Spokane Industries
Spokane Metal Products Div.

SPOKANE METAL PRODUCTS

Spokane Washington

1000 GALLON DEFUELER ON TRAILER

TECHNICAL MANUAL

PARTS, OPERATION AND MAINTENANCE

1000 GALLON DEFUELER ON TRAILER

TECHNICAL MANUAL

PARTS, OPERATION AND MAINTENANCE

INDEX

1.0 INTRODUCTION

1.1 **To obtain optimum benefit from your equipment, it is recommended that all personnel operating it read and understand this manual prior to operation.**

1.2 **Upon receipt of the unit, a visual inspection should be made to determine that it is complete and has not sustained any damage during transportation.**

2.0 SAFETY

2.1 **Potential Fire Or Explosion**

2.1.1 **Due to the nature of fuel, care should be exercised to eliminate all sparks and open flame in the area of the unit.**

2.1.2 **A 50 foot radius area around the unit for no smoking, sparks, or open flames is usually a good practice. It is strongly recommended all local or other regulations be consulted for further restrictions.**

2.2 **Parking Brake**

The parking brake should be activated when unit is in use or unattended.

2.3 **Grounding Reel**

To eliminate static sparks, the unit is equipped with A grounding reel which should be connected to ground prior to draining or filling

2.4 **Towing**
Make sure the trailer is securely attached to the towing vehicle.
Before moving the unit, check to assure the trailer parking brake is released.
Maximum allowable towing speed is 15 MPH.

2.7 Inspections

2.7.1 **Inspection of tires, undercarriage, tow hitch, valves, hoses, sight gauge, reflectors, lights safety labels, etc., should be inspected on a periodic basis. It is recommended these inspections be performed weekly.**

2.7.2 **Internal inspection will be necessary to insure structural integrity and cleanliness. It is recommended that interval inspections be performed at least every (6) six months.**
Caution! When entering confined spaces such as the interior of the tank, care should be taken to provide proper breathing equipment and a separate person dedicated solely to a safety watch of the person inside. It is strongly recommended that all local or other regulations be consulted.

3.0 OPERATION

3.1 Intended Use

The defueling unit is intended for use in draining and collection of fuel from aircraft and the transportation to a disposal site. Any other use is prohibited and may void any and all warranties.

3.2 Parking Brake

The unit is equipped with a mechanically operated parking brake. The brake should be applied prior to disengaging tow hitch and when filling, or draining tank, or whenever the trailer is left unattended. To activate pull lever handle 180 degrees from the handle mount bracket. To release push the lever handle toward the handle mount bracket.

3.3 Tires

Tire inflation should be checked and maintained as listed on the tire.

3.4 Before Towing

Before towing, check to see the parking brake is disengaged, grounding reel and hoses are disconnected, valves are closed, tow hitch is securely attached to the towing vehicle, and all manways and covers are closed and latched.

3.5 Start up

3.5.0 The unit is equipped with a self contained Viper 70 Air compressor, The compressor should be operated and maintained as per the Viper manual that is included in section 8

3.5.1 Start UP

1) Once the Compressor operation is understood, start by closing the relief/ball valve that comes off the outlet of the compressor
2) Next close the drain valve item # E and drain ball valve # D,
3) Close primary and secondary vacuum generator air inlet valves items # A and # B. making sure manway is closed and sealed.
4) Close Hose reel suction line ball valve # C.
5) Start the compressor per the viper instruction manual.
6) Once the compressor is running, open the relief/ball valve that comes off the outlet of the compressor
7) Open ball valve # A, Notice the Vacuum Generator turns on and creates a vacuum inside of the tank. Note:(The vacuum Governor item # F on top of the tank is factory set to open at 8"hg.)

3.5.2 1-1/4" x 50' Sump hose

1) To sump with the large 1-1/4" x 50' hose on the hose reel attach the nozzle of your choice to the hose, Then open ball valve # C. The hose is now able to vacuum
2) Once the tank fills to 92% of its volume the vacuum float shut off gasket closes the suction tank inlet shutting off the suction to the tank.
3) The Hannay hose reel is spring return loaded so the hose will retract. See Hannay Reels manual that is included in the maintance section.

3.5.3 SealVac™ standard suction plate

For operation and parts See the Universal Drain Manual section included At the back of this manual.

3.6 Vacuum Assembly

3.6.1 This assembly is equipped with an air powered vacuum generator.

3.6.2 It is intended for vacuum draining or depuddling fuel and condensation. Caution! If other objects such as rock or metallic pieces are vacuumed into the tank, they may create a hazard due to sparks.

3.6.3 Vacuum is started by attaching a recommended air supply of 60CFM at 100 PSI and turning on the air supply valve.

3.6.4 **The vacuum generator is equipped with an automatic overflow shut off. When the level of product is full, the float controlled valve shuts off and eliminates the vacuum.**
The tank must then be drained in order for vacuuming to continue.

3.6.6 **The vacuum assembly is equipped with (1) one each 1/2" NPT opening equipped with a self-closing quick disconnect. To operate, close vacuum suction valve and turn air supply on and connect ½" drain probe line.**

3.7 Grounding Reels

3.7.1 **The bowser unit is supplied with A grounding reel.**

3.7.2 **Before filling, draining, or vacuuming, the grounding reels must be attached to an appropriate ground.**

3.8 Drain Valves

3.8.0 **The unit is equipped with a 1-1/2" NPT ball valve with a camlock connector for draining**
3.7.1 **The emergency valve actuator item # 7 must be engaged in order to drain the tank.**

3.9 Other Operations

3.9.0 **See the following section (section 8) for manufactures operations on all purchased out components, such as the compressor, hose reel, trailer suspension, etc.**

4.0 MAINTENANCE

4.1 Tank

4.1.0 The tank is constructed from ASTM-A-240 T-304 Stainless steel, with a little care it will last for many years. Never use harsh chemicals such as chlorine, bromine, or acids for cleaning the Tank.

4.1.1 The exterior of the tank is coated with an automotive polyurethane finish that has excellent resistance to weather and fuels. This finish should be treated like any automotive finish, cleaned regularly with soap and water, and polished on an as needed basis.

4.2 Tandem Axle Trailer

4.2.0 The tandem axle trailer is constructed to last many years, and with a little care will operate smoothly.

4.2.1 For proper maintenance please refer to the Dexter Axle operation and service manual included within this manual.

4.3 Parking Brake

4.1.1 The trailer unit is equipped with a parking brake assembly consisting of drum brakes with a cable brake acutator
See the Dexter Axle manual included within this manual for more instructions.

4.4 Vacuum Generator

4.4.0 The vacuum generator is equipped with an overflow shut off valve with an Buna-Nitrile seal gasket that will need to be inspected whenever an internal tank inspection is performed. Replace as required.

4.4.1 Both the primary and secondary vacuum generators (see items # 4 and # 5) are equipped with an exhaust silencer which should be cleaned at least every six (6) months or more often depending on the amount of use and conditions.

4.4.2 The vacuum hose should be inspected monthly for cracks. Any sudden loss of vacuum suction power may indicate a crack in the vacuum hose.

4.5 Grounding Reels

4.5.0 **Grounding reel cables should be pulled out, cleaned and inspected monthly. Cable clamps and ends should be inspected for loose connections monthly.**

4.6 Vacuum Governor

4.6.0 **The Vacuum Governor is located inside the tank (see item # 3) It is pre set at the factory to relieve any vacuum inside the tank that exceeds 8"hg. There is a spring loaded Buna-Nitrile seal gasket that will need to be Inspected whenever an internal tank inspection is performed. Replace as required.**

4.7 Other Maintenance

4.7.0 **See the following section (section 8) for manufactures maintenance on all purchased out components, such as the compressor, hose reel, trailer suspension, etc.**

5.0 Drawings And Sketches

This section provides information for identification of items listed in this manual.

Drawing No. SK-914 Sheet 1 of 1 shows the complete unit

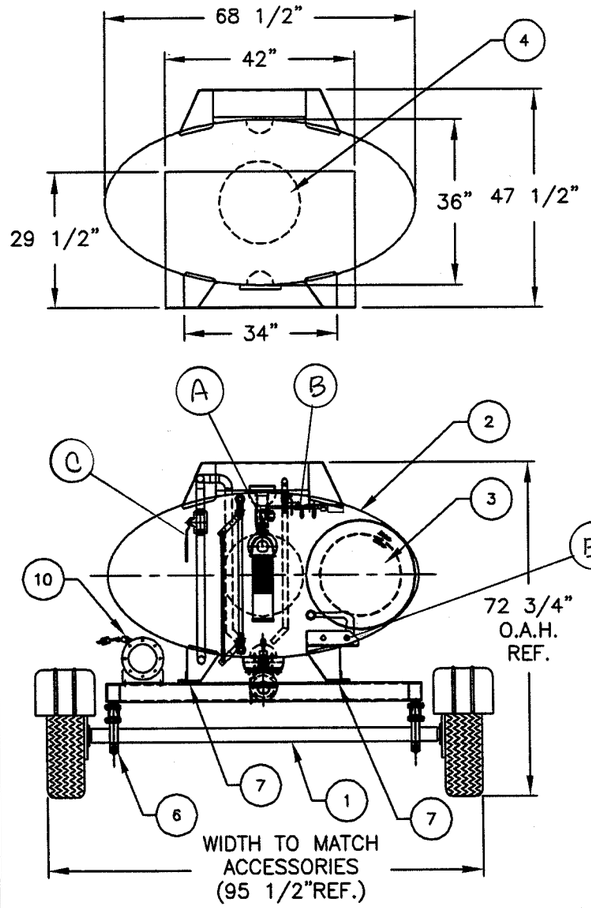
Drawing No. SMP-18929 Sheets 1 and 2 Show fabrication tank details

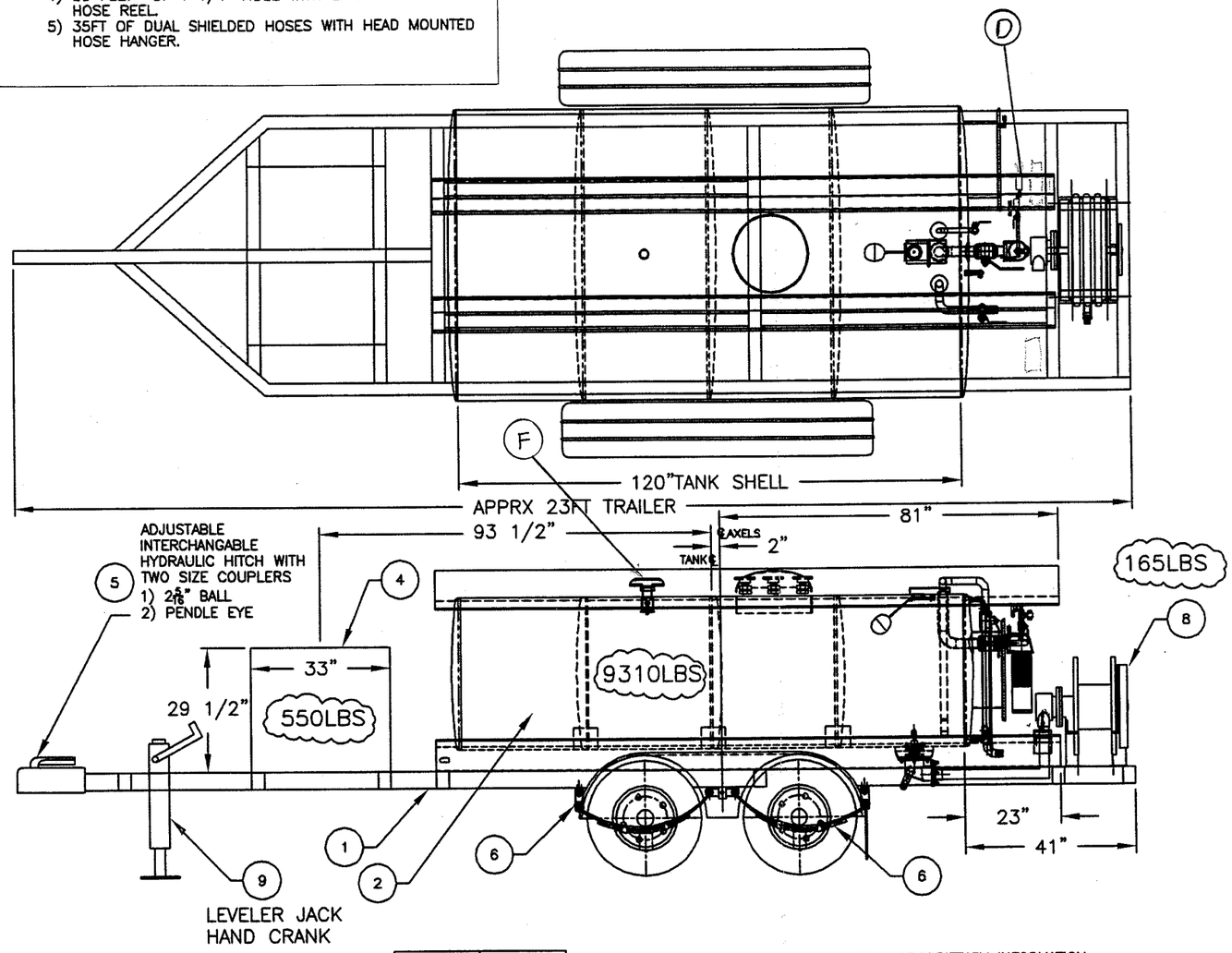
FABRICATE ONE (1) 1000 GALLON REFUELER ASSEMBLY

1) 1000 GALLON REFUELER TANK WITH:
   A) 3 INTERIOR BAFFLES.
   B) INTERNAL EMERGENCY VALVE W/REMOTE SHUT-OFF.
   C) 18" DOT 407 MANWAY.
   D) POLYURETHANE PAINT FINISH AND REFLECTOR TAPE RED W/YELLOW STRIPE AND 4"HIGH LETTERS.
2) 23 FOOT TANDEM-AXLE TRAILER (APPRX):
   A) BOTH AXLE HYDRAULIC BRAKING.
   B) DUAL RECIEVING TOW HITCH.
   C) GALVANIZED OR PAINTED.
3) LOCKABLE PUMP BOX WITH:
   A) AIR OPERATIONAL PUMP.
   B) POLYURETHANE PAINT FINISH AND REFLECTOR TAPE RED W/YELLOW STRIPE AND 4"HIGH LETTERS.
4) 50 FEET OF 1 1/4" HOSE WITH SPRING WOUND HOSE REEL.
5) 35FT OF DUAL SHIELDED HOSES WITH HEAD MOUNTED HOSE HANGER.

DRAWING/REVISION APPROVALS

SYMB.	DESCRIPTION	DWN. BY/DATE	ENG. MGR./DATE	Q.C. MGR./DATE
	ORIGINAL ISSUE	MDD/ 11-21-03		
A	MODIFIED PER REVIEW	MDD/ 12-16-03		
B	MODIFIED FOR FABRICATION NEEDS	MDD/ 2-11-04	KO/ 02-11-04	KO/ 02-11-04





ITEM	QTY.	M.O.D. SPEC. No.	DESCRIPTION	WGHT ESTIMATED MAT'L.	3818# WGHT.
10	1	2.5	STATIC REEL,100AMP AND 100FT CABLE,ML-2930-15	C/S	16#
9	1	2.3	TRAILER JACK	C/S	8#
8	1	2.5	1 1/4"-50FT AIRCRAFT HOSE REEL ASSEMBLY	-	60#
7	8	-	TANK MOUNTING PAD	RUB.	1#
6	4	2.3	LEAF SPRING	C/S	22#
5	1	2.3	DUAL RECIEVING TOW HITCH ASSEMBLY	C/S	26#
4	1	2.5	VANAIR VIPER ENGINE DRIVEN AIR COMPRESSOR	C/S	550#
3	1	-	DUAL SHIELDED SUCTION CUP HOSE ASSEMBLY	-	35#
2	1	-	1000 GALLON S/S JIFFY REFUELER	S/S	1800#
1	1	2.3	23FT TANDEM AXLE TRAILER ASSEMBLY (APPRX)	C/S	1300#

WORK ORDER
W/O: 18929

SALES ORDER
S/O: 9429

TOLS. EXCEPT AS NOTED
FRACT.= 1/8"
.XX =± .13"
.XXX =± .005"
ANG. =± 1°

SPOKANE INDUSTRIES
Metal Products Division
P.O.Box 3303, Spokane, WA 99220 (509) 928 0720

TITLE:
DUAL AXLE TRAILER ASSEMBLY
1000 GALLON REFUELER TANK
WITH 23FT TANDEM TRAILER ASSEMBLY (APPRX)

SIZE: A | DWG. No.: SK-914 | SCALE: N.T.S. | SHT 1 OF 1

6.0 REPLACEMENT PARTS

This section provides information for identification of parts for ordering. To order, it is important to have the Model Number, Subassembly Number, Part Number and Description. Parts may be ordered by calling or writing to:

SPOKANE METAL PRODUCTS
P.O. Box 3303
Spokane, WA 99220-3303
Telephone: (509)921-8867
Tele Fax:(509)927-0826

7.0 Warranty and Certificates

This section provides information for identification of items listed in this manual Including Warranty and other manufactures certificates.

SPOKANE METAL PRODUCTS

Spokane Washington
1000 GALLON defuler on tandem axle trailer
ONE YEAR LIMITED WARRANTY

Seller warrants its 1000 Gallon Fuel Drain Tank to be free from defects in material and workmanship under the normal use and service for which the unit is intended if, but only if the unit has been properly operated, maintained and stored in accordance with printed directions contained in the product manual. Our obligation under this Warranty shall be limited to the repair or exchange of equipment and parts which may prove defective within one year of the date the unit is put into service but shall in no event extend beyond a date three years from the date the unit is shipped from our plant. All transportation charges on parts returned to us for replacement under this warranty must be returned pre-paid.

This warranty does not extend to damage caused be environmental factors varying from normal design conditions, whether natural or man-made, or to units subjected to misuse, negligence or accident. This warranty likewise does not extend to the unit or any parts thereof which have been repaired or altered improperly or in any way so as to effect adversely its stability or reliability. This warranty does not cover parts or labor required to repair or replace parts whose usefulness is exhausted due to normal operation of the unit.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE NOT SET FORTH IN A WRITING SIGNED BY AN AUTHORIZED REPRESENTATIVE OR SELLER. SELLER SHALL IN NO EVENT BE LIABLE FOR ANY CONSEQUENTIAL LOSS OR DAMAGE RESULTING FROM THE USE OR LOSS OF USE OF THE UNIT.

SPOKANE HOUSE OF HOSE, INC.

Aircraft Refueling Hose

TEST CERTIFICATION

This AIRCRAFT REFUELING hose meets API Bulletin 1529 - 5th edition, and 1998 and N.F.P.A. Bulletin 407

CUSTOMER:	Spokane Metal Prod. / Spokane	
ASSEMBLY SERIAL NO.	HH-031104 / #55184	
HOSE SPECIFICATION:	Dayco Gold Label	
HOSE I.D.	1 1/4"	
WORKING PRESSURE:	300 psi	
TEST PRESSURE:	600 psi	
TYPE OF COUPLING:	H521-2 x H522-2 w/125A b/e	
MEGA OHM READING (M.R.)	.010 (MEGA OHMS)	R
ASSEMBLY LENGTH:	9"	L
COVER RESISTANCE	.003644 (MEGA OHMS/METER)	(R/L) x 3.28
ASSEMBLED DATE:	3/11/04	
DATE OF TEST:	3/11/04	

THIS HOSE ASSEMBLY WAS HYDROSTATICALLY TESTED TO 200% OF RECOMMENDED WORKING PRESSURE FOR 10 MINUTES AFTER COUPLINGS WERE ATTACHED.

SPOKANE HOUSE OF HOSE COUPLER

SPOKANE HOUSE OF HOSE, E.5520 SPRAGUE, SPOKANE, WA 99212

PH# 1-800-541-6351, LOCAL 535-3638, FAX# 1-800-541-4673

SPOKANE HOUSE OF HOSE, INC.

Aircraft Refueling Hose

TEST CERTIFICATION

This AIRCRAFT REFUELING hose meets API Bulletin 1529 - 5th edition, and 1998 and N.F.P.A. Bulletin 407

CUSTOMER:	Spokane Metal Prod. / Spokane	
ASSEMBLY SERIAL NO.	HH-031004 / #55004	
HOSE SPECIFICATION:	Goodyear Wingcraft	
HOSE I.D.	1 1/4"	
WORKING PRESSURE:	300 psi	
TEST PRESSURE:	600 psi	
TYPE OF COUPLING:	H522-2 w/125C b/e	
MEGA OHM READING (M.R.)	.005 (MEGA OHMS)	R
ASSEMBLY LENGTH:	50'	L
COVER RESISTANCE	.000328 (MEGA OHMS/METER)	(R/L) x 3.28
ASSEMBLED DATE:	3/10/04	
DATE OF TEST:	3/10/04	

THIS HOSE ASSEMBLY WAS HYDROSTATICALLY TESTED TO 200% OF RECOMMENDED WORKING PRESSURE FOR 10 MINUTES AFTER COUPLINGS WERE ATTACHED.

SPOKANE HOUSE OF HOSE COUPLER

SPOKANE HOUSE OF HOSE, E.5520 SPRAGUE, SPOKANE, WA 99212

PH# 1-800-541-6351, LOCAL 535-3638, FAX# 1-800-541-4673

SPOKANE HOUSE OF HOSE, INC.

Aircraft Refueling Hose

TEST CERTIFICATION

This AIRCRAFT REFUELING hose meets API Bulletin 1529 - 5th edition, and 1998 and N.F.P.A. Bulletin 407

CUSTOMER:	Spokane Metal Prod. / Spokane
ASSEMBLY SERIAL NO.	HH-030404 / #53182
HOSE SPECIFICATION:	GOODYEAR WINGCRAFT
HOSE I.D.	11/2"
WORKING PRESSURE:	300 psi
TEST PRESSURE:	600 psi
TYPE OF COUPLING:	Scovill H523-1 x H523-2 w/15C
MEGA OHM READING (M.R.)	.020 (MEGA OHMS) R
ASSEMBLY LENGTH:	32" L
COVER RESISTANCE	.02400 (MEGA OHMS/METER) (R/L) x 3.28
ASSEMBLED DATE:	3/4/04
DATE OF TEST:	3/4/04

THIS HOSE ASSEMBLY WAS HYDROSTATICALLY TESTED TO 200% OF RECOMMENDED WORKING PRESSURE FOR 10 MINUTES AFTER COUPLINGS WERE ATTACHED.

SPOKANE HOUSE OF HOSE COUPLER

SPOKANE HOUSE OF HOSE, E.5520 SPRAGUE, SPOKANE, WA 99212

PH# 1-800-541-6351, LOCAL 535-3638, FAX# 1-800-541-4673

SPOKANE HOUSE OF HOSE, INC.

Aircraft Refueling Hose

TEST CERTIFICATION

This AIRCRAFT REFUELING hose meets API Bulletin 1529 - 5th edition, and 1998 and N.F.P.A. Bulletin 407

CUSTOMER:	Spokane Metal Prod. / Spokane
ASSEMBLY SERIAL NO.	HH-030904 / #54452
HOSE SPECIFICATION:	Dayco Gold Label
HOSE I.D.	1 1/4"
WORKING PRESSURE:	300 psi
TEST PRESSURE:	600 psi
TYPE OF COUPLING:	Scovill H522-1 x H522-2 w/125A
MEGA OHM READING (M.R.)	.020 (MEGA OHMS) R
ASSEMBLY LENGTH:	26" L
COVER RESISTANCE	.03280 (MEGA OHMS/METER) (R/L) x 3.28
ASSEMBLED DATE:	3/9/04
DATE OF TEST:	3/9/04

THIS HOSE ASSEMBLY WAS HYDROSTATICALLY TESTED TO 200% OF RECOMMENDED WORKING PRESSURE FOR 10 MINUTES AFTER COUPLINGS WERE ATTACHED.

SPOKANE HOUSE OF HOSE COUPLER

SPOKANE HOUSE OF HOSE, E.5520 SPRAGUE, SPOKANE, WA 99212

PH# 1-800-541-6351, LOCAL 535-3638, FAX# 1-800-541-4673

MANUFACTURER'S

CERTIFICATE OF ORIGIN

Comes now the undersigned manufacturer and certifies the sale of the following described vehicle, this 17th day of Feb. 2004 on Invoice No. 9231

to Spokane Industries Inc./Spokane Metal Prod. Div.
(Distributor, Dealer, Etc.)

whose address is N. 3808 Sullivan Rd. #4 SIP
(Street, City and State)

Spokane, WA 99216

Trade Name TRAC PAC Year 04 Series or Model BT18

No. Axles 2 Length 18 Ft.

No. Wheels 4 Serial No. 196S182064ATP0489

Shipping Weight 1500# Mfg. License (WA) No. 6133

Said manufacturer hereby certifies that this written instrument constitutes the first conveyance of said vehicle after its manufacture and that the manufacturer's serial number set forth above has not been and will not be used by the manufacturer on any other vehicle manufactured by said manufacturer, and that there are no other manufacturer's certificates issued by the manufacturer for the vehicle described above.

IN WITNESS WHEREOF the manufacturer of the above described vehicle has hereunto set his hand and certifies that the statements contained in the foregoing manufacturer's certificate are true.

Any Change or Erasure On This Certificate Will Make It Void

METALITE INDUSTRIES, INC.
1805 W. 4th Ave.
Spokane, WA 99224
Phone: (509) 624-4333

By _____ Title Mgr

Name of Applicant for Title _____

Address _____

FIRST ASSIGNMENT

FOR VALUE RECEIVED, the undersigned hereby transfers this Statement of Origin and the motor vehicle described therein to _____

Address _____
and certifies that the vehicle is new and has not been registered in this or any other state: he also warrants the title of said motor vehicle at time of delivery, subject to the liens and encumbrances, if any, as set out below:

Amt. of Lien	Date	To Whom Due	Address

Dated _____, _____, at _____

_____ By: _____
Transferor (Firm Name) Sign Here Position

Dealer License (Permit) No. _____

Before me personally appeared _____ who by me being duly sworn upon oath says that the statements set forth above are true and correct.

Subscribed and sworn to before me this _____ day of _____, _____

_____ Notary Public for _____ County, State of _____
Notary Seal

SECOND ASSIGNMENT

FOR VALUE RECEIVED, the undersigned hereby transfers this Statement of Origin and the motor vehicle described therein to _____

Address _____
and certifies that the vehicle is new and has not been registered in this or any other state: he also warrants the title of said motor vehicle at time of delivery, subject to the liens and encumbrances, if any, as set out below:

Amt. of Lien	Date	To Whom Due	Address

Dated _____, _____, at _____

_____ By: _____
Transferor (Firm Name) Sign Here Position

Dealer License (Permit) No. _____

Before me personally appeared _____ who by me being duly sworn upon oath says that the statements set forth above are true and correct.

Subscribed and sworn to before me this _____ day of _____, _____

_____ Notary Public for _____ County, State of _____
Notary Seal

THIRD ASSIGNMENT

FOR VALUE RECEIVED, the undersigned hereby transfers this Statement of Origin and the motor vehicle described therein to _____

Address _____
and certifies that the vehicle is new and has not been registered in this or any other state: he also warrants the title of said motor vehicle at time of delivery, subject to the liens and encumbrances, if any, as set out below:

Amt. of Lien	Date	To Whom Due	Address

Dated _____, _____, at _____

_____ By: _____
Transferor (Firm Name) Sigh Here Position

Dealer License (Permit) No. _____

Before me personally appeared _____ who by me being duly sworn upon oath says that the statements set forth above are true and correct.

Subscribed and sworn to before me this _____ day of _____, _____

_____ Notary Public for _____ County, State of _____
Notary Seal

MANUFACTURED BY:
METALITE INDUSTRIES, INC.
SPOKANE, WASHINGTON

MFD. DATE: Feb. 2004

GVWR 5520 **KG (** 12168 **LB)**

GAWR ALL 5520 **KG (** 12168 **LB)**

TIRES LT235/85R16E

RIMS 16"

COLD PRES: 550 **KPA (** 80 **PSI) SINGLE**

THIS VEHICLE CONFORMS TO ALL APPLICABLE US FEDERAL MOTOR SAFETY STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE

VIN: 196S182064ATP0489

TYPE: TRAILER

MODEL: BT18

MAX LOAD CAPACITY: 10,663#

8.0 Other Manufactures O & M Manuals

This section provides information on any other manufactures products used.

8.0 Other Manufactures O & M Manuals

This section provides information on any other manufactures products used.

WARNING Read this Manual before installing, operating or working on this equipment. Failure to do so could result in bodily injury and/ or damage.

MANUAL FOR

COMPRESSOR MODEL

60/70/80 VIPER

Vanair Manufacturing Inc
19015 U S 12
New Buffalo MI 49117

Tel. 269-469-4461
800-526-8817
Fax 269-469-0497

POO220-1
12/23/02

WARRANTY – Viper

The rotary screw compressor unit is warranted by the manufacturer for three years against defects in materials and workmanship. The unit will be replaced or repaired at manufacturer's option as a result of such defects. This warranty does not cover damage caused by accident, misuse or negligence. If compressor unit is disassembled the warranty is void. All other parts including the compressor unit shaft seal are warranted for twelve months subject to the same conditions mentioned previously. Any and all such claims for warranty consideration must be coordinated through the Warranty-Service Department at the address below. Do Not return parts without prior authorization.

Warranty is limited to the supply of replacement parts failing within the warranty period. Credit for labor required to refit replacement parts is NOT included. On units supplied with engines, the Engine Manufacturer's Warranty will apply. Please refer to Engine Owner's Manual supplied.

Warranty will commence upon receipt of the Warranty Registration Card. If the Warranty Registration Card is not received within six months, then warranty commencement date shall be thirty days from the date of shipment from VANAIR.

This statement of warranty is expressly in lieu of and disclaims all other express warranties, implied warranties of merchantability and all other implied warranties which extend beyond the description on the face hereof. This warranty does not include incidental or consequential damages.

This warranty shall be void and VANAIR shall have no responsibility to repair, replace or repay the purchase price of defective or damaged parts resulting from the use of or repair of replacement parts not of VANAIR'S manufacture, or approved by VANAIR, or from buyer's failure to store, install, maintain and operate the compressor according to the recommendations contained in the MANUAL.

All claims under the Warranty shall be made by contacting VANAIR Warranty-Service Department.

VANAIR MANUFACTURING INC.

19015, U.S. 12,
NEW BUFFALO,
MICHIGAN 49117
TEL: 269-469-4461
FAX: 269-469-0497

WARRANTY

The rotary screw compressor unit is warranted by the manufacturer for two years against defects in materials and workmanship. The unit will be replaced or repaired at manufacturer's option as a result of such defects. This warranty does not cover damage caused by accident, misuse or negligence. If compressor unit is disassembled the warranty is void. All other parts including the compressor unit shaft seal are warranted for twelve months subject to the same conditions mentioned previously. Any and all such claims for warranty consideration must be coordinated through the Warranty-Service Department at the address below. Do not return parts without prior authorization.

Warranty is limited to supply of replacement parts failing within the warranty period. Credit for labor required to refit replacement parts is NOT included, except for replacement of the compressor unit, when specific, allowable labor credits will apply. Details on such labor credit allowances should be obtained through the Warranty-Service Department. Factory installed units will also include warranty on the installation for one year.

Warranty will commence upon receipt of the Warranty Registration Card. If the Warranty Registration Card is not received within six months, then warranty commence date shall be 30 days from date of shipment from VANAIR.

THIS STATEMENT OF WARRANTY IS EXPRESSLY IN LIEU OF AND DISCLAIMS ALL OTHER EXPRESS WARRANTIES, IMPLIED WARRANTIES OF MERCHANTABILITY AND ALL OTHER IMPLIED WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF. THIS WARRANTY DOES NOT INCLUDE INCIDENTAL OR CONSEQUENTIAL DAMAGES.

This warranty shall be void and VANAIR shall have no responsibility to repair, replace or repay the purchase price of defective or damaged parts or components resulting from the use or repair of replacement parts not of VANAIR'S manufacture, or approved by VANAIR, or from buyer's failure to store, install, maintain and operate the compressor according to the recommendations contained in the Operator & Parts Manual.

All claims under the Warranty shall be made by contacting VANAIR Warranty-Service Department.

VANAIR MANUFACTURING, INC.
19015 U.S. HWY 12
NEW BUFFALO, MI 49117
Tel: 616-469-4461
Fax: 616-469-0497

(PLEASE PRINT)

Model No. 70 GAS VIPER

Serial No. 30-64810

Company Name _____

Address _____

_____

Company Service _____

Product Application _____

Person to Contact _____

Telephone No. _____

Equipment Purchased

From _____

Address _____

_____

_____

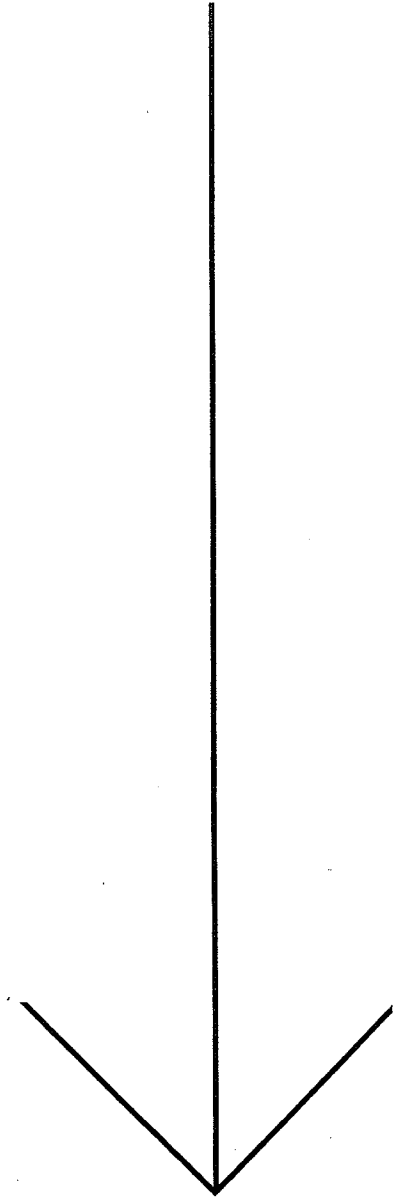
Start-Up ____ Month ____ Day ____ Year

This Card Registers You As A VANAIR Compressor Owner.

Printed in U.S.A.

WC 2-10-98

Please Mail Card Now



Please
Place
Stamp
Here

VANAIR MANUFACTURING, INC.
19015 U.S. HWY. 12
NEW BUFFALO, MI 49117

California Proposition 65 Warning

Engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

TABLE OF CONTENTS – Viper

SPECIFICATIONS – Viper

		60 Viper	70 Viper
Compressor:			
Make/type		Single Stage, Oil Injection	Rotary Screw
Capacity	cfm	60	70
Operating Pressure	psig	150	100
Speed (Full Load)	rpm	4800	5540
Speed (Idle)	rpm	3485	4370
Oil Sump Capacity	gal	2.5	2.5
Service Valves		(1) 3/4"	(1) 3/4"
Inlet Control		0 - 100% Step less	
Cooling System		Air to Oil - Thermostat Controlled	
Air Filtration		Dry Type - Single Stage	
Oil Filtration		25 Micron with By-Pass Relief.	
Ambient Operating Range	Deg. F	-20 Deg. F to +110 Deg. F	
ENGINE:			
Make/Model		Kohler/CH25	
Type		4 Cycle, V-Twin, Overhead Valve	
Size		25 H.P. @ 3600 rpm	
Speed (Full Load)	rpm	3580	3300
Speed (Idle)	rpm	2600	2600
Fuel Type		Gas	Gas
Fuel Tank Capacity	gal	5	5
Electrical System	volts D.C.	12	12
Cooling		Air with Integral Oil Cooler	
PACKAGE:			
Dimensions Overall	inches	46 L x 33 W x 26 Ht	
Weight	lbs	535	535

Specifications subject to change without notice

Vanair Manufacturing Inc. Designs and manufactures all of their products so they can be operated safely. However, the responsibility for safe operation rests with those who use and maintain this equipment. The following safety precautions are offered as a guide, which if conscientiously followed will minimize the possibility of accidents. Many of the following items may seem like common sense, which they are. We would ask that you also use your common sense in operating and maintaining this equipment since each situation may have it's own peculiarities and circumstances.

IMPORTANT - The following safety guidelines are for your safety, well-being and also to help protect from injury to others and prevent equipment damage.

WARNING - **Read this manual** before installing, operating or working on or with this equipment. Failure to do so could result in bodily injury or damage.

CAUTION - Never start this equipment unless it is safe to do so. **Do not operate** the air compressor/systems **with a known unsafe condition.** Tag and render the system inoperative by disconnecting the power source so others who may not know of the unsafe condition cannot operate it.

CAUTION - Install, use and **operate** this equipment **only in full compliance** with all pertinent and applicable O.S.H.A., Federal, State and Local codes,standard sand regulations.

WARNING - **Do not modify this compressor** and/or controls or systems in any way except with written factory approval.

DANGER - **Do not attempt to remove any compressor part or work** on the compressor or it's systems **without first relieving the entire system pressure**, open a service valve to atmosphere to assure all pressure is vented.

DANGER - **Do not** attempt to **service** any part of the machine **while it is operating.**

DANGER - **Do not operate the compressor in excess of pressures and speeds** indicate on the nameplate, or it's ratings as indicated in the "Specifications" section.

CAUTION - **Periodically check** all safety devices for proper operation.

DANGER - **Do not play** with compressed air. It can cause serious injury.

WARNING - **Do not use flammable solvents** for cleaning parts or compressor installation.

CAUTION - Be sure **no tools, rags or loose parts** are left on compressor drive systems or **near intake.**

CAUTION - Exercise **care and cleanliness** during maintenance and **when making repairs.** Cover openings and keep dirt and tools away from parts and openings.

WARNING - **Do not operate compressor** in areas **where there is a possibility of ingesting flammable,** toxic, noxious or corrosive fumes or substances.

WARNING - **Never** disconnect, by-pass or **render inoperative any safety system** and operate the machine.

CAUTION - **Do not operate the compressor without** proper flow of **cooling air,** or without **correct lubricant** levels or types.

DANGER - **Keep** hands, arms, hair and other parts of the body and loose clothing **away** from fans, drive shafts and other **moving parts.**

WARNING - **Do not operate the machine with guards removed or safety devices in-operative.**

DANGER - **Do not use air from this compressor for breathing purposes,** Vanair Manufacturing, Inc. disclaims any and all liabilities for damage or loss due to personal injuries, including death and/or property damages arising out of using Vanair compressors for breathing purposes.

CAUTION - **Operate the compressor only in open or well ventilated areas.**

WARNING - **Do not install shut-off valves between compressor and compressor receiver** tank (sump).

CAUTION - Do not install safety devices and/or replacement parts other than **authorized Vanair replacement parts.**

CAUTION - Ensure all plugs, hoses, covers and **parts which may have been removed for service are replaced before operating.**

WARNING - Ensure that hoses connected to the service valves are **fitted with correctly sized and rated flow limiting devices.** This is to prevent broken or is connected hoses from "whipping". These devices must comply with respective codes.

WARNING - **Do not use tools,** hoses or equipment that are **rated below the maximum rating** of this compressor.

CAUTION - **Keep personnel** out of line with, and **away from, the discharge opening** of valves, hoses and tools.

WARNING - **Hot Surfaces,** compressors generate heat. Take precautions when working on or around this equipment-some surfaces and components are hot!

CAUTION - **Clean up** any lubricant or fuel **spills** immediately.

CAUTION - **Render equipment inoperative when carrying out maintenance or repairs.**

CAUTION - Keep electrical wiring including terminals in good condition. Hoses and fittings with no leaks. **Replace any wiring or hoses which have cracked** or worn.

CAUTION - Keep tools or other **conductive objects away from live electrical parts.**

WARNING - **Wear respective protective equipment** when operating or working on this equipment. Protective equipment should be in full compliance with respective codes.

WARNING - **Over speed is hazardous!** Never tamper with the governor components or settings to increase the maximum speed. Severe personal injury and equipment damage can result if operated at speeds above maximum.

CAUTION - **Never touch electrical wires** or components **while the machine is operating.** They can be sources of electrical shock which could cause severe injury or burns.

Safety decals are supplied as part of the decal package. They should be affixed to the completed vehicle prior to going into service. They should be located so that they are clearly visible to both user and service personnel.

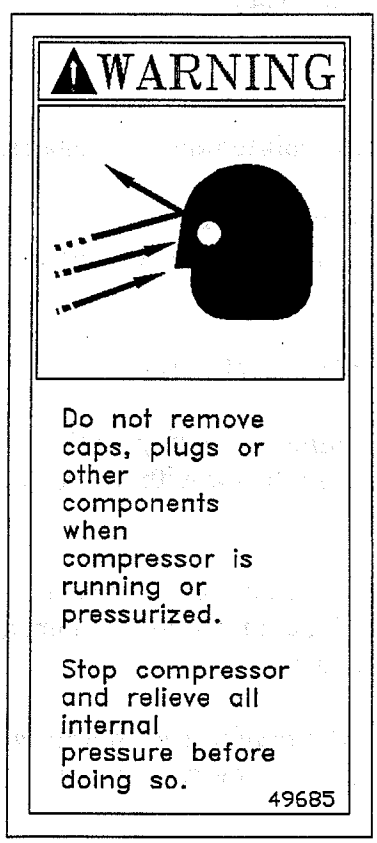


Fig. 3.1

Locate adjacent to oil filler on body or receiver.

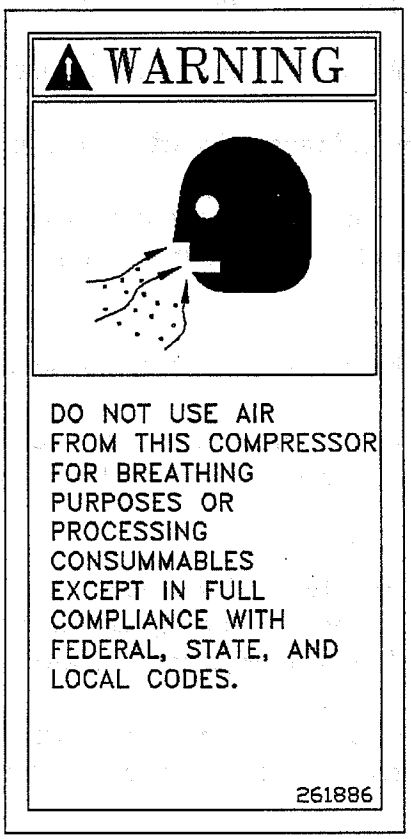
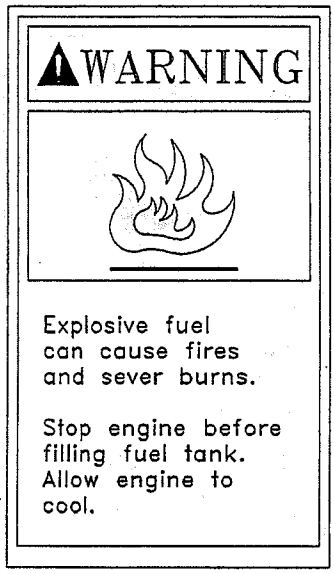


Fig. 3.2

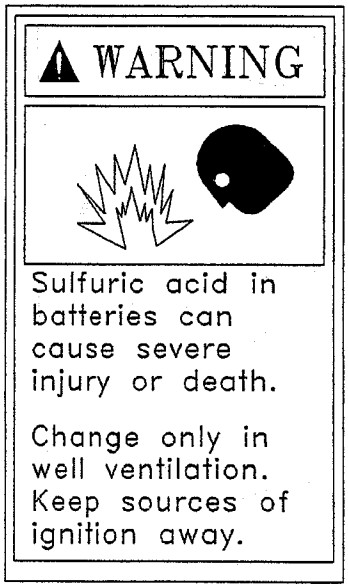
Locate next to each service outlet valve.

Fig. 3.3

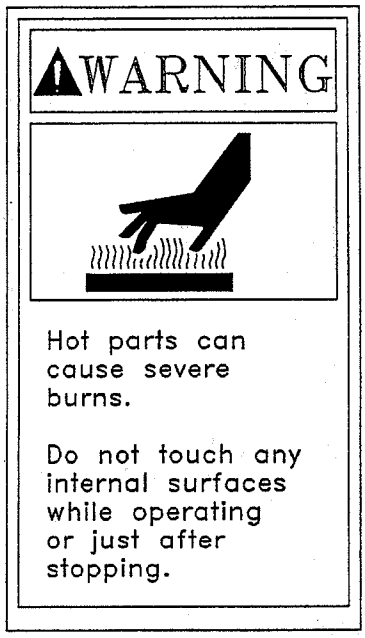
Locate next to each service outlet valve.



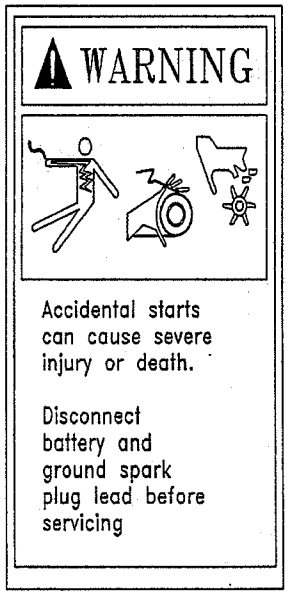
Explosive Fuel! Gasoline is extremely flammable and it's vapors can explode if ignited. Store gasoline only in approved containers, in well-ventilated, unoccupied buildings, away from sparks or flames. **Do not** fill the fuel tank while the engine is hot or running, since spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. **Do not** start the engine near spilled fuel. **Never** use gasoline as a cleaning agent.



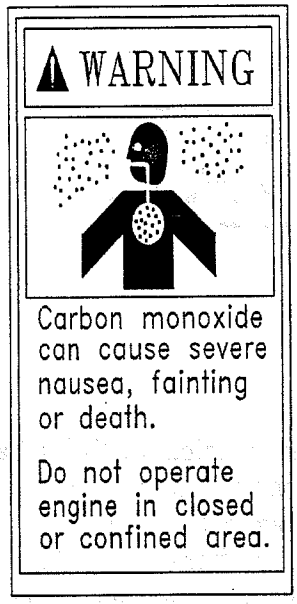
Dangerous Acid, Explosive Gases! Batteries contain sulphuric acid. To prevent acid burns, avoid contact with skin, eyes and clothing. Batteries produce explosive hydrogen gas while being charged. To prevent a fire or explosion, charge batteries only in well ventilated areas. Keep sparks, open flames and other sources of ignition away from the battery at all times. Keep batteries out of the reach of children. Remove all jewelry when servicing batteries.



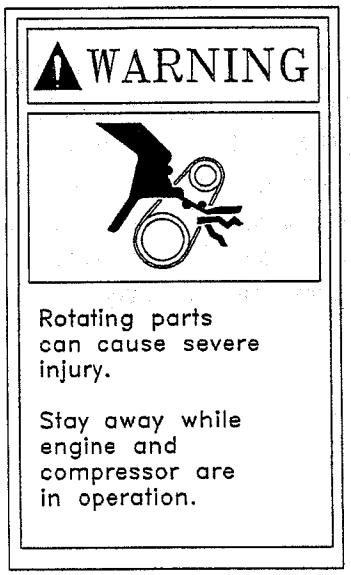
Hot Parts! Engine components can get extremely hot from operation. To prevent severe burns, **do not** touch these areas while the engine is running-or immediately after it is turned off. Never operate the engine with heat shields or guards removed.



Accidental Starts! Before servicing the engine or equipment, always disconnect the spark plug lead to prevent the engine from starting accidentally. Ground the lead to prevent sparks that could cause fires. Disconnect the battery to prevent any shorting of wires or electrical hazard or danger.



Lethal Exhaust Gases! Engine exhaust gases contain poisonous carbon monoxide. Carbon monoxide is odorless, colorless and can cause death if inhaled. Avoid inhaling exhaust fumes, and never run the engine in a closed building or confined area.



Rotating Parts! Keep hands, feet, hair and clothing away from all moving parts to prevent injury. Never operate the machine with covers, shrouds or guards removed.

DANGER - Machine should be lifted using the lifting bail provided. Inspect lifting bail and all points of attachment for cracked welds and cracked, bent, corroded or otherwise degraded members, and for loose bolts or nuts. Keep all personnel out from under and away from the machine when it is suspended. Lift no higher than necessary. Set down and operate compressor on a level surface. **Do not** lift the compressor while it is operating.

DANGER - Forklift unit at the wide span, between the feet of the unit, facing the long side and where decals indicate "**INSERT LIFT FORKS HERE**". **Do not** forklift machine when it is running.

DANGER - **Do not** attempt to jumpstart if battery fluid is frozen or slushy. Bring battery up to 60° F (16° C) before attempting to jumpstart. Jumpstart only from vehicles with a NEGATIVE ground system. **Do not** jumpstart using generator sets, welders, or other sources of D.C. power. Avoid accidental contact between jumper cable terminals/clamps and any metallic portion of the machine or starting vehicle. The safest way to recharge the batter is to remove it from the machine and trickle charge from a suitable battery charger.

2.1 Introduction:

The 60/70 cfm Viper Series air compressor systems will offer superior performance and reliability along with a minimal amount of maintenance requirements.

This Manual should be read in conjunction with other appropriate Manuals or literature, such as Engine Owner's Manual, etc.

The compressor module is equipped with a SULLAIR® Rotary Screw Compressor Unit which is renown for it's durability and reliability.

2.2 Description of Components:

The package includes a heavy duty rotary screw Air Compressor with integral Inlet Valve assembly, Gasoline Engine (use unleaded fuel only) and Fuel Tank, Compressor Cooling and Lubrication System, Compressor Discharge System, Capacity Control System, Instruments and Electrical System. The complete operating system is mounted in a neat compact durable Enclosure providing easy access for maintenance.

2.3 Compressor Air End and Inlet Valve:

The SULLAIR® compressor unit is a single stage, positive displacement, oil flood lubricated type compressor. This unit provides continuous pulse free compression to meet your needs.

Lubricant is injected into the compressor unit and mixes directly with the air as the rotors turn compressing the air. The lubricant has three primary functions:

- As coolant, it controls the rise of air temperature normally associated with the heat of compression.
- Seals the leakage paths between the rotors and the stator, and also between the rotor themselves.
- Acts as a lubricating film between the rotors allowing one rotor to directly drive the other, which is an idler. It also lubricates the bearings and seal.

After the air/lubricant mixture is discharged from the compressor unit, the lubricant is separated from the air. The air then flows to the service line and the fluid is cooled in preparation for re-injection. The integral Inlet Valve results in a low profile compressor module. It's function will be covered under Capacity Control.

