT 84104
801-415-5000

Stewart & Stevenson Power Products, LLC
5170 E 58th Place
Commerce City, CO 80022
303-287-7441

Valley Power Systems, Inc.
425 South Hacienda Boulevard
City of Industry, CA 91745-1123
626-333-1243

W.W. Williams S.W., Inc.
2602 S. 19th Avenue
Phoenix, AZ 85009
602-257-0561

92

93