2.4 Gasoline Engine & Fuel Tank:

The engine selected has been generously sized to have power in hand at the operating speeds to provide rapid acceleration between unload/load conditions and is applied at speeds below it's maximum rating. Fuel for the gasoline engine should be UNLEADED with a minimum Octane Rating of 87. Please refer to the Engine Owner's Manual for service and maintenance requirements.

The Kohler CH25 gasoline engine is a V-Twin, O.H.V. design, air cooled engine. It has numerous features such as: Electronic Ignition, Nickel-Silicon plated cylinders, Hydraulic Valve Lifters, Integral Engine Oil Cooler, etc. Features which add up to a durable prime mover.

The drive system from the engine to the compressor is a V-belt system with provision for belt tensioning. The belt selection is a heavy duty industrial drive.

A 5 gallon fuel tank is provided which incorporates a large fill cap. Access for re-fueling is by raising the hinged top cover. Fuel level can be viewed either through the fill cap or from outside of the enclosure through the slots provided for that purpose. A fuel filter is provided on the engine.

An air cylinder is fitted to the throttle assembly which will automatically speed up/slow down the engine upon air demand. There are two adjustment screws on the engine governor system. The one adjacent to the small cylinder is for the Idle speed control, the one towards the outside of the unit is for high speed, these adjustment screws are retained with locknuts. Refer to the Specification Sheet for correct engine speed settings, these should not normally have to be adjusted after factory setting.

2.5 Compressor Cooling & Lubrication.

A Schematic Diagram of the lubrication system can be found on Drg. No. 262899 (Control System).

Lubricant is stored in the Receiver Tank. Oil flow is created by pressure differential, (there is no separate oil lubrication pump). As the compressor is engaged the resultant air pressure forces the lubricant through the oil filter and oil cooler prior to injection into the compressor. Within the compressor air end the oil mixes with the air and is discharged as a heavy air/oil mix into the receiver tank where the majority of the oil is separated. Carryover of finer particles of oil are separated out in the air/oil separator (coalescer) and is returned to the compressor through the Scavenge line to a low pressure (vacuum) port. The scavenge line is fitted with a check valve to prevent reverse flow during the shutdown process.

The oil filter incorporates a By-Pass Relief Valve to help protect from oil starvation on cold temperature starts and will help protect the compressor in case of a plugged oil filter (this condition should be corrected immediately-refer to Maintenance Section).

The cooler fan is activated by means of a thermal switch which reacts to changes in oil temperature during operation, these changes are influenced by load/unload cycles and ambient conditions (or low oil level).

2.6 Compressor Discharge System:

The compressor unit discharges compressed air/lubricant mixture into the receiver tank. The receiver serves two main purposes:

- It acts as a primary lubricant separator,
- Serves as the compressor oil sump.

The compressed air/lubricant mixture enters the sump and is directed against the side wall. By change of direction and reduction of velocity, larger droplets of fluid fall to the bottom of the sump. The finer particles remaining are carried to the final air/oil separator (coalescer), where they collect on the element media fibers. As more fluid collects it percolates down to the bottom of the element where it is then returned to the compressor (lower pressure zone) through the return scavenge line, which contains both an orifice to reduce the amount of air loss back to the compressor and a check valve to prevent reverse flow during shutdown operations.

Final discharge air from the separator unit has a connection which feeds the Control System. The main service line air passes through a minimum pressure orifice which ensures that a minimum pressure is maintained in the receiver tank for lubricant circulation, it then passes to the Service Valve.

The Service Valve incorporates an automatic bleed-off device for the downstream piping such that when the valve is turned off it will vent downstream air, making for safer hose disconnects.

The receiver tank is A.S.M.E. rated and certified, for 175 psig. Working pressure. A Pressure Relief Valve is connected to the receiver and is set to open if the pressure exceeds 175 psig. The Oil Fill Cap has a built in vent to relieve any remaining internal pressure, should there be an attempt to remove this cap without completely venting down first. IMPORTANT - Relieve all pressure before removing any components.

An oil level Sight Glass is provided. Oil level should be checked with unit shut down and oil allowed to settle. Oil level should be checked daily.

2.7 Capacity Control System:

The purpose of the control system is to regulate the amount of air intake in accordance with the amount of compressed air being used.

The control system consists of an Inlet Valve (mounted integrally in the compressor unit), Pressure Regulating Valve, Speed Control Cylinder, Blowdown Valve and respective air lines.

The following functional description of the control system is described in distinct phases of operation. This description will apply to all control systems with the exception of stated pressures which will vary depending upon machine model. The pressures stated will be in accordance with a compressor having an operating pressure range of 100 to 115 psig.

START 0 to 100 psig.:
When the compressor is started, the receiver pressure quickly rises from 0 to 100 psig. During this period the Pressure Regulator Valve is inoperative. The Inlet Valve is fully open due to inlet air pressure, and the compressor operates at full capacity. As the compressor operates at full capacity the engine runs at full speed.

Regulation 100 to 115 psig.:
Should less than the rated capacity of air be used, the receiver and service line pressure will rise above 100 psig. The Pressure Regulating Valve will start to open and pass air to both the Inlet Valve and the Air Cylinder mounted on the engine. This causes the Inlet Valve to start closing and the engine to start to slow down. As pressure in the receiver increases the Inlet Valve will become fully closed and the Engine will reach idle speed.

Air Demand:
As air is demanded from the service line, the receiver pressure will drop and the Pressure Regulating Valve will close. This allows the Inlet Valve to re-open, the Air Cylinder on the engine will retract, and the engine will once again run at the pre-set full speed.

This cycle will repeat dependent upon air demand from the compressor.

Shutdown:

The unit is fitted with an automatic Blowdown Valve. When the unit is switched off, the compressor air end becomes pressurized and a signal is passed to the Blowdown Valve pilot actuator, this activates the valve and vents the system pressure down to atmosphere.

2.8 Instruments and Electrical System:

The Engine Controls consist of an Ignition Key Switch and pull Choke control. Adjacent to these are the Air Pressure Gauge, Hour meter and engine start oil pressure Override Push-button.

- Ignition Key Switch is used only for starting/stopping the engine. It has three positions OFF/RUN/START.

- Override Push-button is used when starting the engine and will by-pass the low engine oil pressure protective shutdown switch. This button is depressed during cranking and for a few seconds after it has fired, once the engine oil pressure is above the switch setting it can be released.

- Pull Choke is used for cold starts. It allows for a richer mixture, it should be gradually pushed back in as the engine warms up and sustains smooth running. **DO NOT** LEAVE IT PULLED OUT.

- Air Pressure Gauge continually monitors the service line air pressure.

- Hour meter indicates total accumulated hours of compressor operation. This is useful for planning and logging service operations.

Electrical System is comprised not only of the necessary equipment required to operate the compressor unit, but also systems to shut down the compressor in the event of malfunctions. The Electrical System is a 12 volt D.C. negative ground system.

- Engine Components consist of Starter Motor, Alternator (15 amp), Electronic Ignition System, Fuel Solenoid and Low Engine Oil Pressure Switch (This switch will shut down the engine if the oil pressure becomes insufficient).

- Compressor Over temperature Shut down Switch, will shutdown the compressor if the discharge temperature exceeds 240°F.

- Fan Temperature Switch, automatically cycles the compressor oil cooling fan ON/OFF to maintain the compressor oil temperature between 180 to 240° F.

- Electrical Harness, is provided to interconnect all the electrical devices.

- Battery, is a heavy duty 12 volt D.C. with a capacity of 400 C.A. @32° F.

2.9 Main Frame and Enclosure:

The steel mainframe is stiffened to provide rigidity and permit fork lift movement (Locate forks at "Lift Here" arrows). The foot on each corner of the base has a small pad with a hole for boltdown provision if required. Forks should only be inserted in the correct location, or damage may occur to parts under the frame.

The enclosure which is attached to the main frame is made from steel and is powder coated to provide a durable finish.

The complete top cover is hinged for easy access to fuel fill and most maintenance items. It incorporates a prop support.

A detachable front grill provides access to engine oil filter and battery.

Instrumentation and engine controls are conveniently located at one end of the machine along with the service air outlet.

Fuel and compressor oil levels can be checked at a glance from the front of the machine where the top cover release catches are located.

Cooling air outlet for both the compressor and the engine are directed up and out through the roof panel together with the engine exhaust.

A lift bail is provided to allow for overhead lifting (WARNING-**Do not** go underneath the machine at any time while the machine is being lifted). This item is an option.

Safety and information decals are provided in appropriate locations on the machine, please read and understand all the information contained thereon.

3.1 General:

While VANAIR has built into this compressor a comprehensive array of controls and safety systems, you will want to recognize and interpret the readings or malfunctions which will call for service or indicate the beginning of a problem.

Before starting your VANAIR compressor read this section thoroughly and familiarize yourself with the controls and operation.

3.2 Purpose of Controls:

Control or Indicator:	Purpose:
Engine Ignition Switch. (Key Switch).	This switch has three positions: OFF/ON/START In the OFF position the electrical ignition system is switched OFF and the key can be removed. RUN position is detented and is the normal operating mode. START is for cranking the engine, allow the key to return to RUN once the engine has started.
Choke. (Pull Knob)	Used for cold starts, pull out for maximum choke, gradually push in as engine warms up. Normal run position is fully pushed in. **DO NOT** leave pulled out or engine will run with rich mixture.
Start Override. (Push-button)	Used to by-pass the engine low oil pressure switch when starting the engine. Must be pressed simultaneously when cranking the engine, hold depressed for about 5 to 10 seconds after the engine has started.
Discharge Air Pressure. (Pressure Gauge)	Continuously monitors service line discharge air pressure.
Operation Hours. (Hour meter Gauge).	Indicates the accumulated hours of operation. Useful for planning and logging service schedules.
Fluid Level. (Sight Glass).	Indicates the compressor fluid level in the sump. Check the level when the unit is shutdown. Should show in sight glass at half way mark.
Compressor Discharge Temperature Switch.	Opens the electrical circuit to shutdown the compressor when the discharge temperature reaches 240° F.

Control or Indicator:	Purpose:
Minimum Pressure Orifice	Maintains a minimum pressure in the compressor sump of 40 psig. If the service valve is fully opened.
Pressure Relief Valve	Opens sump pressure to atmosphere should the pressure in the sump exceed 175 psig.
Blowdown Valve	Vents compressor sump pressure to atmosphere upon shutdown.
Pressure Regulating Valve	Allows a pressure signal to reach the engine speed control cylinder and the inlet valve, to control air delivery according to demand.
Air Inlet Valve	Regulates the amount of air allowed to enter the compressor. Also acts as a check valve upon shutdown to prevent air/oil blowback into the air filter.
Fan Temperature Switch.	Thermostatically switches the compressor oil cooling fan ON/OFF to maintain a minimum oil temperature of 160° F. (typical operation 170 to 200° F.).

3.3 Initial Start-Up procedure:

The following procedure should be used to make the initial start-up of your compressor.

1. Position the compressor on a level surface so that proper amounts of liquid can be be added if required.
2. Check engine and compressor oil levels, add correct oil if necessary.
3. Fill fuel tank.
4. Crack open the service valve.
5. Pull engine choke out.
6. Turn engine ignition switch to ON position
7. Depress START OVERRIDE button and turn ignition switch to START. As engine engages, release START switch, but hold the OVERRIDE button for approximately 5 to 10 seconds and then release.
8. As engine warms up, push in CHOKE and close service valve.
9. Allow for sufficient warm-up of machine before operating.
10. After the initial run, shut the machine down and top off compressor oil sump as required. Tighten any loose fittings, check drive belt tension and inspect for any leaks.

3.4 Subsequent Start-Up Procedure:

On subsequent starts, follow the procedure explained below:

1. Check engine and compressor oils, add correct oil if necessary. Fill the fuel tank.
2. Crack open the service valve.
3. Pull engine choke out.
4. Turn ignition switch to **ON** position.
5. Depress START OVERRIDE button and turn ignition switch to START. As engine engages, release START switch, but hold the OVERRIDE button for approximately 5 to 10 seconds and then release.
6. As engine warms up push in CHOKE.
7. Allow for sufficient warm up of machine before operating.

3.5 Shutdown Procedure:

1. Close the service valve and run the compressor for about 5 minutes.
2. Turn the ignition switch to the OFF position.

In case of EMERGENCY where immediate shutdown is required this procedure is NOT necessary. TURN ignition switch OFF immediately.

3.6 Operating Conditions:

1. Operate only in well ventilated areas. Exhaust fumes can be lethal.
2. Ensure no obstructions on cooling air intakes at both ends of the machine.
3. Do not leave anything resting on top of the machine. Hot engine exhaust and cooling air will generate high heat and must not be restricted.
4. Be sure to leave sufficient room around the machine for cooling air. Minimum 6 inches each end and at least one side unrestricted.
5. Fuel only when cold.
6. Operate machine with top cover closed. To avoid engine exhaust fumes/heat being deflected.
7. Refer to specifications for operating parameters, speeds, etc.

NOTES

4.1 General:

A good maintenance program is the key to long compressor life. Below is a program that when adhered to, should keep the compressor in top operating condition. However, it should be understood that these intervals are for normal operation in a good clean environment. More frequent inspections, oil changes and general maintenance should be carried out in dusty environments, high ambient temperatures or extended light load conditions. For maintenance requirements on the Engine refer to Engine Operators Manual for a detailed description of Service Instructions.

WARNING - DO NOT remove caps, plugs or any components when the compressor is running or pressurized. Stop the compressor and relieve all internal pressure before doing so.

WARNING - DO NOT work on any electrical components unless the battery is disconnected.

4.2 Daily Operation:

Before Starting:

1. Check fluid levels-engine/compressor/fuel (with machine level).
2. Check for any leaks or loose bolts.
3. Check drive belt is tight.

After Starting:

4. Check pressure gauge for correct operating pressure.
5. Ensure choke is pushed in after warm up.
6. Check for leaks.

4.3 After Initial 50 Hours:

1. Change Oil Filter (Since initial oil filter will have collected any foreign materials which may have collected in manufacture).
2. Check Belt Tension and Alignment (Majority of belt stretch will occur during early operation hours, also be sure to check alignment).
3. Check Engine Operator Manual for required service.
4. Check Compressor oil for water or emulsion.

4.4 Every 500 Hours (or 6 months):

1. Change Compressor Oil and Filter.
2. Change Air Filter (Shorter intervals may be required if dirty environment).
3. Check Belt Tension and Alignment.
4. Blow out Compressor Cooler Core.
5. Lubricate Control Linkage.
6. Check all Fittings and Fastenings.

4.5 Every 1000 Hours (or 1 year):

1. Check Safety Circuit Switches.
2. Check Sump Safety Valve.
3. Replace Spin-On Coalescer (sooner if required).

4.6 Lubrication Guide:

WARNING - It is Important that the Compressor Oil be of a recommended type and that it is inspected and replaced together with the oil and air filters, in accordance with this Manual.

The result of poorly maintained lubricant and/or filters may produce hazardous conditions resulting in ignition, which could cause a fire in the sump. Damage to equipment and serious bodily harm may result.

1. General:

It is not possible to establish limits on all physical and chemical properties of lubricants which can affect their performance over a broad range of operating and environmental influences. The responsibility for recommending a suitable lubricant must rest with the user's lubricant supplier and their knowledge of the suitability of their lubricants in screw compressors, operating in the particular environment involved.

2. Prime Lubricant Characteristics:

1.	Viscosity:	160-210 SUS at 100° F. 47 SUS or greater at 210° F.
2.	Flashpoint:	400° F. Minimum.
3.	Pour point:	Must be at least 20° F. Lower than the lowest expected ambient operating temperature.
4.	Contain:	Rust and Oxidation Inhibitors.
5.	Contain:	Foam Suppressors.

3. Types of Lubricant to be Considered:

1. **Automatic Transmission Fluids (i.e. Dexron® III).**
   Are suitable for the majority of applications. They are commonly applied in heavy duty, high temperature conditions and also where temperatures are consistently below freezing (32° F.) down to approximately 0° F.

   In light load and/or high humidity operating conditions A.T.F. can absorb moisture and may result in emulsification of the lubricant. If this occurs change lubricant immediately since the lubricating properties are breaking down. If this condition persists consider changing to a different type of lubricant (consult supplier).

2. **Industrial Type Oils:**
   Should be of premium quality non-detergent mineral oil, viscosity grade SAE10 (ISO 32). Industrial oils maybe better for high humidity and/or low load factor, where condensed moisture and emulsification may occur. Water will separate and must be drained from the oil sump (daily if necessary). In addition to the primary oil These lubricants should generally only be applied where conditions above 32° F. prevail.

3. **Synthetic Lubricants:**
   In so far as known, all the elastomeric components and metals used in the compressor are fully compatible with Synthetic Hydrocarbon (SHC) and Diester Lubricants.

   However, the synthetic lubricant should not employ Viscosity Index Additives since they could precipitate out and cause plugging. Viscosity ranges selected should be based on those outlined in Prime Characteristics and in close liaison with the lubricant supplier.

CAUTION - Various factors can affect "Extended Life" lubricants, such as reactive gases or vapors which could be ingested into the compressor and may adversely affect these lubricants. It is recommended with these lubricants to maintain oil filter changes as recommended intervals and participate in an oil Sampling Program with the lubricant supplier.

4. **CAUTION - <u>DO NOT</u> MIX OILS OF DIFFERENT TYPES.**

5. **Factory Fill** - A.T.F. -Dexron® III or equivalent.

4.7 Oil Filter Replacement:

The compressor oil filter is a spin on, throw away type. Before attempting to remove the oil filter, ensure all air is relieved from the system. CAUTION- Use only Vanair filters, other filters may not have correct pressure rating.

Remove:

1. Remove old filter (use strap wrench if required) by turning Anti-Clockwise and discard as appropriate.
2. Clean filter head with lint free wiper or cloth.

Replacement:

3. Apply a light film of oil to the seal surface on the new element.
4. Screw new element on Clockwise by hand until seal contacts filter head, then turn an additional 3/4 turn (By Hand).
5. Run compressor and test for leaks.

4.8 Coalescer (Air/Oil Separator) Replacement:

This is a spin-on, throw away type unit. Before attempting to change ensure all pressure is relieved from the system. Change in accordance with Maintenance Guidelines. If oil carryover into the service line occurs and the return line scavenge orifice is clear, than change the element. Verify receiver is not overfull.

Remove:

1. Remove old element (use strap wrench if required) by turning Anti-Clockwise and discard as appropriate.
2. Disconnect bottom oil scavenge line from element.

Replacement:

3. Replace the seal in the head with the new one provided and lubricate with a film of clean oil.
4. Refit oil scavenge line to bottom of element.
5. Screw element on Clockwise until it seats on the head seal, rotate ONE more complete turn (use strap wrench if necessary). Take care not to damage element.
6. Start up and check for leaks.

4.9 Air Filter Replacement:

The air filter is a self contained throw away assembly. **DO NOT** replace with compressor in operation.

Remove:

1. Unscrew the wing nut on top of the air filter and remove filter assembly including the intake Hose.
2. Remove the Intake Hose and discard filter as appropriate.

Replacement:

3. Refit existing Intake Hose onto the new Air Filter.
4. Fit the new filter onto the compressor air end inlet and ensure the Intake Hose pushes into the receptacle on the end panel.
5. Replace and tighten the wing nut to retain the Air Filter assembly.

4.10 Belts - Tightening and Replacement:

Correct tensioning and alignment is important for belt life, bearing life and power transmission.

Correct tensioning and alignment was provided at time of shipment from the factory. However, since maximum belt elongation will occur within the first 50 hours of operation (of new belts), their tension and alignment should be checked several times during this period and corrected as required. The belts should thereafter be checked periodically in order to obtain maximum life and performance.

NOTICE - To avoid possible belt damage, never force belts over the sheaves. Oil spilled or splashed onto the belts in any quantity will cause slippage and severely reduce belt life - Take care when filling compressor oil.

Replacing/Tightening V-Belts:

1. Slacken bolts holding compressor air end to base, accessible under base. Only slacken sufficient for air end to move in slots.
2. Back off the adjusting screw on the engine side to allow old belt/s to be removed and new one/s positioned. Ensure new belt is seated in grooves.
3. Tighten adjusting screw adjacent to engine, to take up main slack. Then loosen adjusting screw on opposite side of air end and screw in to touch air end. Sequentially, tighten engine side adjusting screw and back out opposite side screw. Periodically check tension and alignment, these two adjusting screws will permit you to obtain correct tension and alignment.

Tension Data:

Deflection at center of belt span 0.25 ins.
With a Force of 4 lb.

Ensure pulleys are aligned by using a long straight edge which will span both pulleys. Position the straight edge on the sides of the pulleys, if they are in-line there should be no gaps between the straight edge and the pulleys (for the full contact distance across each pulley side), adjust as necessary to get correct alignment and tension.

It may be necessary to repeat and check several times before both tension and alignment are satisfied.

4.11 Cooler Core Cleaning (exterior):

Remove leaves, papers etc. from outside face. Use compressed air and carefully blow through the core from the inside of the canopy (through fan assembly or remove fan assembly).

DO NOT use high pressure air or pressure washer.

Note- Oil cooler core is aluminum, if this does at some point require internal cleaning, this is best done by a suitably equipped radiator shop. Internal cleaning is **NOT** a normal maintenance item if the oil is maintained in good condition.

4.12 Adding/Changing Compressor Oil:

Ensure all pressure is relieved from the system. Check oil level with unit level, otherwise a false oil level indication will occur.

1. Remove oil fill plug located on top of the receiver.
2. Carefully add lubricant and monitor sight glass, allow time for oil to level out. A complete refill is approximately 2.5 gal. Fill/top-up to half way mark on sight glass. If sump is overfilled, oil carryover may occur.
3. Replace oil fill cap.
4. Run unit and recheck oil level after shutdown, allowing time for oil to settle.

Oil drain is located underneath base. This can be routed to a more convenient location if required, dependent upon installation. Use only Schedule 80 pipe or suitably rated hose.

NOTE - Fill cap has a vent release hole as a safety feature and to act as a "tell-tale". If air escapes while unscrewing the fill cap, then the system still has pressure. Re-tighten the cap and fully release the system pressure through service valve before unscrewing fill cap.

4.13 Pressure Regulating Valve:

Before adjusting the control system it is necessary to determine the rated full load pressure and the high and low speed (rpm) settings. These can be found in the Specification Section.

For this example we will assume a working pressure of 100 psig Full Load

Procedure for Setting:

1. Start the compressor and allow engine to warm up, with service valve closed.
2. Adjust the Pressure Regulating valve (located behind the pressure gauge) by unscrewing the locknut and then adjust the screw as follows:
   Screw IN (clockwise) to INCREASE pressure.
   Screw OUT (anti-clockwise) to Decrease pressure.

3. Set the pressure to approximately **115** psig. On the gauge and tighten the locknut. Note - Air will leak from the small hole adjacent to the locknut.
4. The engine should be in the **IDLE** condition. Check speed and adjust if necessary.
5. Gradually open the service valve and hold the pressure at **100** psig. Note - Air should have stopped leaking from the small hole in regulating valve.
6. The engine should now be in the **HIGH** speed mode. Check speed and adjust high speed stop screw on engine if necessary.

NOTE - If HIGH speed needed any significant adjustment, it may be necessary to then go back and re-adjust the Pressure Regulating Valve again as described above.

7. Cycle the machine using the service valve, check pressure gauge settings are okay and the engine speeds up/down as air demand increases/decreases.

4.14 Inlet Valve:

The most common items which may need attention at some point are the Piston Seal and the Poppet Valve Head. A failure of either of these items would result in the machine over pressuring, and in the case of the Poppet Valve Head (if it was not seating correctly) oil would blow back into the air filter during shutdown. Attention should first be given to the Pressure Regulating Valve to ensure that it is functioning correctly.

Remove:

1. Remove Air Filter.
2. Unscrew the four socket head cap screws holding the large flange on top of the compressor air end. This flange has been sealed with gasket eliminator so it may be necessary to tap with a brass mallet to break this seal.
3. Remove flange, then carefully remove Poppet Head and spring (examine Poppet Head for signs of uneven seating). Take care not to drop anything into the inlet throat of the compressor.
4. Inlet Piston assembly (large brass hexagon) can now be unscrewed (anti-clockwise) with a large socket.
5. Inlet Piston Assembly can be dismantled by removing the retainer ring on the top, remove top cover and spring, the piston can then be carefully pulled out.

Replace:

6. Remove old seal. Generously lubricate new seal with clean oil and fit onto piston. The lip should face down towards bottom of piston (away from rod).
7. Reassemble Piston Assembly and reinstall screwing clockwise, tighten with socket.

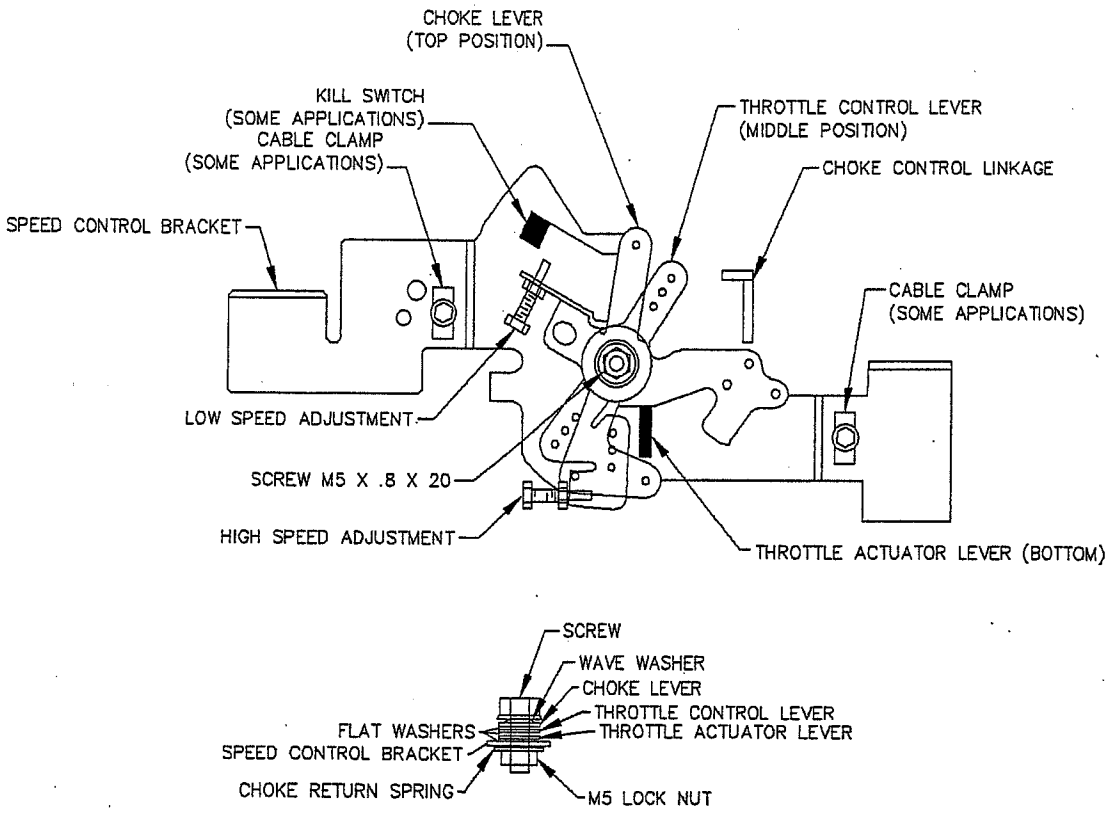
8. Remove old traces of gasket eliminator and wipe clean. Apply a thin coat of gasket eliminator (Locktite® 515 or equivalent) to compressor inlet surface and refit the cleaned flange. Tighten socket cap screws in a Cross pattern to even clamping load.
9. Replace Air Filter, run test and then shutdown. Check for correct functioning and no leaks.

4.15 Recommended Torque Specifications:

Capscrew		Tightening Torque	
SIZE	**GRADE**	**DRY**	**LUBRICATED**
1/4 - 20 UNC	5	8 ft lbs	6 ft lbs
5/16-18 UNC	5	17 ft lbs	13 ft lbs
3/8 - 16 UNC	5	30 ft lbs	23 ft lbs
1/2-13 UNC	5	75 ft lbs	55 ft lbs
3/4 - 10 UNC	5	260 ft lbs	200 ft lbs

4.16 Fuel Tank - Fittings:

If for any reason the lower fitting in the nylon fuel tank has to be removed **DO NOT** refit using TEFLON® tape or pipe dope on the fitting threads. Use PERMATEX® #2 For a Gasket or equivalent compound which is compatible with gasoline/nylon.



4.17 Engine Speed Adjustments:

Note To increase engine RPM, turn adjusting screw clockwise.
To reduce RPM, turn adjusting screw counter clockwise.

Speeds for respective units for V-25 form or customer inquiries:

1.0 60 CFM and 150 PSIG

Engine: Idle 2600 RPM, full load 3580 RPM
Compressor: Idle 3485 RPM, full load 4800 RPM
(i.e. drive ratio 1.46)

2.0 70 CFM and 100 PSIG

Engine: Idle 2600 RPM, full load 3300 RPM
Compressor: Idle 4370 RPM, full load 5540 RPM
(i.e. drive ratio 1.68)

NOTES

The information contained in the Troubleshooting Chart has been compiled from information gathered. It contains symptoms and usual causes for the most common types of problem. All available data concerning the trouble should be systematically analyzed before undertaking any repairs or component replacement.

A visual inspection is worth performing for almost all problems and may avoid unnecessary additional damage to the machine. The procedures which can be performed in the least amount of time and with the least amount of removal or disassembly of parts should be performed first.

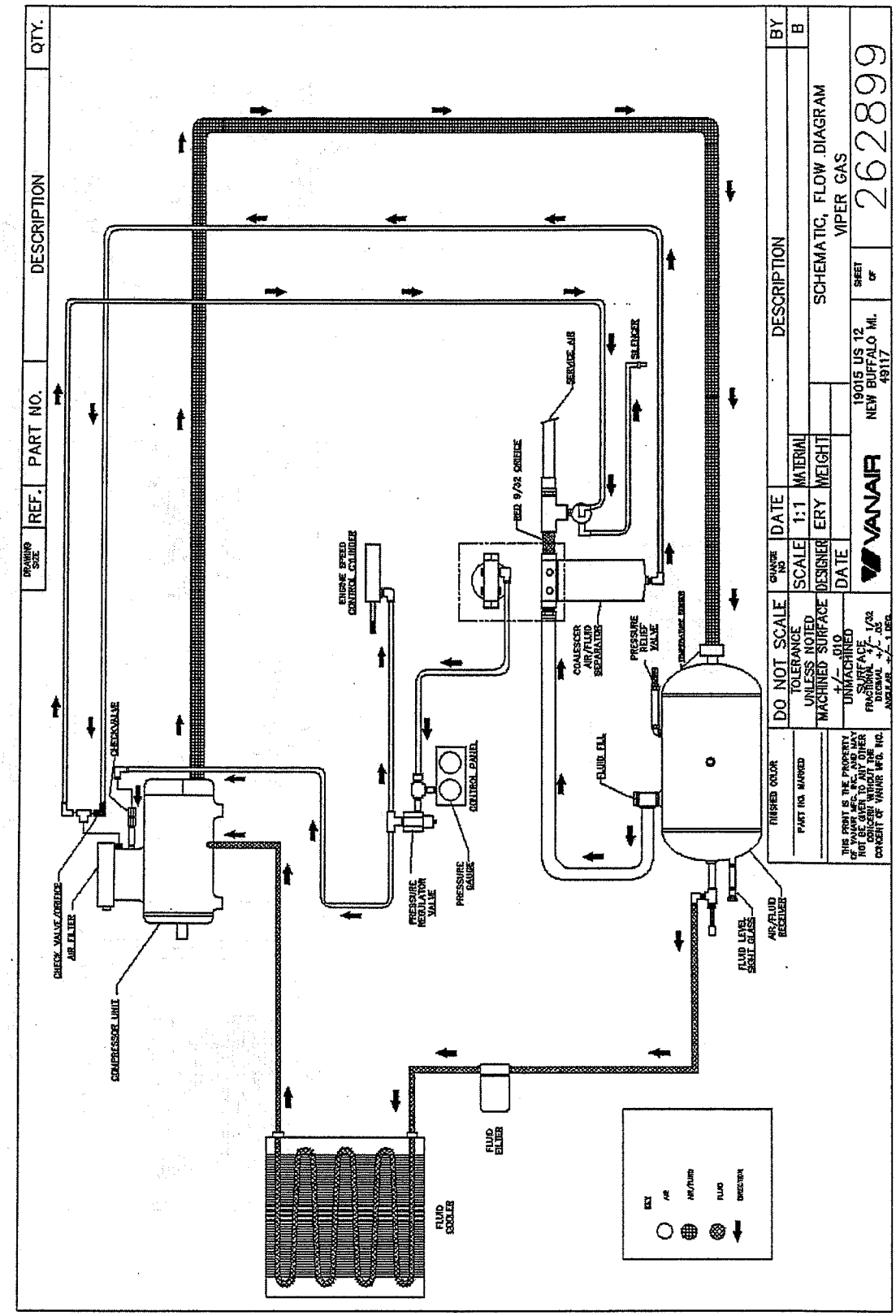
WARNING - Before working on any machine, ensure it is shut down, keys removed, air pressure relieved, battery disconnected and unit has cooled down.

SYMPTOM:	PROBABLE CAUSE:	
1. Failure to Start	1.1 No fuel----------	Fill if necessary.
	1.2 Pinched fuel line----------	Replace or reroute.
	1.3 Plugged fuel filter----------	Replace.
	1.4 Low battery voltage----------	Recharge or replace.
	----------	Loose connections-tighten.
	----------	Dirty connections-clean.
	1.5 Plugged air filter----------	Replace.
	1.6 Defective oil pressure switch----	Check continuity-replace.
	1.7 Defective air temp. switch-------	Check continuity-replace.
	1.8 Blown fuse----------	Check continuity-replace.
	1.9 Poor ground connection---------	Check and clean/renew.
	1.10 Engine problems----------	Refer to Engine Operator Manual.
2. Compressor Shuts Down with Air Demand.	2.1 No fuel ----------	Fill if necessary.
	2.2 Compressor temperature---------	Low oil level-top up.
	switch opening----------	Restricted cooling air intake-clean-reposition machine.
	-------	Fan not operating-check ground-check fan switch.
	2.3 Plugged oil filter----------	Replace
	2.4 Dirty cooler core----------	Clean.
	2.5 Contaminated cooler core-------	Remove and clean.
	2.6 Defective engine oil press switch	Replace.
	2.7 Engine speed too low----------	Adjust and reset.

Symptom:	Probable Cause:	
3. Compressor will Not Build Up Pressure.	3.1 Air demand too great----------	Check for leaks/correct.
	--------	Too much air demand.
	3.2 Air filter plugged----------	Check and replace.
	3.3 Defective pressure regulator-------	Replace.
	3.4 Press. Reg. out of adjustment---	Reset.
	3.5 Engine does not speed up----------	Pressure regulator.
	--------	Speed control adjustment
	--------	Engine governor `stuck.
	3.6 Control cylinder stuck----------	Replace.
	3.7 Belts slipping----------	Readjust.
4. Compressor Over pressures.	4.1 Press. Regul. Out of adjustment---	Reset.
	4.2 Defective Press. Regul----------	Replace.
	4.3 Leak in air control line----------	Check and correct.
	4.4 Inlet valve stuck----------	Free or replace.
	4.5 Restriction in control line----------	Dirt or ice, clean/free up.
	4.6 Check valve stuck----------	Replace.
	4.7 Faulty gauge----------	Check with shop air/replace.
	4.8 Defective Safety Valve----------	Replace.
	4.9 Plugged Coalescer----------	Replace.
5. Insufficient Air Delivery,	5.1 Plugged Air Filter----------	Replace.
	5.2 Plugged Coalescer----------	Replace.
	5.4 Engine speed too low----------	Adjust and reset
	5.5 Inlet valve stuck----------	Free or replace.
	5.6 Belts slipping----------	Readjust.
6. Oil Carryover.	6.1 Oil level overfull----------	Drain to correct level.
	6.2 Plugged oil scavenge orifice-----	Remove and clean.
	6.3 Scavenge return line kinked-----	Replace/re-route.
	6.4 Check valve stuck----------	Replace.
	6.5 Discharge Pressure too low-----	Review air usage.
	------	Check press. regul. setting.
	6.6 Defective coalescer----------	Replace.

Symptom:	Probable Cause:	
7. Compressor Overheating.	7.1 Insufficient oil----------	Check level and top up.
	7.2 Restricted cooling air flow-------	Reposition machine.
	7.3 Fan not operating----------	Check ground connection.
	-------	Check fan switch.
	-------	Check air pressure switch.
	-------	Check circuit breaker.
	-------	Check for shorted wires.
	-------	Check fan motor.
	7.4 Plugged oil filter----------	Replace.
	7.5 Cooler core plugged----------	Clean.
	7.6 Pressure set too high----------	Readjust.
	7.7 Restricted cooling air flow------	Reposition machine.
	7.8 Contaminated cooler core-------	Remove and clean.
8. System Retains Pressure After Shutdown	8.1 No signal to blowdown valve---	Check pilot line for leak/fold
	8.2 Blowdown silencer plugged-----	Clean or replace.
	8.3 Blowdown valve plugged--------	Replace.
	8.4 Plugged coalescer element-------	Replace.
9. Improper Control Operation	9.1 Engine does not speed up--------	Cylinder stuck, replace.
	-------	Governor stuck, free/lube.
	-------	Operating pressure too high.
	-------	Fuel filter partly plugged.
	9.2 Engine does not slow down------	Leak in control line.
	--------	Press.regul.out of adjustment.
	--------	Press. regul. faulty.
	--------	Air cylinder stuck, replace.
	--------	Governor stuck, free/lube.
10. Engine Overheating	10.1 Low oil level----------	Top up.
	10.2 Oil filter plugged----------	Replace.
	10.3 Restricted cooling air in/out----	Clean engine intake grill.
	-------	Too close to obstruction.
	-------	Engine oil cooler plugged.
	10.4 Compressor pressure---------- to high	Readjust.
	10.5 Check engine manual.	

NOTES


DRAWING SIZE
REF.
PART NO.
DESCRIPTION
QTY.
SERVICE AIR
SLIDER
RED 9/32 ORIFICE
ENGINE SPEED CONTROL CYLINDER
COALESCER AIR/FLUID SEPARATOR
PRESSURE RELIEF VALVE
FLUID FILL
CHECK VALVE
CONTROL PANEL
PRESSURE REGULATION VALVE
PRESSURE GAUGE
CHECK VALVE ORIFICE
AIR FILTER
COMPRESSOR UNIT
FLUID LEVEL SIGHT GLASS
AIR/FLUID RECEIVER
FLUID FILTER
FLUID COOLER
KEY
AIR
AIR/FLUID
FLUID
DIRECTION
DO NOT SCALE
TOLERANCE UNLESS NOTED
MACHINED SURFACE +/- .010
UNMACHINED SURFACE +/- .06
FRACTIONAL +/- 1/32
DECIMAL +/- .03
ANGULAR +/- 1 DEG.
FINISHED COLOR
PART NO. MARKED
THIS PRINT IS THE PROPERTY OF VANAIR MFG. INC. AND MAY NOT BE GIVEN TO ANY OTHER PERSON WITHOUT THE CONSENT OF VANAIR MFG. INC.
CHANGE NO
DATE
DESCRIPTION
BY
B
SCALE 1:1
DESIGNER ERY
DRAWN
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MATERIAL
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VANAIR
19015 US 12
NEW BUFFALO MI.
49117
SCHEMATIC, FLOW DIAGRAM
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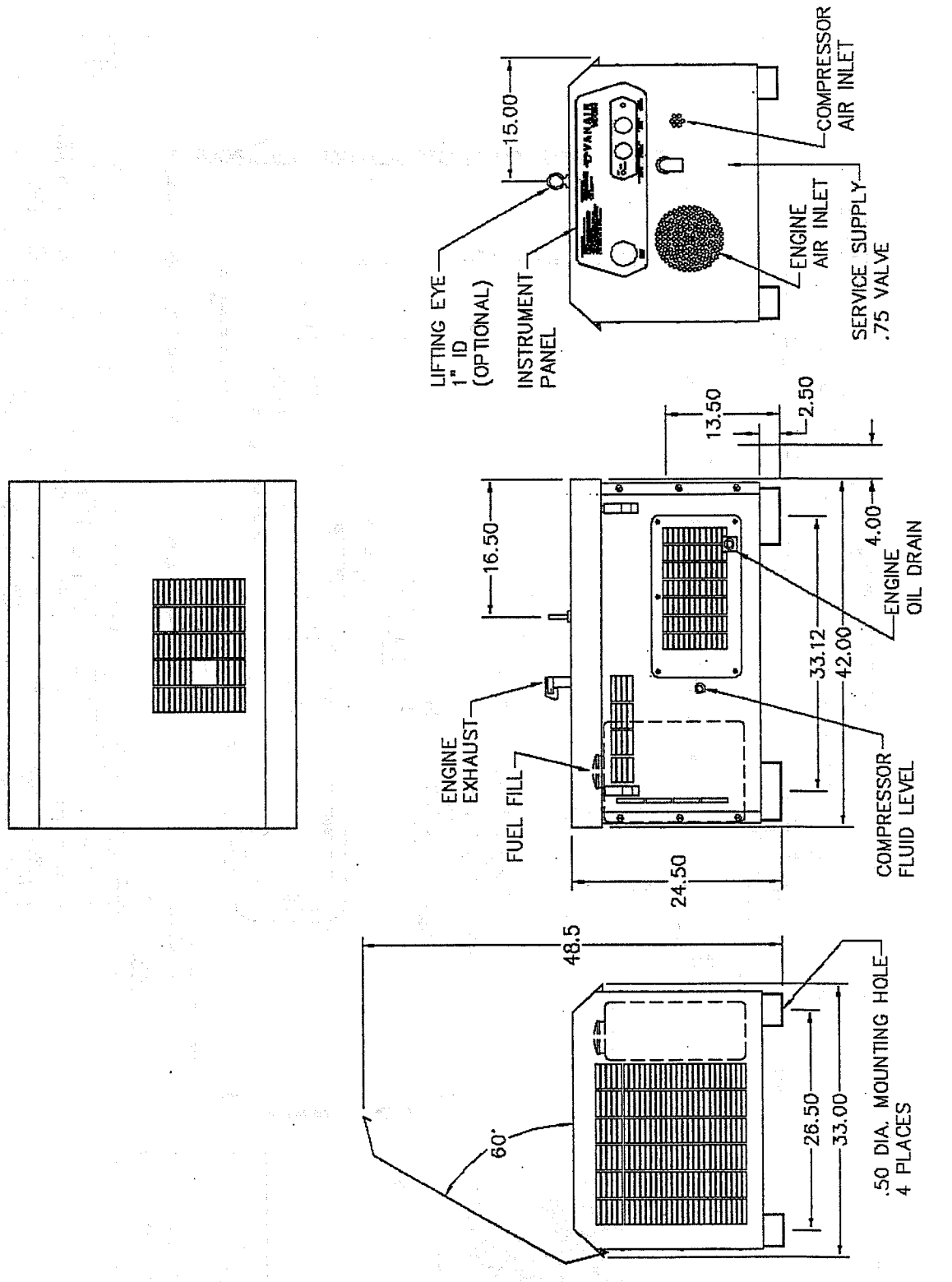
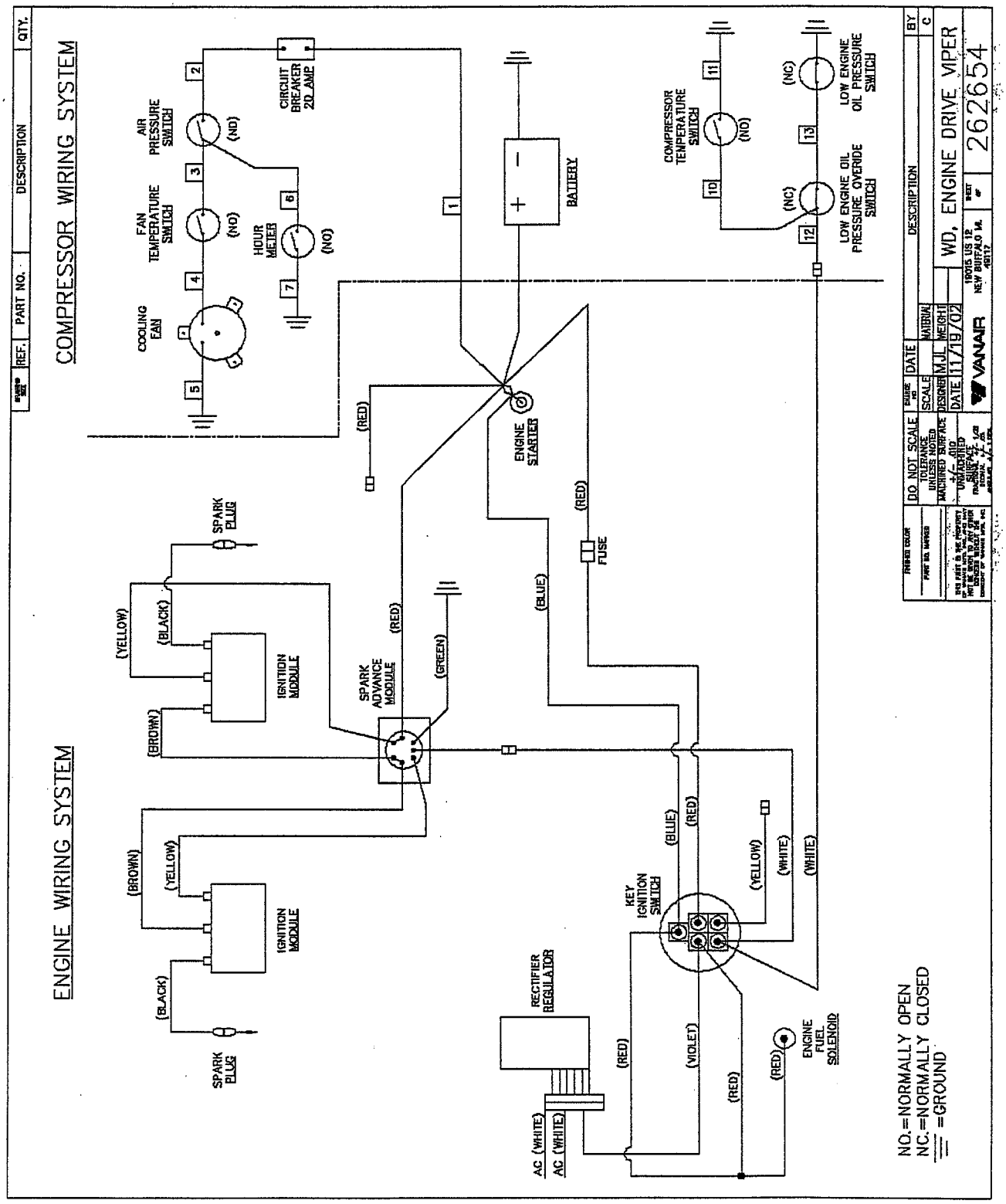
SHEET OF
262899


15.00
COMPRESSOR AIR INLET
LIFTING EYE 1" ID (OPTIONAL)
INSTRUMENT PANEL
ENGINE AIR INLET
SERVICE SUPPLY .75 VALVE
13.50
2.50
16.50
4.00
ENGINE OIL DRAIN
33.12
42.00
ENGINE EXHAUST
FUEL FILL
COMPRESSOR FLUID LEVEL
24.50
48.5
60°
26.50
33.00
.50 DIA. MOUNTING HOLE 4 PLACES

262733

ELECTRICAL DIAGRAM



7.1 Procedure for Ordering Parts:

Parts should be ordered from the nearest Sullair®/Vanair Distributor, from whom the unit was purchased. If for any reason parts cannot be obtained in this manner, contact the factory direct at the address below.

When ordering parts it its IMPORTANT to indicate the SERIAL NUMBER of the machine. This is located on the top of the cooler housing.

Some standard fasteners (capscrews, nuts, washers, etc.) And fittings plus other standard hardware may not have been included in the Parts List. Unless otherwise stated, standard pipe and fittings are Schedule 40 Malleable Iron to conform to A.N.S.I. B16.3 Class 150. Fastenings unless otherwise listed are Grade 5. These are items which may be obtained quicker and more economically from local sources.

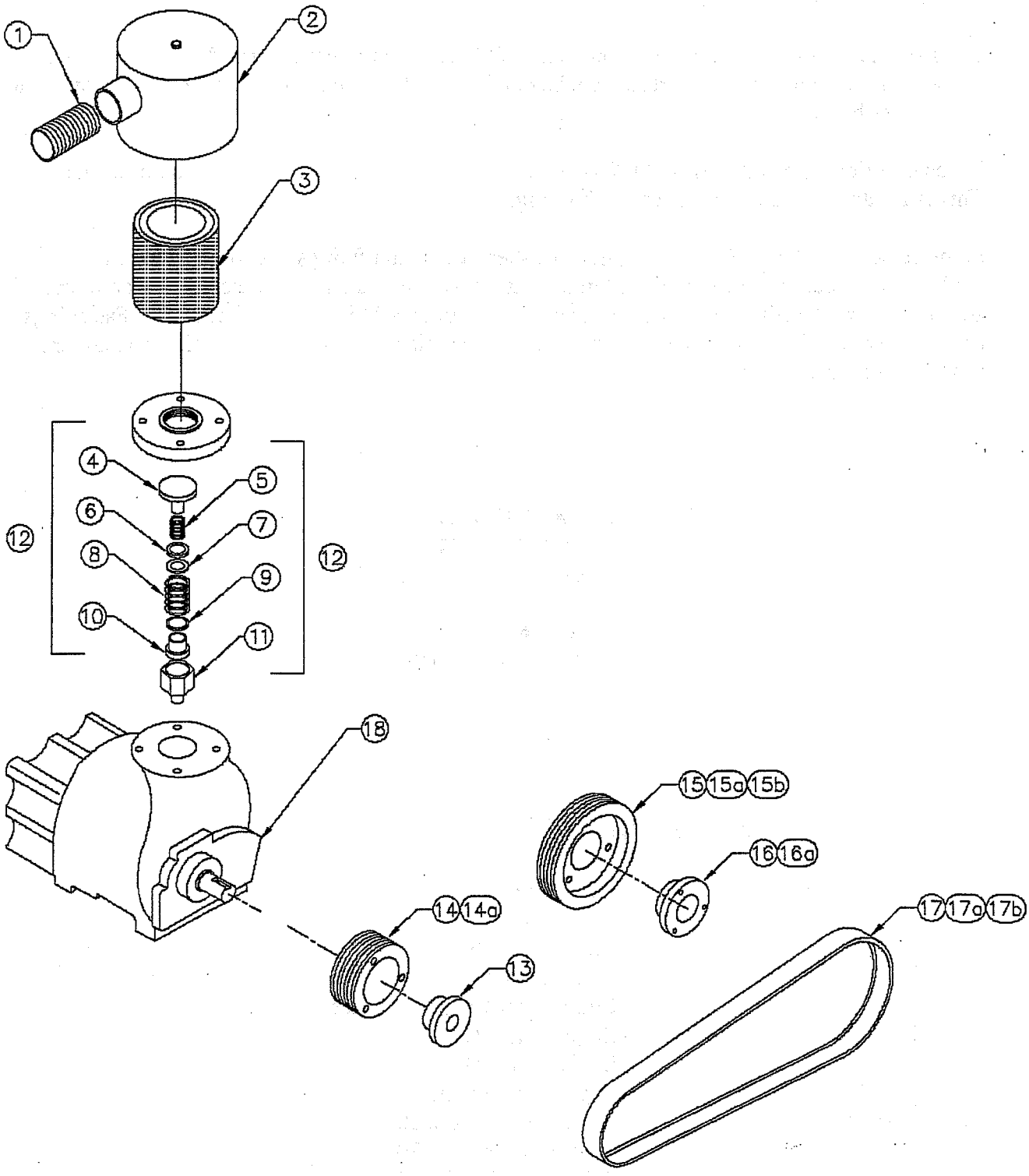
VANAIR MANUFACTURING INC.
19015, US 12,
NEW BUFFALO, MI 49117.

TEL. 269-469-4461.
FAX. 269-469-0497.

7.2 Recommended Replacement Parts:

Part Number:	Description:
264166	Element, Air Filter.
261991	Compressor Oil Filter.
262715	Compressor Coalescer Filter.
262722	Engine Air Filter.
262723	Engine Oil Filter.
262724	Engine Fuel Filter.
262813	Drive Belt - Model 60.
262617	Drive Belt - Model 70.
263661	Drive Belt - Model 80

COMPRESSOR / INLET VALVE / DRIVE ASSEMBLY



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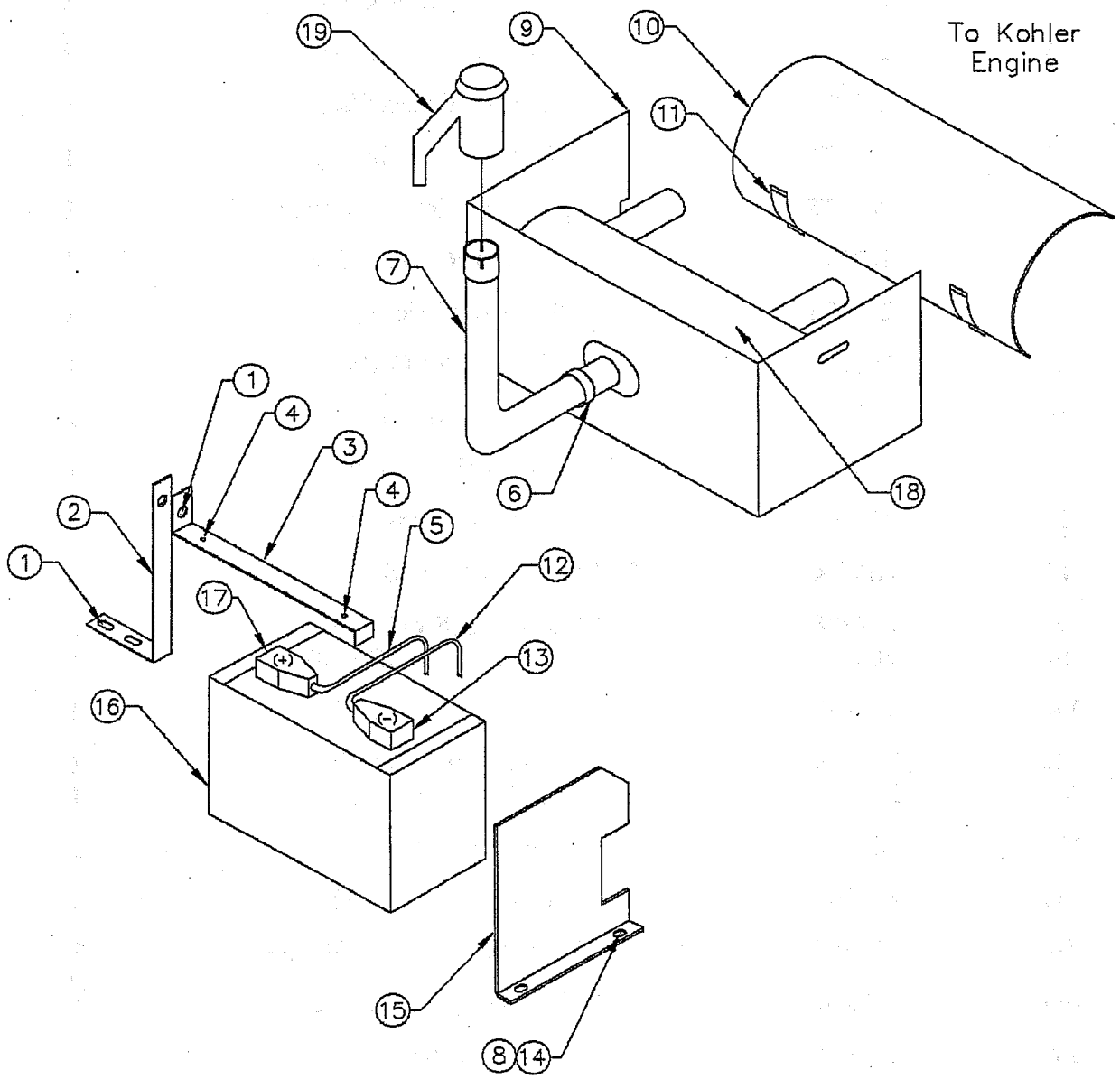
7.2 COMPRESSOR / INLET VALVE / DRIVE ASSEMBLY

REF. NO.	PART NO.	PART DESCRIPTION	QTY. REQ'D
1	262705	Exhaust Hose	1
2	264417	Inlet Air Filter Cover	1
3	264418	Air Filter Element	1
4	262978	Air Inlet Check Valve	1
5	262977	Check Valve Spring	1
6	262975	Spring Air Inlet Retainer	1
7	262974	Air Inlet Retainer Ring	1
8	262973	Piston Air Inlet Spring	1
9	262972	Inlet Valve O-Ring	1
10	262971	Inlet Valve Piston	1
11	262970	Inlet Valve Cylinder	1
12	262969	Inlet Valve Assembly	1
13	262614	60 / 70 / 80 Bushing (Small Sheave)	1
13a	264488	60 Bushing (Small Sheave)	1
14	262613	60 / 70 Sheave (Small)	1
14a	263659	80 Sheave (Small)	1
14b	264716	60 Sheave (Small)	1
15	262812	60 Sheave (Large)	1
15a	262616	70 Sheave (Large)	1
15b	263660	80 Sheave (Large)	1
16	262615	60 / 70 Bushing (Large Sheave)	1
16a	263614	80 Bushing (Large Sheave)	1
17	262813	60 Belt	1
17a	262617	70 Belt (before s/n: 30-64303)	1
17b	262813	70 Belt (after s/n: 30-64304)	1
17c	263661	80 Belt	1
18	262708	Compressor	1

EXHAUST / BATTERY SYSTEMS



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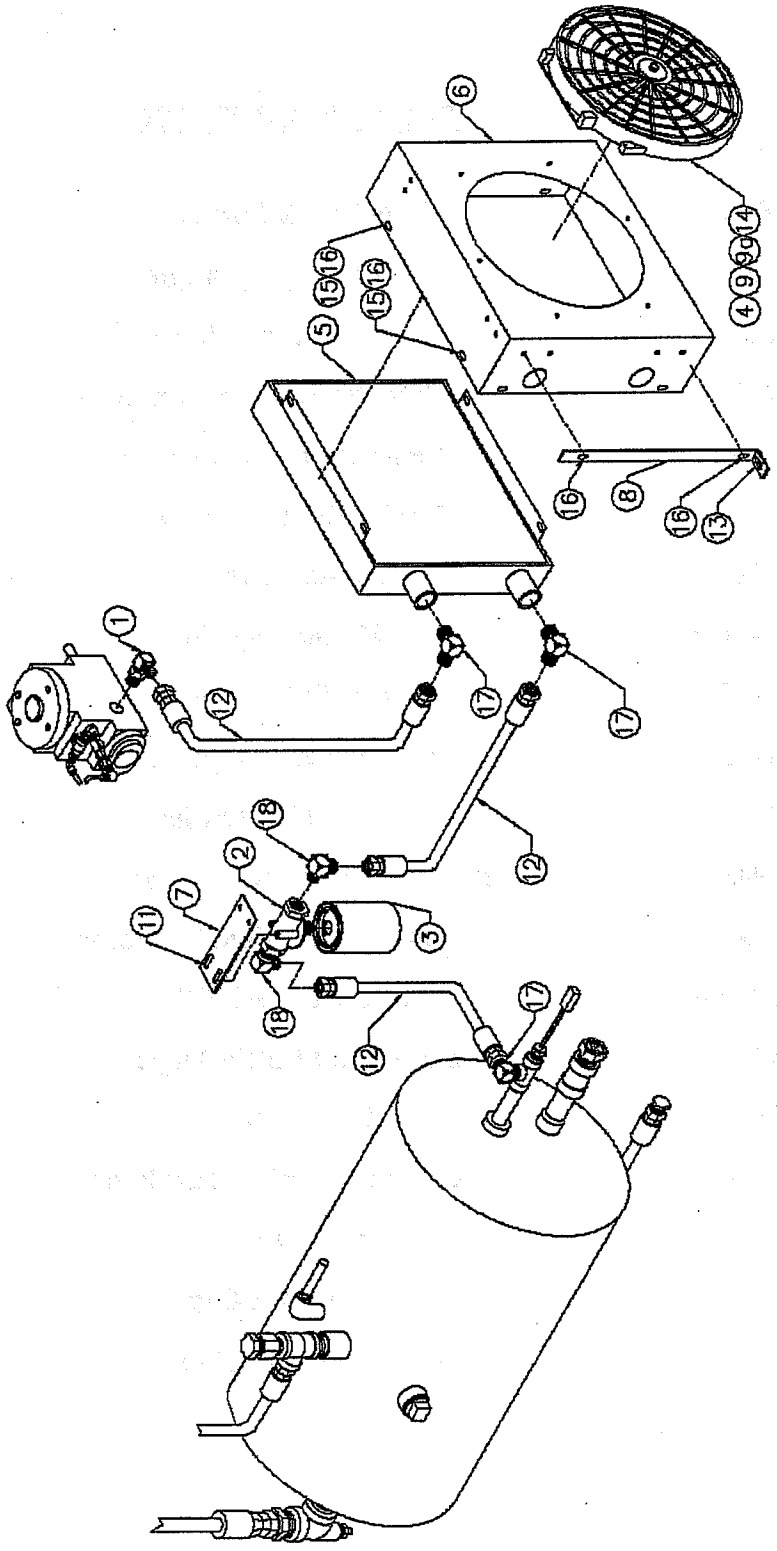
7.4 EXHAUST/ BATTERY SYSTEMS

REF. NO.	PART NO.	PART DESCRIPTION	QTY. REQ'D
1	829705-075	5/16-18 x 3/4 Screw	2
2	263377	Battery Support Angle	1
3	263376	Battery Hold Down Bracket	1
4	262955	9/16 Diameter Rubber Bumpers	2
5	263942	32" Positive Battery Cable	1
6	262906	1 1/4 Exhaust Clamp	1
7	262707	Exhaust Tube	1
8	825504-145	1/4-20 Locking Nut	2
9	263449	Exhaust Shield Panel	1
10	264411	Anti Icing Kit - Option	1
11	264411	Anti Icing Kit - Option	1
12	263943	20" Negative Battery Cable	1
13	261192	Black Battery Terminal Insulator	1
14	829104-150	1/4-20 x 1 ½ HHCS	2
15	262701	Engine Cool Baffle Angle	1
16	262596	12Volt Battery	1
17	261191	Red Battery Terminal Insulator	1
18	262646	Exhaust Muffler	1
19	262706	Exhaust Rain Cap	1
N/S	262645	Kohler Gas Engine	1

OIL COOLING



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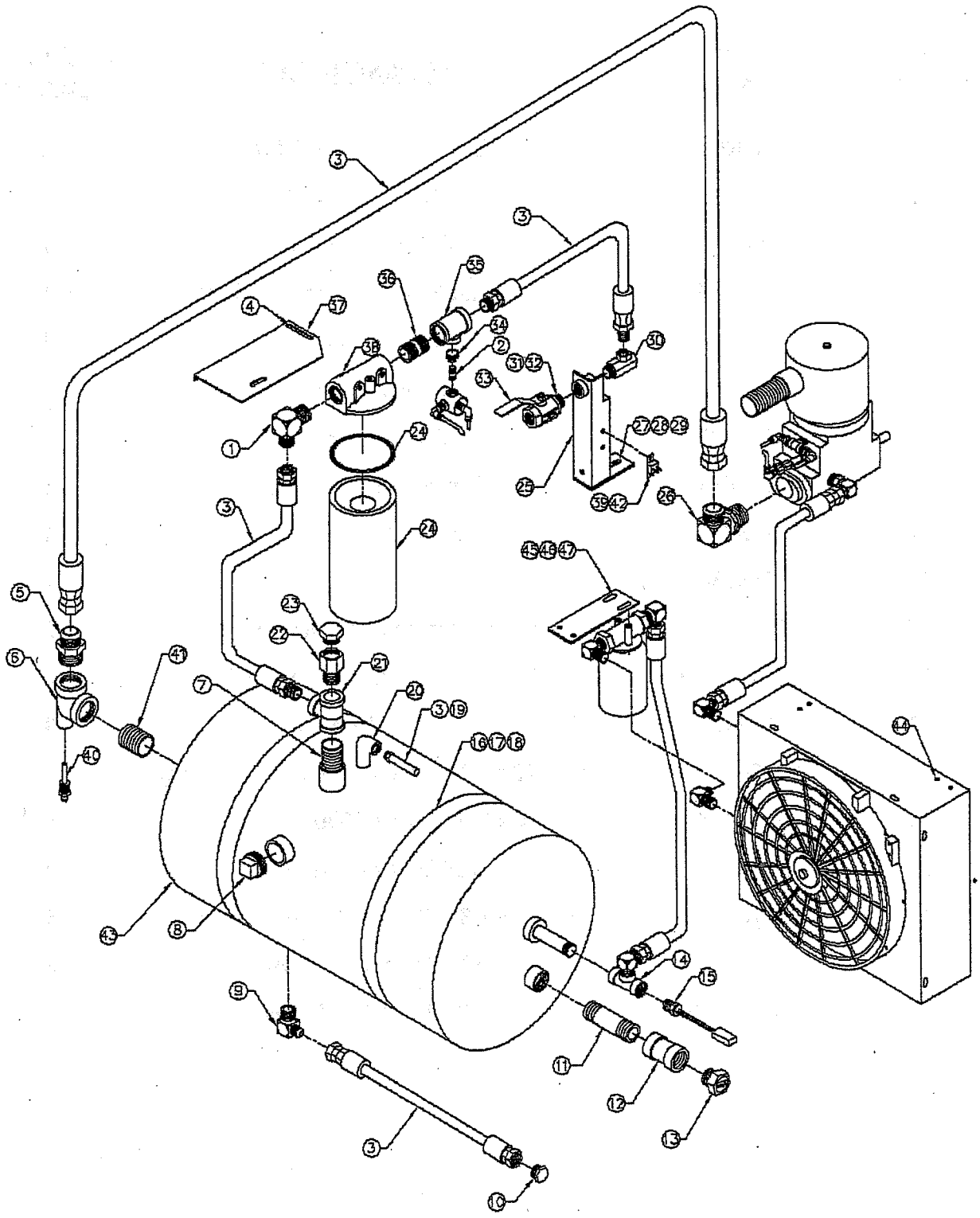
7.6 OIL COOLING SYSTEM

REF. NO.	PART NO.	PART DESCRIPTION	QTY. REQ'D
1	260403-112	1/2 JIC x 5/8 SAE Elbow	1
2	261990	Oil Filter Head	1
3	261991	Oil Filter Element	1
4	262105	Fan and Motor Mounting Clips	6
5	262274	Oil Cooler	1
6	262311	Cooler Shroud	1
7	262597	Oil Filter Plate	1
8	262634	Cooler Support Angle	1
9	263744	Fan And Motor Assembly	1
9a	263758	Fan Motor	1
10	825504-145	1/4-20 Hex Plated Locking Nut	2
11	829705-075	5/16-18 x 3/4 Serrated Washer Screw	2
12	263872	Viper Hose Kit	3
13	829705-100	5/16-18 x 1 Hex Serrated Washer Screw	7
14	834204-075	1/4 x 3/4 Hex Self Thread Screw	6
15	825305-283	5/16 Hex Flange Nut	4
16	829705-075	5/16-18 x 3/4 Serrated Washer Screw	6
17	860208-050	1/2 JIC x 1/2 Elbow	2
18	860208-075	1/2 JIC X 3/4 Elbow	2

DISCHARGE SYSTEM



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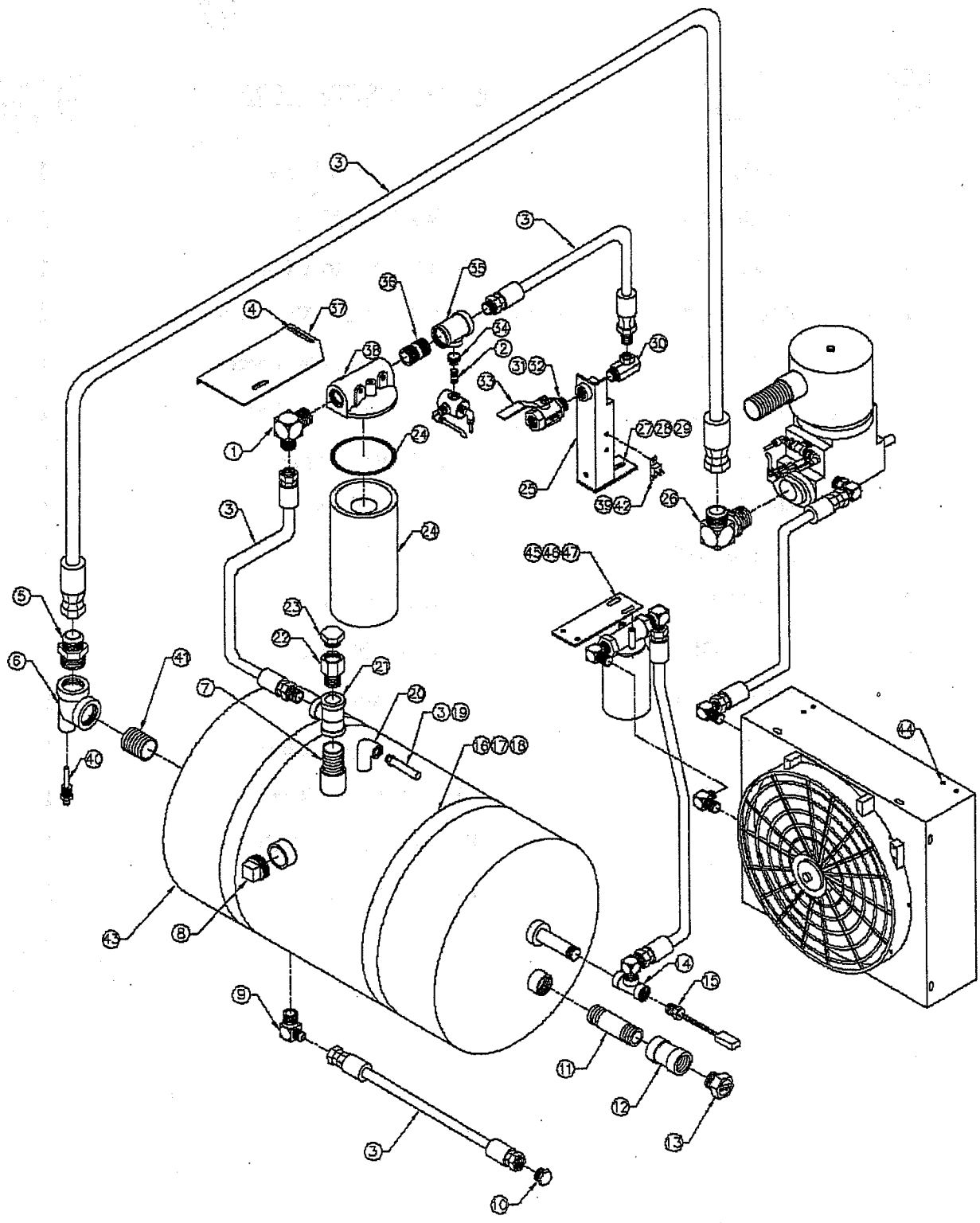
7.8 Discharge System

REF. NO.	PART NO.	PART DESCRIPTION	QTY. REQ'D
1	860216-075	1 JIC x 3/4 Elbow	1
2	802904-033	1/4 x 1 1/2 Nipple	1
3	263872	Gas Viper Hose Kit	1
4	829705-075	5/16-18 x 3/4 Serrated Washer Screw	2
5	860124-125	1 1/4 JIC X 1 1/2 Connector	1
6	802906-026	1 1/2 x 1/2 x 1 1 /2 Tee	1
7	822216-000	1" Close Nipple	1
8	807800-060	1 1/2 Plug	1
9	860208-075	1/2 JIC x 3/4 Elbow	1
10	263293	1/2 NPT Plug	1
11	823116-000	1" x 6 Nipple	1
12	801215-040	1" Coupling	1
13	041327	Oil Level Sight Glass	1
14	802903-022	3/4 x 1/2 x 1/2 Tee	1
15	260230	Temperature Switch	1
16	262600	10" Mounting Band	2

DISCHARGE SYSTEM

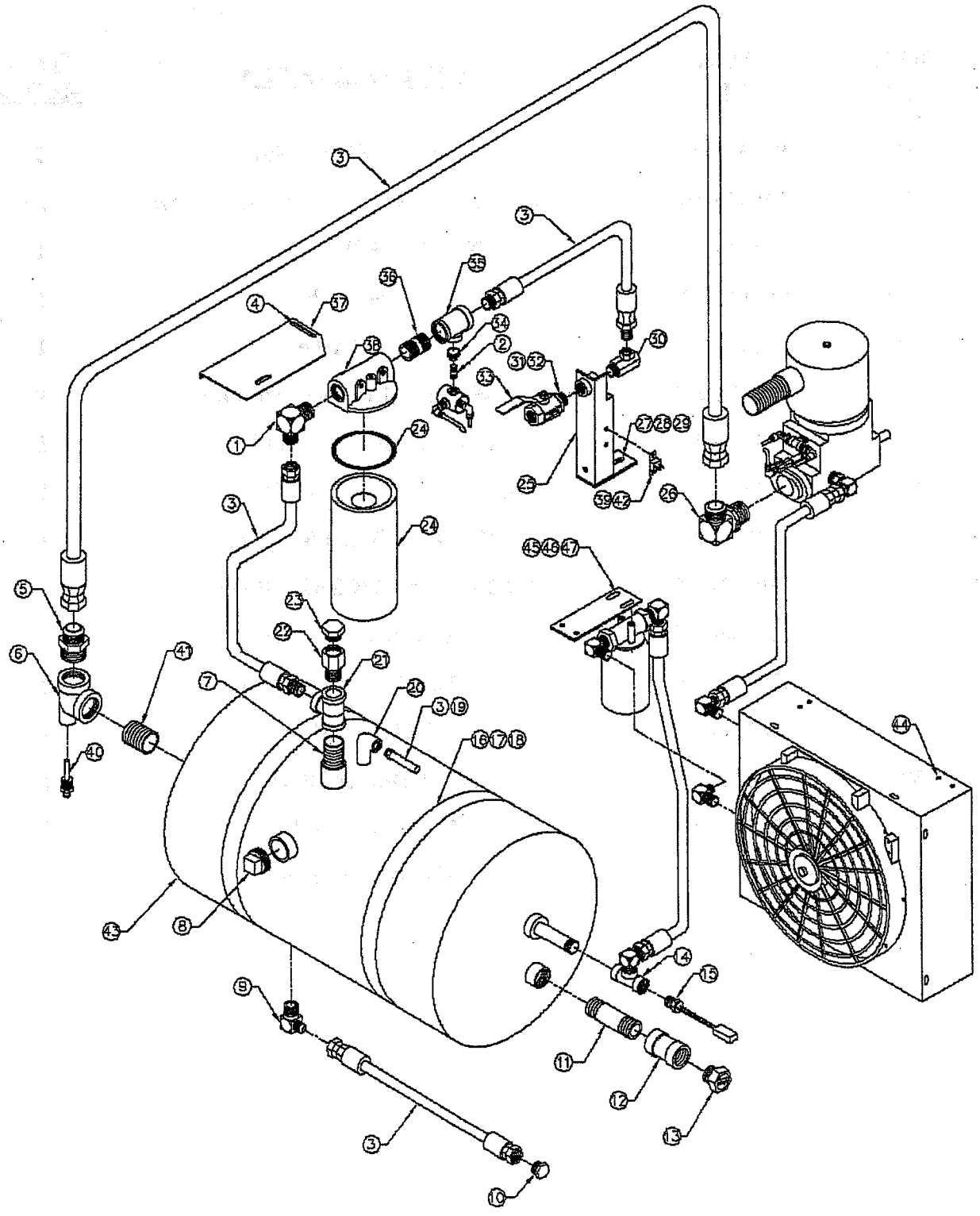


264678

7.10 Discharge System Continued

REF. NO.	PART NO.	PART DESCRIPTION	QTY. REQ'D
17	825305-283	5/16 Hex Flange Nut	2
18	829705-150	5/16-18 x 1 1/2 Serrated Washer Screw	2
19	262008	1/2 NPT 175 PSI Relief Valve	1
20	801115-020	1/2 Street Elbow	1
21	802904-043	1 x 1 x 3/4 Tee	1
22	250028-663	1" MPT x 1 5/16 SAE Adapter	1
23	048063	1 5/16 Oil Fill Cap With Vent	1
24	262715	Spin - On Separator Element	1
25	262637	Discharge Outlet Support	1
26	260403-110	1 1/4 Jic x 1 1/4 SAE Elbow	1
27	825506-198	3/8-16 Hex Locking Nut	4
28	829506-100	3/8-16 x 1 Carriage Bolt	2
29	838206-071	3/8 Flat Washer	4
30	048429	3/4 90 Degree Elbow	1
31	822212-000	3/4 Close Nipple	1
32	801115-030	3/4 Street Elbow	1

DISCHARGE SYSTEM



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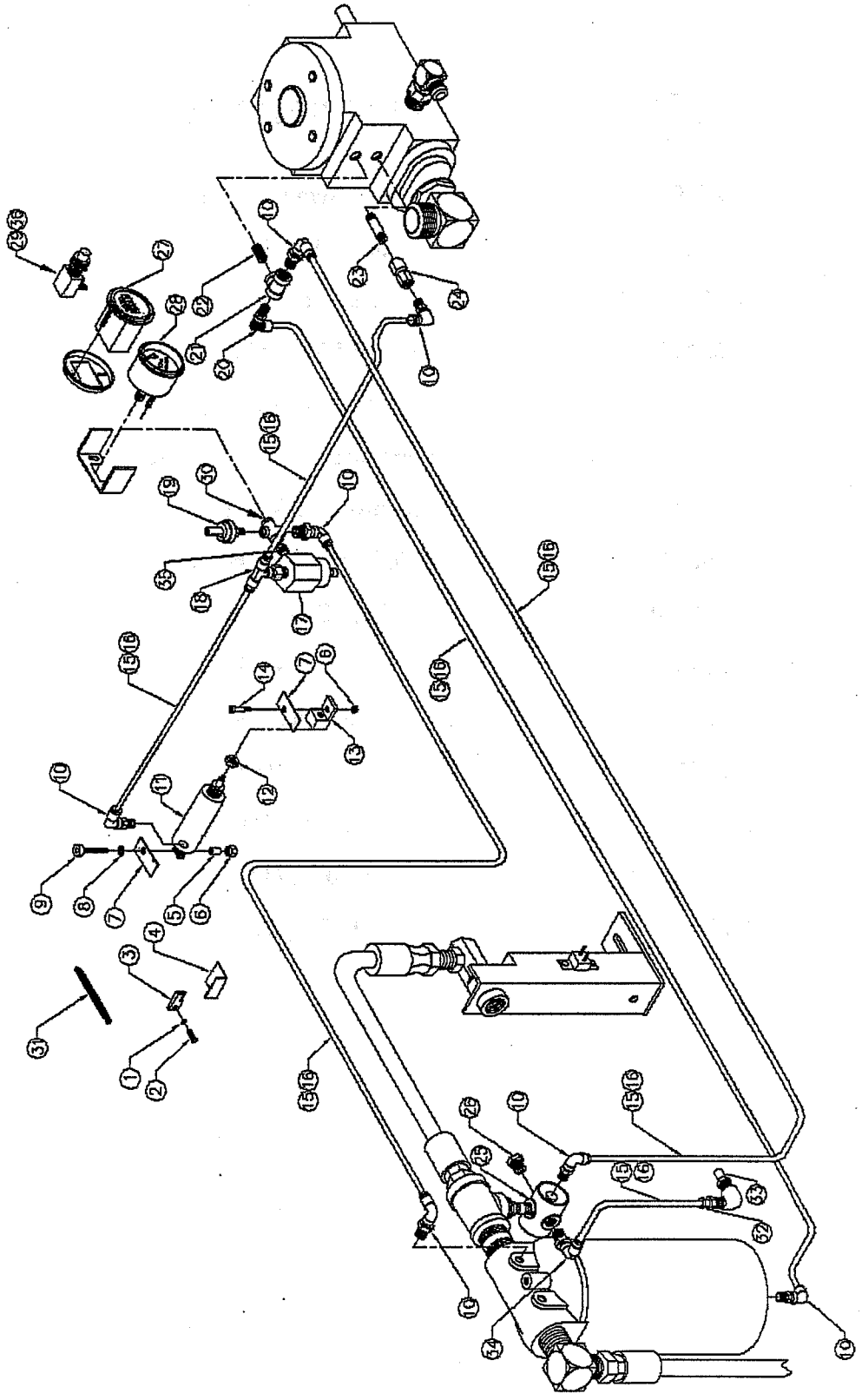
7.12 Discharge System Continued

REF. NO.	PART NO.	PART DESCRIPTION	QTY. REQ'D
33	261982	3/4 Service Valve	1
34	804103-020	3/4 x 1/2 Bushing	1
35	802904-033	1 x 3/4 x 3/4 Tee	1
36	262912	60/70/80 CFM Orifice	1
37	262598	Separator Mounting Angle	1
38	262714	Separator Element Head	1
39	260034	Circuit Breaker 20 Amp	1
40	046048	N.O. Temperature Switch	1
41	822224-000	1 ½ Close Nipple	1
42	263273	#8-32 x 1/2 Truss Head Screw	2
43	262288	Receiver Tank	1
44	829705-075	5/16-18 x 3/4 Screw	2
45	838504-062	1/4 Lock Washer	2
46	829104-075	1/4-20 x 3/4 Screw	2
47	838204-071	1/4 Flat Washer	2

CONTROL SYSTEMS AND INSTRUMENTS



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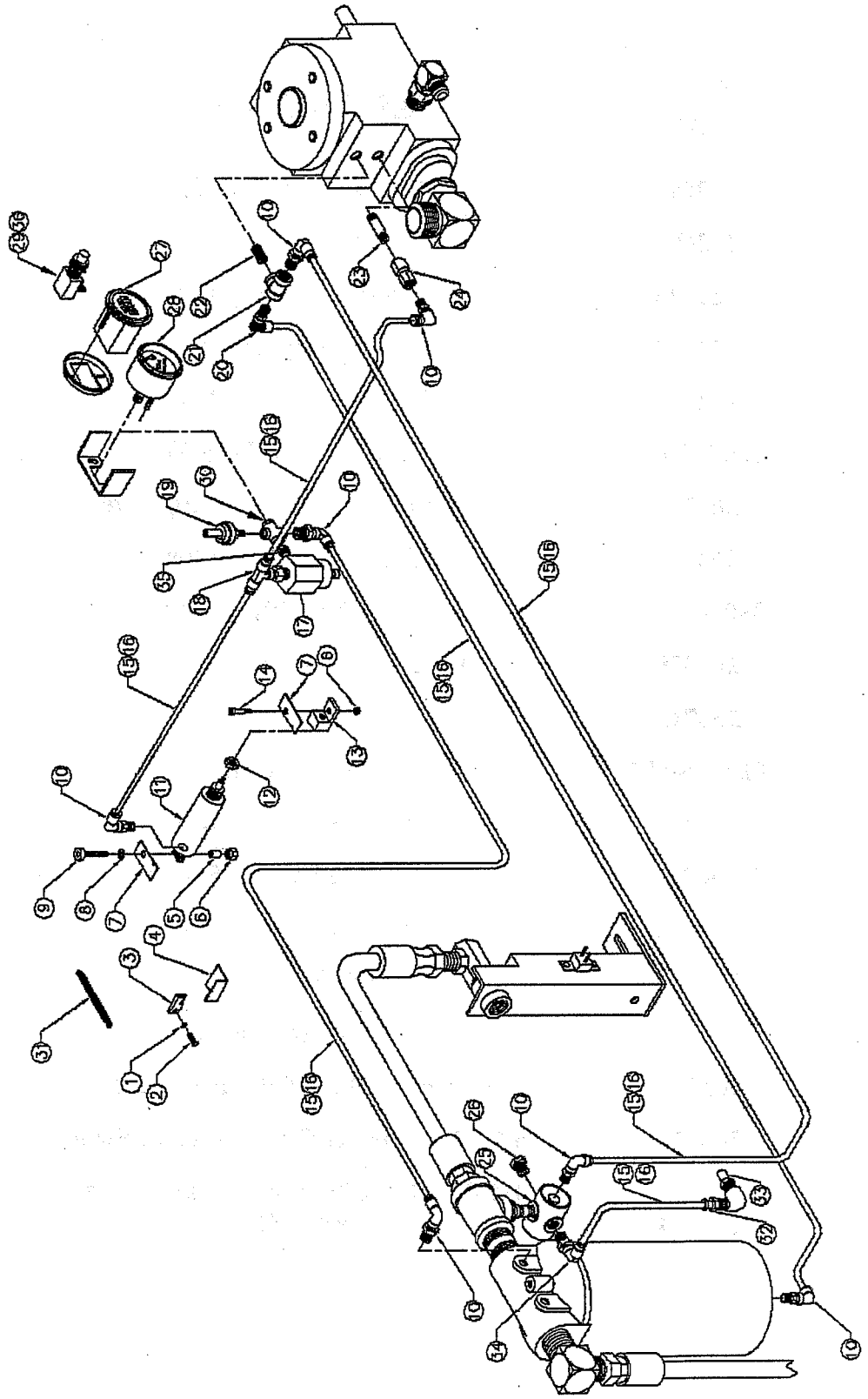
7.14 CONTROL SYSTEM AND INSTRUMENTS

REF. NO.	PART NO.	PART DESCRIPTION	QTY. REQ'D
1	263696	M4 - .7 x 30mm Hex Screw	1
2	263697	M4 - .7 Nut	1
3	262838	Engine Idle Support	1
4	262837	Idle Stop Angle	1
5	262760	5/16 O.D. Spacer Tube	2
6	825502-083	#10-24 Hex Locking Nut	2
7	262717	Cylinder Spring Mounting Plate	1
8	262704	1/4 Flat Nylon Washer	2
9	830504-100	1/4 x 1 Shoulder Screw	1
10	261309	1/4 T x 1/8 P Push-On Elbow	6
11	262712	Engine Air Cylinder	1
12	824605-195	5/16 Jam Nut	1
13	262711	Engine Control Clevis	1
14	830504-075	1/4 x 3/4 Shoulder Screw	1
15	261322	1/4 Push - On Tubing	1
16	261410	3/8 Flex Loom	1
17	262047	Regulator Valve	1
18	261313	M Branch 1/4 x 1/4 P Push - On Tee	1
19	262450	25 P.S.I. Normally Open Pressure Switch	1
20	264104	1/4 T x 1/8 P Elbow With Check Valve and Orifice	1

CONTROL SYSTEMS AND INSTRUMENTS



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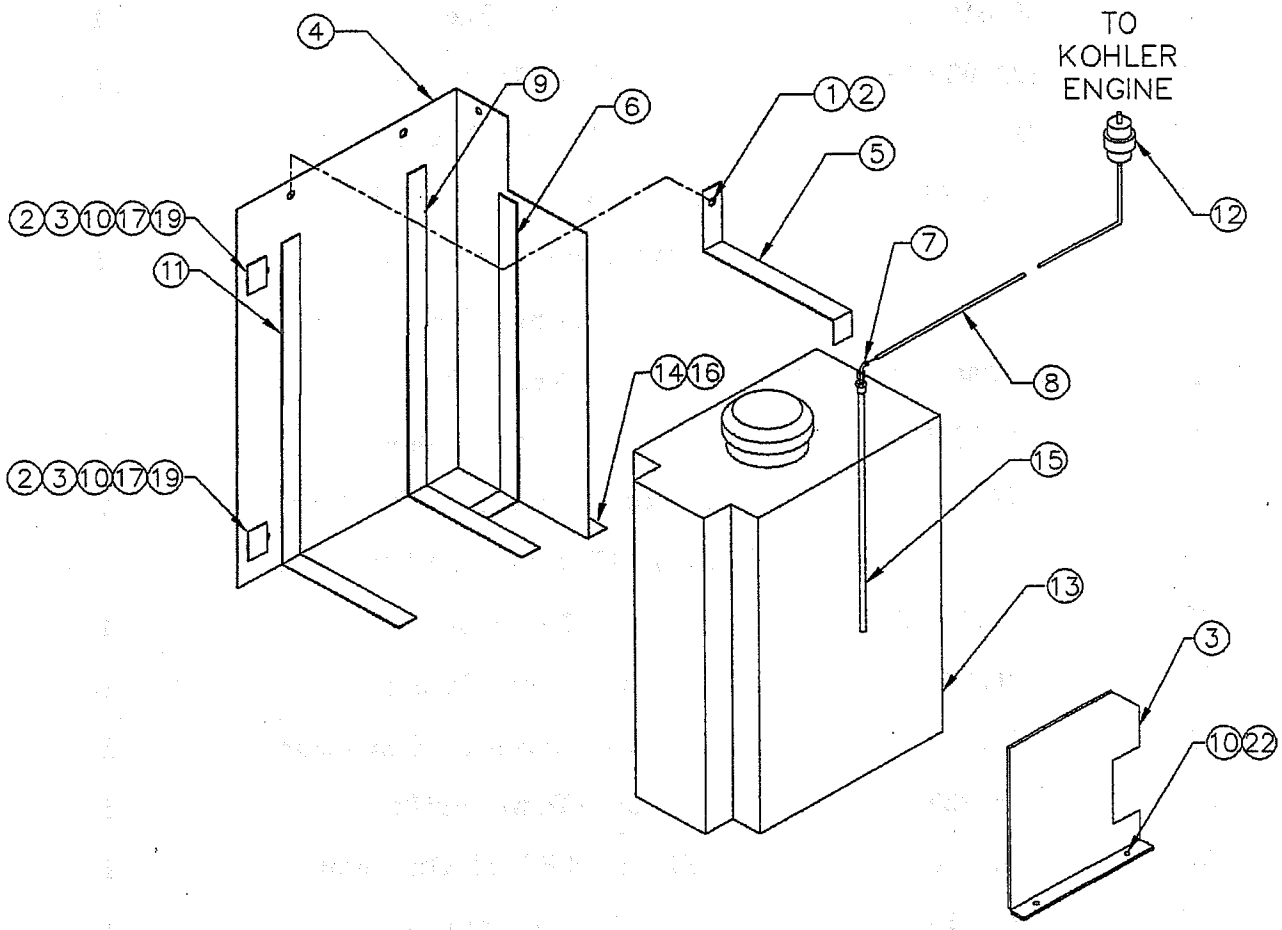
7.16 CONTROL SYSTEM AND INSTRUMENTATION

REF. NO.	PART NO.	PART DESCRIPTION	QTY. REQ'D
21	804415-005	1/8" Tee	1
22	823102-015	1/8 x 1 1/2 Nipple	1
23	822202-000	1/8" Close Nipple	1
24	264103	1/8 Female Pipe Check Valve	1
25	262254	1/4" Normally Open 3-Way Pneumatic Valve	1
26	807800-010	1/4 Pipe Plug	1
27	040035	Hour Meter Gauge	1
28	261974	Air Pressure Gauge with Switch	1
29	262653	Normally Closed Pushbutton Switch	1
30	801315-005	1/8 Cross	1
31	262713	3" Control Spring	1
32	261317	1/4 T x 1/4 P Push- On Connector	1
33	261223	Blow Down Muffler	1
34	261310	1/4 T x 1/4 P Push-On Elbow	1
N/S	262810	Wiring Harness	1
N/S	261546	Hose Support Clamps (With Lifting Bail)	2
N/S	261546	Hose Support Clamps (Without Lifting Bail)	4
35	861604-012	1/4 x 1/8 Hex Nipple	1
36	263965	5/8-32 Brass Nut	1

FUEL SYSTEM

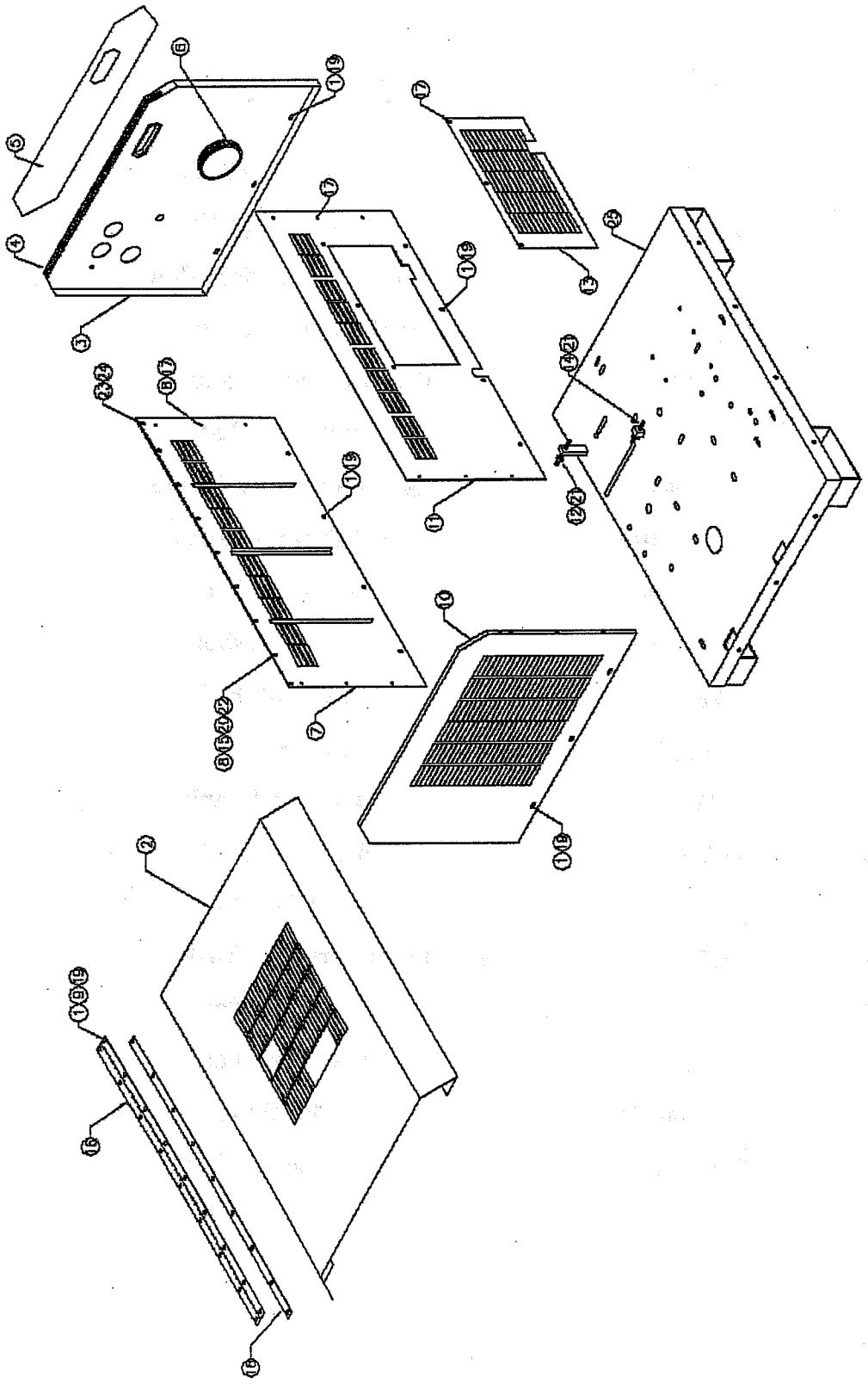


264680

7.18 FUEL SYSTEM

REF. NO.	PART NO.	PART DESCRIPTION	QTY. REQ'D
1	829705-075	5/16-18 x 3/4 HHCS	1
2	825305-283	5/16-18 Flange Nut	1
3	829505-075	5/16 x 3/4 Carriage Bolt	2
4	262694	Fuel Tank Baffle Panel	1
5	262782	Fuel Tank Strap Support	1
6	262709	Fuel Tank Pad	1
7	260864	3/16 - 5/16 Hose Clamp	2
8	842315-025	1/4" Fuel Line Hose	1
9	262709	Fuel Tank Pad	1
10	838204-071	1/4 Flat Washer	4
11	262709	Fuel Tank Pad	1
12	262724	Fuel Filter	1
13	262609	Plastic Fuel Tank	1
14	825505-166	5/16-18 Locking Nut	2
15	263291	Fuel Line Tube	1
16	829705-100	5/16-18 x 1 Serrated Washer Screw	2
17	262709	Fuel Tank Pad	1
18	262709	Fuel Tank Pad	1
19	838204-071	1/4 Flat Washer	2
20	838205-071	5/16 Flat Washer	2

SHEET METAL



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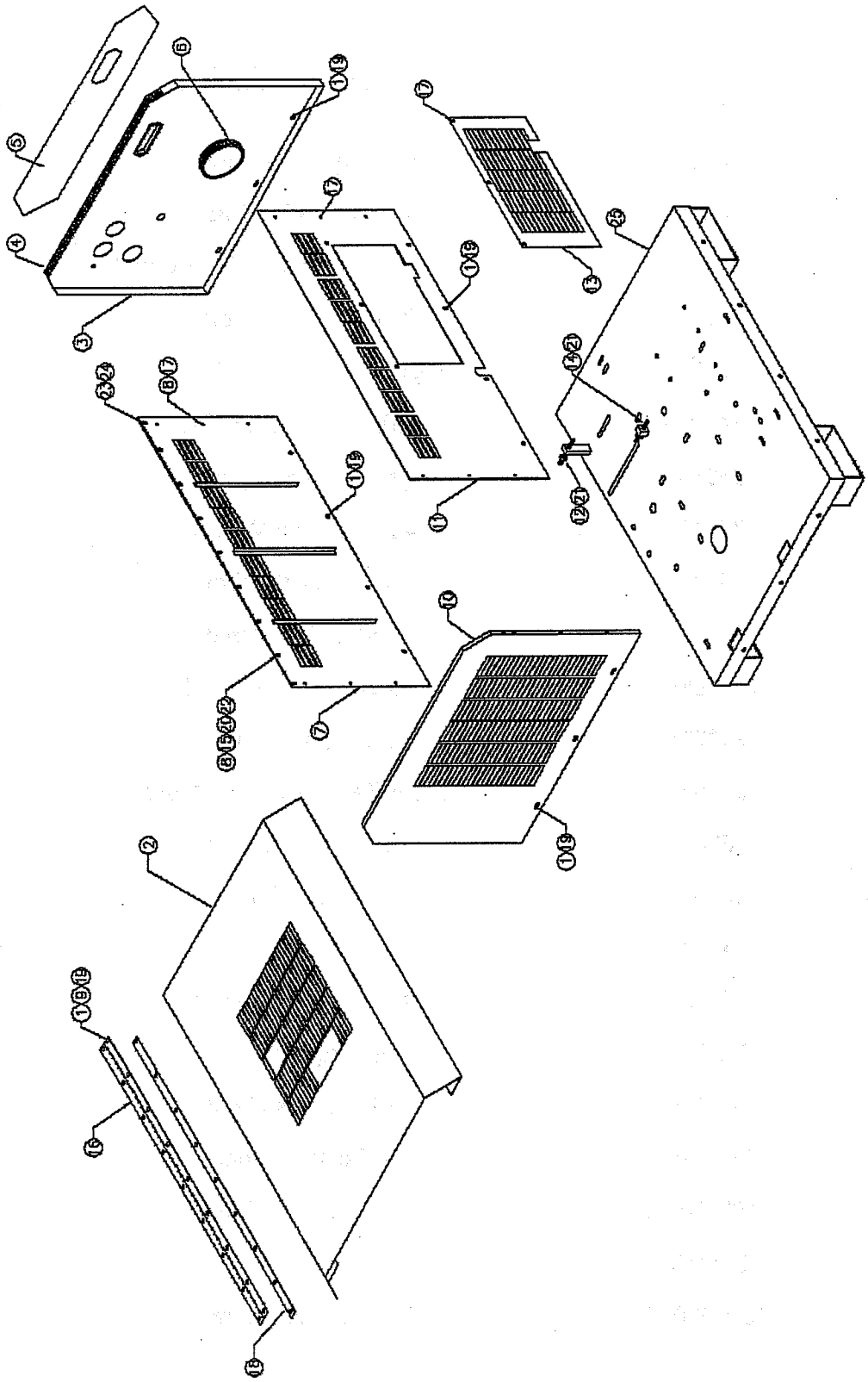
7.20 SHEET METAL AND FRAME ASSEMBLY

REF. NO.	PART NO.	PART DESCRIPTION	QTY. REQ'D
1	262943	5/16 Nylon Washer	21
2	262681	Roof Assembly Panel	1
3	262678	Instrument/Discharge End Panel	1
4	261228	Trim Lock Edging	1
5	262716	Instrument Panel Decal	1
6	262785	Rubber Air Inlet Seal	1
7	262648	Right Hand Side Panel	1
8	262704	1/4 Flat Nylon Washer	7
9	262950	5/16 Lock Washer	7
10	262679	Cooler End Panel	1
11	262680	Left Hand Side Panel	1
12	263274	1/2-13 x 2 Bolt	1
13	262689	Engine/Battery Cover Panel	1
14	262814	1/2-13 x 3-1/2 Bolt	1
15	262952	1/4-20 Nut	7
16	262688	Hinge	1
17	262703	#14 Truss Head Screw	15
18	262795	Hinge Support Plate	1
19	262945	5/16-18 x 3/4 Truss Head Screw	14
20	262951	1/4 Lock Washer	7
21	825208-448	½-13 Locking Nut	2
22	262953	1/4-20 Nut	7
23	829705-050	5/16-18 x ½ Screw	2

SHEET METAL

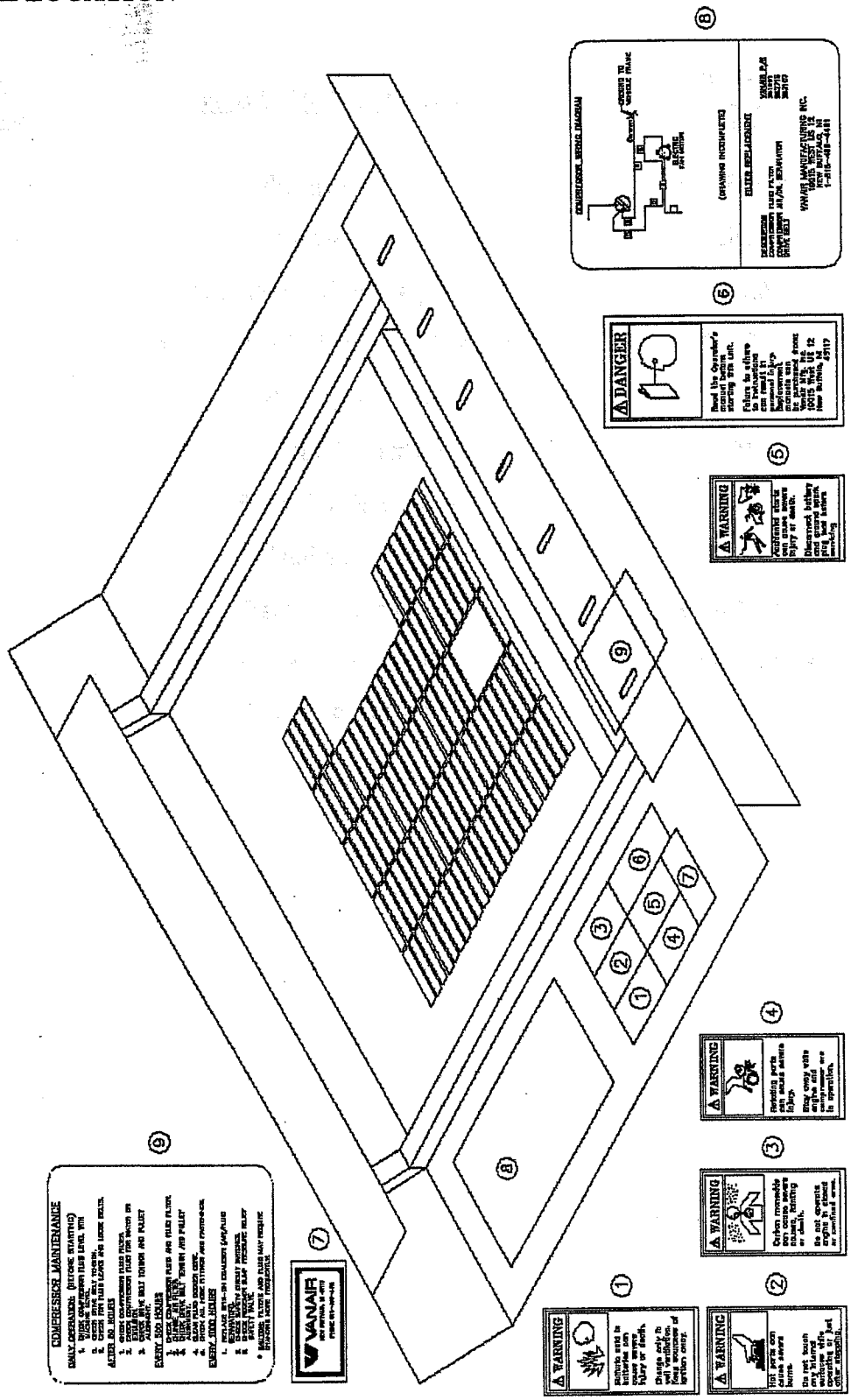


264687

7.22 SHEET METAL AND FRAME ASSEMBLY

REF. NO.	PART NO.	PART DESCRIPTION	QTY. REQ'D
24	825305-283	5/16 Flange Nut	2
25	262633	Viper Frame	1
N/S	262997	Canopy Cable Assembly	1
N/S	263270	Right Hand Angle Keep Latch	1
N/S	262783	Roof Support Rod	1
N/S	263610	3/16 Push-On Retainer	1
N/S	263611	3/16 x 1 ½ Clevis Pin	1
N/S	264138	Rubber Seal	1
N/S	829107-075	7/16-14 x 3/4 HHCS	1
N/S	838507-140	7/16 Lock Washer	1
N/S	263270	Latch, Rubber	2

DECAL LOCATION



264681-1

7.24 DECAL LOCATION

REF. NO.	PART NO.	PART DESCRIPTION	QTY. REQ'D
1	264375	Decal, Sulfuric Acid	1
2	264372	Decal, Hot Parts	1
3	264376	Decal, Carbon Monoxide	1
4	264374	Decal, Rotating Parts	1
5	264373	Decal, Accidental Starts	1
6	264382	Decal, Read Operator's Manual	1
7	NPN	Decal, Vanair	1
8	NPN	Decal, Compressor Wiring	1
9	NPN	Decal, Compressor Maintenance	1

NPN No Part Number

7.26 DECAL LOCATION CONTINUED

REF. NO.	PART NO.	PART DESCRIPTION	QTY. REQ'D
1	264377	Decal, Explosive Fuel	1
2	NPN	Decal, Gasoline Only	1
3	NPN	Decal, Insert Forks Here	4
4	NPN	Decal, VANAIR Viper Logo	1
5	NPN	Decal, VANAIR Viper Logo	1
6	NPN	Decal, Compressor Fluid Drain	1
7	NPN	Decal, Engine Oil Drain	1

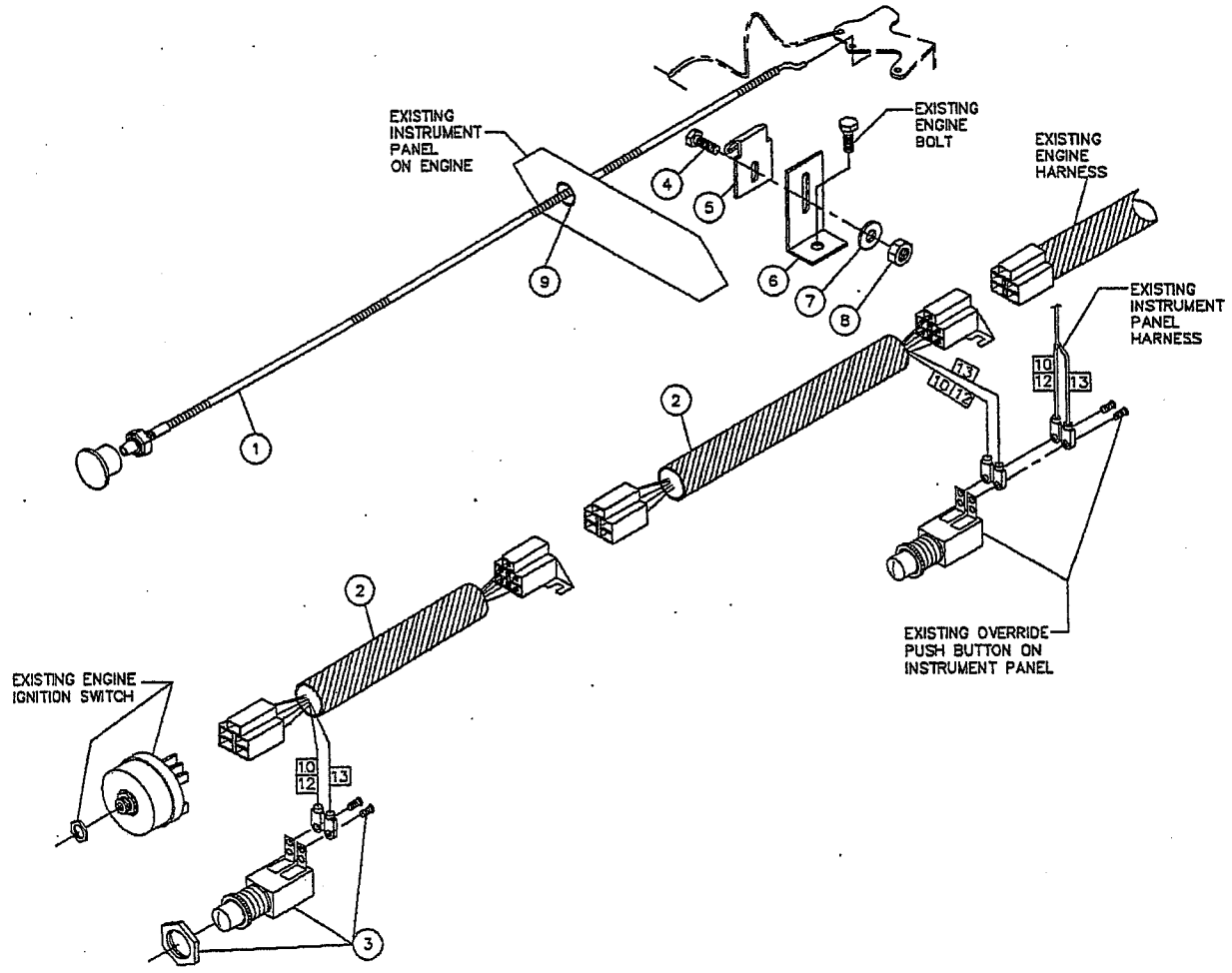
NPN No Part Number

7.28 DECAL LOCATION CONTINUED

REF. NO.	PART NO.	PART DESCRIPTION	QTY. REQ'D
1	264378	Decal, Do Not Remove Caps	1
2	NPN	Decal, Compressor Oil	1
3	264379	Decal, Do Not Use Air	1
4	264381	Decal, Connect Air Hoses	1

Remote Starting Option: (Ref. ID 263059)

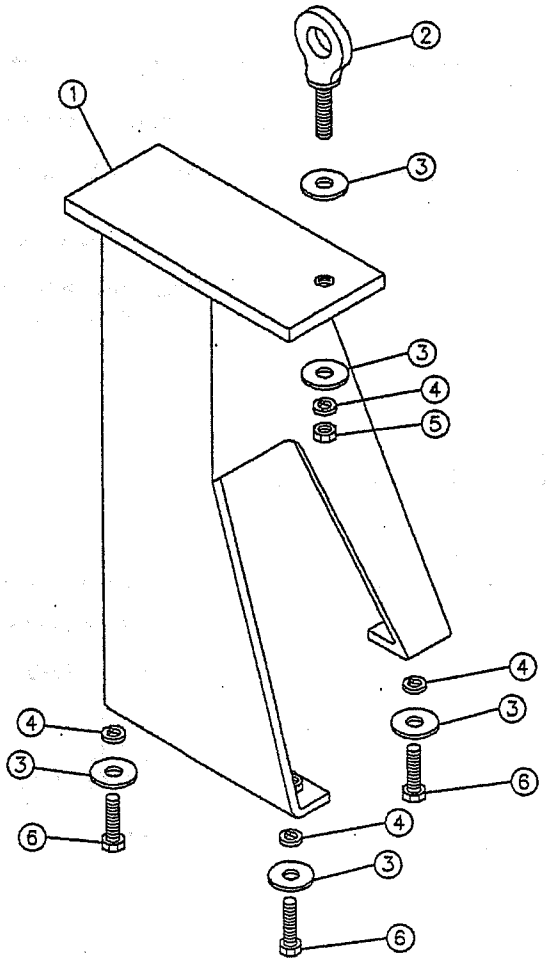
Ref. No.	Description	Part No.	Qty.
1	Cable, Engine Choke.	263054	1
2	Harness, Engine	263058	2
3	Switch, Push-Button	262653	1
4	Screw, Pan Hd. #8-32 x 1/2	831601-050	15
5	Clamp, Conduit	263101	1
6	Angle, Choke Cable	263100	1
7	Washer, Flat	263102	1
8	Nut, Hex Hd. #8-32	825201-130	1
9	Grommet, Rubber	263103	1



265094

8.3 Lifting Bail Option (Ref. Id 264809).

Ref.	Description	Part No.	Qty
1	Bail, Lifting Assy	264683	1
2	Bolt, Eye Lifting	262700	1
3	Washer, Flat ½	838208-112	5
4	Washer, Lock ½	835808-125	4
5	Nut, Hex Locking ½ - 13	825508-262	1
6	Capscrew, Hex Hd GR8 ½ - 13 x 2	829408-200	3



264809

CITGO TRANSGARD® ATF, Dexron III®/Mercon®

Material Safety Data Sheet

CITGO Petroleum Corporation
P.O. Box 3758
Tulsa, OK 74102-3758

MSDS No. 633123001

Revision Date 05/22/2001

IMPORTANT: Read this MSDS before handling or disposing of this product and pass this information on to employees, customers and users of this product.

Hazard Rankings

	HMIS	NFPA
Health Hazard	0	0
Fire Hazard	1	1
Reactivity	0	0

* = Chronic Health Hazard

Protective Equipment

Minimum Requirements
See Section 8 for Details

Emergency Overview

Physical State Liquid.

Color Red. **Odor** Mild petroleum odor

WARNING:
Oil injected into the skin from high-pressure leaks in hydraulic systems can cause severe injury.
Most damage occurs during the first few hours.
Seek Medical Attention Immediately.
Surgical removal of oil may be necessary.
Can cause mild skin irritation and inflammation with prolonged or repeated contact.
Spills may create a slipping hazard.

SECTION 1: IDENTIFICATION

Trade Name	CITGO TRANSGARD® ATF, Dexron III®/Mercon®	**Technical Contact**	(918) 495-5933
Product Number	633123001	**Medical Emergency**	(918) 495-4700
CAS Number	Mixture.	**CHEMTREC Emergency (United States Only)**	(800) 424-9300
Product Family	Automatic Transmission Fluid		
Synonyms	Automatic Transmission Fluid; Former ILS Code: 33123; CITGO SAP Product Code No.: 633123001		

SECTION 2: COMPOSITION

Component Name(s)	CAS Registry No.	Concentration (%)
1) Highly-Refined Petroleum Lubricant Oils	64741-76-0; 64741-88-4; 64741-89-5; 64742-54-7; 64742-55-8; 64742-65-0	90 - 100
2) Proprietary Ingredients	Proprietary Mixture	0 - 10

SECTION 3: HAZARDS IDENTIFICATION

Also see Emergency Overview and Hazard Ratings on the top of Page 1 of this MSDS.

Major Route(s) of Entry Skin contact.

Signs and Symptoms of Acute Exposure

Inhalation	No significant adverse health effects are expected to occur upon short-term exposure to this product. Aspiration of liquid into the lungs can cause severe lung damage or death.
Eye Contact	This product can cause transient mild eye irritation with short-term contact with liquid sprays or mists.
Skin Contact	This material can cause mild skin irritation from prolonged or repeated skin contact. Injection under the skin, in muscle, or into the blood stream can cause irritation, inflammation, swelling, fever, and systemic effects and mild central nervous system depression. Injection of pressurized hydrocarbons can cause severe, permanent tissue damage. Initial symptoms may be minor. Injection of petroleum hydrocarbons requires immediate medical attention.
Ingestion	If swallowed, no significant adverse health effects are anticipated. Ingestion can cause a laxative effect. If aspirated into the lungs, liquid can cause severe lung damage or death.
Chronic Health Effects Summary	Contains a petroleum-based mineral oil. Prolonged or repeated skin contact can cause mild irritation and inflammation characterized by drying, cracking, (dermatitis) or oil acne. Repeated or prolonged inhalation of petroleum-based mineral oil mists at concentrations above applicable workplace exposure levels can cause respiratory irritation or other pulmonary effects.
Conditions Aggravated by Exposure	Personnel with pre-existing skin disorders should avoid repeated or prolonged contact with this product.
Target Organs	May cause damage to the following organs: skin.
Carcinogenic Potential	This product does not contain any components at concentrations above 0.1% which are considered carcinogenic by OSHA, IARC or NTP.

OSHA Hazard Classification is indicated by an "X" in the box adjacent to the hazard title. If no "X" is present, the product does not exhibit the hazard as defined in the OSHA Hazard Communication Standard (29 CFR 1910.1200).

OSHA Health Hazard Classification				OSHA Physical Hazard Classification					
Irritant		Toxic		Combustible		Explosive		Pyrophoric	
Sensitizer		Highly Toxic		Flammable		Oxidizer		Water-reactive	
Corrosive		Carcinogenic		Compressed Gas		Organic Peroxide		Unstable	

SECTION 4: FIRST AID MEASURES

Take proper precautions to ensure your own health and safety before attempting rescue or providing first aid. For more specific information, refer to Exposure Controls and Personal Protection in Section 8 of this MSDS.

Inhalation	Vaporization is not expected at ambient temperatures. This material is not expected to cause inhalation-related disorders under anticipated conditions of use. In case of overexposure, move the person to fresh air.
Eye Contact	Check for and remove contact lenses. Flush eyes with cool, clean, low-pressure water while occasionally lifting and lowering eyelids. Seek medical attention if excessive tearing, redness, or pain persists.
Skin Contact	Remove contaminated shoes and clothing. Wipe off excess material. Wash exposed skin with soap and water. Seek medical attention if tissue appears damaged or if irritation persists. Thoroughly clean contaminated clothing before reuse. Discard contaminated leather goods. If material is injected under the skin, into muscle, or into the bloodstream, seek medical attention immediately.

Ingestion	Do not induce vomiting unless directed to by a physician. Do not give anything to drink unless directed to by a physician. Never give anything by mouth to a person who is not fully conscious. Seek medical attention immediately.
Notes to Physician	The viscosity of the product represented by this MSDS is 100 to 400 SUS at 100° F. Accordingly, upon ingestion there is a low to moderate risk of aspiration. Careful gastric lavage may be considered to evacuate large quantities of material. In the event of injection in underlying tissue, immediate treatment should include extensive incision, debridement and saline irrigation. Inadequate treatment can result in ischemia and gangrene. Early symptoms may be minimal.

SECTION 5: FIRE FIGHTING MEASURES

NFPA Flammability Classification	NFPA Class-IIIB combustible material. Slightly combustible!
Flash Point Method	CLOSED CUP: 171°C (340°F). (Pensky-Martens (ASTM D-93).) OPEN CUP: 199°C (390°F) (Cleveland.).
Lower Flammable Limit	No data. **Upper Flammable Limit** No data.
Autoignition Temperature	Not available.
Hazardous Combustion Products	Carbon dioxide, carbon monoxide, smoke, fumes, unburned hydrocarbons and trace oxides of sulfur and/or nitrogen.
Special Properties	This material can burn but will not readily ignite. This material will release vapors when heated above the flash point temperature that can ignite when exposed to a source of ignition. In enclosed spaces, heated vapor can ignite with explosive force. Mists or sprays may burn at temperatures below the flash point.
Extinguishing Media	Use dry chemical, foam, Carbon Dioxide or water fog.
Fire Fighting Protective Clothing	Firefighters must use full bunker gear including NIOSH-approved positive pressure self-contained breathing apparatus to protect against potential hazardous combustion or decomposition products and oxygen deficiencies.

SECTION 6: ACCIDENTAL RELEASE MEASURES

Take proper precautions to ensure your own health and safety before attempting spill control or clean-up. For more specific information, refer to the Emergency Overview on Page 1, Exposure Controls and Personal Protection in Section 8 and Disposal Considerations in Section 13 of this MSDS.

Do not touch damaged containers or spilled material unless wearing appropriate protective equipment. Slipping hazard; do not walk through spilled material. Stop leak if you can do so without risk. For small spills, absorb or cover with dry earth, sand, or other inert non-combustible absorbent material and place into waste containers for later disposal. Contain large spills to maximize product recovery or disposal. Prevent entry into waterways or sewers. In urban area, cleanup spill as soon as possible. In natural environments, seek cleanup advice from specialists to minimize physical habitat damage. This material will float on water. Absorbent pads and similar materials can be used. Comply with all laws and regulations.

SECTION 7: HANDLING AND STORAGE

Handling	Avoid water contamination and extreme temperatures to minimize product degradation. Empty containers may contain product residues that can ignite with explosive force. Do not pressurize, cut, weld, braze solder, drill, grind or expose containers to flames, sparks, heat or other potential ignition sources. Consult appropriate federal, state and local authorities before reusing, reconditioning, reclaiming, recycling or disposing of empty containers and/or waste residues of this product.
Storage	Keep container closed. Do not store with strong oxidizing agents. Do not store at temperatures above 120° F or in direct sunlight for extended periods of time. Consult appropriate federal, state and local authorities before reusing, reconditioning, reclaiming, recycling or disposing of empty containers or waste residues of this product.

SECTION 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

Engineering Controls Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of mists and/or vapors below the recommended exposure limits (see below). An eye wash station and safety shower should be located near the work-station.

Personal Protective Equipment Personal protective equipment should be selected based upon the conditions under which this material is used. A hazard assessment of the work area for PPE requirements should be conducted by a qualified professional pursuant to OSHA regulations. The following pictograms represent the minimum requirements for personal protective equipment. For certain operations, additional PPE may be required.

Eye Protection Safety glasses equipped with side shields should be adequate protection under most conditions of use. Wear goggles and/or face shield if splashing or spraying is anticipated. Wear goggles and face shield if material is heated above 125°F (51°C). Have suitable eye wash water available.

Hand Protection No special skin protection other than good personal hygiene practice is recommended under anticipated conditions of use. However, when prolonged or extensive contact is possible, use of disposable PCV or nitrile gloves is recommended. Wash hands with plenty of mild soap and water before eating, drinking, smoking, using toilet facilities, or leaving work.

Body Protection Use clean and impervious protective clothing (e.g., neoprene or Tyvek®) if splashing or spraying conditions are present. Protective clothing may include long-sleeve outer garment, apron, or lab coat. If significant contact occurs, remove oil-contaminated clothing as soon as possible and promptly shower. Launder contaminated before reuse or discard. Wear heat protective boots and protective clothing when handling material at elevated temperatures.

Respiratory Protection Vaporization or misting is not expected at ambient temperatures. Therefore, the need for respiratory protection is not anticipated under normal use conditions and with adequate ventilation. If elevated airborne concentrations above applicable workplace exposure levels are anticipated, a NIOSH-approved organic vapor respirator equipped with a dust/mist prefilter should be used. Protection factors vary depending upon the type of respirator used. Respirators should be used in accordance with OSHA requirements (29 CFR 1910.134).

General Comments Use good personal hygiene practices. Wash hands and other exposed skin areas with plenty of mild soap and water before eating, drinking, smoking, use of toilet facilities, or leaving work. DO NOT use gasoline, kerosene, solvents or harsh abrasives as skin cleaners. Since specific exposure standards/control limits have not been established for this product, the "Oil Mist, Mineral" exposure limits shown below are suggested as minimum control guidelines.

Occupational Exposure Guidelines

Substance	Applicable Workplace Exposure Levels
1) Oil Mist, Mineral	TWA: 5 STEL: 10 (mg/M³) from ACGIH (TLV) TWA: 5 (mg/M³) from OSHA (PEL) TWA: 5 STEL: 10 (mg/M³) from NIOSH

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Physical State	Liquid.	**Color**	Red.	**Odor**	Mild petroleum odor
Specific Gravity	0.87 (Water = 1)	**pH**	Not Applicable.	**Vapor Density**	>1 (Air = 1)
Boiling Point/Range	Not available.			**Melting/Freezing Point**	Not available.
Vapor Pressure	<0.1 mm of Hg (@ 20°C)			**Viscosity (cSt @ 40°C)**	36
Solubility In Water	Insoluble in cold water.			**Volatile Characteristics**	Negligible volatility

Additional Properties API Gravity (ASTM D287) = 31.5 @ 60º F
Density = 7.23 Lbs/gal.
Viscosity (ASTM D2161) = AP 180 SUS @ 100º F

SECTION 10: STABILITY AND REACTIVITY

Chemical Stability Stable. **Hazardous Polymerization** Not expected to occur.

Conditions to Avoid Keep away from extreme heat, sparks, open flame, and strongly oxidizing conditions.

Materials Incompatibility Strong oxidizers.

Hazardous Decomposition Products No additional hazardous decomposition products were identified other than the combustion products identified in Section 5 of this MSDS.

SECTION 11: TOXICOLOGICAL INFORMATION

For other health-related information, refer to the Emergency Overview on Page 1 and the Hazards Identification in Section 3 of this MSDS.

Toxicity Data

Highly-Refined Petroleum Lubricant Oils:
ORAL (LD50): Acute: >5000 mg/kg [Rat].
DERMAL (LD50): Acute: >2000 mg/kg [Rabbit].

Highly-Refined Petroleum Lubricant Oils:
Mineral oil mists derived from highly refined oils are reported to have low acute and sub-acute toxicities in animals. Effects from single and short-term repeated exposures to high concentrations of mineral oil mists well above applicable workplace exposure levels include lung inflammatory reaction, lipoid granuloma formation and lipoid pneumonia. In acute and sub-acute studies involving exposures to lower concentrations of mineral oil mists at or near current work place exposure levels produced no significant toxicological effects. In long term studies (up to two years) no carcinogenic effects have been reported in any animal species tested.

SECTION 12: ECOLOGICAL INFORMATION

Ecotoxicity Analysis for ecological effects has not been conducted on this product. However, if spilled, this product and any contaminated soil or water may be harmful to human, animal, and aquatic life. Also, the coating action associated with petroleum and petroleum products can be harmful or fatal to aquatic life and waterfowl.

Environmental Fate An environmental fate analysis has not been conducted on this specific product. However, plants and animals may experience harmful or fatal effects when coated with petroleum-based products. Petroleum-based (mineral) lube oils will normally float on water. In stagnant or slow-flowing waterways, an oil layer can cover a large surface area. As a result, this oil layer might limit or eliminate natural atmospheric oxygen transport into the water. With time, if not removed, oxygen depletion in the waterway might be enough to cause a fish kill or create an anaerobic environment.

SECTION 13: DISPOSAL CONSIDERATIONS

Hazard characteristic and regulatory waste stream classification can change with product use. Accordingly, it is the responsibility of the user to determine the proper storage, transportation, treatment and/or disposal methodologies for spent materials and residues at the time of disposition.

Conditions of use may cause this material to become a hazardous waste, as defined by Federal or State regulations. It is the responsibility of the user to determine if the material is a hazardous waste at the time of disposal. Transportation, treatment, storage and disposal of waste material must be conducted in accordance with RCRA regulations (see 40 CFR 260 through 40 CFR 271). State and/or local regulations may be more restrictive. Contact the RCRA/Superfund Hotline at (800) 424-9346 or your regional US EPA office for guidance concerning case specific disposal issues.

SECTION 14: TRANSPORT INFORMATION

DOT Status	Not a U.S. Department of Transportation regulated material.
Proper Shipping Name	Not regulated.
Hazard Class	Not regulated.
Packing Group(s)	Not regulated.
UN/NA ID	Not applicable.
Reportable Quantity	A Reportable Quantity (RQ) has not been established for any components of this material.
Placards	
Emergency Response Guide No.	Not applicable.
HAZMAT STCC No.	Not assigned.
MARPOL III Status	Not a DOT "Marine Pollutant" per 49 CFR 171.8.

SECTION 15: REGULATORY INFORMATION

TSCA Inventory	This product and/or its components are listed on the Toxic Substance Control Act (TSCA) inventory.
SARA 302/304	The Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III requires facilities subject to Subparts 302 and 304 to submit emergency planning and notification information based on Threshold Planning Quantities (TPQs) and Reportable Quantities (RQs) for "Extremely Hazardous Substances" listed in 40 CFR 302.4 and 40 CFR 355. No components were identified.
SARA 311/312	The Superfund Amendments and Reauthorization Act of 1986 (SARA) Title III requires facilities subject to this subpart to submit aggregate information on chemicals by "Hazard Category" as defined in 40 CFR 370.2. This material would be classified under the following hazard categories: No SARA 311/312 hazard categories identified.
SARA 313	This product contains the following components in concentrations above de minimis levels that are listed as toxic chemicals in 40 CFR Part 372 pursuant to the requirements of Section 313 of SARA: No components were identified.
CERCLA	The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) requires notification of the National Response Center concerning release of quantities of "hazardous substances" equal to or greater than the reportable quantities (RQ's) listed in 40 CFR 302.4. As defined by CERCLA, the term "hazardous substance" does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically designated in 40 CFR 302.4. Chemical substances present in this product or refinery stream that may be subject to this statute are: None Identified
CWA	This material is classified as an oil under Section 311 of the Clean Water Act (CWA) and the Oil Pollution Act of 1990 (OPA). Discharges or spills which produce a visible sheen on waters of the United States, their adjoining shorelines, or into conduits leading to surface waters must be reported to the EPA's National Response Center at (800) 424-8802.
California Proposition 65	This product is not known to contain the any components for which the State of California has found to cause cancer, birth defects or other reproductive harm.
New Jersey Right-to-Know Label	Petroleum Oil (Automatic Transmission Fluid)
Additional Regulatory Remarks	No additional regulatory remarks.

SECTION 16: OTHER INFORMATION

Refer to the top of Page 1 for the HMIS and NFPA Hazard Ratings for this product.

REVISION INFORMATION

Version Number	3.0
Revision Date	05/22/2001
Print Date	Printed on 05/22/2001.

ABBREVIATIONS

AP = Approximately EQ = Equal > = Greater Than < = Less Than NA = Not Applicable ND = No Data NE = Not Established

ACGIH = American Conference of Governmental Industrial Hygienists AIHA = American Industrial Hygiene Association

IARC = International Agency for Research on Cancer NTP = National Toxicology Program

NIOSH = National Institute of Occupational Safety and Health OSHA = Occupational Safety and Health Administration

NPCA = National Paint and Coating Manufacturers Association HMIS = Hazardous Materials Information System

NFPA = National Fire Protection Association EPA = Environmental Protection Agency

DISCLAIMER OF LIABILITY

THE INFORMATION IN THIS MSDS WAS OBTAINED FROM SOURCES WHICH WE BELIEVE ARE RELIABLE. HOWEVER, THE INFORMATION IS PROVIDED WITHOUT ANY WARRANTY, EXPRESSED OR IMPLIED REGARDING ITS CORRECTNESS. SOME INFORMATION PRESENTED AND CONCLUSIONS DRAWN HEREIN ARE FROM SOURCES OTHER THAN DIRECT TEST DATA ON THE SUBSTANCE ITSELF. THIS MSDS WAS PREPARED AND IS TO BE USED ONLY FOR THIS PRODUCT. IF THE PRODUCT IS USED AS A COMPONENT IN ANOTHER PRODUCT, THIS MSDS INFORMATION MAY NOT BE APPLICABLE. USERS SHOULD MAKE THEIR OWN INVESTIGATIONS TO DETERMINE THE SUITABILITY OF THE INFORMATION OR PRODUCTS FOR THEIR PARTICULAR PURPOSE.

THE CONDITIONS OR METHODS OF HANDLING, STORAGE, USE, AND DISPOSAL OF THE PRODUCT ARE BEYOND OUR CONTROL AND MAY BE BEYOND OUR KNOWLEDGE. FOR THIS AND OTHER REASONS, WE DO NOT ASSUME RESPONSIBILITY AND EXPRESSLY DISCLAIM LIABILITY FOR LOSS, DAMAGE OR EXPENSE ARISING OUT OF OR IN ANY WAY CONNECTED WITH HANDLING, STORAGE, USE OR DISPOSAL OF THE PRODUCT.

***** END OF MSDS *****

Vanair Manufacturing, Incorporated
19015 U.S. Hwy 12
New Buffalo, MI 49117
Tel. 269 469 4461
Fax. 269 469 0497

Form Number: VT-25
POO220
Serial Number: 30-64810

Viper Data & Test Report

Model: 70 C.F.M @ 100

Compressor Serial No. 0060309696

Receiver Serial No. 376463

Engine: Model: CH730-S Fuel Type GAS
Spec No.: CH730-0011 Cooling EIE
Serial Number: 331630542 1

Drive Type: No. of Belts One No. of Grooves 3

TEST DATA:

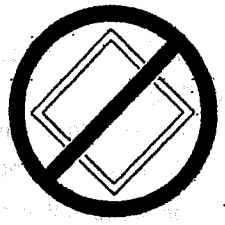
Capacity: CFM 70 Pressure 100
Speeds:
Engine: Idle 2620 Full Load 3314
Compressor Idle 4406 Full Load 5514

CHECKS:
- Compressor Cooling ✓
- Belt Tension & Alignment ✓
- Gauges ✓
- Oil Levels ✓
- Starting ✓
- Load/Unload ✓
- Fit & Finish ✓

NOTES/SPECIAL FEATURES: LIFT BAIL

Assembled by: Perry Date: 3-1-04
Tested by: M.R.C Date: 3-1-04

SECTION 14: TRANSPORT INFORMATION

DOT Status	Not a U.S. Department of Transportation regulated material.
Proper Shipping Name	Not regulated.
Hazard Class	Not regulated.
Packing Group(s)	Not regulated.
UN/NA ID	Not applicable.
Reportable Quantity	A Reportable Quantity (RQ) has not been established for any components of this material.
Placards	
Emergency Response Guide No.	Not applicable.
HAZMAT STCC No.	Not assigned.
MARPOL III Status	Not a DOT "Marine Pollutant" per 49 CFR 171.8.

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New Jersey Right-to-Know Label	Petroleum Oil (Automatic Transmission Fluid)
Additional Regulatory Remarks	No additional regulatory remarks.

SECTION 16: OTHER INFORMATION

Refer to the top of Page 1 for the HMIS and NFPA Hazard Ratings for this product.

REVISION INFORMATION

Version Number	3.0
Revision Date	05/22/2001
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ABBREVIATIONS

AP = Approximately Established EQ = Equal > = Greater Than < = Less Than NA = Not Applicable ND = No Data NE = Not

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***** END OF MSDS *****

Vanair Manufacturing, Incorporated
19015 U.S. Hwy 12
New Buffalo, MI 49117
Tel. 269 469 4461
Fax. 269 469 0497

Form Number: VT-25
POO220
Serial Number: 30- 64810

Viper Data & Test Report

Model: 70 C.F.M @ 100

Compressor Serial No. 00603009696

Receiver Serial No. 376463

Engine: Model: CH730-S Fuel Type GAS
Spec No.: CH730-0011 Cooling EIE
Serial Number: 3316305421

Drive Type: No. of Belts One No. of Grooves 3

TEST DATA:

Capacity: CFM 70 Pressure 100

Speeds:
Engine: Idle 2620 Full Load 3314
Compressor Idle 4406 Full Load 5514

CHECKS:
- Compressor Cooling ✓
- Belt Tension & Alignment ✓
- Gauges ✓
- Oil Levels ✓
- Starting ✓
- Load/Unload ✓
- Fit & Finish ✓

NOTES/SPECIAL FEATURES: LEFT BAIL

Assembled by: Perry Date: 3-1-04
Tested by: M.R.C Date: 3-1-04

Vanair Manufacturing, Inc.
19015 US 12
New Buffalo, MI 49117
Tel. 269-469-4461
Fax. 269-469-0497

FORM V-25

VIPER by VANAIR

Order No.:	**30-64810**	*Part No.:*	**050136**
Distributor:	**DICKINSON EQUIPMENT**	*Date:*	**FEBRUARY 27, 2004**
	3220 17TH AVENUE WEST	*Contact:*	**JRV**
	SEATTLE, WA 98119	*Tel:*	**206-285-1090**
End User:	**SPOKANE METAL PRODUCTS**	*Fax:*	**206-285-0750**

COMPRESSOR DATA

Capacity:	**70**	*P.S.I.*	**100 MAX.**
Type:	*Single Stage Screw*	*Cooling:*	**ELECTRIC**

DRIVER

Engine:	**KOHLER**	*Hydraulic Motor:*		
Size:	**25 HP**	*Input Req□mnts:*		*g.p.m.*
Fuel Type:	**GAS**	@		*p.s.i.g.*

SPEEDS

	Idle:		*Full Load:*	
Driver:	**2600**	*r.p.m.*	**3300**	*r.p.m.*
Compressor:	**4370**	*r.p.m.*	**5540**	*r.p.m.*

Compressor:	

COMMAND SERIES
CH18-26, CH730-740
HORIZONTAL CRANKSHAFT

KOHLER® engines

BORN TO RUN™

Safety Precautions

To insure safe operations please read the following statements and understand their meaning. Also refer to your equipment owner's manual for other important safety information. This manual contains safety precautions which are explained below. Please read carefully.

WARNING

Warning is used to indicate the presence of a hazard that *can* cause *severe* personal injury, death, or substantial property damage if the warning is ignored.

CAUTION

Caution is used to indicate the presence of a hazard that *will* or *can* cause *minor* personal injury or property damage if the caution is ignored.

NOTE

Note is used to notify people of installation, operation, or maintenance information that is important but not hazard-related.

For Your Safety!

These precautions should be followed at all times. Failure to follow these precautions could result in injury to yourself and others.

WARNING

Explosive Fuel can cause fires and severe burns.

Stop engine before filling fuel tank.

Explosive Fuel!

Gasoline is extremely flammable and its vapors can explode if ignited. Store gasoline only in approved containers, in well ventilated, unoccupied buildings, away from sparks or flames. Do not fill the fuel tank while the engine is hot or running, since spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. Do not start the engine near spilled fuel. Never use gasoline as a cleaning agent.

WARNING

Rotating Parts can cause severe injury.

Stay away while engine is in operation.

Rotating Parts!

Keep hands, feet, hair, and clothing away from all moving parts to prevent injury. Never operate the engine with covers, shrouds, or guards removed.

CAUTION

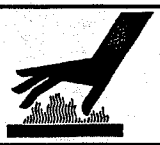
Electrical Shock can cause injury.

Do not touch wires while engine is running.

Electrical Shock!

Never touch electrical wires or components while the engine is running. They can be sources of electrical shock.

WARNING



Hot Parts can cause severe burns.

Do not touch engine while operating or just after stopping.

Hot Parts!

Engine components can get extremely hot from operation. To prevent severe burns, do not touch these areas while the engine is running, or immediately after it is turned off. Never operate the engine with heat shields or guards removed.

California Proposition 65 Warning

Engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

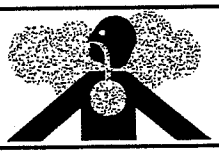
⚠ WARNING

Accidental Starts can cause severe injury or death.

Disconnect and ground spark plug leads before servicing.

Accidental Starts!
Disabling engine. Accidental starting can cause severe injury or death. *Before working on the engine or equipment, disable the engine as follows: 1) Disconnect the spark plug lead(s). 2) Disconnect negative (-) battery cable from battery.*

⚠ WARNING



Carbon Monoxide can cause severe nausea, fainting or death.

Do not operate engine in closed or confined area.

Lethal Exhaust Gases!
Engine exhaust gases contain poisonous carbon monoxide. Carbon monoxide is odorless, colorless, and can cause death if inhaled. Avoid inhaling exhaust fumes, and never run the engine in a closed building or confined area.

⚠ WARNING

Explosive Gas can cause fires and severe acid burns.

Charge battery only in a well ventilated area. Keep sources of ignition away.

Explosive Gas!
Batteries produce explosive hydrogen gas while being charged. To prevent a fire or explosion, charge batteries only in well ventilated areas. Keep sparks, open flames, and other sources of ignition away from the battery at all times. Keep batteries out of the reach of children. Remove all jewelry when servicing batteries.

Before disconnecting the negative (-) ground cable, make sure all switches are OFF. If ON, a spark will occur at the ground cable terminal which could cause an explosion if hydrogen gas or gasoline vapors are present.

Congratulations – You have selected a fine four-cycle, twin cylinder, air-cooled engine. Kohler designs long life strength and on-the-job durability into each engine...making a Kohler engine dependable...dependability you can count on. Here are some reasons why:

- Efficient overhead valve design and full pressure lubrication provide maximum power, torque, and reliability under all operating conditions.
- Dependable, maintenance-free electronic ignition ensures fast, easy starts time after time.
- Kohler engines are easy to service. All routine service areas like the dipstick, oil fill, air cleaner, and spark plugs are easily and quickly accessible.
- Parts subject to the most wear and tear (like the cylinder liner* and camshaft) are made from precision formulated cast iron. Because the cylinder liner* can be rebored, these engines can last even longer.

  *Some CH25/26 engines have POWER-BORE™ Cylinders. These cylinders are plated with nickel-silicon to give increased power, virtually permanent cylinder life, superior oil control, and reduced exhaust emissions. These cylinders cannot be rebored.
- Every Kohler engine is backed by a worldwide network of over 10,000 distributors and dealers. Service support is just a phone call away. Call 1-800-544-2444 (U.S. & Canada) for Sales & Service assistance.

To keep your engine in top operating condition, follow the maintenance procedures in this manual.

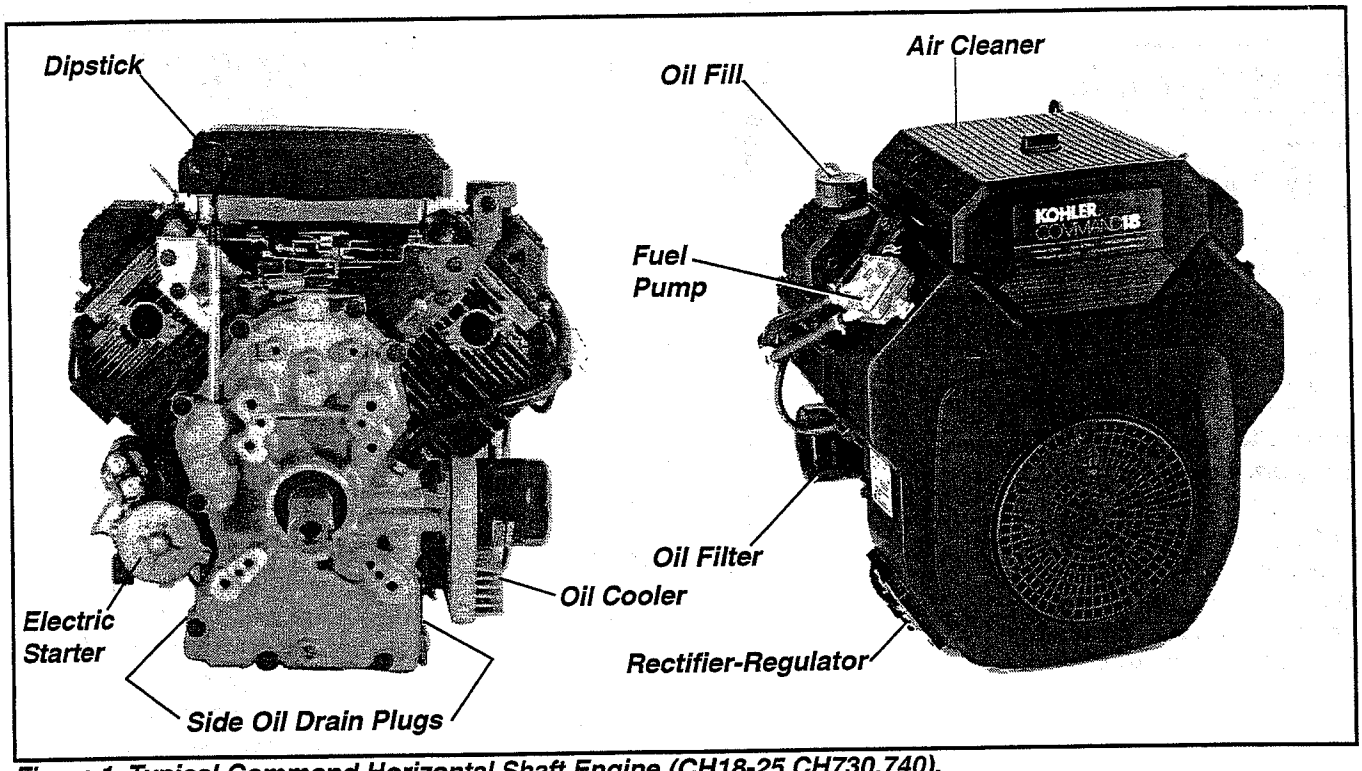


Figure 1. Typical Command Horizontal Shaft Engine (CH18-25,CH730,740).

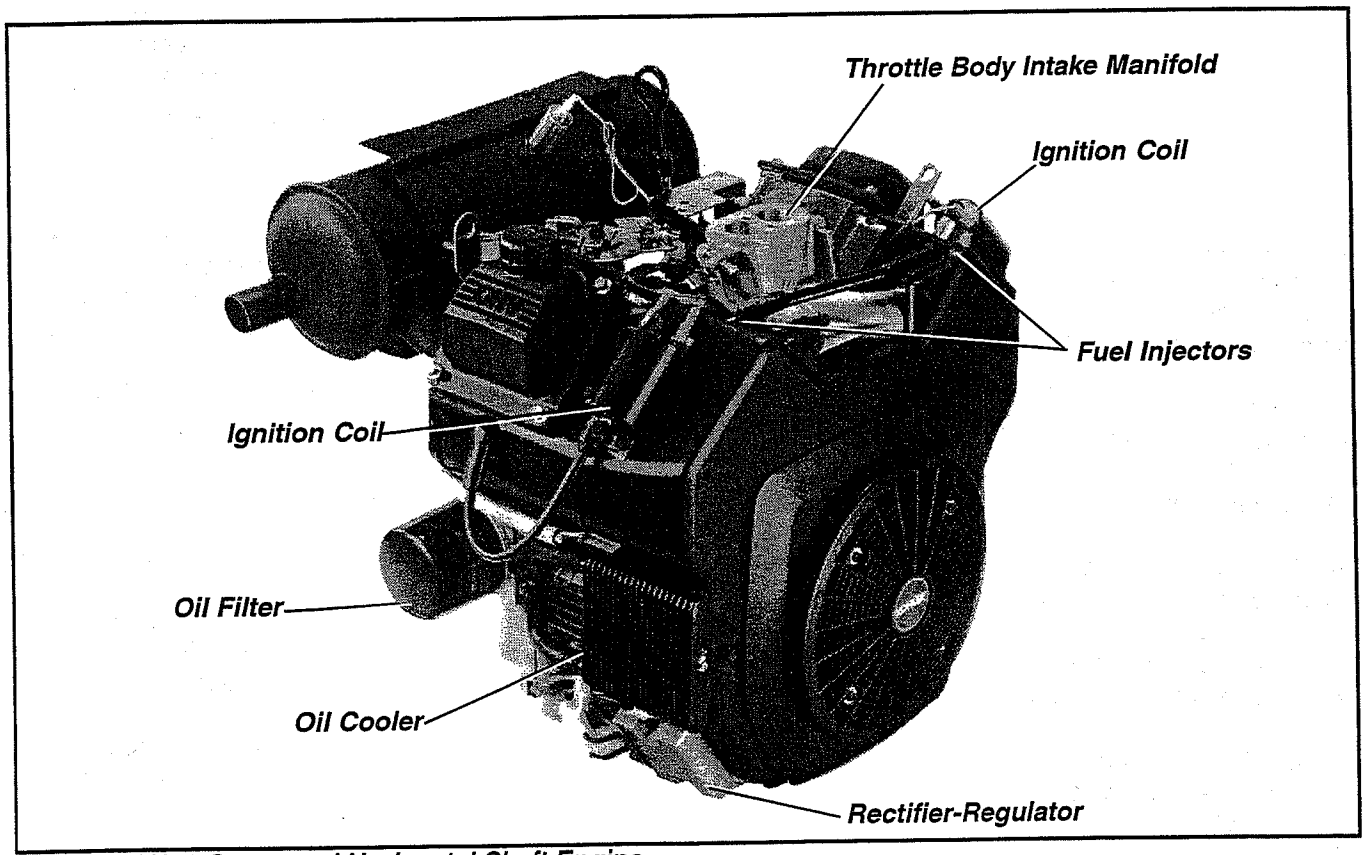


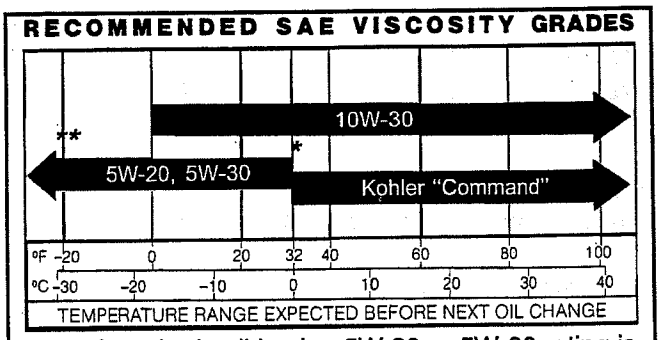
Figure 2. CH26 Command Horizontal Shaft Engine.

Oil Recommendations

Using the proper type and weight of oil in the crankcase is extremely important. So is checking oil daily and changing oil regularly. Failure to use the correct oil, or using dirty oil, causes premature engine wear and failure.

Oil Type

Use high quality detergent oil of ***API (American Petroleum Institute) service class SG, SH, SJ or higher***. Select the viscosity based on the air temperature at the time of operation as shown in the following table.



*Use of synthetic oil having 5W-20 or 5W-30 rating is acceptable, up to 40°F.

**Synthetic oils will provide better starting in extreme cold (below -10°F).

Figure 3. Viscosity Grades Table.

NOTE: Using other than service class SG, SH, SJ or higher oil or extending oil change intervals longer than recommended can cause engine damage.

A logo or symbol on oil containers identifies the API service class and SAE viscosity grade. See Figure 4.

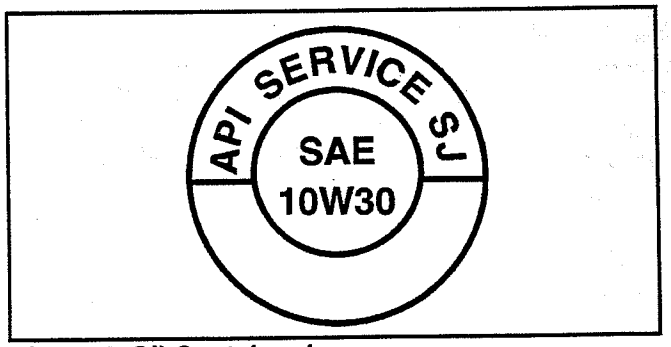


Figure 4. Oil Container Logo.

Refer to "Maintenance Instructions" beginning on page 8 for detailed oil check, oil change, and oil filter change procedures.

Fuel Recommendations

WARNING: Explosive Fuel!

Gasoline is extremely flammable and its vapors can explode if ignited. Store gasoline only in approved containers, in well ventilated, unoccupied buildings, away from sparks or flames. Do not fill the fuel tank while the engine is hot or running, since spilled fuel could ignite if it comes in contact with hot parts or sparks from ignition. Do not start the engine near spilled fuel. Never use gasoline as a cleaning agent.

General Recommendations

Purchase gasoline in small quantities and store in clean, approved containers. A container with a capacity of 2 gallons or less with a pouring spout is recommended. Such a container is easier to handle and helps eliminate spillage during refueling.

Do not use gasoline left over from the previous season, to minimize gum deposits in fuel system and to insure easy starting.

Do not add oil to the gasoline.

Do not overfill the fuel tank. Leave room for the fuel to expand.

Fuel Type

For best results use only clean, fresh, ***unleaded*** gasoline with a pump sticker octane rating of 87 or higher. In countries using the Research method, it should be 90 octane minimum.

Unleaded gasoline is recommended as it leaves less combustion chamber deposits and reduces harmful exhaust emissions. Leaded gasoline is not recommended and ***must not*** be used on CH26 engine, or on other models where exhaust emissions are regulated.

Gasoline/Alcohol blends

Gasohol (up to 10% ethyl alcohol, 90% unleaded gasoline by volume) is approved as a fuel for Kohler engines. Other gasoline/alcohol blends are not approved.

Gasoline/Ether blends

Methyl Tertiary Butyl Ether (MTBE) and unleaded gasoline blends (up to a maximum of 15% MTBE by volume) are approved as a fuel for Kohler engines. Other gasoline/ether blends are not approved.

Engine Identification Numbers

When ordering parts, or in any communication involving an engine, always give the ***Model, Specification, and Serial Numbers*** of the engine.

The engine identification numbers appear on a decal affixed to the engine shrouding. Include letter suffixes, if there are any.

Record your engine identification numbers on the identification label below (Figure 5) for future reference.

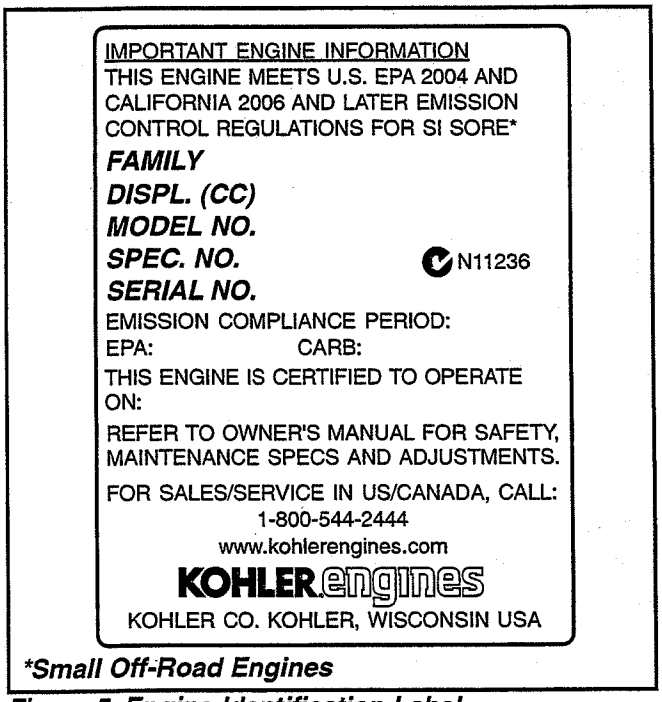


Figure 5. Engine Identification Label.

The Emission Compliance Period referred to on the Emission Control or Air Index label indicates the number of operating hours for which the engine has been shown to meet Federal and CARB emission requirements. The following table provides the Engine Compliance Period (in hours) associated with the category descriptor found on the certification label.

Emission Compliance Period (Hours)

EPA	Category C 250 hours	Category B 500 hours	Category A 1000 hours
CARB	Moderate 125 hours	Intermediate 250 hours	Extended 500 hours

Refer to certification label for engine displacement.

Exhaust Emission Control System for models CH18,20,22,23,25,730,740 is EM. Exhaust Emission Control System for model CH26 is EM, O2S, ECM, MFI.

Model Designation

Model CH20S for example: C designates Command engine, H designates horizontal crankshaft, and 20 designates horsepower. Some model numbers (CH730) use the approximate displacement rather than horsepower. A letter suffix designates a specific version as follows:

Suffix	*Designates*
S	Electric Start
ST	Electric Start/Retractable Start
QS	Quiet Model/Electric Start
EP	Electric Plant
CS	Clutch Model/Electric Start

Operating Instructions

Also read the operating instructions of the equipment this engine powers.

Pre-Start Checklist

- Check oil level. Add oil if low. Do not overfill.
- Check fuel level. Add fuel if low.
- Check cooling air intake areas and external surfaces of engine. Make sure they are clean and unobstructed.
- Check that the air cleaner components and all shrouds, equipment covers, and guards are in place and securely fastened.
- Check that any clutches or transmissions are disengaged or placed in neutral. This is especially important on equipment with hydrostatic drive. The shift lever must be exactly in neutral to prevent resistance which could keep the engine from starting.

WARNING: Lethal Exhaust Gases!

Engine exhaust gases contain poisonous carbon monoxide. Carbon monoxide is odorless, colorless, and can cause death if inhaled. Avoid inhaling exhaust fumes, and never run the engine in a closed building or confined area.

Cold Weather Starting Hints

1. Be sure to use the proper oil for the temperature expected. See Figure 3 on page 5.
2. Disengage all possible external loads.
3. Be sure the battery is in good condition. A warm battery has much more starting capacity than a cold battery.
4. Use fresh winter grade fuel. NOTE: Winter grade gasoline has higher volatility to improve starting. Do not use gasoline left over from summer.

Starting

1. Place the throttle control ***midway*** between the ***"slow"*** and ***"fast"*** positions. Place the choke control (non-EFI engines only) into the ***"on"*** position. See Figure 6.

Figure 6. Optional Engine Mounted Throttle and Choke Controls (CH18-25,CH730,740).

2. Start the engine by activating the key switch. Release the switch as soon as the engine starts.

   NOTE: Do not crank the engine continuously for more than 10 seconds at a time. If the engine does not start, allow a 60 second cool down period between starting attempts. Failure to follow these guidelines can burn out, or permanently damage, the starter motor.

   NOTE: Upon start-up, a metallic ticking may occur. This is caused by hydraulic lifter leakdown during storage. Run the engine for 5 minutes. The noise will normally cease in the first minute. If noise continues, run the engine at mid-throttle for 20 minutes. If noise persists, take the engine to your local authorized Kohler Engine Service Dealer.

   NOTE: If the engine develops sufficient speed to disengage the starter but does not keep running (a false start), engine rotation must be allowed to come to a complete stop before attempting to restart the engine. If the starter is engaged while the flywheel is rotating, the starter pinion and flywheel ring gear may clash resulting in damage to the starter.

   If the starter does not turn the engine over, shut off starter immediately. Do not make further attempts to start the engine until the condition is corrected. Do not jump start using another battery (refer to "Battery" on this page). See your Kohler Engine Service Dealer for service assistance.

Carbureted Engines Only:

3. ***For a Cold Engine –*** Gradually return the choke control to the ***"off"*** position after the engine starts and warms up.

   The engine/equipment may be operated during the warm-up period, but it may be necessary to leave the choke partially on until the engine warms up.

4. ***For a Warm Engine –*** Return choke to ***"off"*** position as soon as engine starts.

Stopping

1. Remove the load by disengaging all PTO driven attachments.

2. ***For Carbureted Engines Without A Shutdown Solenoid:*** Move the throttle to the ***"slow"*** or ***"low"*** idle position. Allow the engine to run at idle for 30-60 seconds; then stop the engine.

   For Carbureted Engines Equipped With A Shutdown Solenoid: Position the throttle control somewhere between half and full throttle; then stop the engine.

   For EFI Engines: Move the throttle to the "slow" or "idle" position; turn key ***"off"*** to stop engine.

Battery

A 12 volt battery is normally used. Refer to the operating instructions of the equipment this engine powers for specific battery requirements.

If the battery charge is not sufficient to crank the engine, recharge the battery (see page 13).

Operating

Angle of Operation

This engine will operate continuously at angles up to 25°. Check oil level to assure crankcase oil level is at the "F" mark on the dipstick.

Refer to the operating instructions of the equipment this engine powers. Because of equipment design or application, there may be more stringent restrictions regarding the angle of operation.

NOTE: Do not operate this engine continuously at angles exceeding 25° in any direction. Engine damage could result from insufficient lubrication.

Cooling

NOTE: If debris builds up on the grass screen or other cooling air intake areas, stop the engine immediately and clean. Operating the engine with blocked or dirty air intake and cooling areas can cause extensive damage due to overheating.

WARNING: Hot Parts!

Engine components can get extremely hot from operation. To prevent severe burns, do not touch these areas while the engine is running, or immediately after it is turned off. Never operate the engine with heat shields or guards removed.

Engine Speed

NOTE: Do not tamper with the governor setting to increase the maximum engine speed. Overspeed is hazardous and will void the engine warranty. The maximum allowable high idle speed for these engines is 3750 RPM, no load.

Maintenance Instructions

Maintenance, repair, or replacement of the emission control devices and systems, which are being done at the customers expense, may be performed by any non-road engine repair establishment or individual. Warranty repairs must be performed by an authorized Kohler service outlet.

WARNING: Accidental Starts!

Disabling engine. Accidental starting can cause severe injury or death. *Before working on the engine or equipment, disable the engine as follows: 1) Disconnect the spark plug lead(s). 2) Disconnect negative (-) battery cable from battery.*

Maintenance Schedule

These required maintenance procedures should be performed at the frequency stated in the table. They should also be included as part of any seasonal tune-up.

Frequency	Maintenance Required
Daily or Before Starting Engine	• Fill fuel tank. • Check oil level. • Check air cleaner for dirty[1], loose, or damaged parts. • Check air intake and cooling areas, clean as necessary[1].
Every 25 Hours	• Service precleaner element[1].
Every 100 Hours	• Replace air cleaner element[1]. • Change oil. (More frequently under severe conditions.) • Remove cooling shrouds and clean cooling areas[1,3]. • Check oil cooler fins, clean as necessary (if equipped).
Every 200 Hours	• Check spark plug condition and gap. • Change oil filter.
Every 250 Hours	• Replace heavy-duty air cleaner element and check inner element[1].
Annually or Every 500 Hours	• Have bendix starter drive serviced[2]. • Have solenoid shift starter disassembled and cleaned[2].
Every 500 Hours	• Have crankshaft spline lubricated[2].
Every 1500 Hours	• Replace fuel filter[1] (EFI engines).

[1]Perform these maintenance procedures more frequently under extremely dusty, dirty conditions.

[2]Have a Kohler Engine Service Dealer perform this service.

[3]Cleanout Kits 25 755 20-S (black) or 25 755 21-S (gold) allow cooling areas to be cleaned without removing shrouds.

Check Oil Level

The importance of checking and maintaining the proper oil level in the crankcase cannot be overemphasized. Check oil ***BEFORE EACH USE*** as follows:

1. Make sure the engine is stopped, level, and is cool so the oil has had time to drain into the sump.
2. To keep dirt, debris, etc., out of the engine, clean the area around the dipstick before removing it.
3. Remove the dipstick; wipe oil off. Reinsert the dipstick into the tube and press all the way down.
4. Remove the dipstick and check the oil level.

   The oil level should be up to, but not over, the "F" mark on the dipstick. See Figure 7.

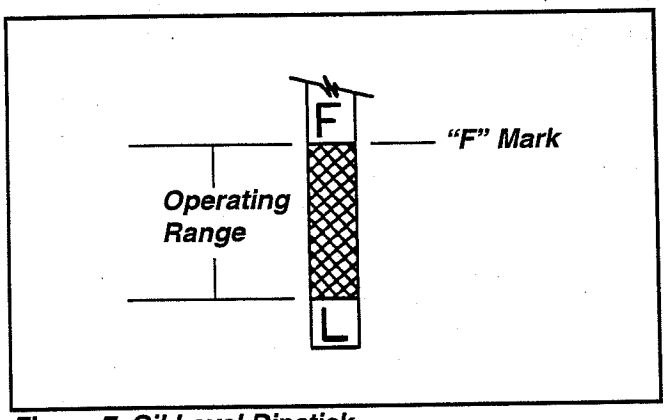


Figure 7. Oil Level Dipstick.

5. If the level is low, add oil of the proper type, up to the "F" mark on the dipstick. (Refer to "Oil Type" on page 5.) Always check the level with the dipstick before adding more oil.

   NOTE: To prevent extensive engine wear or damage, always maintain the proper oil level in the crankcase. Never operate the engine with the oil level below the "L" mark or over the "F" mark on the dipstick.

Oil Sentry™

Some engines are equipped with an optional Oil Sentry™ oil pressure switch. If the oil pressure decreases below an acceptable level, the Oil Sentry™ will either shut off the engine or activate a warning signal, depending on the application.

NOTE: Make sure the oil level is checked ***BEFORE EACH USE*** and is maintained up to the "F" mark on the dipstick. This includes engines equipped with Oil Sentry™.

Change Oil and Filter, Service Oil Cooler

Change Oil

Change oil after every ***100 hours*** of operation (more frequently under severe conditions). Refill with service class SG, SH, SJ or higher oil as specified in the "Viscosity Grades" table (Figure 3) on page 5.

Change the oil while the engine is still warm. The oil will flow more freely and carry away more impurities. Make sure the engine is level when filling, checking, and changing the oil.

Change the oil as follows (see Figures 8 and 9):

1. To keep dirt, debris, etc., out of the engine, clean the area around the oil fill cap/dipstick before removing it.
2. Remove one of the oil drain plugs, oil fill cap, and dipstick. Be sure to allow ample time for complete drainage.
3. Reinstall the drain plug. Make sure it is tightened to ***13.6 N·m (10 ft. lb.)*** torque.
4. Fill the crankcase, with new oil of the proper type, to the "F" mark on the dipstick. Refer to "Oil Type" on page 5. Always check the level with the dipstick before adding more oil.
5. Reinstall the oil fill cap and tighten securely. Reinstall dipstick.

   NOTE: To prevent extensive engine wear or damage, always maintain the proper oil level in the crankcase. Never operate the engine with the oil level below the "L" mark or over the "F" mark on the dipstick.

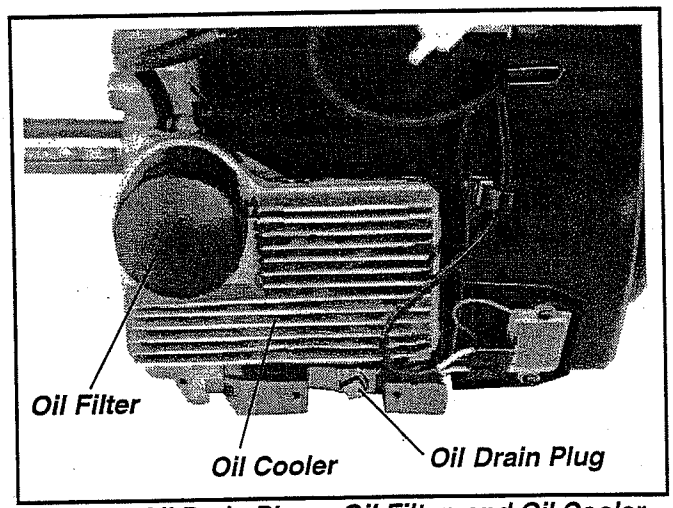


Figure 8. Oil Drain Plugs, Oil Filter, and Oil Cooler (CH25 shown).

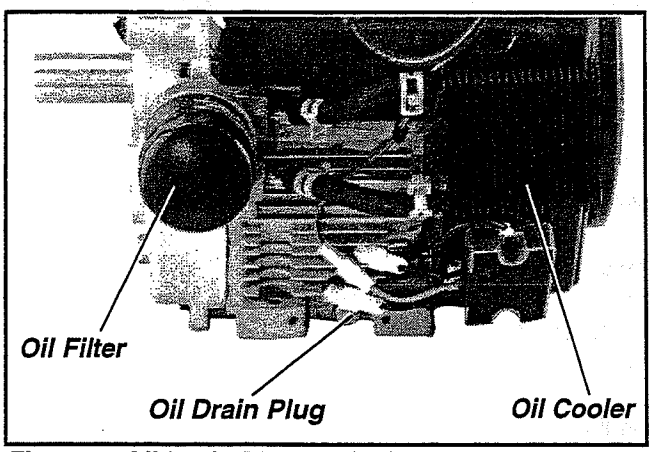


Figure 9. Oil Drain Plugs, Oil Filter, and Oil Cooler (CH26 shown).

Change Oil Filter

Replace the oil filter ***at least every other oil change (every 200 hours of operation).*** *Always use a genuine Kohler oil filter, Part No. 12 050 01-S.*

Replace the oil filter as follows:

1. Drain the oil from the engine crankcase.
2. Allow the oil filter to drain.
3. Before removing the oil filter, clean the area around the oil filter to keep dirt and debris out of the engine. Remove the old filter. Wipe off the surface where the oil filter mounts.
4. Place a new replacement filter in a shallow pan with the open end up. Pour new oil, of the proper type, in through the threaded center hole. Stop pouring when the oil reaches the bottom of the threads. Allow a minute or two for the oil to be absorbed by the filter material.
5. Put a drop of oil on your fingertip and wipe it on the rubber gasket.
6. Install the replacement oil filter to the filter adapter or oil cooler. Turn the oil filter clockwise until the rubber gasket contacts the filter adapter or oil cooler, then tighten the filter an additional ***2/3 to 1 turn.***
7. Reinstall the drain plug. Make sure it is tightened to ***13.6 N·m (10 ft. lb.)*** torque.
8. Fill the crankcase with new oil of the proper type to the "F" mark on the dipstick.
9. Start the engine and check for oil leaks. Correct any leaks before placing the engine into service. Check oil level to be sure it is up to but not over the "F" mark.

Service Oil Cooler

Some engines are equipped with an oil cooler. One style of oil cooler mounts on the engine crankcase and has the oil filter on it (See Figure 8). The other style of oil cooler is mounted on the blower housing (See Figure 9), separate from the oil filter.

Inspect and clean the oil cooler ***every 100 hours of operation*** (more frequently under severe conditions). Oil cooler must be kept free of debris.

To service the crankcase mounted oil cooler clean off the outside fins with a brush or with compressed air.

To service the blower housing mounted oil cooler, clean the outside of fins with a brush. Remove the two screws holding the cooler unit to the blower housing. Tilt the cooler downward as shown in Figure 10. Clean the inside of cooler with a brush as shown in Figure 10 or with compressed air. After cleaning, reinstall oil cooler to blower housing with two mounting screws.

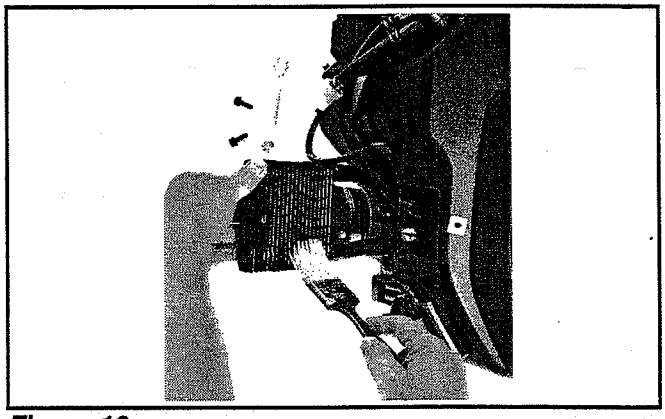


Figure 10.

Service Precleaner and Air Cleaner Element

This engine is equipped with a replaceable, high density paper air cleaner element. Most engines are also equipped with an oiled, foam precleaner which surrounds the paper element. See Figure 11.

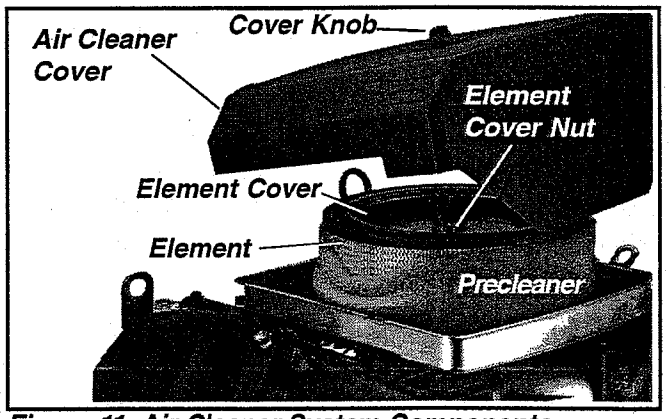


Figure 11. Air Cleaner System Components.

Check the air cleaner ***daily or before starting the engine.*** Check for a buildup of dirt and debris around the air cleaner system. Keep this area clean. Also check for loose or damaged components. Replace all bent or damaged air cleaner components.

NOTE: Operating the engine with loose or damaged air cleaner components could allow unfiltered air into the engine causing premature wear and failure.

Service Precleaner
If so equipped, wash and reoil the precleaner every ***25 hours*** of operation (more often under extremely dusty or dirty conditions).

1. Loosen the cover retaining knob and remove the cover.
2. Remove the precleaner from the paper element.
3. Wash the precleaner in warm water with detergent. Rinse the precleaner thoroughly until all traces of detergent are eliminated. Squeeze out excess water (do not wring). Allow the precleaner to air dry.
4. Saturate the precleaner with new engine oil. Squeeze out all excess oil.
5. Reinstall the precleaner over the paper element.
6. Reinstall the air cleaner cover. Secure cover with the cover retaining knob.
7. When precleaner replacement is necessary, order genuine Kohler parts.

24 083 02-S	***61 mm deep x 173 mm O.D.***
24 083 05-S	***71 mm deep x 173 mm O.D.***

Service Paper Element
Every ***100 hours*** of operation (more often under extremely dusty or dirty conditions) replace the paper element.

1. Loosen the cover retaining knob and remove the cover.
2. Remove the element cover nut, element cover, and paper element with precleaner.
3. Remove the precleaner (if so equipped) from the paper element. Service the precleaner as described above.
4. Do not wash the paper element or ***use pressurized air***, as this will damage the element. Replace a dirty, bent, or damaged element with a genuine Kohler element. Handle new elements carefully; do not use if the sealing surfaces are bent or damaged.
5. When servicing the air cleaner, check the air cleaner base. Make sure it is secured and not bent or damaged. Also, check the element cover for damage or improper fit. Replace all damaged air cleaner components.

   NOTE: If any loose dirt or debris fell on the air cleaner base when the element was removed, carefully remove it and wipe the base clean. Be careful that none of it drops into the intake throat. Check the condition of the rubber seal on the air cleaner stud. If the condition is questionable in any way, replace it with the new seal packaged with the replacement element.

6. Reinstall the paper element, precleaner, element cover, element cover nut, and air cleaner cover. Secure cover with the cover retaining knob.
7. When element replacement is necessary, order genuine Kohler parts.

47 083 03-S	***65 mm deep x 178 mm O.D.***
24 083 03-S	***74 mm deep x 178 mm O.D.***

Heavy-Duty Air Cleaner

To Service
Every ***250 hours*** of operation (more often under extremely dusty or dirty conditions), replace the paper element and check inner element. Follow these steps.

1. Unhook the two retaining clips and remove the end cap from the air cleaner housing.
2. Pull the air cleaner element out of the housing. See Figure 12.

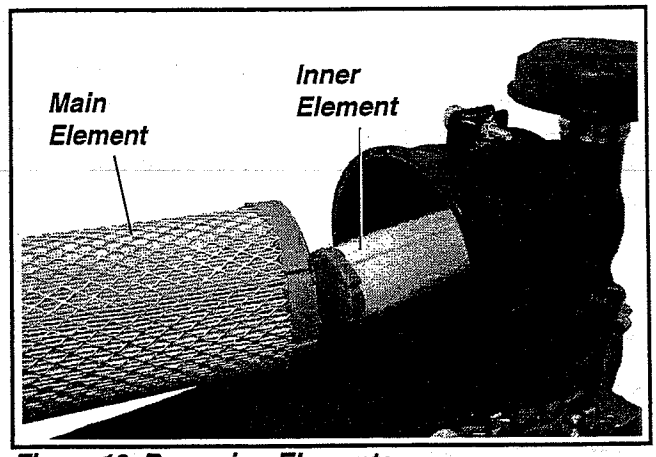


Figure 12. Removing Elements.

3. After the main element is removed, check the condition of the inner element. It should be replaced whenever it appears dirty, typically every other time the main element is replaced. Clean the area around the base of the inner element before removing it, so dirt does not get into the engine.

4. ***Do not*** was the paper element and inner element or use pressurized air, this will damaged the elements. Replace dirty, bent or damaged elements with new genuine Kohler elements as required. Handle new elements carefully; do not use if the sealing surfaces are bent or damaged.

5. Check all parts for wear, cracks, or damage. Replace any damaged components.

6. Install the new inner element, Kohler Part No. ***25 083 04-S*** followed by the outer element, Kohler Part No. ***25 083 01-S***. Slide each fully into place in the air cleaner housing.

7. Reinstall the end cap so the dust ejector valve is down and secure with the two retaining clips. See Figure 13.

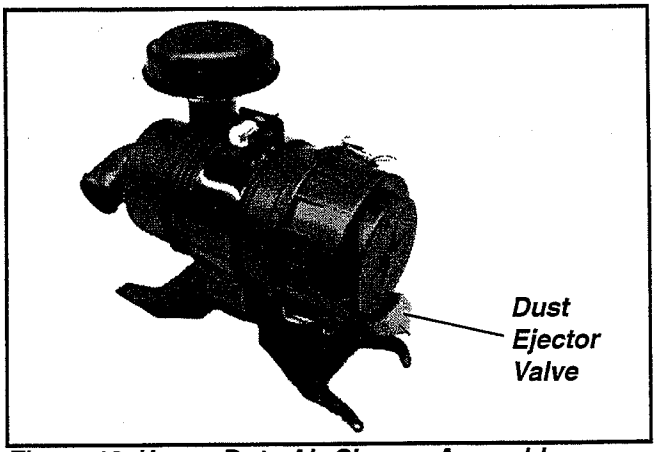


Figure 13. Heavy-Duty Air Cleaner Assembly.

Clean Air Intake/Cooling Areas

To ensure proper cooling, make sure the grass screen, cooling fins, and other external surfaces of the engine are kept clean ***at all times***.

Every ***100 hours*** of operation (more often under extremely dusty, dirty conditions), remove the blower housing* and other cooling shrouds. Clean the cooling fins and external surfaces as necessary. Make sure the cooling shrouds are reinstalled.

NOTE: Operating the engine with a blocked grass screen, dirty or plugged cooling fins, and/or cooling shrouds removed, will cause engine damage due to overheating.

*Cleanout kits 25 755 20-S (black) or 25 755 21-S (gold) allow inspection and cleanout of the cooling fins, without removing the blower housing.

Ignition System

Carbureted Engines - Use an electronic Capacitive Discharge (CD) ignition system. Other than periodically checking/replacing the spark plugs, no maintenance, timing, or adjustments are necessary or possible with this system.

EFI Engines - Incorporate a computer-controlled battery ignition system with individual coils. Other than periodically checking/replacing the spark plugs, no maintenance, timing, or adjustments are necessary or possible with this system.

Check Spark Plugs

Every ***200 hours*** of operation, remove the spark plugs, check condition, and reset the gap or replace with new plugs as necessary. The standard spark plug is a Champion® RC12YC (Kohler Part No. 12 132 02-S). A high-performance spark plug, Champion® Premium Gold 2071 (used on Pro Series engines, Kohler Part No. 12 132 06-S) is also available. Equivalent alternate brand plugs can also be used.

1. Before removing the spark plug, clean the area around the base of the plug to keep dirt and debris out of the engine.

2. Remove the plug and check its condition. Replace the plug if worn or reuse is questionable.

   NOTE: Do not clean the spark plug in a machine using abrasive grit. Some grit could remain in the spark plug and enter the engine causing extensive wear and damage.

3. Check the gap using a wire feeler gauge. Adjust the gap to ***0.76 mm (0.030 in.)*** by carefully bending the ground electrode. See Figure 14.

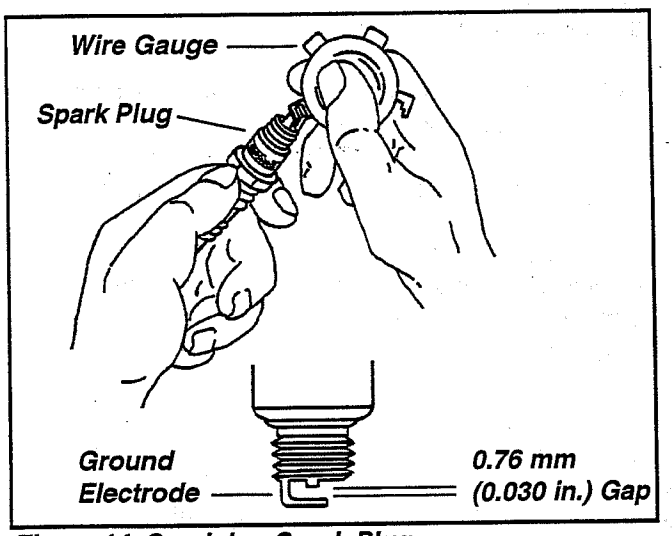


Figure 14. Servicing Spark Plug.

4. Reinstall the spark plug into the cylinder head. Torque the spark plug to ***24.4-29.8 N·m (18-22 ft. lb.)***.

Battery Charging

WARNING: Explosive Gas!

Batteries produce explosive hydrogen gas while being charged. To prevent a fire or explosion, charge batteries only in well ventilated areas. Keep sparks, open flames, and other sources of ignition away from the battery at all times. Keep batteries out of the reach of children. Remove all jewelry when servicing batteries.

Before disconnecting the negative (-) ground cable, make sure all switches are OFF. If ON, a spark will occur at the ground cable terminal which could cause an explosion if hydrogen gas or gasoline vapors are present.

NOTE: Do not apply 12 volt DC to kill terminal of ignition module.

Fuel System

WARNING: Fuel System Under Pressure!

The EFI fuel system operates under high pressure, and the fuel filter and fuel line used must be approved system components only. Use of substitute parts can result in system failure, gasoline leakage and possible explosion.

Fuel Filter

Carbureted Engines: Some engines are equipped with an in-line fuel filter. Periodically inspect the filter and replace when dirty. *Always use genuine Kohler parts.*

EFI Engines: A special, high volume, high pressure filter with greater filtration capabilities and internal surface area is used. See Figure 15.

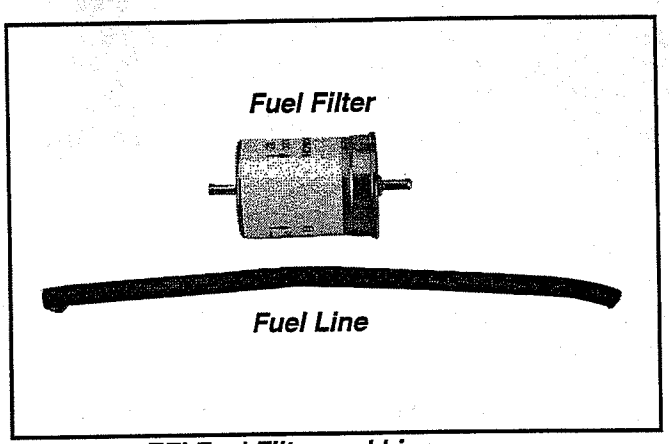


Figure 15. EFI Fuel Filter and Line.

Replacement is recommended ***every 1500 hours***, or more frequently under extremely dusty or dirty conditions. When replacement is necessary, always use genuine Kohler parts.

Fuel Line

EFI Engines: A special fuel line, capable of withstanding the high pressure of the EFI fuel system, is used (must meet SAE R9 specifications). See Figure 15. If fuel line must be replaced, see your Kohler Engine Service Dealer.

Carburetor Troubleshooting and Adjustments

NOTE: Carburetor adjustments should be made only after the engine has warmed up.

The carburetor is designed to deliver the correct fuel-to-air mixture to the engine under all operating conditions. To comply with current emission regulations, the fuel mixture settings are made at the factory and cannot be adjusted.

NOTE: To ensure correct engine operating at altitudes above 1525 meters (5000ft.), it may be necessary to have an authorized Kohler dealer install a special high-altitude jet kit in the carburetor. If a high-altitude kit has been installed, the engine must be reconverted to the original jet size, before it is operated at lower altitudes, or overheating and engine damage can result.

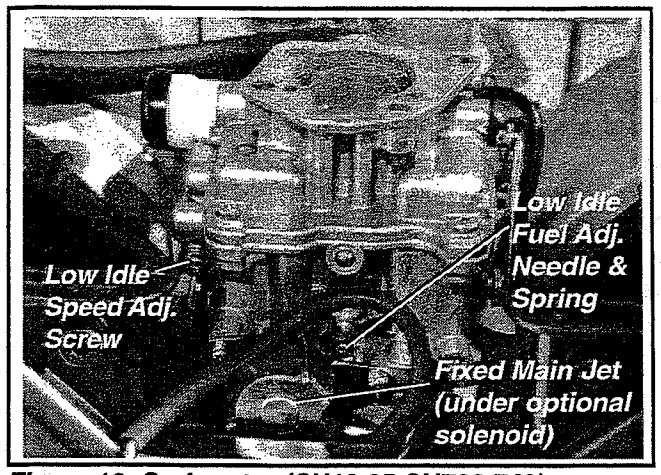


Figure 16. Carburetor (CH18-25,CH730,740).

Troubleshooting

If engine troubles are experienced that appear to be fuel system related, check the following areas before adjusting the carburetor.

- Make sure the fuel tank is filled with clean, fresh gasoline.
- Make sure the fuel tank cap vent is not blocked and that it is operating properly.
- If the fuel tank is equipped with a shut-off valve, make sure it is open.
- If the engine is equipped with an in-line fuel filter, make sure it is clean and unobstructed. Replace the filter if necessary.
- Make sure fuel is reaching the carburetor. This includes checking the fuel lines and fuel pump for restrictions or faulty components, replace as necessary.
- Make sure the air cleaner element is clean and all air cleaner element components are fastened securely.

If, after checking the items listed above, the engine is hard to start, runs roughly, or stalls at low idle speed, it may be necessary to adjust or service the carburetor.

Adjust Carburetor

There are no accessible mixture adjustment screws on the carburetor. The only setting which can be changed is the low idle speed.

1. Start the engine and run at half throttle for 5 to 10 minutes to warm up. The engine must be warm before making final settings (steps 2 and 3).
2. ***Low Idle Speed Setting:*** Place the throttle control into the ***"idle"*** or ***"slow"*** position. Set the low idle speed to ***1200 RPM**** (± 75 RPM) by turning the low idle speed adjusting screw ***in*** or ***out***. Check the speed using a tachometer.

   *NOTE: The actual low idle speed depends on the application – refer to equipment manufacturers recommendations. The standard low idle speed is 1200 RPM.

3. If proper operation is not restored after adjusting the low idle speed, carburetor servicing by an authorized Kohler Engine Service Dealer may be required.

Electronic Fuel Injection (EFI) System

The EFI system is a complete, electronically-controlled fuel management system, designed to deliver a precisely controlled fuel flow under all operating conditions. The electronic control unit (ECU), the "brain" of the system, automatically adjusts fuel delivery and ignition timing based upon load, speed, operating temperature, and exhaust emission levels. The low idle speed is the only manual adjustment possible.

The ECU continuously monitors operation of the EFI system. If it detects a problem or fault within the system, it will illuminate the malfunction indicator light (MIL), which is mounted in view of the operator. This is a signal that normal, programmed operation has been affected, and service by an authorized Kohler Engine Dealer is required.

NOTE: The EFI system requires a rather complex wiring harness to carry the electrical signals between the sensors and the ECU. ***Do not*** spray water at the wiring harness or any of the electrical components, especially the ECU, as it could cause malfunction, damage, or failure.

Troubleshooting

If the MIL comes on, or the engine becomes hard to start, runs roughly, or stalls at low idle speed, initial checks should be made in the following areas:

- Make sure the fuel tank is filled with clean, fresh gasoline, and shut-off valve (if so equipped) is opened completely.
- Make sure fuel tank vent cap is not blocked and it is operating properly.
- Make sure the air cleaner element and precleaner are clean and all components are properly secured. Clean or replace as necessary.

- Make sure the proper fuel filter is being used, and it is clean and unobstructed. Replace filter ***only*** with genuine Kohler parts.

- Make sure all connections to sensors, ECU, and fuel injectors are properly secured.

- Make sure a good 12 volt battery is being used and is fully charged.

If these checks do not correct the problem, or the MIL remains on, further diagnosis and servicing by an authorized Kohler Engine Dealer is necessary.

Adjustment – EFI Throttle Body

Low Idle Speed (RPM) is the only adjustment that can be made. All other fuel calibrations are permanently preset and controlled by the ECU. The standard low idle speed is ***1500 RPM**** (± 75 RPM).

*NOTE: The actual low idle speed depends on the application -- refer to equipment manufacturer's recommendations.

When an EFI engine is started cold, the ECU will be using internal programming for cold running, and the idle speed may vary from the manual setting. Do not attempt to perform any readjustment during this "warm-up" period.

If adjustment is to be made, the engine must be at operating temperature, air cleaner in place, and check engine light must be off (no fault codes present).

1. Start the engine and run at half throttle for 5 to 10 minutes to warm up.

2. Place the throttle control into the ***"idle"*** or ***"slow"*** position.

3. Turn the low idle speed adjusting screw in or out and check RPM with a tachometer. See Figure 17.

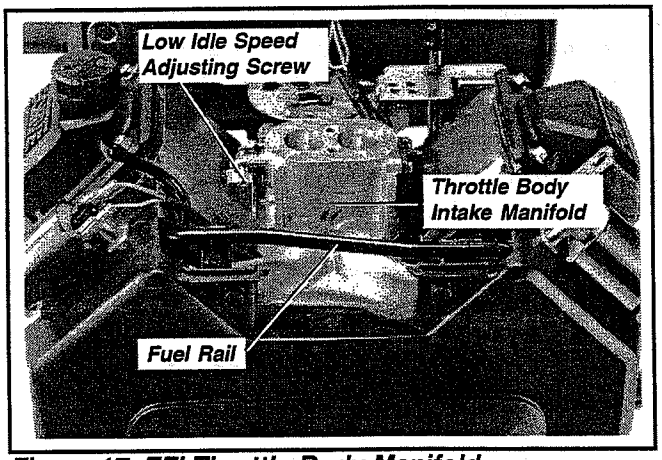


Figure 17. EFI Throttle Body Manifold.

Troubleshooting

When troubles occur, be sure to check the simple causes which, at first, may seem too obvious to be considered. For example, a starting problem could be caused by an empty fuel tank. Some common causes of engine troubles are listed in the following table.

Do not attempt to service or replace major engine components, or any items that require special timing or adjustment procedures. Have your Kohler Engine Service Dealer do this work.

Possible Cause / Problem	*No Fuel*	*Improper Fuel*	*Dirt In Fuel Line/System*	*Dirty Grass Screen*	*Incorrect Oil Level*	*Engine Overloaded*	*Dirty Air Cleaner*	*Faulty Spark Plug*
Will Not Start	•	•	•		•	•	•	•
Hard Starting		•	•		•	•	•	•
Stops Suddenly	•		•	•	•	•	•	
Lacks Power		•	•	•	•	•	•	•
Operates Erratically		•	•	•		•	•	•
Knocks or Pings		•		•		•		•
Skips or Misfires		•	•	•			•	•
Backfires			•			•	•	•
Overheats			•	•	•	•	•	
High Fuel Consumption						•	•	•

Storage

If the engine will be out of service for two months or more, use the following storage procedure:

1. Clean the exterior surfaces of the engine. On EFI engines, avoid spraying water at the wiring harness or any of the electrical components.

2. Change the oil and filter while the engine is still warm from operation. See "Change Oil and Oil Filter" on page 9.

3. The fuel system must be completely emptied, or the gasoline must be treated with a stabilizer to prevent deterioration. If you choose to use a stabilizer, follow the manufacturers recommendations, and add the correct amount for the capacity of the fuel system. Fill the fuel tank with clean, fresh gasoline. Run the engine for 2-3 minutes to get stabilized fuel into the rest of the system. Close fuel shut-off valve when unit is being stored or transported.

   To empty the system, run the engine until the tank and system are empty.

4. Remove the spark plugs. Add one tablespoon of engine oil into each spark plug hole. Install the plugs, but do not connect the plug leads. Crank the engine two or three revolutions.

5. Store the engine in a clean, dry place.

Parts Ordering

The engine Specification, Model, and Serial Numbers are required when ordering replacement parts from your Kohler Engine Service Dealer. These numbers are found on the identification plate which is affixed to the engine shrouding. Include letter suffixes if there are any. See "Engine Identification Numbers" on page 6.

Always insist on genuine Kohler parts. All genuine Kohler parts meet strict standards for fit, reliability, and performance.

Major Repair

Major repair information is available in Kohler Engine Service Manuals. However, major repair generally requires the attention of a trained mechanic and the use of special tools and equipment. Your Kohler Engine Service Dealer has the facilities, training, and genuine Kohler replacement parts necessary to perform this service. For Sales & Service assistance call 1-800-544-2444 (U.S. & Canada) or contact your Kohler Engine Dealer or Service Distributor, they're in the Yellow Pages under Engines-Gasoline.

Specifications

Model:		CH18,20,22	CH25,26,730,740
Bore:	mm (in.)	77 (3.03)#	83 (3.27)
Stroke:	mm (in.)	67 (2.64)	67 (2.64)
Displacement:	cm^3 (in^3)	624 (38.1)#	725 (44.0)
Power (@3600 RPM):	kW (HP)	13.4 (18*)/14.9 (20*)/16.4 (22*)	18.4 (25*)/19.4 (26)
			18.6 (25*)/20.1 (27)
Max. Torque (@ RPM):	N·m (ft. lb.)	41 (30) @2500	54 (39.5) @2200
		44 (32) @2500	56.4 (41.6) @2200
		45 (33) @2500	52 (38) @2800
			54 (40) @2800
Compression Ratio:		8.5:1	9.0:1
Weight:	kg (lb.)	41 (90)	43 (94)
Oil Capacity (w/filter):	L (U.S. qt.)	2 (2.1)	2 (2.1)
Lubrication:		Full Pressure w/full Flow Filter	

Exhaust Emission Control System for models CH18,20,22,23,25,730,740 is EM.
Exhaust Emission Control System for model CH26 is EM, O2S, ECM, MFI.

*Horsepower ratings are established in accordance with Society of Automotive Engineers – Small Engine Test Code –J1995 GROSS. Kohler Co. reserves the right to change product specifications, design, and standard equipment without notice and without incurring obligation.

#CH22 or CH23 engines with Spec. Numbers of 765xx have bore size of 80 mm (3.15 in.) and displacement of 674 cm^3 (41.1 in^3).

LIMITED 2 YEAR COMMAND ENGINE WARRANTY

We warrant to the original consumer that each new COMMAND engine sold by us will be free from manufacturing defects in materials or workmanship in normal service for a period of two (2) years from date of purchase, provided it is operated and maintained in accordance with Kohler Co.'s instructions and manuals.

Our obligation under this warranty is expressly limited, at our option, to the replacement or repair at Kohler Co., Kohler, Wisconsin 53044, or at a service facility designated by us of such parts as inspection shall disclose to have been defective.

EXCLUSIONS:
Mufflers on engines used commercially (non-residential) are warranted for one (1) year from date of purchase, except catalytic mufflers, which are warranted for two (2) years.

This warranty does not apply to defects caused by casualty or unreasonable use, including faulty repairs by others and failure to provide reasonable and necessary maintenance.

The following items are not covered by this warranty:

Engine accessories such as fuel tanks, clutches, transmissions, power-drive assemblies, and batteries, unless supplied or installed by Kohler Co. These are subject to the warranties, if any, of their manufacturers.

WE SHALL NOT BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OF ANY KIND, including but not limited to labor costs or transportation charges in connection with the repair or replacement of defective parts.

ANY IMPLIED OR STATUARY WARRANTIES, INCLUDING WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSLY LIMITED TO THE DURATION OF THIS WRITTEN WARRANTY. We make no other express warranty, nor is any one authorized to make any in our behalf.

Some states do not allow limitations on how long an implied warranty lasts, or the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

TO OBTAIN WARRANTY SERVICE:
Purchaser must bring the engine to an authorized Kohler service facility. For the facility nearest you, consult your Yellow Pages or write Kohler Co., Attn: Engine Warranty Service Dept., Kohler, Wisconsin, 53044.

ENGINE DIVISION, KOHLER CO., KOHLER, WISCONSIN 53044

KOHLER CO.
FEDERAL AND CALIFORNIA EMISSION CONTROL SYSTEMS
LIMITED WARRANTY
SMALL OFF-ROAD ENGINES

The U.S. Environmental Protection Agency (EPA), the California Air Resources Board (CARB), and Kohler Co. are pleased to explain the Federal and California Emission Control Systems Warranty on your small off-road equipment engine. For California, engines produced in 1995 and later must be designed, built and equipped to meet the state's stringent anti-smog standards. In other states, 1997 and later model year engines must be designed, built and equipped, to meet the U.S. EPA regulations for small non-road engines. The engine must be free from defects in materials and workmanship which cause it to fail to conform with U.S. EPA standards for the first two years of engine use from the date of sale to the ultimate purchaser. Kohler Co. must warrant the emission control system on the engine for the period of time listed above, provided there has been no abuse, neglect or improper maintenance.

The emission control system may include parts such as the carburetor or fuel injection system, the ignition system, and catalytic converter. Also included are the hoses, belts and connectors and other emission related assemblies.

Where a warrantable condition exists, Kohler Co. will repair the engine at no cost, including diagnosis (if the diagnostic work is performed at an authorized dealer), parts and labor.

MANUFACTURER'S WARRANTY COVERAGE
Engines produced in 1995 or later are warranted for two years in California. In other states, 1997 and later model year engines are warranted for two years. If any emission related part on the engine is defective, the part will be repaired or replaced by Kohler Co. free of charge.

OWNER'S WARRANTY RESPONSIBILITIES
(a) The engine owner is responsible for the performance of the required maintenance listed in the owner's manual. Kohler Co. recommends that you retain all receipts covering maintenance on the engine, but Kohler Co. cannot deny warranty solely for the lack of receipts or for your failure to assure that all scheduled maintenance was performed.

(b) Be aware, however, that Kohler Co. may deny warranty coverage if the engine or a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.

Continued on next page.

(c) For warranty repairs, the engine must be presented to a Kohler Co. service center as soon as a problem exists. Call 1-800-544-2444 or access our website at: www.kohlerengines.com, for the names of the nearest service centers. The warranty repairs should be completed in a reasonable amount of time, not to exceed 30 days.

If you have any questions regarding warranty rights and responsibilities, you should contact Kohler Co. at 1-920-457-4441 and ask for an Engine Service representative.

COVERAGE

Kohler Co. warrants to the ultimate purchaser and each subsequent purchaser that the engine will be designed, built and equipped, at the time of sale, to meet all applicable regulations. Kohler Co. also warrants to the initial purchaser and each subsequent purchaser, that the engine is free from defects in materials and workmanship which cause the engine to fail to conform with applicable regulations for a period of two years.

Engines produced in 1995 or later are warranted for two years in California. For 1997 and later model years, EPA requires manufacturers to warrant engines for two years in all other states. These warranty periods will begin on the date the engine is purchased by the initial purchaser. If any emission related part on the engine is defective, the part will be replaced by Kohler Co. at no cost to the owner. Kohler Co. is liable for damages to other engine components caused by the failure of a warranted part still under warranty.

Kohler Co. shall remedy warranty defects at any authorized Kohler Co. engine dealer or warranty station. Warranty repair work done at an authorized dealer or warranty station shall be free of charge to the owner if such work determines that a warranted part is defective.

Listed below are the parts covered by the Federal and California Emission Control Systems Warranty. Some parts listed below may require scheduled maintenance and are warranted up to the first scheduled replacement point for that part. The warranted parts are:

- Carburetor assembly
- Throttle body (EFI Systems)
- Catalytic muffler (if equipped)
- Fuel metering valve (if equipped)
- Crankcase breather
- Fuel pressure regulator (EFI Systems)
- Ignition module(s) with high tension lead
- Spark advance module (if equipped)
- Oxygen, speed, throttle position, and temperature sensors (if equipped)
- Electronic control unit (if equipped)
- Fuel injectors (EFI Systems)
- Air filter, fuel filter, and spark plugs (only to first scheduled replacement point)

LIMITATIONS

This Emission Control Systems Warranty shall not cover any of the following:

(a) repair or replacement required because of misuse or neglect, improper maintenance, repairs improperly performed or replacements not conforming to Kohler Co. specifications that adversely affect performance and/or durability and alterations or modifications not recommended or approved in writing by Kohler Co.,

(b) replacement of parts and other services and adjustments necessary for required maintenance at and after the first scheduled replacement point,

(c) consequential damages such as loss of time, inconvenience, loss of use of the engine or equipment, etc.,

(d) diagnosis and inspection fees that do not result in eligible warranty service being performed, and

(e) any add-on or modified part, or malfunction of authorized parts due to the use of add-on or modified parts.

MAINTENANCE AND REPAIR REQUIREMENTS

The owner is responsible for the proper use and maintenance of the engine. Kohler Co. recommends that all receipts and records covering the performance of regular maintenance be retained in case questions arise. If the engine is resold during the warranty period, the maintenance records should be transferred to each subsequent owner. Kohler Co. reserves the right to deny warranty coverage if the engine has not been properly maintained; however, Kohler Co. may not deny warranty repairs solely because of the lack of repair maintenance or failure to keep maintenance records.

Normal maintenance, replacement or repair of emission control devices and systems may be performed by any repair establishment or individual; however, ***warranty repairs must be performed by a Kohler authorized service center.*** Any replacement part or service that is equivalent in performance and durability may be used in non-warranty maintenance or repairs, and shall not reduce the warranty obligations of the engine manufacturer.

About Vacuum Pumps

Designed to create a vacuum, these pumps produce a negative, or below atmospheric, pressure condition in a vessel or tank. Low to medium or rough vacuum is measured in inches of mercury (Hg). Rough vacuum is vacuum up to 28" Hg. It's suitable for light lifting, grabbing, and moving parts. High or deep vacuum is 29.9" Hg and greater. High vacuum is also measured in microns of mercury (Hg). High vacuum is often needed in refrigeration service.

When measured in inches Hg, the higher the number, the better the vacuum; when measured in microns, the lower the number, the better the vacuum.

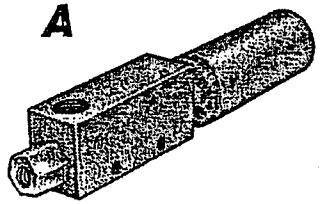
Free air is the initial pull needed to create a vacuum. The vessel or tank size and how quickly the vacuum level needs to be reached will determine the cfm (flow) the pump needs to generate. Tubing ID and fitting ID sizes also affect flow through the pump. You can estimate how many minutes it will take to form a vacuum by dividing the tank capacity by the cfm of the pump. Forming a vacuum in a large tank will take much longer than in a small tank when using a comparable pump.

Venturi Vacuum Pumps

Also known as vacuum generators, these compressed-air powered pumps are easy to install and maintain because they have no moving parts or seals. They don't require lubrication either. Plus, they're compact and lightweight. All have a silencer to reduce noise level. Maximum temperature is 300° F for aluminum body pumps; 125° F for Delrin body pumps.

A- *Single Stage*—Use for low airflow or as an intermittent vacuum source.

A



Max. Vacuum, Hg	Free Air, cfm	Air Consumption @ Operating Pressure, cfm	Operating Pressure, psi	dB Rating	*Connection Size* Intake Vacuum	Exhaust Connection, NPT female	O'all Size, Lg. × Wd.	*NPT Female Intake & Vacuum Connections*
(A) Single Stage, Fixed Flow—*Aluminum body*								
27"	2.2	3.5	30–75	65	1/8"	1/4"	1/4"	$7\frac{23}{64}$" × $1\frac{21}{32}$"	41605K14

SINGLE-AND MULTI-STAGED VACUUM GENERATORS- DELIVERING UNMATCHED PERFORMANCE, PRICE, AND VERSATILITY

When compressed air is forced through a conical nozzle, its velocity increases and a decrease in pressure occurs. This principle, discovered by 18th century physicist G.B. Venturi, can be used to generate vacuum economically without a single moving part.

Multi-Venturi Design

patented design of vacuum generators incorporates a series of venturi nozzles. Each nozzle has a progressively larger orifice selected to extract the maximum amount of energy from the compressed air while optimizing the levels of vacuum generated.

Normally, no special prefilters are required because the venturi nozzles are aligned to allow "straight through" air flow. Thus, any air line contaminants easily clear the generator without clogging or build-up.

Packaged in compact, light-weight housings, the entire family of multi-venturi vacuum generators are easy to use and provide outstanding performance at a price that makes sense for even the most demanding applications.

Two Families of High Performance Vacuum Generators

Select from either single-or multi-stage designs to achieve up to 27.0 inches of mercury with vacuum flow rates ranging from .2 CFM to 158 CFM.

Only two pipe connections are required: (1) compressed air supply, and (2) vacuum port. Both ports are contained in one head for ease of installation. Should field modification or repair ever be necessary, the body of the pump can be removed without disturbing any of the plumbing.

Multi-stage units are manufactured with brass venturi nozzles housed in either Delrin® acetal or anodized aluminum vacuum stages. Delrin® is a tough plastic resistant to compressor oils and a variety of chemicals. Anodized aluminum, also used on the single-stage models, offers the ultimate in chemical resistance and is ideal for severe duty, aggressive gas applications.

The finished assembly is then encased in an outer body shell of anodized aluminum tubing. Gaskets and check valves are neoprene or viton, depending on the model, tie rods are steel.

Ten Important Design Features That Set Us Apart

- **Compressed Air Driven**

vacuum generators are easy to install. They operate efficiently on shop air and avoid the possible spark associated with electric motors on critical applications. And, there's no RF noise generated to affect electrical/ electronic systems either.

- **Economical to Operate**

The innovative multi-venturi design uses less compressed air, yet delivers substantially more vacuum flow than single-venturi units.

- **Compact Size**

Allows the vacuum source to be located closer to the point of use. Shorter air lines cost less and quicken response.

- **Light-Weight Construction**

Most models weigh less than one pound, providing maximum flexibility and mounting ease.

- **Superior Control**

Vacuum levels are controlled by adjusting inlet pressure. Generators can be cycled on and off by controlling inlet pressure rather than by regulating the vacuum line through venting to atmosphere. Maximum performance and lowest noise is achieved at stated optimum inlet pressure.

- **Low Air Consumption**

Multi-venturi design improves efficiency to achieve 90% vacuum (27" Hg against a barometric pressure of 29.92") while attaining high vacuum flow rates.

- **No Moving Parts**

Expect extra long life with no lubrication required.

- **Quiet Operation**

Generators can be used with exhaust silencers, resulting in low noise levels in the 60-65 dB range.

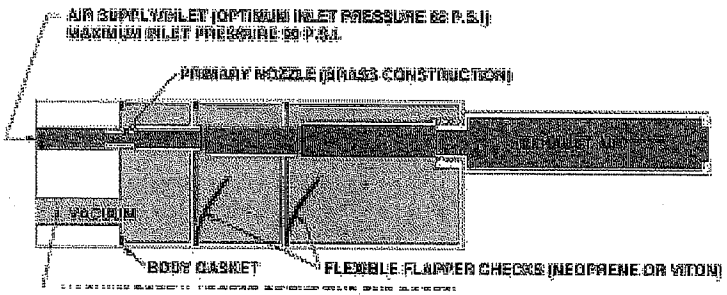
- **Minimal Maintenance**

Plan for virtually no down time. The units can be flushed with soap and water and reassembled in 2 minutes --all without removing the generator from its mounting location.

- **Low Cost**

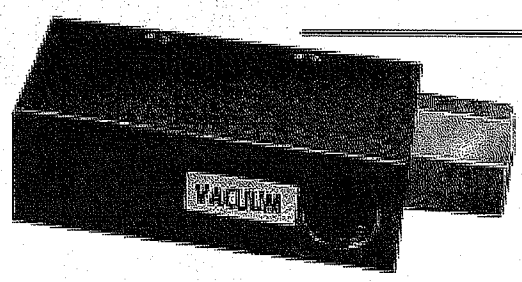
Pricing that's well below foreign imports is only part of the picture. Combined with ease of installation, control and maintenance, it means that your total investment is far less when you use vacuum generators.

Efficient, Reliable, Straight-Through Venturi Design (Multi-stage model shown here)



Single-Stage Vacuum Generators to 27" Hg

High Vacuum Series



NOTE: Unit shown without sound attenuator

VG-005-00-00 (METRIC VERSION MG-005-00-00)
27" HG MAX. VAC., UP TO .2 CFM VACUUM FLOW

VG-010-00-00 (METRIC VERSION MG-010-00-00)
26" HG MAX. VAC., UP TO .85 CFM VACUUM FLOW

VG-015-00-00 (METRIC VERSION MG-015-00-00)
27" HG MAX. VAC., UP TO 2.2 CFM VACUUM FLOW

VG-020-00-00 (METRIC VERSION MG-020-00-00)
27" HG MAX. VAC., UP TO 4 CFM VACUUM FLOW

PRODUCT FEATURES

- Low cost vacuum source
- Compact size easy to mount
- No moving parts/zero maintenance
- Metric versions available—consult factory

INCLUDES

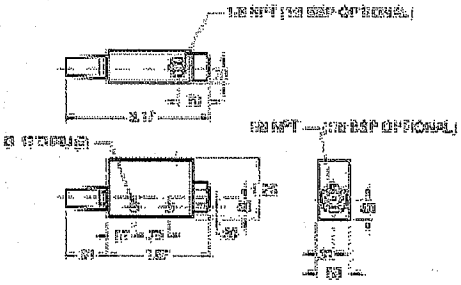
- VG2015 sound attenuator (VG-005)
- B3003 sound attenuator (VG-010)
- VG2045 sound attenuator (VG-015)
- VG2055 sound attenuator (VG-020)

Important Notice:

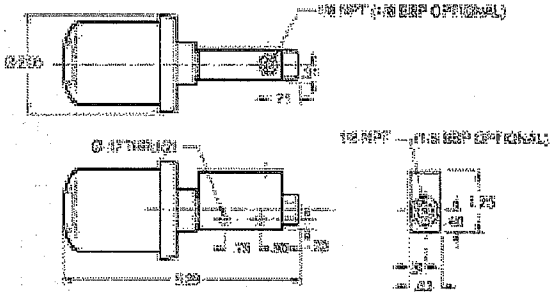
Pictorial and dimensional data is subject to change without notice.

Product Dimensions - with Sound Attenuators (inches)

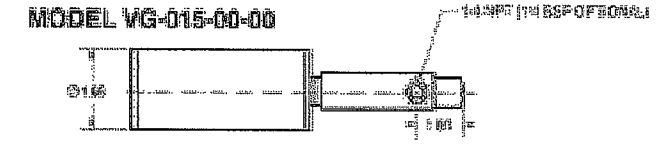
MODEL VG-005-00-00

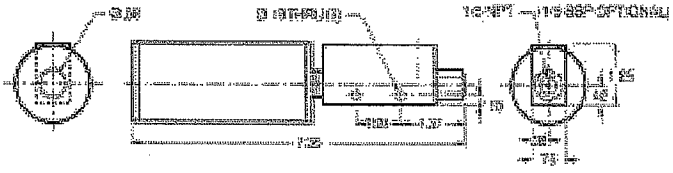


MODEL VG-010-00-00

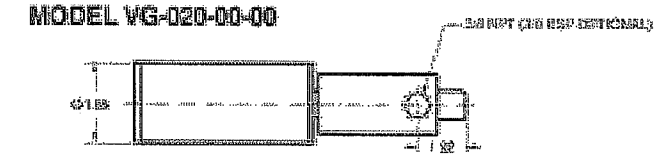


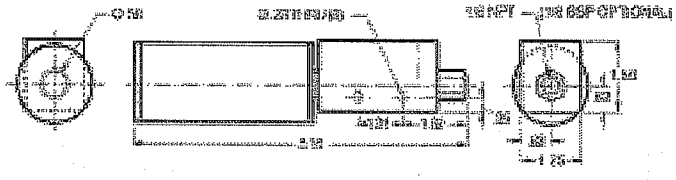
MODEL VG-015-00-00





MODEL VG-020-00-00





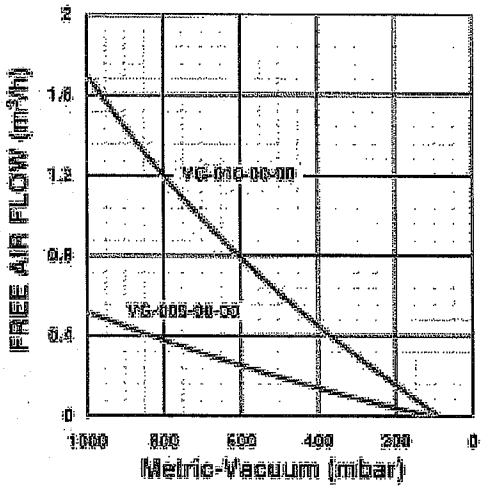
Product Specifications

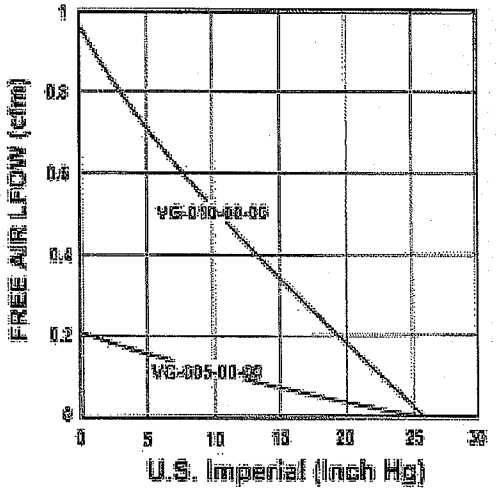
Model Number*	Suggested Operating Pressure	Air Consumption @ Suggested Operating Pressure	Vacuum Port Size	Supply Air Port Size	Net Weight
VG-005-00-00	30-75 PSI	.45 CFM	1/8" NPT	1/8" NPT	3 ounces
VG-010-00-00	30-75 PSI	1.60 CFM	1/8" NPT	1/8" NPT	3 ounces
VG-015-00-00	30-75 PSI	3.50 CFM	1/4" NPT	1/8" NPT	6 ounces
VG-020-00-00	30-75 PSI	6.40 CFM	3/8" NPT	1/8" NPT	12 ounces

* Metric versions have identical performance specifications.

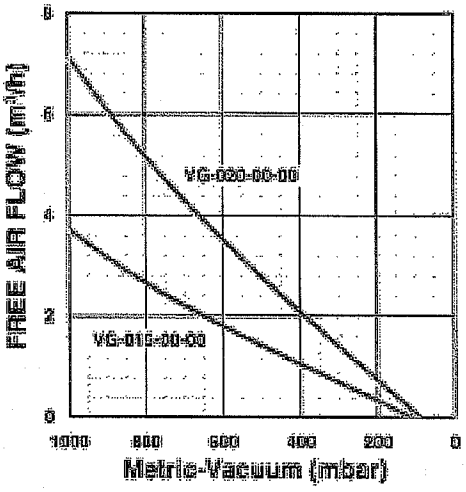
Product Performance (Metric U.S. Imperial)

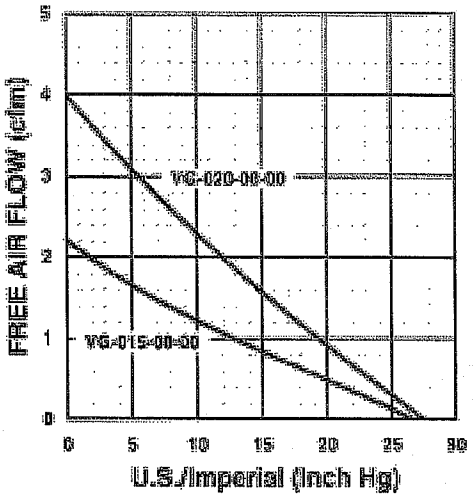
Models VG-005 VG-010





Models VG-015 VG-020





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The reel leader.
Hannay Reels, Inc., 553 State Route 143
Westerlo, NY 12193-0159
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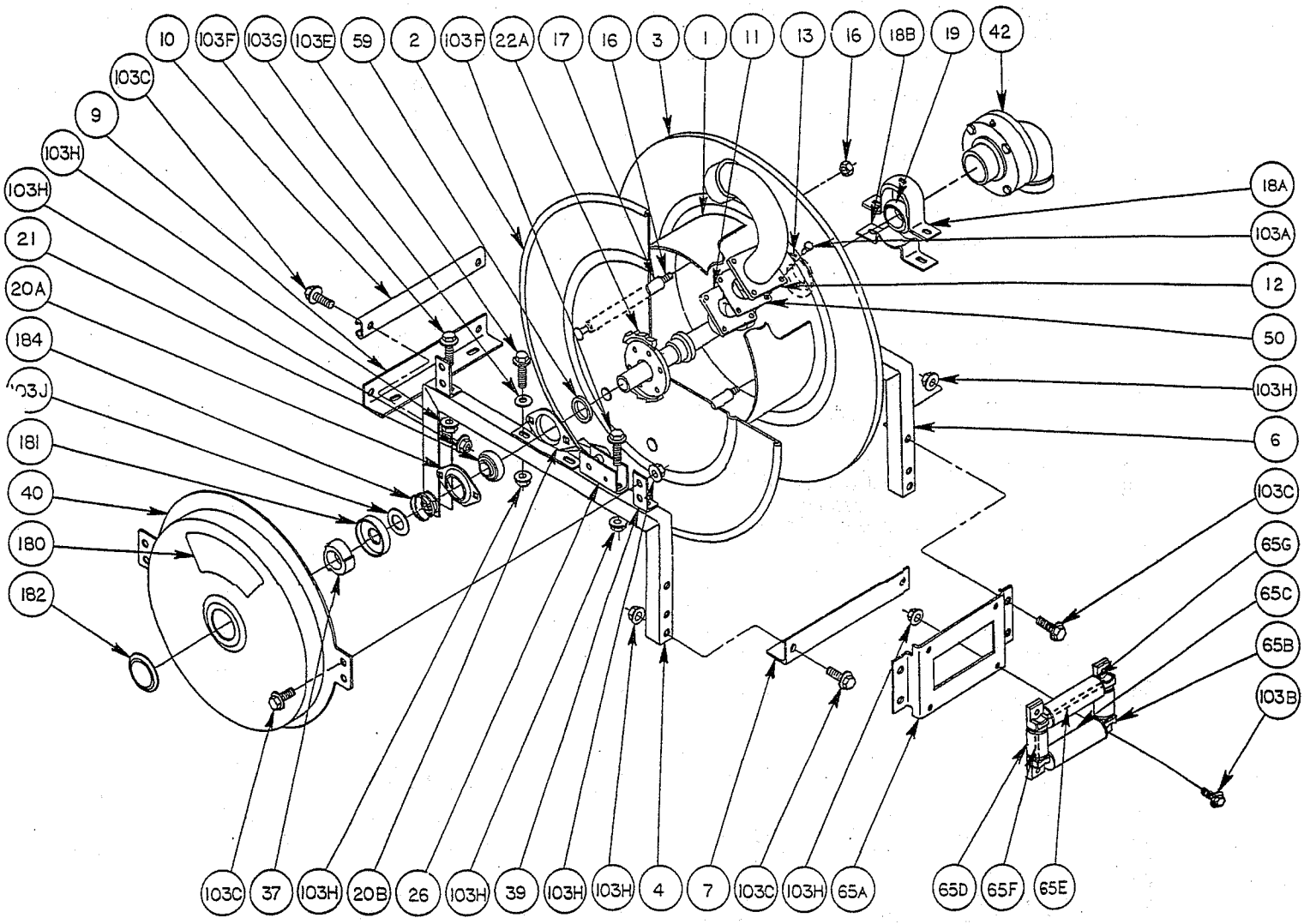
FAX 1-800-REELING (733-5464)
INT'L FAX (518) 797-3259
Website: www.hannay.com
E-mail: reels@hannay.com

ISO 29
PARTS LIST
SERIES 900



Hannay ISO Parts Lists are available at www.hannay.com

PARTS LIST
ISO 29
Series 900

When ordering parts

BE SURE TO SPECIFY COMPLETE MODEL NUMBER and SERIAL NUMBER OF REEL.

USE PART NUMBER!

Item No.	Description	PART NUMBER	Quantity
1	Drum, 10-1/2" Dia.	(Specify Model)	1
2	Front Disc, 23-24, 21-3/4" Dia.	(Specify Model)	1
2	Front Disc, 25-26, 24-3/4" Dia.	(Specify Model)	1
2	Front Disc, 28-29, 26-3/4" Dia.	(Specify Model)	1
2	Front Disc, 30-31, 28-3/4" Dia.	(Specify Model)	1
3	Back Disc, 23-24, 21-3/4" Dia.	(Specify Model)	1
3	Back Disc, 25-26, 24-3/4" Dia.	(Specify Model)	1
3	Back Disc, 28-29, 26-3/4" Dia.	(Specify Model)	1
3	Back Disc, 30-31, 28-3/4" Dia.	(Specify Model)	1
4	Front Frame, 23-24	9906.0111	1
4	Front Frame, 25-26	9906.0121	1
4	Front Frame, 28-29	9906.0141	1
4	Front Frame, 30-31	9906.0151	1
6	Back Frame, 23-24	9906.0111	1
6	Back Frame, 25-26	9906.0121	1
6	Back Frame, 28-29	9906.0141	1
6	Back Frame, 30-31	9906.0151	1
7	Front Foot	(Specify Model)	1
9	Back Foot	9907.2000	1
10	Back Brace - C Channel	9907.2000	1
11	1-1/2" Flanged Hub	9907.7000	1
12	1-1/2" FNPT Flanged Riser	9901.3640	1
13	Disc Washer w/Rivets, EH-936	9901.3760	1
16	3/8" - 16 Carriage Bolt w/Nut	9965.0015	1
17	Spacer Pipe	(Specify Model)	6
18A	Greasable Bearing Holder (Top Strap)	9904.3200	6
18B	Greasable Bearing Holder (Bottom Strap)	9902.2955	1
19	1-1/2" Bronze Bearing Insert (w/Grease Fitting)	9902.2950	1
20A	Self-Aligning Bearing Holder (Front)	9902.1710	1
20B	Self-Aligning Bearing Pillow Block (Front)	9902.2800	1
21	Self-Aligning Bearing Insert (Front)	9902.2900	1
22A	Ratchet Wheel	9902.1500	1
26	Ratchet Locking Assembly, GH-784	9922.0015	1
37	Spring Arbor For A Spring	9922.0005	1
37	Spring Arbor For B Spring	9922.0001	1
39	Spring Mounting Bracket	9922.0002	1
40	Spring Motor, A	9922.0009	2
40	Spring Motor, B	9921.0010	1
42	1-1/2" 90 Deg. FxF Swivel Joint	9921.0015	1
50	Gasket	9930.4210	1
59	Hub Spacer	9965.0021	1
65A	R300 Roller Mounting Frame	9954.0021	2
65B	Roller Mounting Block	A69A-00100-66	1
65C	1-1/2" Stainless Steel Roller Tubing	9940.0075	4
65D	1-1/2" Stainless Steel Roller Tubing	(Specify Length)	2
65E	Roller Rod	(Specify Length)	2
65F	Roller Rod	(Specify Length)	2
65G	1-1/2" Trunion Bearing	(Specify Length)	2
103A	5/16" - 18 x 3/4" Hex Head Bolt	9940.0009	2
103B	3/8" - 16 X 1" Spinlock Bolt	9940.0009	2
103C	3/8" - 16 x 3/4" Spinlock Bolt	9940.0007	8
103D	3/8" - 16 x 3/4" Carriage Bolt	9904.1101	4
103E	3/8" - 16 x 1-1/4" Spinlock Bolt	9904.2202	4
103F	3/8" - 16 x 1-1/2" Spinlock Bolt	9904.2201	12
103G	3/8" Flat Washer	9904.0201	4
103H	3/8" - 16 Spinlock Nut	9904.2203	4
103J	1-7/8" O.D. x 1-5/16" I.D. x .049 Washer	9904.2204	4
180	Caution Decal, "Spring Under Tension"	9954.0007	4
181	Cap-Plug for Spring (Inner Side)	9904.6200	24
182	Cap-Plug for Spring (Outer Side)	9954.0019	1
184	Dust Cap Spring	9922.0010	1
		9922.0036	1
		9922.0037	1
		9922.0038	1

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Website: www.hannay.com
E-mail: reels@hannay.com

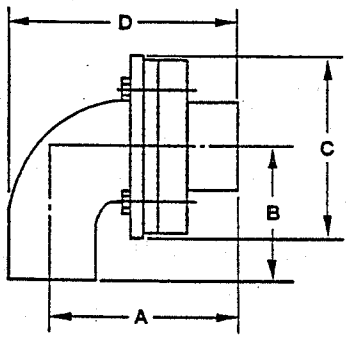
ISO 194
PARTS LIST
WHJ SERIES SWIVEL JOINT

WHJ Series Ball-Bearing Swivel Joints for 1-1/2″ & 2″ Reels

APPROPRIATE APPLICATIONS: Liquid Fuels, Water
MATERIAL: Ductile Iron or Alum
RATING: 1000 psi (Ductile Iron), 600 PSI (Alum)
PACKING: Buna-N (standard); Viton (optional)

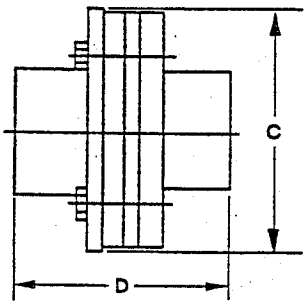
Changing the Packing (Refer to Diagram on Back): Remove any three of the four 5/16" x 1-1/4" cap screws *(item 12).* Loosen the remaining screw and pivot the packing ring *(item 2)* so that the packing *(item 5)* is exposed. Remove old packing and replace with new packing. Rotate packing ring back into place and reinstall three cap screws *(item 12)* and torque all cap screws to 100 lb-in. Caution: Before pivoting packing ring, be sure to clean joint of all dirt and debris which may fall into the joint and damage the seal.

Greasing the Joint: The frequency of greasing will, of course, vary according to usage of the reel, but generally speaking one pump with a manual grease gun every six months is more than sufficient. Do not overgrease this joint.



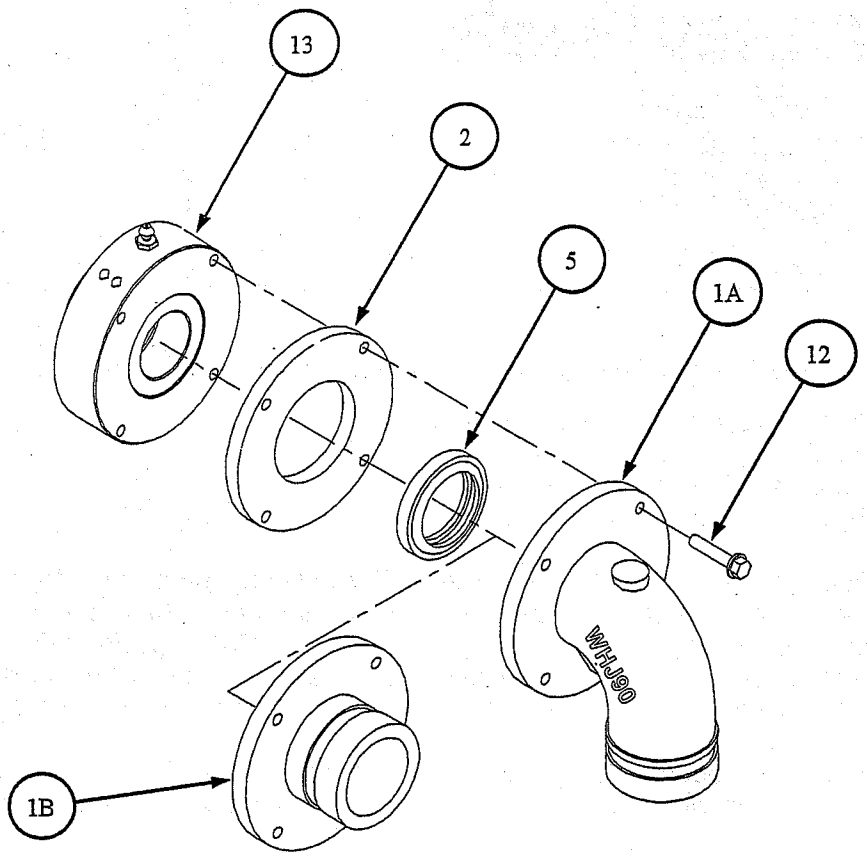
90° – STYLE 30

Model No.	Material	Thread at Reel End	Inlet	Dimensions (Inches) A	B	C	D
WHJ1590	Ductile Iron	1½" FPT	1½" FPT & 2" Groove	4 13/16"	3 3/8"	4 5/8"	6"
WHJ1590A	Aluminum	1½" FPT	1½" FPT & 2" Groove	4 13/16"	3 3/8"	4 5/8"	6"
WHJ290	Ductile Iron	2" FPT	1½" FPT & 2" Groove	5 1/4"	3 3/8"	4 5/8"	6 7/16"
WHJ2290	Ductile Iron	2" FPT	2" FPT & No Groove	5 1/4"	3 1/4"	4 5/8"	6 11/16"



STRAIGHT – STYLE 20

Model No.	Material	Thread at Reel End	Inlet	Dimensions (Inches) A	B	C	D
WHJ15180	Ductile Iron	1½" FPT	1½" FPT & 2" Groove			4 5/8"	4 3/16"
WHJ15180A	Aluminum	1½" FPT	1½" FPT & 2" Groove			4 5/8"	4 3/16"
WHJ2180	Ductile Iron	2" FPT	1½" FPT & 2" Groove			4 5/8"	4 3/16"
WHJ22180	Ductile Iron	2" FPT	2" FPT & No Groove			4 5/8"	4 3/16"



PARTS LIST
ISO-194
WHJ Ball Bearing Swivel Joints For 1-1/2" & 2˝ I.D. Reels

When ordering parts

BE SURE TO SPECIFY COMPLETE MODEL NUMBER and SERIAL NUMBER OF REEL.

USE PART NUMBER!

Drawing No.	Description	PART NUMBER	Quantity
ISO-194-1A	Inlet Fitting 90° 1-1/2" FIPT x 2˝ VICT	9938.0001	1
ISO-194-1A	Alum Inlet Fitting 90° 1 1/2" FIPT x 2˝ VICT	9938.0007	1
ISO-194-1A	Inlet Fitting 90° 2˝ FIPT	9938.0005	1
ISO-194-1B	Inlet Fitting 180° 1-1/2" FIPT x 2˝ VICT	9938.0004	1
ISO-194-1B	Alum Inlet Fitting 180° 1 1/2" FIPT x 2˝ VICT	9938.0002	1
ISO-194-1B	Inlet Fitting 180° 2˝ FIPT	9938.0006	1
ISO-194-2	P53A-00010 Packing Ring	call factory	1
ISO-194-5A	1-1/2" PK-1 Buna-N Pkg (CDI)	9936.0642	1
ISO-194-5B	1-1/2" PK-1V Viton Pkg	9936.0641	1
ISO-194-12	5/16"-18 x 1-1/4" Hex Head Capscrew	9904.1103	4
ISO-194-13A	WHJ Bearing Assembly (1-1/2")	9938.0030	1
ISO-194-13B	WHJ Bearing Assembly (1 1/2") Alum	9938.0031	1
ISO-194-13C	WHJ Bearing Assembly (2˝)	9938.0032	1

IMPORTANT INSTRUCTIONS

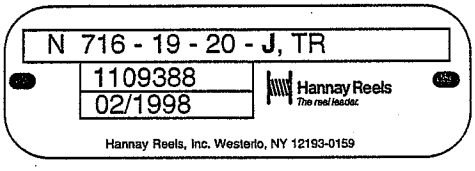
INSTALLING HOSE OR CABLE ON A HANNAY SPRING RETRACTABLE REEL

Note: Instructions must be followed or warranty is void.

1) *CHECK SPRING TYPE*

The spring type is indicated by the first letter at the end of the model number on the metal nameplate. It is also stamped on the mounting ear of the spring housing on most models. The maximum number of usable turns for which each spring is designed, is shown at right (listed in descending order of pull force ability):

Spring Type	Usable Turns
"SA"	17
"A"	23
"K"	13
"B"	18
"D"	30
"G"	25
"J"	17
"C"	14
"F"	32
"SCR" and "SGCR"	26
"LC"	18
"L"	17
"B5" (HGR-100)	42
"B6" (HGR-50)	30

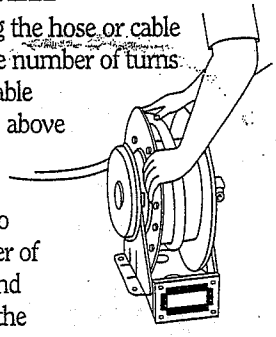


2) *ATTACH HOSE OR CABLE*

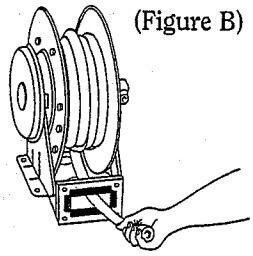
Be sure spring tension is relaxed before starting.
HOSE: attach hose fitting to the reel outlet. (If you have a 1-1/2" spring reel, also known as the 900 series, the outlet riser can be temporarily removed to aid in attaching the hose).
CABLE: feed the cable through the drum and hub with the aid of the pull wire supplied. Then connect the cable to the collector ring pigtails. You will need to remove the collector cover to expose the collector rings if you have an SCR 700 series cable reel. Caution: always use a cable clamp connected to the drum in order to keep pressure off the wire connections.

3) *WIND HOSE OR CABLE TO REEL*

Carefully turn the discs by hand winding the hose or cable onto the reel, see fig. A. Keep track of the number of turns required to store the length of hose or cable being installed. Refer to chart in step #1 above and note the number of turns available for the spring as supplied on the reel. Subtract the number of turns required to install the hose or cable from the number of turns available. With the hose or cable end retained on the spool, turn the spool in the unwind direction this number of turns. Then pass the hose or cable thru the roller assembly and install the ball stop, see fig.B.



(Figure A)



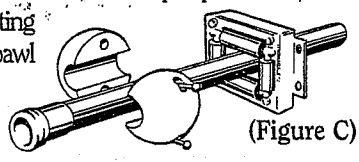
(Figure B)

4) *REDUCE TENSION*

If the spring tension is greater than that required to adequately retract the hose, you can decrease this tension. Just let the end of the hose (after it is completely rewound on the reel) pass back through the roller assembly and carefully allow the reel to unwind by another revolution (or possibly more) until the proper tension is reached. Relock the reel and pass the end of the hose back through the rollers.

5) *ATTACH BALL STOP TO HOSE OR CABLE*

Draw the hose or cable through the rollers to the point where the ball stop should be attached. *NOTE:* After ball stop is positioned, make sure that when the stop is resting against the rollers the brass pawl is *disengaged* from the ratchet wheel. Now take the two halves of the ball stop and join them together over the hose or cable. Fasten ball stop with provided fasteners. (Figure C.)



(Figure C)

6) *MAKE FINAL CONNECTIONS*

You should now be ready to make your hose or cable connection to the inlet swivel joint or junction box on the side of the reel. **NOTICE: A flexible connector must be used between the inlet pipe and the inlet swivel joint on the reel or the warranty will be void.**

CAUTION: **Hose or cable end must be walked back to reel on all spring reels when rewinding. If allowed to rewind unattended, personal injury or damage to reel could occur.**

CHANGING THE ROLLER ARM POSITION ON "N" SERIES SPRING REELS

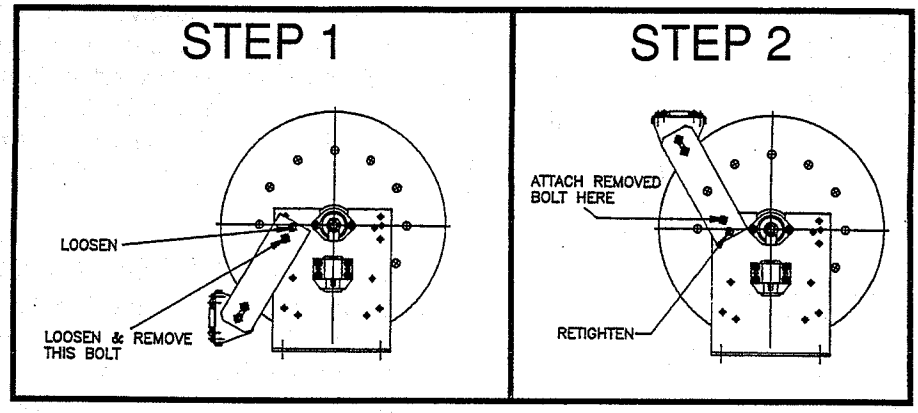
From "SR" position to "VR" position (and vice versa):

All "N" series reels that have the suffix "SR" or "VR" and have a serial tag date of 4-94 or later are interchangeable between those two roller positions. For safety reasons, **NEVER** work on a spring reel unless the tension is first removed from the spring (i.e., fully retract the hose or cable onto the reel before starting).

1. Loosen and remove the two bolts with a 9/16˝ wrench as shown in the diagram below and swing the arm up into the VR position.

2. Retighten both bolts in the new position.

3. If you have a spring reel with a DOUBLE roller arm (which became standard in 1999 on all reels), you will have to repeat steps 1 & 2 above on the 2nd roller arm. However, this requires first removing the spring motor itself. A separate sheet is available for help with this additional task. (see form HTD-9808 Rev.2)

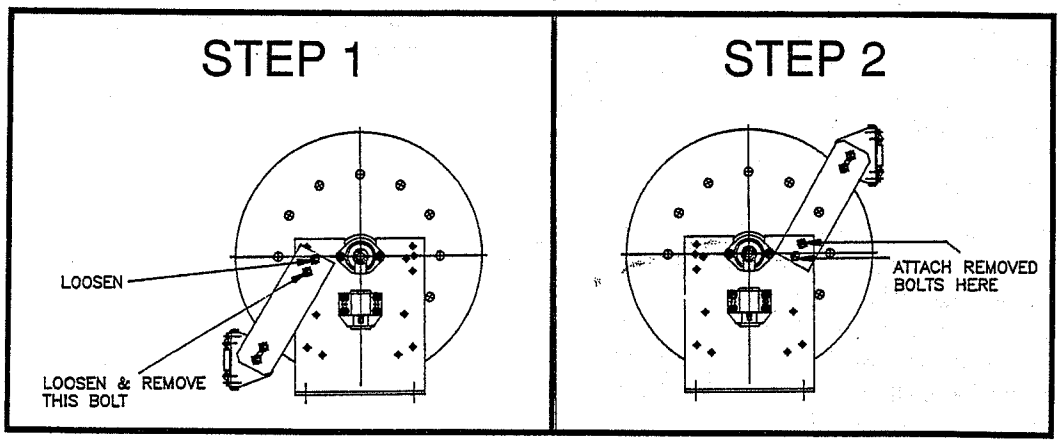


From "SR" (or "VR") position to "TR" position (and vice versa):

1. Loosen and remove the two bolts with a 9/16˝ wrench as shown in the diagram below and move the arm to the TR position, which is on the opposite side of the frame as shown in the diagram.

2. Retighten both bolts in the new position.

3. If you have a spring reel with a DOUBLE roller arm (which became standard in 1999 on all reels), you will have to repeat steps 1 & 2 above on the 2nd roller arm. However, this requires first removing the spring motor itself. A separate sheet is available for help with this additional task. (see form HTD-9808 Rev.2)



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The reel leader.
553 State Route 143, Westerlo, NY 12193-0159, USA
Phone: (518)797-3791; Toll Free 1-877-GO-REELS (467-3357)
FAX: (800) REELING (733-5464); Int'l. FAX: (518)797-3259
Website: www.hannay.com
E-mail: reels@hannay.com

AVERTISSEMENT : POINTS DE PINCEMENT

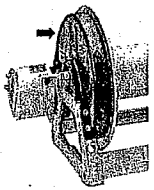
ÊTRE TRÈS PRUDENT LORS DU FONCTIONNEMENT PRÈS DE CHAÎNES ET DE PIGNONS.

Si les enrouleurs sont fournies avec des protections de chaîne, il ne faut pas les utiliser avec les protections retirées.

REMARQUE :

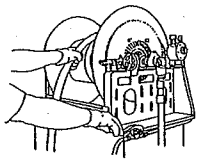
OSHA indique qu'une protection appropriée des chaînes et des pignons est au moins partiellement la responsabilité de l'installateur final d'équipement, étant donné que l'équipement peut être installé dans un nombre important de positions différentes et avec un grand nombre de degrés d'accès différents pour l'opérateur.

Veuillez vous assurer d'avoir résolu ce problème lors de l'installation de l'enrouleur.

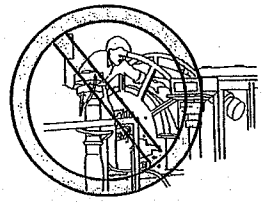


E'TRE PRUDENT LORS DU GUIDAGE DES TUYAUX OU DU CÂBLE POUR LE REMBOBINAGE SUR LES ENROULEURS MOTORISÉES.

Garder la main guidant le flexible sur l'enrouleur à plusieurs centimètres du tambour pour éviter les risques de coincement ou de pincement des doigts. Porter des protections individuelles adequates.



GARDER LES MAINS ÉLOIGNÉES DES DISQUES À RAYONS LORS DE LEUR ROTATION.

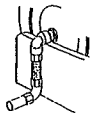


INSTRUCTIONS DE MANIPULATION SANS DANGER DES FLUIDES

UTILISER UN ENROULEUR DE FLEXIBLE ET UN FLEXIBLE D'UNE CAPACITÉ SUFFISANTE POUR LE TRAVAIL ENVISAGÉ.

Ne jamais dépasser la pression nominale spécifiée pour un enrouleur et un tuyau particuliers. De plus, s'assurer que la taille et le matériau de l'enrouleur et du tuyau soient adaptés à l'utilisation envisagée.

UTILISER UN CONNECTEUR FLEXIBLE ENTRE UNE ARTICULATION ET UNE CONDUITE D'ADMISSION.



VÉRIFIER L'ABSENCE DE FUITE AUX RACCORDS DE FLUIDE AVANT L'EMPLOI.

RELÂCHER LA PRESSION DANS LE FLEXIBLE AVANT DE RETIRER LES RACCORDS OU D'EFFECTUER UN ENTRETIEN.

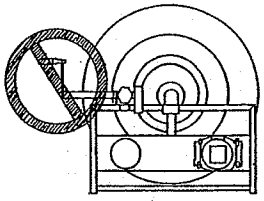
AVANT D'ENROULER UN FLEXIBLE PLAT SUR UN DÉVIDOIR S'ASSURER QUELE FLEXIBLE A ÉTÉ VIDANGÉ DE TOUT LIQUIDE.

ENROULEURS À REMBOBINAGE MOTORISÉ

UTILISER DES DISJONCTEURS POUR LES MOTEURS ÉLECTRIQUES DE REMBOBINAGE.

S'assurer que le disjoncteur soit correctement dimensionné pour le moteur. Vérifier également la bonne installation de toutes les connexions électriques avant l'emploi.

RETIRER LA MANIVELLE AUXILIAIRE DE REMBOBINAGE AVANT DE L'UTILISATION DU REMBOBINAGE MOTORISÉ.



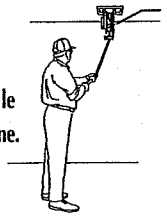
DÉBRANCHER LA SOURCE D'ALIMENTATION AVANT D'EFFECTUER UN ENTRETIEN.

Ceci s'applique à la fois aux enrouleurs électriques et pneumatiques. Débrancher également l'alimentation électrique avant de déposer les couvercles de boîte de jonction et les boîtiers de bague de collecteur.

ENROULEURS À REMBOBINAGE À RESSORT

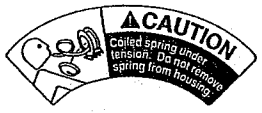
ÊTRE PRUDENT LORSQUE LE VERROUILLAGE DE CLIQUET DE ENROULEUR À RESSORT EST DÉSENGAGÉ.

Lorsque le verrou est désengagé, toujours tenir le flexible, ou le câble, et le glisser sur l'enrouleur pendant qu'elle se rembobine.



SUR L'ENROULEUR À RESSORT, NE JAMAIS DÉPOSER LE COUVERCLE CONTENANT LE RESSORT.

Les ressorts enrouleurs sont sous tension, et la dépose du couvercle peut entraîner des blessures corporelles graves.



SAFETY GUIDELINES

READ THIS FIRST.

These guidelines provide general safety recommendations for using hose and cable reels. However, the employer should assess and determine if any additional safety measures are required for its particular application and operation, and fully instruct employees on those safety measures.

Additionally, the employer should make a copy of this safety manual available to all employees working with reels. Additional copies of this safety manual may be obtained upon request. No warranty of the correctness or sufficiency of the information in this manual is made by Hannay Reels.

Read all relevant manuals and safety instructions prior to unpackaging reels. If there is ANYTHING you do not understand about the safe installation and use of your Hannay reel, please contact Hannay Reels (Attn Customer Service). We are always glad to help.

NOTICE

Hannay Reels will not assume any liability for any alterations and/or modifications to Hannay Reels or products supplied by Hannay Reels nor for uses other than for which these products are intended. All warranties expressed or implied will become null and void.

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Hannay Reels
553 State Route 143
Westerlo, NY 12193-0159
(518) 797-3791
USA Toll Free 1-877-GO REELS (467-3357)
FAX: 1-800-REELING (733-5464)
Int'l. Fax: (518) 797-3259

35M HP 12-03

H-9602-ISG
REV 4

WARNING: PINCH POINT AREAS

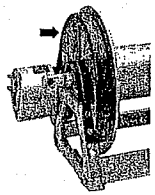
USE CAUTION WHEN OPERATING NEAR CHAIN AND SPROCKETS.

Where chain guards are furnished, the reels should not be operated with them removed.

NOTE:

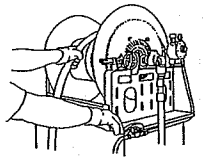
OSHA indicates the appropriate guarding of chains and sprockets is at least partly the responsibility of the final installer of equipment, based on the fact that equipment can be installed in so many different positions and so many different degrees of accessibility to the operator.

Please make sure that you have thoroughly reviewed this issue when making the installation of the reel.

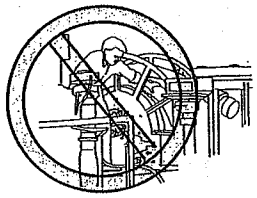


USE CAUTION WHEN GUIDING HOSE OR CABLE BACK ONTO POWER REELS.

Keep the hand guiding the hose back onto the reel several inches away from the drum so that there is no possibility of trapped or pinched fingers. Use proper personal protection equipment.



KEEP HANDS AWAY FROM SPOKED DISCS WHEN TURNING.

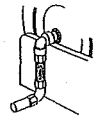


INSTRUCTIONS FOR SAFE FLUID HANDLING

USE A HOSE REEL AND HOSE PROPERLY RATED FOR THE JOB.

Never exceed the pressure rating (psi) specified for a particular reel and hose. Also, make sure that the size and material of both the reel and hose are designed for the intended use.

USE A FLEXIBLE CONNECTOR BETWEEN A SWIVEL JOINT AND INLET PIPING.



CHECK FOR POSSIBLE LEAKS AT FLUID CONNECTIONS PRIOR TO USE.

RELEASE PRESSURE IN HOSE BEFORE REMOVING FITTINGS OR PERFORMING ANY MAINTENANCE.

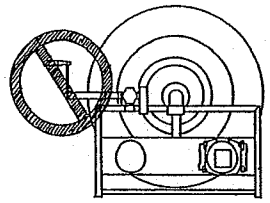
BEFORE WINDING COLLAPSIBLE HOSE ONTO A LIVE REEL, HOSE MUST BE EVACUATED OF ALL FLUID.

POWER REWIND REELS

USE CIRCUIT BREAKERS FOR ELECTRIC REWIND MOTORS.

Make sure that the circuit breaker is properly sized for the motor. Also, check all electrical connections for proper installation prior to use.

REMOVE AUXILIARY CRANK REWIND HANDLE BEFORE USING POWER REWIND.



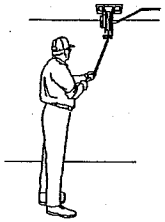
DISCONNECT POWER SOURCE BEFORE PERFORMING MAINTENANCE.

This applies to both electric and air-powered reels. Also, disconnect electrical power before removing junction box covers or collector ring housings.

SPRING REWIND REELS

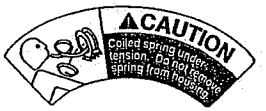
USE CAUTION WHEN SPRING REEL RATCHET ASSEMBLY LOCK IS DISENGAGED.

When the lock is disengaged, always hold onto the hose or cable and guide it onto the reel as it rewinds.



ON SPRING REELS, NEVER REMOVE THE COVER CONTAINING THE SPRING.

Coiled springs are under tension and removal of cover can result in severe personal injury.



CONSIGNES DE SÉCURITÉ

À LIRE EN PREMIER.

Ces instructions donnent des recommandations générales de sécurité pour l'utilisation d'enrouleurs de câble et de flexible. Mais c'est à l'employeur qu'il revient d'évaluer et de déterminer s'il est nécessaire d'adopter des mesures de sécurité supplémentaires dans le cadre de son application particulière, et d'en informer ses employés.

De plus, l'employeur doit s'assurer que tous les employés travaillant avec l'enrouleurs puissent prendre connaissance de ce manuel de sécurité. Des copies supplémentaires de ce manuel de sécurité peuvent être obtenues sur demande. Aucune garantie n'est faite par Hannay Reels quant à l'exactitude de ce manuel ni à la qualité de son information.

Lire tous les manuels et toutes les consignes de sécurité applicables avant de déballer les enrouleurs. S'il y a QUOI QUE CE SOIT d'incompréhensible au niveau de l'installation et de l'utilisation en toute sécurité des enrouleurs Hannay, veuillez contacter Hannay Reels (à l'attention de Service des clients). Nous serons ravis de vous aider.

REMARQUE

Hannay Reels n'assume aucune responsabilité pour les altérations ou modifications des enrouleurs Hannay ou des produits fournis par Hannay Reels, ni pour les utilisations autres que celles prévues pour ces produits. Toutes les garanties express ou implicites deviennent nulles et non avenues.

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The reel leader.
Hannay Reels
553 State Route 143
Westerlo, NY 12193-0159 U.S.A.
Tél : (518) 797-3791
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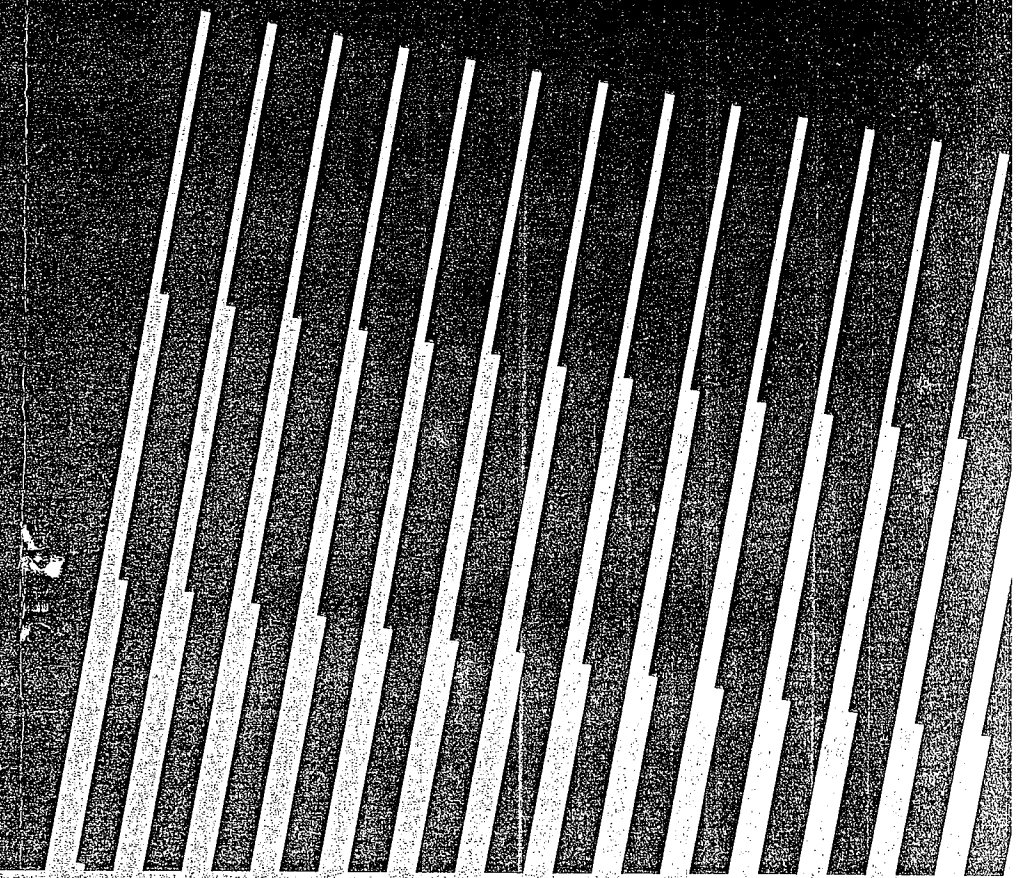
DEXTER AXLE

Operation Maintenance Service Manual

600-8,000 Lb. Axles & Related Components

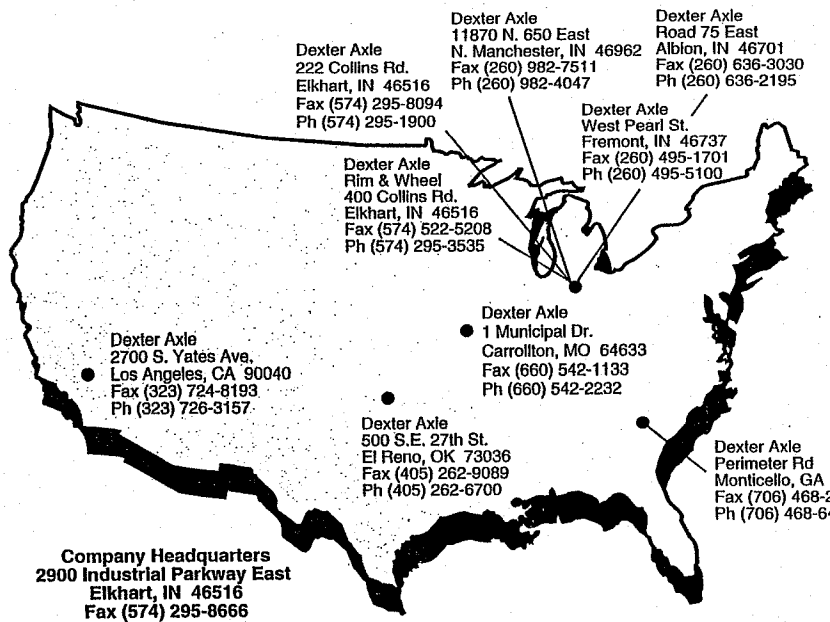


10-02

LIT-001-00

Genuine Dexter axles and components are available nationwide from our plant locations listed below or through our network of distributors. Check our website for the distributor nearest you.

Visit us at our website: www.dexteraxle.com



Company Headquarters
2900 Industrial Parkway East
Elkhart, IN 46516
Fax (574) 295-8666
Ph (574) 295-7888

DEXTER AXLE

Service Record

Refer to page 57 for Maintenance Schedule

Date	Service Performed	Mileage

Introduction

This manual is designed to provide information for you to understand, use, maintain, and service your trailer running gear system. Your axles are manufactured by Dexter Axle. The Dexter product line, the most complete in the industry, is the result of over 30 years of experience in the design, testing and manufacture of trailer axles. The Dexter running gear system consists of spindles, hubs, drums, brakes, and wheels which are engineered to provide you the finest towing and stopping performance currently available in the industry today.

Two Dexter philosophies are at work to provide you the best product available and have enabled us to maintain our position of leadership. First, we operate on the theory that "there is always a better way" for a product to operate, to be manufactured, and/or to be serviced. We are constantly striving to find that better way.

Secondly, we maintain wall-to-wall production control so that all the major components of your running gear system are manufactured in Dexter facilities under our strict quality control standards. These manufactured components include the axle beam, hubs, drums, spindles, brakes, magnets, rims, wheels and most of the steel stampings used in the attachment of your axle to your trailer. Dexter has the most complete, state-of-the-art manufacturing facilities which enable us to provide you, the trailer owner, with the finest product possible.

For all your running gear needs...

Look first to Dexter!

Now visit us at our web site!
www.dexteraxle.com

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Service Record

Refer to page 57 for Maintenance Schedule

Date	Service Performed	Mileage

Service Record

Refer to page 57 for Maintenance Schedule

Date	Service Performed	Mileage

Table of Contents

Important Safety Notice

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all running gear as well as the personal safety of the individual doing the work. This manual provides general directions for performing service and repair work with tested, effective techniques. Following these guidelines will help assure reliability.

There are numerous variations in procedures, techniques, tools, parts for servicing axles, as well as in the skill of the individual doing the work. This manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Anyone who departs from the instructions provided in this manual must first establish that they neither compromise their personal safety nor the vehicle integrity by their choice of methods, tools, or parts.

Refer to your vehicle manufacturer's owners manual for additional procedures, techniques, and warnings prior to performing any maintenance or repairs.

THIS SYMBOL WARNS OF POSSIBLE PERSONAL INJURY.

Getting Started - Setup and Adjustment

For proper performance, all new axles should have the following checked at the specified intervals:

- *Wheel Nut Torque:* at 10, 25, and 50 miles
- *Brake Adjustment:* at 200 and 3,000 miles
- *Tire pressure:* to manufacturer's requirements
- *Brake synchronization*: set brake controller per controller manufacturer's directions

Service Record

Refer to page 57 for Maintenance Schedule

Date	Service Performed	Mileage

These warranties give you specific legal rights, and you may also have other rights which vary from state to state.

THE DURATION OF ANY IMPLIED WARRANTIES, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED TO THE DURATION OF THE EXPRESS WARRANTIES HEREIN. DEXTER AXLE HEREBY EXCLUDES INCIDENTAL AND CONSEQUENTIAL DAMAGES, INCLUDING LOSS OF TIME, INCONVENIENCE, LOSS OF USE, TOWING FEES, TELEPHONE CALLS OR COST OF MEALS, FOR ANY BREACH OF ANY EXPRESS OR IMPLIED WARRANTY, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

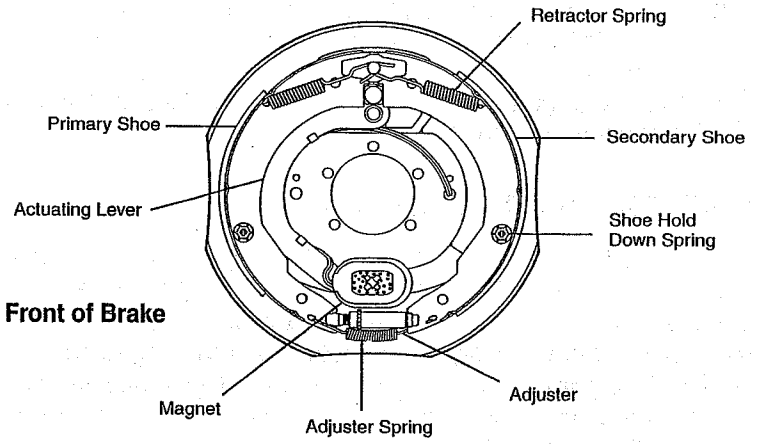
Some states do not allow limitations on how long an implied warranty lasts, or the exclusion or limitation of incidental or consequential damages, so the above exclusion or limitation may not apply to you.

Inquiries regarding these warranties should be sent to:

Dexter Axle
P.O. Box 250
Elkhart, Indiana 46515

Electric Brakes

The electric brakes on your trailer are similar to the drum brakes on your automobile. The basic difference is that your automotive brakes are actuated by hydraulic pressure while your electric trailer brakes are actuated by an electromagnet. With all of the brake components connected into the system, the brake will operate as follows:



When the electrical current is fed into the system by the controller, it flows through the electromagnets in the brakes. The high capacity electromagnets are energized and are attracted to the rotating armature surface of the drums which moves the actuating levers in the direction that the drums are turning.

The resulting force causes the actuating cam block at the shoe end of the lever to push the primary shoe out against the inside surface of the brake drum. The force generated by the primary shoe acting through the adjuster link moves the secondary shoe out into contact with the brake drum.

Increasing the current flow to the electromagnet causes the magnet to grip the armature surface of the brake drum more firmly. This results in increasing the pressure against the shoes and brake drums until the desired stop is accomplished.

Features

Electrically actuated brakes have several advantages over other brake actuation systems.

1. They can be manually adjusted at the controller to provide the correct braking capability for varying road and load conditions.
2. They can be modulated to provide more or less braking force, thus easing the brake load on the towing vehicle.
3. They have very little lag time from the moment the tow vehicle's brakes are actuated until the trailer brakes are actuated.
4. In an emergency situation, they can provide some braking independent of the tow vehicle.

Parking Brake Option *(not available on all sizes)*

Dexter electric brakes with parking brake option are mechanically operated by a cable. Cable force applied to the parking lever creates a torque through the pivot pin and cam assembly. Torque transferred to the parking cam results in a spreading force between the primary and secondary shoes. The shoes, in turn, move towards the drum until contact is made. Friction generated between the drum and lining contact surface keeps the drum from rotating under normal loading conditions.

Self Adjusting Feature *(12¼" brakes series only)*

Forward self adjust electric brakes were introduced in October of 1996. This feature adjusts the brakes on both forward and reverse stops. Brake adjustment occurs when lining wear results in enough gap between the shoes and the brake drum surface. This added clearance will allow the adjuster mechanism to rotate the screw assembly at the bottom of the brake. That action expands the distance between the shoes and thus closes the gap to the drum surface.

EXCLUSIONS

These warranties do not extend to or do not cover defects caused by:

1. The connecting of brake wiring to the trailer wiring or trailer wiring to the towing vehicle wiring.
2. The attachment of the running gear to the frame.
3. Hub imbalance, or any damage caused thereby.
4. Parts not supplied by Dexter Axle.
5. Any damage whatever caused by or related to any alteration of the axle including welding supplemental brackets to the axle.
6. Use of an axle on a unit other than the unit to which it was originally mounted.
7. Normal wear and tear.
8. Alignment.
9. Improper installation.
10. Unreasonable use (including failure to provide reasonable and necessary maintenance as specified in Dexter Axle's publication "Operation, Maintenance Service Manual" including required maintenance after "Prolonged Storage").
12. Improper wheel nut torque.
13. Cosmetic finish or corrosion.

LIMITATIONS

1. **In all cases, Dexter Axle reserves the right to fully satisfy its obligations under the Limited Warranties by refunding the then-current list price of the defective axle (or, if the axle has been discontinued, of the most nearly comparable current product).**
2. Dexter Axle reserves the right to furnish a substitute or replacement component or product in the event an axle or any component of the axle is discontinued or is otherwise unavailable.
3. These warranties are nontransferable.

GENERAL

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES EXCEPT THAT OF TITLE, WHETHER WRITTEN, ORAL OR IMPLIED, IN FACT OR IN LAW (INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE).

Dexter Axle Limited Warranty

WHAT PRODUCTS ARE COVERED

All Dexter trailer axles, wheels, and suspensions.

LIMITED 2 YEAR WARRANTY

Dexter Axle warrants to the original purchaser that its axles, wheels, and suspension systems shall be free from defects in material and workmanship for a period of two years from the date of first sale of the trailer incorporating such components.

LIMITED 5 YEAR WARRANTY

Dexter Axle warrants to the original purchaser that its Nev-R-Lube™ bearings and the suspension components only of its Torflex® axles shall be free from defects in material and workmanship for a period of five years from the date of first sale of the trailer incorporating such components.

EXCLUSIVE REMEDY

Dexter Axle will, at its option, repair or replace (without installation) the affected components of any defective axle, repair or replace (without installation) the entire defective axle, or refund the then-current list price of the axle. In all cases, a reasonable time period must be allowed for warranty repairs to be completed.

WHAT YOU MUST DO

In order to make a claim under these warranties:

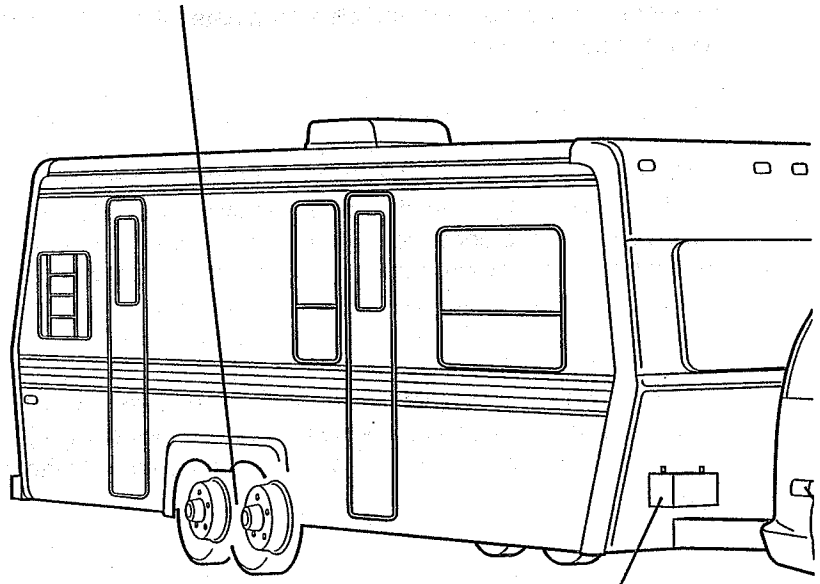
1. You must be the original purchaser of the vehicle in which the Spring Suspension Axles or Torflex® Axles were originally installed.
2. You must promptly notify us within the warranty period of any defect and provide us with any substantiation that we may reasonably request.
3. The axles, wheels, or suspensions must have been installed and maintained in accordance with good industry practice and any specific Dexter Axle recommendations, including those specified in Dexter Axle's publication "Operation, Maintenance Service Manual."

Brake Controllers

Electric brake controllers provide power to the magnets to actuate the trailer brakes. Dexter Axle offers a state-of-the-art inertial controller. This controller features a patented pendulum design which senses the deceleration of the towing vehicle and sends a proportional voltage to the electric trailer brakes. Other features include a visual gain setting for quick and easy adjustment and a digital LED display to show the voltage output. A manual override sends full voltage to the trailer brakes, regardless of gain setting, for emergency conditions and also illuminates the brake lights to warn of an impending stop.

Most electric brake controllers provide a modulation function that varies the current to the electric brakes with the pressure on the brake pedal or amount of deceleration of the tow vehicle. Electronic or timing controllers do not provide proportional modulation. These controllers tend to be inexpensive but not the best choice for optimum braking. It is important that your brake controller provide approximately 2 volts to the braking system when the brake pedal is first depressed and gradually increases the voltage to 12 volts as brake pedal pressure is increased. If the controller "jumps" immediately to a high voltage output, even during a gradual stop, then the electric brakes will always be fully energized and will result in harsh brakes and potential wheel lockup.

Dexter Electric Brakes
Wired in parallel

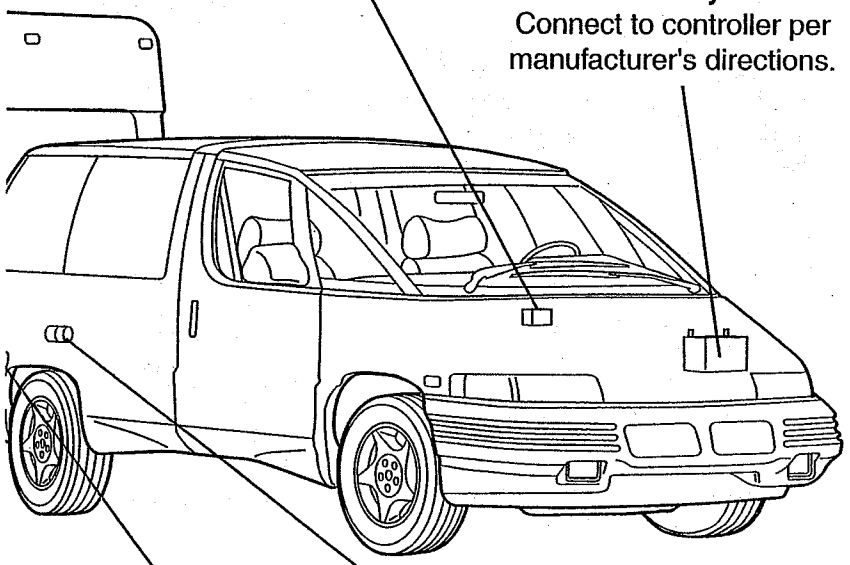


Breakaway Battery
Provides power to actuate trailer brakes in the event of trailer breakaway.

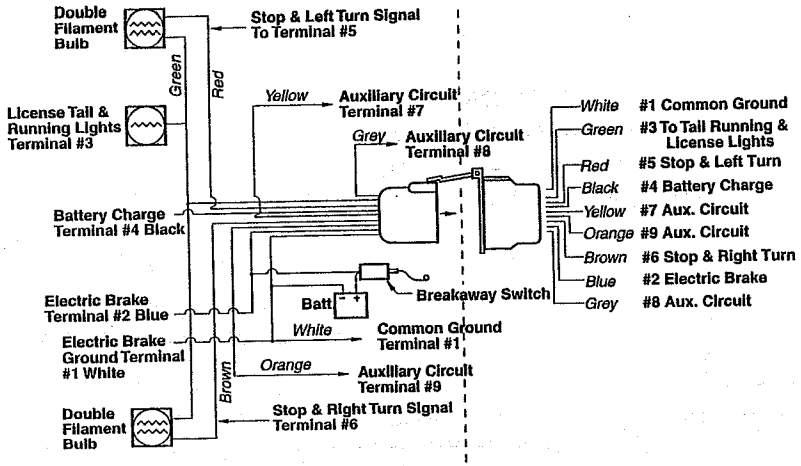
Maintenance Schedule

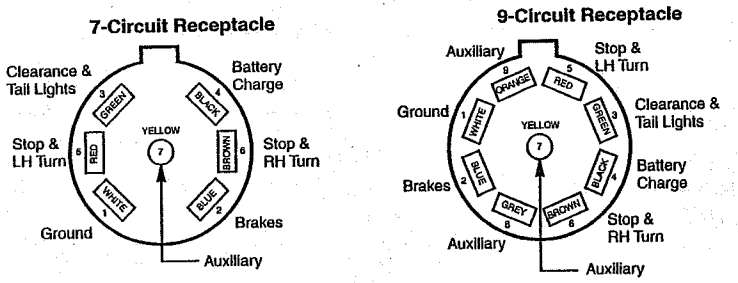
Item	Function Required	Weekly	3 Months or 3000 Miles	6 Months or 6000 Miles	12 Months or 12000 Miles
Brakes	Test that they are operational.	*At Every Use*			
Brake Adjustment	Adjust to proper operating clearance.		●		
Brake Magnets	Inspect for wear and current draw.			●	
Brake Linings	Inspect for wear or contamination.				●
Brake Controller	Check for correct amperage & modulation.			●	
Brake Cylinders	Check for leaks, sticking.				●
Brake Lines	Inspect for cracks, leaks, kinks.				●
Trailer Brake Wiring	Inspect wiring for bare spots, fray, etc.				●
Breakaway System	Check battery charge and switch operation.	*At Every Use*			
Hub/Drum	Inspect for abnormal wear or scoring.				●
Wheel Bearings & Cups	Inspect for corrosion or wear. Clean & repack.				●
Seals	Inspect for leakage. Replace if removed.				●
Springs	Inspect for wear, loss of arch.				●
Suspension Parts	Inspect for bending, loose fasteners, wear.			●	
Hangers	Inspect Welds.				●
Wheel Nuts and Bolts	Tighten to specified torque values.		●		
Wheels	Inspect for cracks, dents or distortion.			●	
Tire Inflation Pressure	Inflate tires to mfg's. specifications.	●			
Tire Condition	Inspect for cuts, wear, bulging, etc.		●		

4. Inspect towing hookup for secure attachment.
5. Load your trailer so that approximately 10% of the trailers total weight is on the hitch. For light trailers this should be increased to 15%.
6. *Do Not Overload.* Stay within your gross vehicle rated capacity (consult your trailers identification plate).
7. Inflate tires according to manufacturer's specifications; inspect tires for cuts, excessive wear, etc.
8. Check wheel mounting nuts/bolts with a torque wrench. Torque, in proper sequence, to the levels specified in this manual.
9. Make certain brakes are synchronized and functioning properly.
10. Check tightness of hanger bolt, shackle bolt, and U-bolt nuts per torque values specified in manual.
11. Check operation of all lights.
12. Check that your trailer is towing in a level position and adjust hitch height if required.



Typical Trailer Wiring





View Looking into Tow Vehicle Receptacle

2. Inspect suspension for wear.
3. Check tightness of hanger bolt, shackle bolt, and U-bolt nuts per recommended torque values.
4. Check brake linings, brake drums and armature faces for excessive wear or scoring.
5. Check brake magnets with an ohmmeter. The magnets should check 3.2 ohms. If shorted or worn excessively, they must be replaced.
6. Lubricate all brake moving parts using a high temperature brake lubricant (LUBRIPLATE or Equivalent).

CAUTION:

Do not get grease or oil on brake linings or magnet face.

7. Remove any rust from braking surface and armature surface of drums with fine emery paper or crocus cloth. Protect bearings from contamination while so doing.
8. Inspect oil or grease seals for wear or nicks. Replace if necessary.
9. Lubricate hub bearings. Refer to procedure in manual.
10. Reinstall hubs and adjust bearings per instructions in manual.
11. Mount and tighten wheels per instructions in manual.

Trip Preparation Checklist

There are a number of simple rules to follow in caring for your trailer axle assembly that can add to its life and in the case of some of these rules, you may be protecting your own life as well. Using the following checklist before starting a trip with your trailer is highly recommended. Some of these items should be checked 2-3 weeks prior to a planned trip to allow sufficient time to perform maintenance.

1. Check your maintenance schedule and be sure you are up-to-date.
2. Check hitch. Is it showing wear? Is it properly lubricated?
3. Fasten safety chains and breakaway switch actuating chain securely. Make certain the breakaway battery is fully charged.

Storage

Storage Preparation

If your trailer is to be stored for an extended period of time or over the winter, it is important that the trailer be prepared properly.

1. Remove the emergency breakaway battery and store inside, out of the weather. Charge the battery at least every 90 days.
2. Jack up the trailer and place jack stands under the trailer frame so that the weight will be off the tires. Follow trailer manufacturer's guidelines to lift and support the unit. Never jack up or place jack stands on the axle tube or on the equalizers.

> **CAUTION:**
>
> *Follow the trailer manufacturer's recommendations for lifting and supporting the unit. Do not lift or place supports on any part of the suspension system.*

3. Lubricate mechanical moving parts such as the hitch, and suspension parts, that are exposed to the weather.
4. Boat trailer axles are subject to repeated immersion. Before storing, remove brake drums; clean, dry and re-lubricate moving brake components; inspect bearings - clean and re-lubricate.
5. On oil lubricated hubs the upper part of the roller bearings are not immersed in oil and are subject to potential corrosion. For maximum bearing life, it is recommended that you revolve your wheels periodically (every 2-3 weeks) during periods of prolonged storage.

After Prolonged Storage - Inspection Procedures

Before removing trailer from jack stands:

1. Remove all wheels and hubs or brake drums. Note which spindle and brake that the drum was removed from so that it can be reinstalled in the same location.

How to Use Your Electric Brakes Properly

Your trailer brakes are designed to work in synchronization with your tow vehicle brakes. Never use your tow vehicle or trailer brakes alone to stop the combined load.

Your brake controller must be set up according to the manufacturer's recommendations to ensure proper synchronization between the tow vehicle and the trailer. Additionally, you may have to make small adjustments occasionally to accommodate changing loads and driving conditions.

Proper synchronization of tow vehicle to trailer braking can only be accomplished by road testing. Brake lockup, grabbiness, or harshness is quite often due to the lack of synchronization between the tow vehicle and the trailer being towed, too high of a threshold voltage (over 2 volts), or under adjusted brakes.

Before any synchronization adjustments are made, your trailer brakes should be burnished-in by applying the brakes 20-30 times with approximately a 20 m.p.h. decrease in speed, e.g. 40 m.p.h. to 20 m.p.h. Allow ample time for brakes to cool between application. This allows the brake shoes and magnets to slightly "wear-in" to the drum surfaces.

Synchronizing Your Trailer Brakes

To insure safe brake performance and synchronization, *read the brake controller manufacturer's instructions completely before attempting any synchronization procedure.*

> **CAUTION:**
>
> *Before making road tests, make sure the area is clear of vehicular and pedestrian traffic.*

Make several hard stops from 20 m.p.h. on a dry paved road free of sand and gravel. If the trailer brakes lock and slide, decrease the gain setting on the controller. If they do not slide, slightly increase the gain setting. Adjust the controller just to the point of impending brake lockup and wheel skid.

Note: Not all trailer brakes are capable of wheel lockup. Loading conditions, brake type, wheel and tire size can all affect whether a brake can lock. It is not generally considered desirable to lock up the brakes and slide the tires. This can cause unwanted flat spotting of the tires and could also result in a loss of control.

If the controller is applying the trailer brakes before the tow vehicle brakes, then the controller adjustments should be made so the trailer brakes come on in synchronization with the tow vehicle brakes. For proper braking performance, it is recommended that the controller be adjusted to allow the trailer brakes to come on just slightly ahead of the tow vehicle brakes. When proper synchronization is achieved there will be no sensation of the trailer "jerking" or "pushing" the tow vehicle during braking.

> **CAUTION:**
>
> *Minimum vehicle stopping distances are achieved when wheels approach lock up. Brake lock up should be avoided as it results in poor vehicle stability and control.*

Bearing Replacement Chart

Brake Size	Hub Size	Bearings	Dexter Kit Number	Industry Part # Cup /Cone
7 x 1¼	4 or 5 Bolt	Inner Outer	K71-306-00 K71-306-00	L44610 / L44649 L44610 / L44649
10 x 1½	4 or 5 Bolt	Inner Outer	K71-307-00 K71-306-00	LM67010 / LM67048 L44610 / L44649
10 x 2¼	4 or 5 Bolt	Inner Outer	K71-390-00 K71-306-00	L68111 / L68149 L44610 / L44649
12 x 2	6 Bolt	Inner Outer	K71-308-00 K71-307-00	25520 / 25580 LM67010 / LM67048
12 x 2	5 Bolt Demount	Inner Outer	K71-308-00 K71-309-00	25520 / 25580 15245 / 15123
12 x 2	8 Bolt	Inner Outer	K71-308-00 K71-310-00	25520 / 25580 14125A / 14276
12 x 2 *	6 Bolt	Inner Outer	K71-308-00 K71-309-00	25520 / 25580 15245 / 15123
12¼ x 2½	8 Bolt	Inner Outer	K71-308-00 K71-415-00	25520 / 25580 02420 / 02475
12¼ x 3⅜	8 Bolt	Inner Outer	K71-308-00 K71-415-00	25520 / 25580 02420 / 02475

*Special Application

Seal Replacement Reference

Brake Size	*Hub*	*Seal Part No.* *Std.*	*E-Z Lube™*	*Oil*
7 x 1¼	4 or 5 Bolt	010-009-00	K71-301-00	NA
10 x 2¼	4, 5 or 6 Bolt	010-004-00	K71-303-00	NA
12 x 2*	5 Bolt Demount; 6 or 8 Bolt	010-054-00	K71-305-00	K71-305-00
12¼ x 2½	8 Bolt	K71-386-00	K71-386-00	K71-386-00
12¼ x 3⅜	8 Bolt	K71-386-00	K71-386-00	K71-386-00

*2.12" diameter seal journal prior to 10/97

*2.25" diameter seal journal after 10/97

Replacement Parts/Kits

Magnet Replacement Kits

Brake Size	Magnet Kit No. (one magnet per kit)	Wire Color	Nut Torque Brake Mounting
7 x 1¼	K71-057-00	White	45-70
10 x 2¼	K71-104-00	Green	45-70
12 x 2	K71-105-00	White	25-50
12 x 2	K71-125-00 (7K)	Black	25-50
12¼ x 2½	K71-441-00	Red	55-80
12¼ x 3⅜	K71-375-00 oval magnet	White	55-80

Brake Shoe Replacement Kits

Brake Size	Shoe and Lining Replacement (1 Brake) *Electric*	*Hydraulic*
7 x 1¼	K71-045-00	N/A
7 x 1¾	N/A	K71-466-00
10 x 2¼	K71-047-00	K71-267-00
Free Backing		K71-393-00
Corrosion Resistant		K71-423 -00
12 x 2 (5.2K)	K71-048-00	K71-268-00
12 x 2 (7K)	K71-127-00	K71-269-00 LH K71-270-00 RH
Free Backing		K71-394-00 LH K71-395-00 RH
Free Backing, Corrosion Resistant		K71-427-00 LH K71-428-00 RH
12¼ x 2½	K71-497-00LH K71-496-00RH	N/A
12¼ x 3⅜	K71-499-00LH K71-498-00RH	K71-165-00 LH K71-166-00 RH

Over 200 repair kits now available **on-line** at the Dexter Marketplace ready for immediate shipment **direct to your door!**
www.dexteraxle.com

General Maintenance - Electric Brakes

Brake Adjustment

Brakes should be adjusted (1) after the first 200 miles of operation when the brake shoes and drums have "seated," (2) at 3,000 mile intervals, (3) or as use and performance requires. The brakes should be adjusted in the following manner:

1. Jack up trailer and secure on adequate capacity jack stands. Follow trailer manufacturer's recommendations for lifting and supporting the unit. Make sure the wheel and drum rotates freely.

CAUTION:

Do not lift or support trailer on any part of the axle or the suspension system. Never crawl under your trailer unless it is resting on properly placed jack stands.

2. Remove the adjusting hole cover from the adjusting slot on the bottom of the brake backing plate.
3. With a screwdriver or standard adjusting tool, rotate the starwheel of the adjuster assembly to expand the brake shoes. Adjust the brake shoes out until the pressure of the linings against the drum makes the wheel very difficult to turn.

   Note: *For drop spindle axles, a modified adjusting tool may be necessary.*
4. Then rotate the starwheel in the opposite direction until the wheel turns freely with a slight lining drag.
5. Replace the adjusting hole cover and lower the wheel to the ground.
6. Repeat the above procedure on all brakes. For best results, the brakes should all be set at the same clearance.

Brake Cleaning and Inspection

Your trailer brakes must be inspected and serviced immediately if a loss of performance is indicated. With normal use, servicing at one year intervals is usually adequate. With increased usage, this work should be done more frequently as required. Magnets and shoes must be changed when they become excessively worn or scored, a condition which can reduce vehicle braking.

Clean the backing plate, magnet arm, magnet, and brake shoes. Make certain that all the parts removed are replaced in the same brake and drum assembly. Inspect for any loose or worn parts, stretched or deformed springs and replace as necessary.

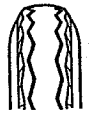
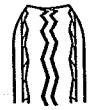
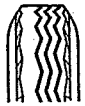
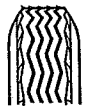
Brake Lubrication

Before reassembling, apply a light film of grease or anti-seize compound on the brake anchor pin, the actuating arm bushing and pin, and the areas on the backing plate that are in contact with the brake shoes and magnet lever arm. Apply a light film of grease on the actuating block mounted on the actuating arm.

⚠ CAUTION:

Do not get grease or oil on the brake linings, drums or magnets.

Tire Wear Diagnostic Chart

Wear Pattern		Cause	Action
	Center Wear	Over Inflation	Adjust pressure to particular load per tire catalog
	Edge Wear	Under Inflation	Adjust pressure to particular load per tire catalog
	Side Wear	Loss of camber or overloading	Make sure load doesn't exceed axle rating. Align at alignment shop.
	Toe Wear	Incorrect toe-in	Align at alignment shop.
	Cupping	Out-of-balance	Check bearing adjustment and balance tires.
	Flat Spots	Wheel lockup & tire skidding	Avoid sudden stops when possible and adjust brakes.

Tires

Before mounting tires onto the wheels, make certain that the rim size and contour is approved for the tire as shown in the Tire and Rim Association Yearbook or the tire manufacturers catalog. Also, make sure the tire will carry the rated load. If the load is not equal on all tires due to trailer weight distribution, use the tire rated for the heaviest wheel position.

Note: *The capacity rating molded into the sidewall of the tire is not always the proper rating for the tire if used in a trailer application. Use the following guidelines:*

1. LT and ST tires. Use the capacity rating molded into the tire.
2. Passenger Car Tires. Use the capacity rating molded into the tire sidewall **divided by 1.10** for trailer use.

Use tire mounting procedures as outlined by the Rubber Manufacturer's Association or the tire manufacturers.

Tire inflation pressure is the most important factor in tire life. Inflation pressure should be as recommended by the manufacturer for the load. Pressure should be checked cold before operation. Do not bleed air from tires when they are hot. Check inflation pressure weekly during use to insure the maximum tire life and tread wear. The following tire wear diagnostic chart will help you pinpoint the causes and solutions of tire wear problems.

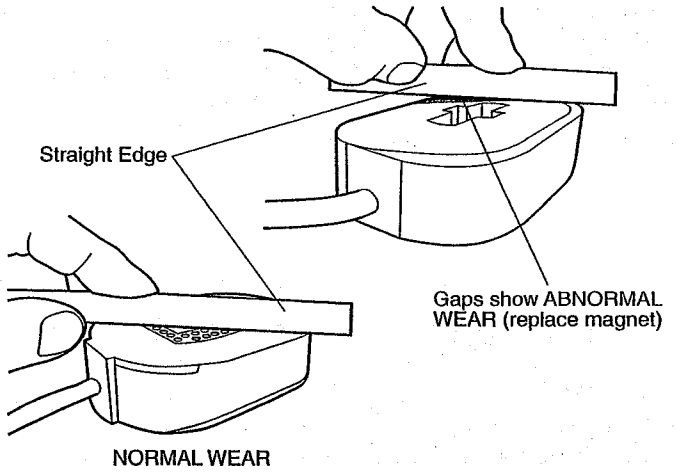
CAUTION:

Tire wear should be checked frequently because once a wear pattern becomes firmly established in a tire it is difficult to stop, even if the underlying cause is corrected.

Magnets

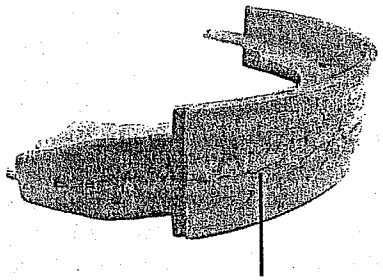
Your electric brakes are equipped with high quality electromagnets that are designed to provide the proper input force and friction characteristics. Your magnets should be inspected and replaced if worn unevenly or abnormally. As indicated below, a straightedge should be used to check magnet condition. For best results, the magnet should be flat.

Even if wear is normal as indicated by your straightedge, the magnets should be replaced if any part of the magnet coil has become visible through the friction material facing of the magnet. It is also recommended that the drum armature surface be refaced when replacing magnets (see section on Brake Drum Inspection). Magnets should also be replaced in pairs - both sides of an axle. Use only genuine Dexter replacement parts when replacing your magnets.



Shoes and Linings

A simple visual inspection of your brake linings will tell if they are usable. Replacement is necessary if the lining is worn (to within 1/16" or less), contaminated with grease or oil, or abnormally scored or gouged. Hairline heat cracks are normal in bonded linings and should not be cause for concern. When replacement is necessary, it is important to replace both shoes on each brake and both brakes of the same axle. This will help retain the "balance" of your brakes.



Acceptable Hairline Cracks

After replacement of brake shoes and linings, the brakes must be re-burnished to seat in the new components. This should be done by applying the brakes 20 to 30 times from an initial speed of 40 m.p.h., slowing the vehicle to 20 m.p.h. Allow ample time for brakes to cool between applications. This procedure allows the brake shoes to seat in to the drum surface.

Introduction to Troubleshooting

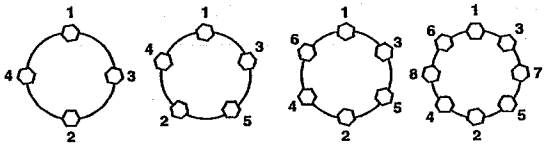
Proper brake function is critical to the safe operation of any vehicle. If problems are encountered with your trailer braking system, the following guide can be used to find the causes and remedies for some of the more common problems. If you are unsure or unable to resolve the problem, please contact your nearest repair facility for professional assistance.

Be sure to use only the fasteners matched to the cone angle of your wheel (usually 60° or 90°). The proper procedure for attaching your wheels is as follows:

1. Start all bolts or nuts by hand to prevent cross threading.
2. Tighten bolts or nuts in the sequence shown for Wheel Torque Requirements.
3. The tightening of the fasteners should be done in stages. Following the recommended sequence, tighten fasteners per wheel torque chart below.
4. Wheel nuts/bolts should be torqued before first road use and after each wheel removal. Check and re-torque after the first 10 miles, 25 miles, and again at 50 miles. Check periodically thereafter.

Wheel Torque Requirements

Wheel Size	Torque Sequence 1st Stage	2nd Stage	3rd Stage
12"	20-25	35-40	50-75
13"	20-25	35-40	50-75
14"	20-25	50-60	90-120
15"	20-25	50-60	90-120
16"	20-25	50-60	90-120
16.5" x 6.75"	20-25	50-60	90-120
16.5" x 9.75"	55-60	120-125	175-225
14.5" Demount.	Tighten sequentially to		85-95
17.5" Hub Pilot Clamp Ring & Cone Nuts	50-60	100-120	190-210
17.5" Hub Pilot 5/8" Flange Nuts	50-60	190-200	275-325



4. *Rim Contour.*

> **CAUTION:**
>
> *Use only the approved rim contours as shown in the Tire and Rim Yearbook or the tire manufacturer's catalog. The use of other rim contours is dangerous. Failure to use the proper rim contour can result in explosive separation of the tire and wheel and could cause a serious accident.*

> **CAUTION:**
>
> *Do not attempt to repair or modify a wheel. Even minor modifications can have a great effect. Do not install a tube to correct a leak through the rim. If the rim is cracked, the air pressure in the tube may cause the pieces of the rim to explode with great force and can cause serious injury or death.*

Torque Requirements

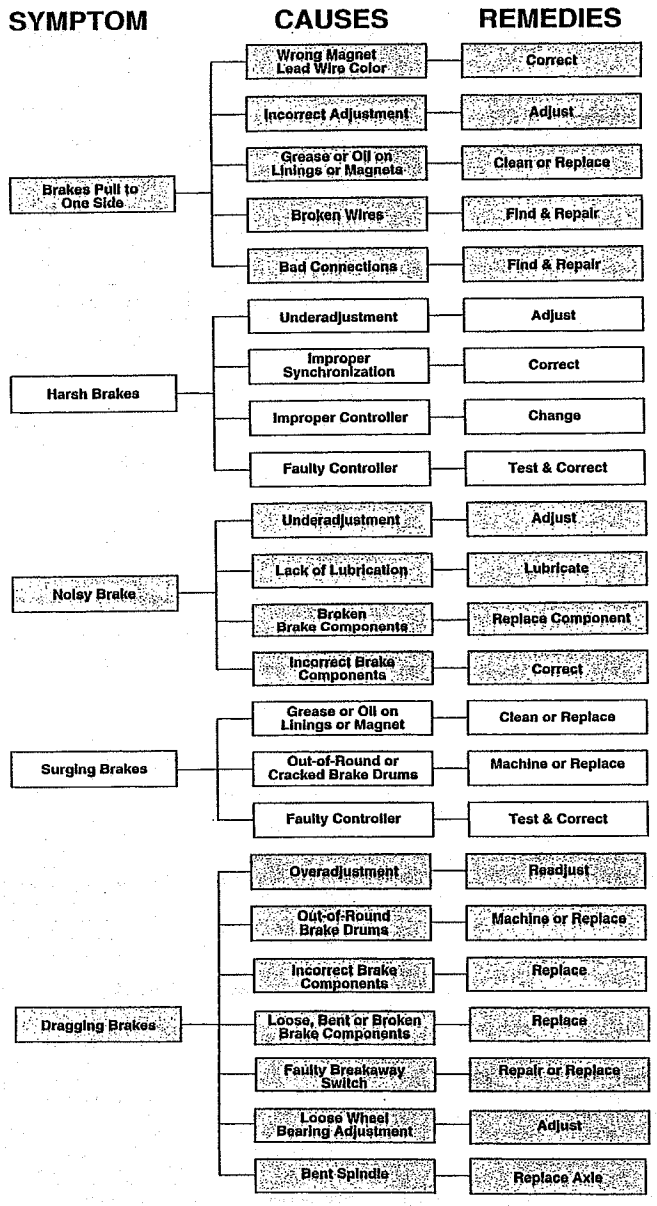
It is extremely important to apply and maintain proper wheel mounting torque on your trailer axle. Torque is a measure of the amount of tightening applied to a fastener (nut or bolt) and is expressed as length times force. For example, a force of 90 pounds applied at the end of a wrench one foot long will yield 90 lbs.-ft. of torque. Torque wrenches are the best method to assure the proper amount of torque is being applied to a fastener.

> **CAUTION:**
>
> *Wheel nut or bolts must be tightened and maintained at the proper torque levels to prevent loose wheels, broken studs, and possible dangerous separation of wheels from your axle.*

Troubleshooting

SYMPTOM	CAUSES	REMEDIES
No Brakes	Open Circuits	Find & Correct
	Severe Underadjustment	Adjust Brakes
	Faulty Controller	Test & Correct
	Short Circuits	Find & Correct
Weak Brakes	Grease or Oil on Magnets or Linings	Clean or Replace
	Corroded Connections	Clean & Correct Cause of Corrosion
	Worn Linings or Magnets	Replace
	Scored or Grooved Brake Drums	Machine or Replace
	Improper Synchronization	Correct
	Underadjustment	Adjust Brakes
	Glazed Linings	Reburnish or Replace
	Overloaded Trailer	Correct
Locking Brakes	Underadjustment	Adjust
	Improper Synchronization	Correct
	Faulty Controller	Test & Correct
	Loose, Bent or Broken Brake Components	Replace Components
	Out-of-Round Brake Drums	Machine or Replace
	Insufficient Wheel Load	Adjust System Resistor and Synchronize
Intermittent Brakes	Faulty Controller	Test & Correct
	Broken Wires	Repair or Replace
	Loose Connections	Find & Repair
	Faulty Ground	Find & Repair

Troubleshooting



Except for periodic inspection of the fasteners used to attach the TORFLEX® axle to the vehicle frame, no other suspension maintenance is required on TORFLEX® axles. They are, of course, subject to the maintenance and inspection procedures regarding brakes, hubs, bearings, seals, wheels, and tires as outlined in this manual.

> **CAUTION:**
>
> ***DO NOT WELD ON THE TORFLEX® BEAM.*** *It has rubber cords inside and the heat generated by welding could damage the cord.*

Wheels

Wheel Selection

Wheels are very important and critical components of your running gear system. When specifying or replacing your trailer wheels it is important that the wheels, tires, and axle are properly matched. The following characteristics are extremely important and should be thoroughly checked when replacement wheels are considered.

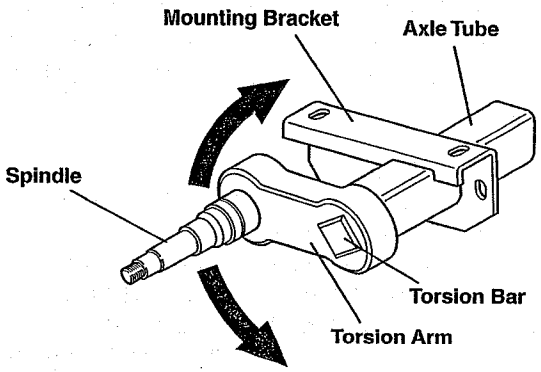
1. *Bolt Circle.* Many bolt circle dimensions are available. Some vary by so little that it might be possible to attach an improper wheel that does not match the axle hub. Be sure to match your wheel to the axle hub.
2. *Capacity.* Make sure that the wheels have enough load carrying capacity and pressure rating to match the rated load of the tire.
3. *Offset.* This refers to the relationship of the center line of the tire to the hub face of the axle. Care should be taken to match any replacement wheel with the same offset wheel as originally equipped. Failure to match offset can result in reducing the load carrying capacity of your axle.

> **CAUTION:**
>
> *Be sure to wear safety glasses when removing or installing force fitted parts. Failure to comply may result in serious injury.*

All of the pivot points on your standard suspension system have been fitted with anti-friction bearing materials which do not require routine lubrication. When otherwise servicing the unit, these pivot points may be lubricated if you so desire. If your trailer has been fitted with the Heavy Duty Attaching Parts Kit, you should lubricate periodically to ensure long component life.

Torflex® Suspension

The TORFLEX® suspension system is a torsion arm type suspension which is completely self contained within the axle tube. It attaches directly to the trailer frame using brackets which are an integral part of the axle assembly. The TORFLEX® axle provides improved suspension characteristics relative to leaf spring axles through the unique arrangement of a steel torsion bar surrounded by four natural rubber cords encased in the main structural member of the axle beam.



The wheel/hub spindle is attached to a lever, called the torsion arm, which is fastened to the rubber encased bar. As load is applied, the bar rotates causing a rolling/compressive resistance in the rubber cords. This action provides the same functions as conventional sprung axles with several operating advantages including independent suspension.

Troubleshooting

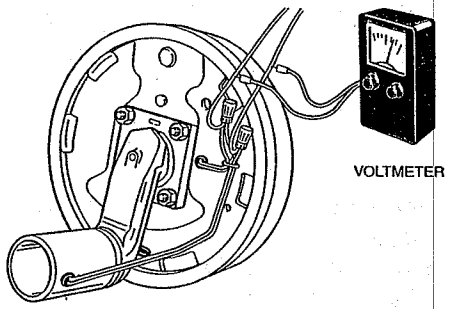
Most electric brake malfunctions, that cannot be corrected by either brake adjustments or synchronization adjustments, can generally be traced to electrical system failure. Voltmeters and ammeters are essential tools for proper troubleshooting of electric brakes.

Mechanical causes are ordinarily obvious, i.e. bent or broken parts, worn out linings or magnets, seized lever arms or shoes, scored drums, loose parts, etc. Replace defective parts with genuine Dexter replacements.

How to Measure Voltage

System voltage is measured at the magnets by connecting the voltmeter to the two magnet lead wires at any brake. This may be accomplished by using a pin probe inserted through the insulation of the wires. The engine of the towing vehicle should be running when checking the voltage so that a low battery will not affect the readings.

Voltage in the system should begin at 0 volts and, as the controller bar is slowly actuated, should gradually increase to about 12 volts. If the controller does not produce this voltage control, consult your controller manual.



The threshold voltage of a controller is the voltage applied to the brakes when the controller first turns on. Lower threshold voltage will provide for smoother braking. If the threshold voltage is too high, the brakes may feel grabby and harsh.

How to Measure Amperage

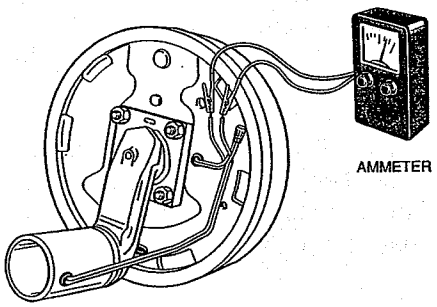
System amperage is the current flowing in the system when all the magnets are energized. The amperage will vary in proportion to the voltage. The engine of the tow vehicle should be running with the trailer connected when checking the trailer braking system.

One place to measure system amperage is at the BLUE wire of the controller which is the output to the brakes. The BLUE wire must be disconnected and the ammeter put in series into the line. System amperage draw should be as noted in the following table. Make sure your ammeter has sufficient capacity and note polarity to prevent damaging your ammeter.

Magnet Amperes Chart

Brake Size	Amps/ Magnet	Two Brakes	Four Brakes	Six Brakes
7 x 1¼	2.5	5.0	10.0	15.0
10 x 1½	3.0	6.0	12.0	18.0
10 x 2¼	3.0	6.0	12.0	18.0
12 x 2	3.0	6.0	12.0	18.0
12¼ x 2½	3.0	6.0	12.0	18.0
12¼ x 3⅜	3.0	6.0	12.0	18.0

If a resistor is used in the brake system, it must be set at zero or bypassed completely to obtain the maximum amperage reading. Individual amperage draw can be measured by inserting the ammeter in the line at the magnet you want to check. Disconnect one of the magnet lead wire connectors and attach the ammeter between the two wires. Make sure that the wires are properly reconnected and sealed after testing is completed.



2. After the unit is properly supported place a suitable block under the axle tube near the end to be repaired. This block is to support the weight of the axle only, so that suspension COMPONENTS can be removed.
3. Disassemble the U-bolts, nuts, and tie plates.
4. Remove the spring eye bolts and remove the spring and place on a suitable work surface.
5. If the spring eye bushings are to be replaced, drive out the old bushing using a suitable drift punch.

CAUTION:

Be sure to wear safety glasses when removing or installing force fitted parts. Failure to comply may result in serious inury.

6. Drive the new bushing into the spring eye using a piloted drift punch or a close fitting bolt inserted through the bushing.
7. Reinstall repaired or replaced components in reverse order.

Note: *For multiple axle units, the weight of each axle must be supported as outlined in Step 2 before disassembly of any component of the suspension system.*

If the equalizer or equalizer bushings must be replaced, follow the instructions above for lifting and supporting the trailer unit and then proceed as follows:

1. With both axles blocked up, remove the spring eye bolt, shackle bolt, and equalizer bolt from the equalizer to be repaired or replaced.
2. Take the equalizer to suitable work surface and remove the worn bushings using a suitable drift punch.
3. Drive the new bushings into place using a piloted drift punch or a close fitting bolt through the bushing.
4. Reassemble in reverse order.

Inspection and Replacement

All the components of your suspension system should be visually inspected at least every 6,000 miles for signs of excess wear, elongation of bolt holes, and loosening of fasteners. Whenever loose or replaced, the fasteners in your suspension system should be torqued as detailed in the charts below.

> **CAUTION:**
>
> *Failure to do proper and periodic maintenance of these important structural parts may result in severe and catastrophic injury or damage to property.*

Suspension Fastener Torque Values

Item	Torque (lbs.-ft.) Min	Max
3/8" U-Bolt	30	50
7/16" U-Bolt	45	70
1/2" U-Bolt	45	70
Non shoulder type with 9/16" threads Shackle Bolt Spring Eye Bolt Equalizer Bolt	Snug fit only. Parts must rotate freely. Locking nuts or cotter pins are provided to retain nut-bolt assembly.	
Shoulder Type Shackle Bolt with 7/16" threads	30	50

Worn spring eye bushings, sagging springs, or broken springs should be replaced using the following method.

1. Support the trailer with the wheels just off the ground.

> **CAUTION:**
>
> *Follow the trailer manufacturer's recommendations for lifting and supporting the unit. Do not lift or place supports on any part of the suspension system.*

The most common electrical problem is low or no voltage and amperage at the brakes. Common causes of this condition are:

1. Poor electrical connections
2. Open circuits
3. Insufficient wire size
4. Broken wires
5. Blown fuses (fusing of brakes is not recommended)
6. Improperly functioning controllers or resistors

Another common electrical problem is shorted or partially shorted circuits (indicated by abnormally high system amperage). Possible causes are:

1. Shorted magnet coils
2. Defective controllers
3. Bare wires contacting a grounded object

Finding the cause of a short circuit in the system is done by isolating one section at a time. If the high amperage reading drops to zero by unplugging the trailer, then the short is in the trailer. If the amperage reading remains high with all the brake magnets disconnected, the short is in the trailer wiring.

All electrical troubleshooting procedures should start at the controller. Most complaints regarding brake harshness or malfunction are traceable to improperly adjusted or non-functioning controllers. See your controller manufacturer's data for proper adjustment and testing procedures. For best results, all the connection points in the brake wiring should be sealed to prevent corrosion. Loose or corroded connectors will cause an increase in resistance which reduces the voltage available for the brake magnets.

Hydraulic Drum Brakes

The hydraulic brakes on your trailer are much like those on your automobile or light truck. The hydraulic fluid from a master cylinder is used to actuate the wheel cylinder which, in turn, applies force against the brake shoes and drum. The main difference between automotive hydraulic brakes and hydraulic trailer brakes is the trailers' actuation system. These systems respond to the braking signal from the tow vehicle and supply the required brake fluid volume and pressure to the trailer brakes.

CAUTION:

The operating pressure required for Dexter brakes:

- *7" diameter brakes*
  maximum operating pressure is 750 PSI
- *10" diameter and larger*
  maximum operating pressure is 1,000 PSI

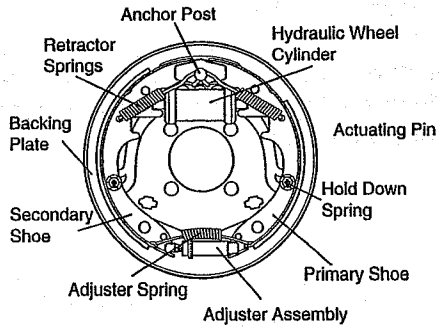
Actuation Systems

Dexter Axle does not currently offer brake acuation systems. Refer to your trailer manufacturer or actuation system manual for information on proper setup and use.

Hydraulic Brake Operation

Duo-Servo

The duo-servo brake uses a dual piston wheel cylinder to apply the brakes. This type of brake is typically used in a vacuum/hydraulic, electric/hydraulic or air/ hydraulic system. A description of operation of this brake is as follows:



Grease Lubricated Suspension Bushings

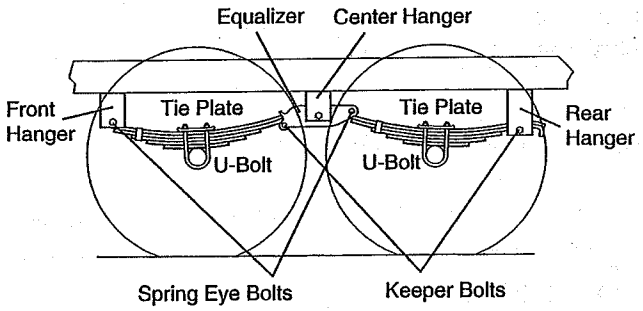
Dexter Axle offers an optional heavy duty attaching parts kit for double eye leaf spring suspensions up to 7,000 lb. axle capacity. The kit contains extra heavy shackle links, bronze bushings for the spring eyes and suspension bolts and equalizers equipped with grease fittings to provide a convenient means to lubricate all the pivot points. For availability, contact your nearest Dexter Axle facility or visit us online at ***www.dexteraxle.com*** for a complete listing of genuine repair parts.

Slipper Leaf Springs

Slipper springs have an eye formed in one end only with the other end formed into a reverse curve. The attachment of these springs is as follows:

1. The front eye is attached directly into the front hanger with a bolt and nut.
2. The rear end of the spring is captured in the rear hanger or equalizer with a "keeper bolt" that prevents the spring from coming out when the trailer is jacked up for service.

The articulation of this suspension occurs when the rear end of each slipper spring slides against the wear surfaces provided in the rear hangers or equalizers. This suspension is also available in single and multiple axle configurations.



Overslung Shown

Suspension Systems

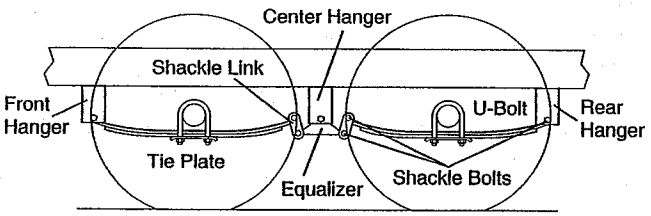
The suspension systems incorporated into Dexter axles are designed to provide the trailer owner three basic functions:

1. Attach the axle to the trailer
2. Dampen the effects of road shock
3. Cushion the cargo or load

All Dexter suspension systems are available in single and multiple axle configurations. The three types most commonly available are double eye leaf spring, slipper spring and Torflex®.

Double Eye Leaf Springs

Double eye springs have eyes formed in each end of the spring with anti-friction bushings fitted for wear resistance. The springs are held to the axle tube using a system of U-bolts and clamp plates and are attached to the trailer as shown.



Underslung Shown

Articulation of this suspension occurs when the spring becomes loaded and consequently lengthens. The double pivot action of the shackle links accommodates this articulation and allows the system to move freely.

In multiple axle installations, the action is the same with the additional movement of the equalizer assembly. This serves to transfer instantaneous loads from one axle to another in an effort to "equalize" the load between the axles.

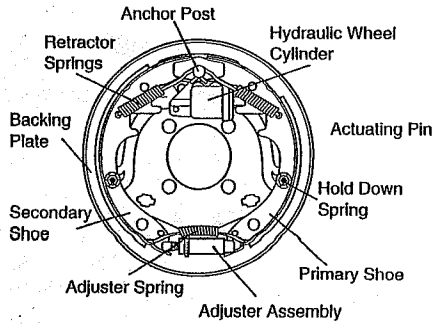
When the brakes are applied, the double-acting wheel cylinder moves the primary and secondary shoes towards the drum. The frictional force between the brake drum and lining attempts to turn the primary shoe into the secondary shoe. The secondary shoe is forced onto the anchor pin and from this point, the secondary and primary shoes attempt to "wrap around". In essence, the brake has utilized frictional force to help the applying force on both shoes.

If the brakes are applied while the vehicle is backing, the shoes rotate in the direction of the drum rotation. This causes the secondary shoe to leave the anchor and causes the primary shoe to move against the anchor. Action of the brake is the same in reverse as forward.

Uni-Servo

This type of hydraulic brake utilizes a single acting cylinder. Upon actuation, the primary shoe is pressed against the brake drum, which causes the shoe to move in the direction of rotation. This movement in turn actuates the secondary shoe through the adjuster link assembly. Braking in reverse is significantly less effective than in the forward direction.

Another variation is called a "free backing" brake which is commonly used on trailers with a surge hitch system. When backing with a surge brake hitch, normal brakes are applied through the surge mechanism and if there is more brake force on the trailer than the tow vehicle can override, no backing is possible. The free backing brake was developed to allow backing in this application. This brake has a primary shoe on a pivot which allows normal application in the forward direction, but allows the primary shoe to rotate away from the drum surface when backing.

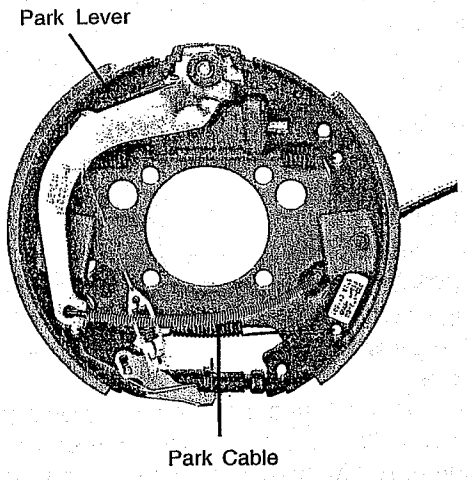


Self Adjusting Mechanism for 12¼" Hydraulic Brakes

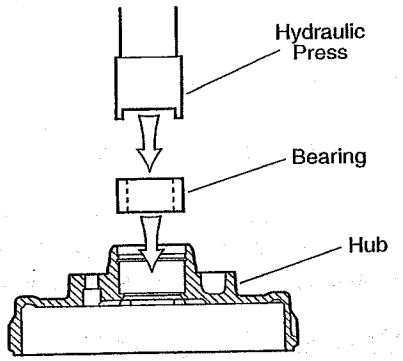
Forward self-adjust hydraulic brakes were introduced in March, 1997. This feature adjusts the brakes on both forward and reverse stops. Brake adjustment occurs only when lining wear results in enough gap between the shoes and the drum surface. This added clearance will allow the adjuster mechanism to rotate the screw assembly at the bottom of the brake. That action expands the distance between the shoes and thus closes the gap to the drum surface.

Hydraulic Parking Brake Option

The parking feature on Dexter hydraulic brakes is cable operated. On the 10" and 12" brakes, the parking cable body is mounted to the brake backing plate. The cable end is attached to the internal parking brake lever to actuate the brake. On Dexter 12¼" brakes manufactured before February 2002, the parking cable body mounts to a support plate which is attached to the brake mounting flange. The cable end is routed through the dust shield and the brake spider to attach to the internal parking brake lever. For 12¼" brakes produced after February 2002, a short cable is installed directly into the backing plate to provide a convenient means for the trailer manufacturer to attach an appropriate operating system.



3. When replacing a Nev-R-Lube™ bearing pack, the bore in the hub should be cleaned and inspected for visual damage (replace as necessary).
4. Installing the new bearing should be conducted using an arbor press and a "hollow" or "stepped" mandrel to press only on the outer housing of the bearing assembly (failure to follow procedure will damage bearing and/or seals during installation). Press bearing until it seats against the backup shoulder machined into the hub.



5. Install "internal" snap ring into hub.
6. Clean and inspect spindle shaft. Apply a light coating of anti-seize lubricant to the spindle shaft prior to assembling drum.
7. Install drum assembly onto spindle (*Do Not Force*).
8. Install steel washer onto spindle end.
9. Start self-locking nut onto spindle thread by hand. Complete installation using a 1½" or 1⁷/₁₆" socket and torque wrench. Nut should be torqued to 145-155 lb.-ft. (this torque will set the internal bearing adjustment, no other adjustments are to be made).
10. Install "torque instruction" washer onto end of spindle.
11. Install "external" snap ring onto end of spindle to retain washer.
12. Inspect assembly for excessive end play, noise, and rotation restriction prior to mounting final wheel end hardware.

Nev-R-Lube™ Bearing End Play Inspection

The following lists the maximum axial end play for each of the sizes of Nev-R-Lube™ bearings and the amount of tilt that can be expected. Since there are a large number of wheel and tire combinations in use on trailers, the tilt is expressed in inches per inch. The movement as measured at the tire tread can be found by the following method:

Example: if the tilt value is shown as .003" per inch and the tire measures 30" in diameter, simply multiply .003" X 30" = .090" which is the total expected movement at the tires' outer diameter.

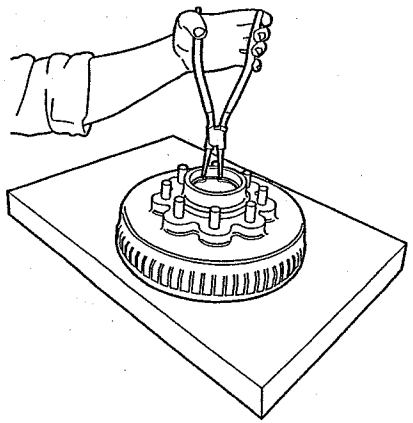
Bearing size	End play	Resultant tilt value
35 MM	.005" axial	.003"/ per inch
42 MM	.006" axial	.005"/ per inch
50 MM	.008" axial	.004"/ per inch

It is important to note that most mounted tires will deflect fairly easily when enough hand pressure is applied while shaking the tire. Excessive pressure will result in the perception that the bearings' tilt is greater than it actually is. This same phenomenon will occur when checking any wheel end, even those equipped with conventional bearing sets.

Bearing Replacement and Drum Installation

1. Once the drum and bearing assembly is removed from the axle, remove "internal" snap ring from the bearing bore that retains bearing.

2. Using an arbor press and mandrel, press the bearing out of the drum. Bearing will exit on the wheel side of the drum.



The internal parking brake lever of 10" and 12" Dexter brakes, which is mounted to the secondary shoe, transfers applied cable force through a parking strut which is attached to the primary shoe. This transferred load generates a spreading force between the primary and secondary shoes. The shoes move toward the drum until contact is made. Friction generated between the drum and lining contact surface results in parking brake capability.

The internal parking brake lever of Dexter 12¼" brakes transfers the applied cable force through a cam mechanism. The cam mechanism generates a spreading force between the primary and secondary shoes. The shoes move toward the drum until contact is made. Friction generated between the drum and lining contact surface results in parking brake capability.

General Maintenance - Hydraulic Brakes

Brake Adjustment - Manual

Brakes should be adjusted (1) after the first 200 miles of operation when the brake shoes and drums have "seated," (2) at 3,000 mile intervals, (3) or as use and performance requires. The brakes should be adjusted in the following manner:

1. Jack up trailer and secure on adequate capacity jack stands. Follow trailer manufacturer's recommendations for lifting and supporting the unit. Make sure the wheel and drum rotates freely.

CAUTION:

Do not lift or support trailer on any part of the axle or the suspension system.

Never crawl under your trailer unless it is resting on properly placed jack stands

2. Remove the adjusting hole cover from the adjusting slot on the bottom of the brake backing plate.
3. With a screwdriver or standard adjusting tool, rotate the starwheel of the adjuster assembly to expand the brake

shoes. Adjust the brake shoes out until the pressure of the linings against the drum makes the wheel very difficult to turn.

Note: *For drop spindle axles, a modified adjusting tool may be necessary.*

4. Then rotate the starwheel in the opposite direction until the wheel turns freely with a slight lining drag.
5. Replace the adjusting hole cover and lower the wheel to the ground.
6. Repeat the above procedure on all brakes. For best results, the brakes should all be set at the same clearance.

Most of the brake components are very similar to those used in electric brakes, and maintenance is comparable for the hub and drum, shoes and linings, and bearings. Specific maintenance activities are as follows:

Wheel Cylinders

Inspect for leaks and smooth operation. Clean with brake cleaner and flush with fresh brake fluid. Hone or replace as necessary.

Brake Lines

Check for cracks, kinks, or blockage. Flush with fresh brake fluid. Bleed system to remove all air. Replace as necessary.

Shoes and Linings

A simple visual inspection of your brake linings will tell if they are usable. Replacement is necessary if the lining is worn (to within $^{1}/_{16}$" or less), contaminated with grease or oil, or abnormally scored or gouged. Hairline heat cracks are normal in bonded linings and should not be cause for concern. When replacement is necessary, it is important to replace both shoes on each brake and both brakes of the same axle. This will help retain the "balance" of your brakes.

After replacement of brake shoes and linings, the brakes must be re-burnished to seat in the new components. This should be done by applying the brakes 20 to 30 times from an initial speed of 40 m.p.h., slowing the vehicle to 20 m.p.h. Allow ample time for brakes to cool between applications. This procedure allows the brake shoes to seat in to the drum surface.

2. Remove the wheel.
3. Remove the grease cap from the hub by carefully prying progressively around the flange.
4. Remove snap ring on the end of the spindle. Remove "torque instruction" washer.
5. Unscrew the spindle nut (counterclockwise) and remove the spindle washer.
6. Carefully remove the hub from the spindle. The Nev-R-Lube™ bearing cartridge will remain in the hub.

Note: Do not remove cartridge bearing from the hub bore unless replacement of the bearing cartridge is intended. Special tools and techniques are required for removal of the old bearing.

Bearing Inspection

Important:

1. Elevate and support the trailer unit per manufacturer's instructions.

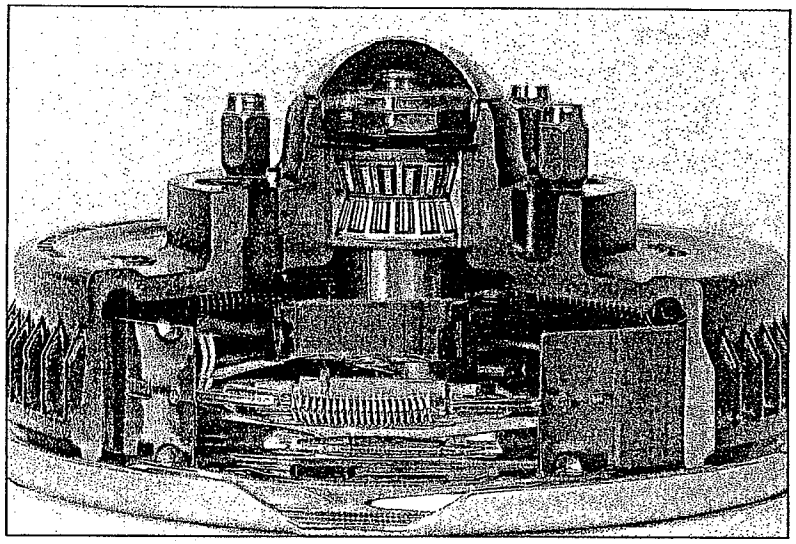
> ⚠ **CAUTION:**
>
> *Follow the trailer manufacturer's recommendations for lifting and supporting the unit. Do not lift or place supports on any part of the suspension system.*

2. Check for excessive wheel end clearance by pulling the tire assembly towards you and by pushing the assembly away from you. Slight end play is acceptable.
3. Rotate tire slowly forwards and backwards. The wheel assembly should turn freely and smoothly.
4. Excessive wheel end play, restriction to rotation, noise, or "bumpy" rotation should be remedied by replacing the bearing unit.
5. Bearing units should be inspected every year or 12,000 miles whichever comes first.

Note: *A slight amount of grease weeping from the seal area is normal. Excessive leakage may indicate abnormal bearing operation.*

Nev-R-Lube™ Drums/Bearings

Dexter's Nev-R-Lube™ bearings are comprised of opposed tapered roller bearing cones sealed inside of a precision ground, one piece double cup arrangement. These bearings are designed with a small amount of axial end play. This end play is essential to the longevity of the bearings service life.



Drum Removal

Whenever the hub equipment on your axle must be removed for inspection or maintenance, the following procedure should be utilized.

1. Elevate and support the trailer unit per manufacturer's instructions.

⚠ CAUTION:

Follow the trailer manufacturer's recommendations for lifting and supporting the unit. Do not lift or place supports on any part of the suspension system.

Hardware

Check all hardware. Check shoe return spring, hold down springs, and adjuster springs for stretch or wear. Replace as required. Service kits are available.

Troubleshooting

Proper brake function is critical to the safe operation of any vehicle. A properly installed vacuum/hydraulic, electric/hydraulic or air/hydraulic system should not require any special attention with the exception of routine maintenance as defined by the manufacturer. If problems occur, the entire tow vehicle/trailer braking system should be analyzed by a qualified mechanic. Typical problems in a hydraulic braking system are:

- Air or vacuum leaks
- Hydraulic system leaks
- Air in brake lines
- Water or other impurity in brake fluid
- Rusted or corroded master or wheel cylinders
- Actuation system malfunction

Troubleshooting

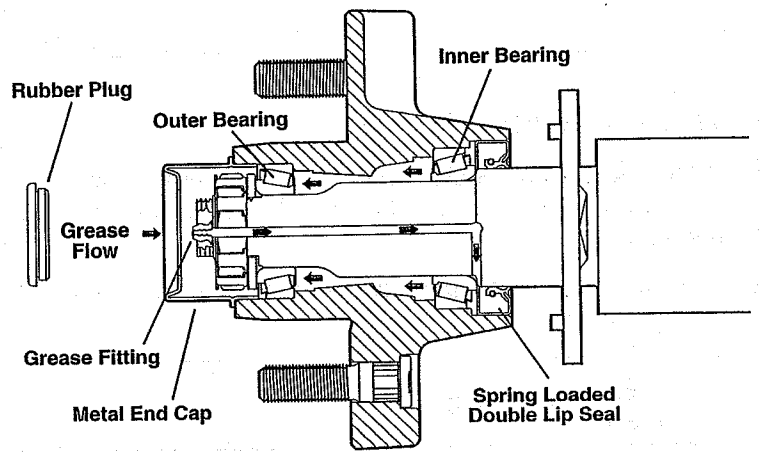
SYMPTOM	CAUSES	REMEDIES
Noisy Brakes	Underadjustment	Adjust
	Lack of Lubrication	Lubricate
	Broken Brake Components	Replace Components
	Incorrect Brake Components	Correct
Locking Brakes	Loose, Bent or Broken Brake Components	Replace Components
	Underadjustment	Adjust
	Out-of-Round Drums	Machine or Replace
Pulls to One Side	Incorrect Tire Pressure	Inflate Evenly on Both Sides to Req. Pressures
	Unmatched Tires on Same Axle	Match Tires on Axle
	Restricted Brake Lines or Hoses	Repair or Replace
	Malfunctioning Cylinder Assembly	Check for Stuck or Sluggish Pistons
	Defective or Damaged Shoe and Lining	Install New Shoe and Lining-Complete Axle
	One Side Out-of-Adjustment	Adjust
Dragging	Improper Fluid	Replace Rubber Parts Fill with DOT4 Fluid
	Blocked Master Cylinder	Open with Compressed Air or Replace Cylinder
	Parking Brake Cable Frozen	Free Cable and Lubricate
	Improper Lining Thickness or Location	Install New Shoes and Linings

E-Z Lube™ Lubrication

The procedure is as follows:

1. Remove the rubber plug from the end of the grease cap.
2. Place a standard grease gun onto the grease fitting located in the end of the spindle. Make sure the grease gun nozzle is fully engaged on the fitting.
3. Pump grease into the fitting. The old displaced grease will begin to flow back out the cap around the grease gun nozzle.
4. When the new clean grease is observed, remove the grease gun, wipe off any excess, and replace the rubber plug in the cap.
5. Rotate hub or drum while adding grease.

Note: The E-Z Lube™ feature is designed to allow immersion in water. Axles not equipped with E-Z Lube™ are not designed for immersion and bearings should be repacked after each immersion. If hubs are removed from an axle with the E-Z Lube™ feature, it is imperative that the seals be replaced BEFORE bearing lubrication. Otherwise, the chance of grease getting on brake linings is greatly increased.

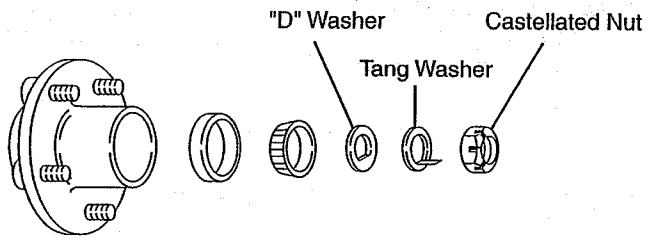


5. Bend over the cotter pin legs to secure the nut (or locking tang in the case of E-Z Lube™).
6. Nut should be free to move with only restraint being the cotter pin (or locking tang).

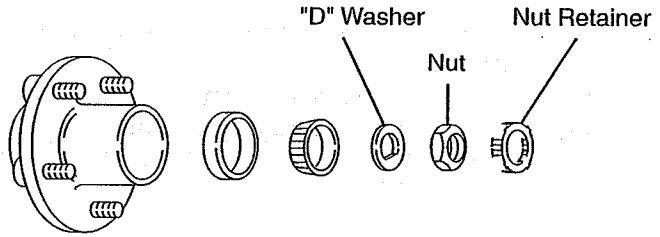
For axles using the new nut retainer:

1. Finger tighten the nut until just snug, align the retainer to the machined flat on the spindle and press the retainer onto the nut. The retainer should snap into place. Once in place, the retainer/nut assembly should be free to move slightly.
2. If the nut is too tight, remove the retainer and back the nut off approximately one twelfth of a turn and reinstall the retainer. The nut should now be free to move slightly.
3. Reinstall grease cap.

Typical E-Z Lube™ Prior to Spring 2002



Typical E-Z Lube™ After Spring 2002



Troubleshooting

SYMPTOM	CAUSES	REMEDIES
No Brakes	Broken or Kinked Brake Line	Repair or Replace
	Severe Underadjustment	Adjust Brakes
	Malfunctioning Actuation System	Troubleshoot System
Weak Brakes	Brake Adjustment Not Correct	Manual-Adjust Brakes Automatic-Make Several Reverse Stops
	Excessively Worn Brake Linings	Replace Shoe and Lining
	Incorrect Lining	Install Correct Shoe and Lining
	Grease or Fluid Soaked Lining	Repair Grease Seal or Wheel Cylinder. Install New Shoe and Lining.
	Frozen Master Cylinder or Wheel Cylinder Pistons	Recondition or Replace All Cylinders, Brake Fluid
	Glazed Lining	Reburnish or Replace
	Excessive Drum Wear	Replace
	Trapped Air in Lines	Bleed System
	Overloaded Trailer	Correct
	Malfunctioning Actuating System	Troubleshoot System
Harsh Brakes	Brake Adjustment Not Correct	Manual-Adjust Brakes Automatic-Make Several Reverse Stops
	Grease or Fluid on Linings	Replace Shoes and Linings
Surging Brakes	Grease or Oil on Linings	Clean or Replace
	Out of Round Drums or Cracked Drums	Machine or Replace

Hubs/Drums/Bearings

Dexter Axle offers several types of bearing arrangements and lubrications methods.

- Dexter's standard wheel bearing configuration consists of opposed tapered roller bearing cones and cups, fitted inside of a precision machined cast hub. This method of using tapered roller bearings requires that a minimal amount of axial end play be provided at assembly. This end play is essential to the longevity of the bearings service life. This design is typically lubricated with grease, packed into the bearings. Oil lubrication is another method which is available in some of the larger axle capacities.

- E-Z Lube™ is another option chosen by some trailer manufacturers. If your axle is equipped with the Dexter E-Z Lube™ feature, the bearings can be periodically lubricated without removing the hubs from the axle. This feature consists of axle spindles that have been specially drilled and assembled with grease fittings in their ends. When grease is pumped into the fitting, it is channeled to the inner bearing and then flows back to the outer bearing and eventually back out the grease cap hole.

- Nev-R-Lube™ option is the latest innovation from Dexter. Nev-R-Lube™ bearings are comprised of opposed tapered roller bearing cones sealed inside of a precision ground, one piece double cup arrangement. These bearings are designed with a small amount of axial end play. This end play is essential to the longevity of the bearings service life. They are lubricated, assembled and sealed at the factory. No further lubrication is ever needed.

Before attempting any disassembly of your Dexter axle, make sure you read and follow the instructions for the appropriate axle type.

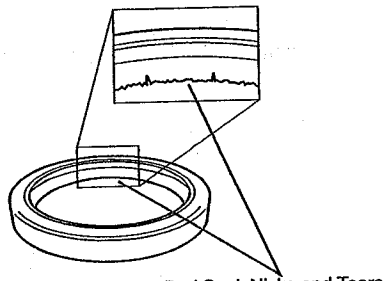
Hub Removal - Standard Bearings

Whenever the hub equipment on your axle must be removed for inspection or maintenance the following procedure should be utilized.

1. Elevate and support the trailer unit per manufacturers' instructions.

Seal Inspection and Replacement

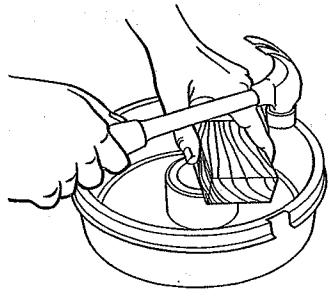
Whenever the hub is removed, inspect the seal to assure that it is not nicked or torn and is still capable of properly sealing the bearing cavity. If there is any question of condition, replace the seal. Use only the seals specified in the Seal Replacement Chart. To replace the seal:



Bad Seal: Nicks and Tears (REPLACE SEAL)

1. Pry the seal out of the hub with a screwdriver. Never drive the seal out with the inner bearing as you may damage the bearing.
2. Apply a PERMATEX sealant to the outside of the new seal.

Note: *Permatex sealant should not be used on rubber encased seals.*



3. Tap the new seal into place using a clean wood block.

Bearing Adjustment and Hub Replacement

If the hub has been removed or bearing adjustment is required, the following adjustment procedure must be followed:

1. After placing the hub, bearings, washers, and spindle nut back on the axle spindle in reverse order as detailed in the previous section on hub removal, rotate the hub assembly slowly while tightening the spindle nut to approximately 50 lbs.-ft. (12" wrench or pliers with full hand force.)
2. Then loosen the spindle nut to remove the torque. *Do not rotate the hub.*
3. Finger tighten the spindle nut until just snug.
4. Back the spindle nut out slightly until the first castellation lines up with the cotter key hole and insert the cotter pin (or locking tang in the case of E-Z Lube™).

4. Continue this process until you have the entire bearing completely filled with grease.
5. Before reinstalling, apply a light coat of grease on the bearing cup.

Bearing Lubrication - Oil

If your axles are equipped with oil lubricated hubs, periodically check and refill the hub as necessary with a high quality hypoid gear oil to the level indicated on the clear plastic oil cap. The oil can be filled from either the oil fill hole, if present, in the hub or through the rubber plug hole in the cap itself.

Recommended Wheel Bearing Lubrication Specifications

Grease:

Thickener Type	Lithium Complex
Dropping Point	215°C (419°F) Minimum
Consistency	NLGI No. 2
Additives	EP, Corrosion & Oxidation Inhibitors
Viscosity Index	80 Minimum

Approved Sources:

Mobil Oil	Mobilgrease HP, Mobilith AW2
Exxon/Standard	Ronex MP
Kendall Refining Co.	Kendall L-427
Ashland Oil Co.	Valvoline Multipurpose GM
76 Lubricants	76 Multiplex EP
Citgo Petroleum	Lithoplex MP#2
Mystik	Mystik JT-6 Hi Temp Grease

Oil:

SAE 90, SAE 80W-90, SAE 75W-90

Approved Sources:

Union Oil Co.	Unocal MP Gear Lube
Exxon Co. USA	Gear Oil GX 80W-90
Mobil Oil Corp	Mobilube SHC 75W-90
Pennzoil Prod. Co.	Gear Plus 80W-90 GL-5
	Gear Plus Super 75W-90

Note: *The convenient lubrication provisions of the E-Z Lube™ and the oil lubrication must not replace periodic inspection of the bearings.*

CAUTION:

Failure to do proper and periodic maintenance of these important structural parts may result in severe and catastrophic injury or damage to property.

2. Remove the wheel.
3. Remove the grease cap by carefully prying progressively around the flange of the cap. If the hub is an oil lube type, then the cap can be removed by unscrewing it counterclockwise while holding the hub stationary.
4. Remove the cotter pin from the spindle nut or, in the case of E-Z Lube™ versions, bend the locking tang to the free position.

   For E-Z Lube™ axles produced after February 2002, a new type of retainer is used. Gently pry off retainer from the nut and set aside.
5. Unscrew the spindle nut (counterclockwise) and remove the spindle washer.
6. Remove the hub from the spindle, being careful not to allow the outer bearing cone to fall out. The inner bearing cone will be retained by the seal.
7. For 7,200 lb. and 8,000 lb. axles, a hub puller should be used to assist in drum removal.

Brake Drum Inspection

There are two areas of the brake drum that are subject to wear and require periodic inspection. These two areas are the drum surface where the brake shoes make contact during stopping and the armature surface where the magnet contacts (only in electric brakes).

The drum surface should be inspected for excessive wear or heavy scoring. If worn more than .020" oversized, or the drum has worn out of round by more than .015", then the drum surface should be re-machined. If scoring or other wear is greater than .090" on the diameter, the drum must be replaced. When turning the drum surface, the maximum rebore diameter is as follows:

- 7" Brake Drum-7.090" diameter
- 10" Brake Drum-10.090" diameter
- 12" Brake Drum-12.090" diameter
- 12¼" Brake Drum-12.340" diameter

The machined inner surface of the brake drum that contacts the brake magnet is called the armature surface. If the armature surface is scored or worn unevenly, it should be refaced to a 120 micro inch finish by removing not more than .030" of material. To insure proper contact between the armature face and the magnet face, the magnets should be replaced whenever the armature surface is refaced and the armature surface should be refaced whenever the magnets are replaced.

Note: *It is important to protect the wheel bearing bores from metallic chips and contamination which result from drum turning or armature refacing operations. Make certain that the wheel bearing cavities are clean and free of contamination before reinstalling bearing and seals. The presence of these contaminants will cause premature wheel bearing failure.*

Bearing Inspection

Wash all grease and oil from the bearing cone using a suitable solvent. Dry the bearing with a clean, lint-free cloth and inspect each roller completely.

CAUTION:

Never spin the bearing with compressed air. THIS CAN DAMAGE THE BEARING.

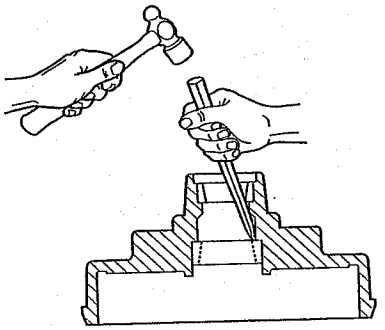
If any pitting, spalling, or corrosion is present, then the bearing must be replaced. The bearing cup inside the hub must be inspected.

IMPORTANT: *Bearings must always be replaced in sets of a cone and a cup.*

CAUTION:

Be sure to wear safety glasses when removing or installing force fitted parts. Failure to comply may result in serious eye injury.

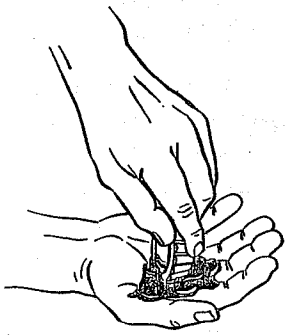
When replacing the bearing cup proceed as follows:



1. Place the hub on a flat work surface with the cup to be replaced on the bottom side.
2. Using a brass drift punch, carefully tap around the small diameter end of the cup to drive out.
3. After cleaning the hub bore area, replace the cup by tapping in with the brass drift punch. *Be sure the cup is seated all the way up against the retaining shoulder in the hub.*

Bearing Lubrication - Grease

Along with bearing adjustment, proper lubrication is essential to the proper function and reliability of your trailer axle. Bearings should be lubricated every 12 months or 12,000 miles. The method to repack bearing cones is as follows:



1. Place a quantity of grease into the palm of your hand.
2. Press a section of the widest end of the bearing into the outer edge of the grease pile closest to the thumb forcing grease into the interior of the bearing.
3. Repeat this while rotating the bearing from roller to roller.

SPOKANE INDUSTRIES, INC.

SPOKANE METAL PRODUCTS DIVISION

Spokane Washington

UNIVERSAL DRAIN ASSEMBLY (UDA)

TECHNICAL MANUAL
PARTS AND OPERATION

SECTION 18

UNIVERSAL DRAIN ASSEMBLY (UDA)

INTRODUCTION:

VACUUM GENERATOR AND UNIVERSAL DRAIN ASSEMBLY (UDA)

The use of a vacuum generator for the primary delivery of fuel into the bowser unit was based upon many optimal benefits. The generator is economical to operate, compact in size, low cost, minimal maintenance as well as built to lightweight construction with no moving parts.

To obtain optimum benefit from your vacuum system it is recommended that all personnel operating it read and understand this section prior to operating.

Upon receipt of the unit, a visual inspection should be made to determine that it is complete and has not sustained any damage during transportation.

When compressed air is forced through a double conical nozzle it velocity increases and the pressure decreases. Vacuum generators operate on this principle, which creates vacuum without a single moving part.

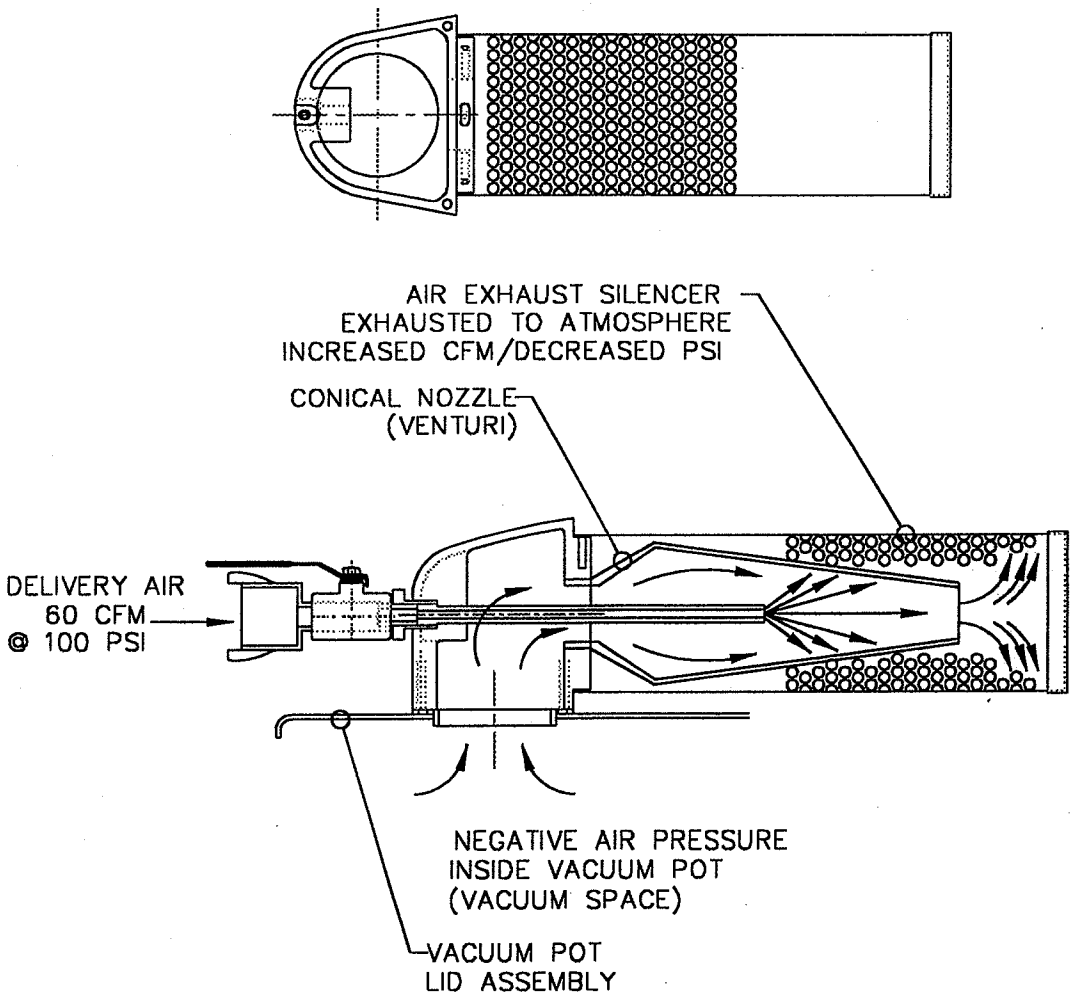
If the aircraft is equipped with a "POP-IT", also known as a "PENCIL" type low point drain then the fuel bowser should be able to hook up and function properly.

The vacuum lid assembly is provided with quick connects for attaching the suction fuel delivery lines.

There are (4) four ½" inch suction fuel delivery lines provided on the lid of the vacuum assembly.

If the vacuum probes do not work, you will have to find a Sumping tool adapter to enable hook up.

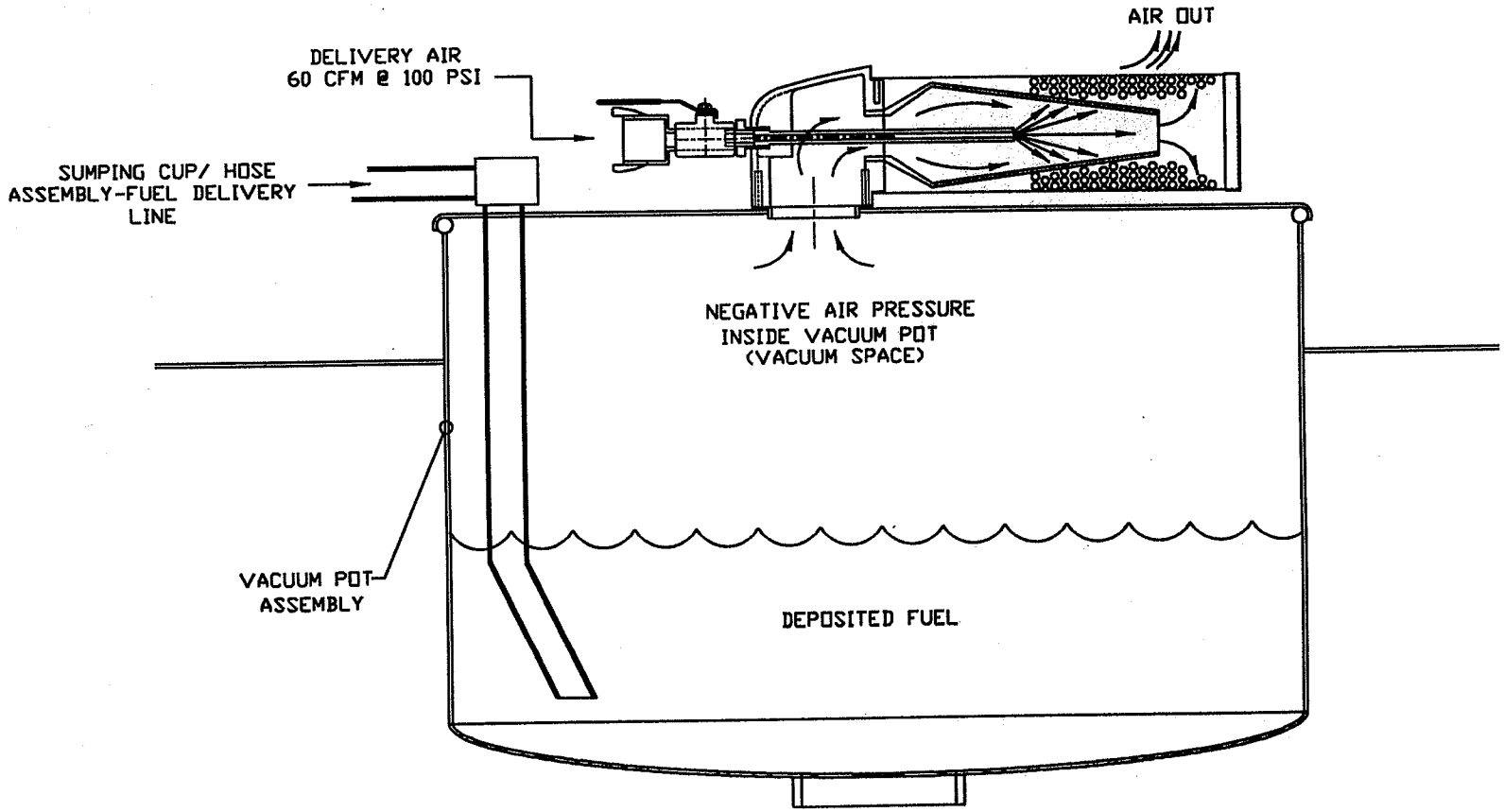
SECTION 18
UNIVERSAL SUMPING ASSEMBLY



HIGH SPEED AIR PRESSURE CREATES A NEGATIVE PRESSURE INSIDE THE VACUUM POT THERE BY EVACUATING THE AIR OUT OF THE VACUUM POT AND CREATING SUCTION IN THE SUMPING CUP/ HOSE ASSEMBLY, SUCKING FUEL INTO THE VACUUM POT REPLACING THE NEGATIVE VOID.

SECTION 18

UNIVERSAL SUMPING ASSEMBLY



SECTION 18

UNIVERSAL DRAIN ASSEMBLY (UDA)

SAFETY

The vacuum generator is an air-operated generator. An air supply of 40 to 60 CFM @ 80 to 100 PSI is recommended to operate this system. Smaller capacity air supply will result in decreased performance.

Check the air pressure of supply lines to the vacuum generator to assure it is not in excess of 100 PSI.

Parking brake must be applied when operating the vacuum system.

The vacuum system should never be used inside of an enclosed area. Proper ventilation is required at all times.

Due to the nature of fuel, care should be exercised to eliminate all sparks and open flames in the area of the vacuum system.

To eliminate static sparks, prior to operating the vacuum system connect the grounding reels to the proper ground and to the Aircraft to be defueled.

A 50-foot radius area around the fuel bowser for no smoking, sparks or open flames is usually a good practice. It is strongly recommended all local or other regulations be consulted for further restrictions.

If other objects such as rock or metallic pieces are vacuumed into the vacuum system they may create a hazard due to sparks.

Prior to any defueling to the aircraft you must insure proper venting to the aircraft fuel tanks or fuel cells or damage to the aircraft will occur.

SECTION 18

UNIVERSAL DRAIN ASSEMBLY (UDA)

OPERATIONS

18.0 Safety Note: Review Safety Section prior to operating or maintaining (UDA).

18.1 Operation

18.1.0 Setting up the Universal Drain Assembly (UDA) with the suction fuel delivery lines to the aircraft low point pencil drains:

1) (Item #C4) on the drawing shows a set of probe tips with the same diameters and different lengths. The service technician will have to determine which length works best for the type of pencil drain provided with the aircraft. Thread the selected probe tip into the probe (Item # C1)
(NOTE: If you choose a tip length too short no or little flow occurs. If you choose a tip length too long, proper sealing between (Item #B1) and the aircraft will not be achieved and the unit could fall and be damaged.)

2) A good clean sealing surface is required around the pencil drain for the sumping cup, (Item #B1), to vacuum seal. If the aircraft has seams or uneven surfaces an artificial mating surface may need to be considered.

3) There is a check valve provided, (Item #A5), on the ¼ inch clear tube line. Insure this check valve is installed, and that the direction of flow goes from (Item #B1) toward (Item #A9). This line is required for providing a vacuum area between the inner and the outer gasket seals(Items # B2 & B3) provided with the sumping cup.

4) Connect the female quick coupler (Item # A9) on each of the ¼ inch clear lines to the male quick couplers (Item #H2) and manifolds (Item # H1) located on the vacuum generator cover.

4) Connect the opposite end of the ¼ inch clear line assembly (Item #A4) to the sumping cup (Item #B1) 1/8 inch NPT port that is provided.

6) Connect the male quick coupler (Item E1) on each black ½ inch line x 25 Feet long, to the female quick couplers (Item # F4) located on the vacuum lid assembly.

7) Connect the male quick coupler (Item #D3) on each black ½ inch line x 3 feet long to the female quick coupler (Item # E2) on the black ½ inch line x 25 feet long.

8) Install the vacuum probe (Item #C1) into the sumping cup center (Item # B1) by inserting probe and turning 90 degrees to lock into place.

9) Cover the inner and outer gasket seals (Items #B2 & B3) with a light coat of petroleum jelly.

10) Close each of the 1/8 inch slider valves (Item #A3) located on the sumping cups where the ¼ inch clear lines attach to the sumping cups by sliding the knurled valve ring away from the sumping cup.

11) Connect 1/2 inch minimum air supply line to the vacuum generator inlet twist coupler making sure that both vacuum generator ball valves are in the off position. (Note: the air supply recommended is 40 to 60 CFM at 80 to 100PSI) (Note: make sure that all aircraft fuel tank or fuel cell vents are open prior to any defueling or damage to the aircraft will occur.)

12) Turn on the small vacuum generator (Item #J1) by opening the ¼ inch ball valve (Item #J6) located on the left side of the centered main vacuum generator on the top of the vacuum lid.

13) Align the vacuum probe (Item #C1) with the proper tip (Item #C4) installed to the aircraft "POP-IT" (pencil) low point drain on the wing and the fuselage low point drains.

14) Open the 1/8 inch slide valve (Item #A3) on the selected cup (Item #B1) to attach to aircraft by moving the knurled ring toward the sumping cup and attaching the cup/probe (Items #B1 & C3) into the low point drain making sure probe tip is centered on the low point drain.

15) Observe the clear ¼ inch line (Item #A4) for fuel leaking past inner seal (Item #B3). If any fuel is present in the ¼" inch line (Item #A4) remove sumping cup assembly (Item #B1) by reversing the previous directions. Re-seal or replace the seals (Items #B2 & B3) as required.

16) Turn on the large vacuum generator by opening the ½ inch ball valve located on the centered main vacuum generator on the top of the vacuum lid.

17) Slowly open up the 1/2 inch quick coupler ball valves (Item #F2) located on the vacuum lid for only the black ½ inch lines to be used, watching for leaks and seepage past the seals. Repair as required to stop any leaks.

18) Reinstall sumping cup if required.

19) Commence with defueling operation only when all observations prove a proper seal tight operation.

20) Once the operation has started the fuel is delivered from the aircraft to the vacuum.

21) For the intermittent vacuum type units only:
the vacuum chamber is equipped with an automatic drain valve that opens when vacuum is eliminated in the chamber. This valve opens directly into the main tank.

22) The vacuum generator is equipped with a float actuated automatic overflow shutoff. When the vacuum chamber or the tank is full the float valve shuts off and eliminates the vacuum. (On the intermittent type units the vacuum chamber will then automatically drain and the air supply must be shut off to reset the overflow valve before defueling can continue.)

18.2 Maintenance

1) The vacuum generator is supplied with a filtered exhaust silencer. Remove and wash this with soap and water. Thoroughly dry and reinstall as needed.

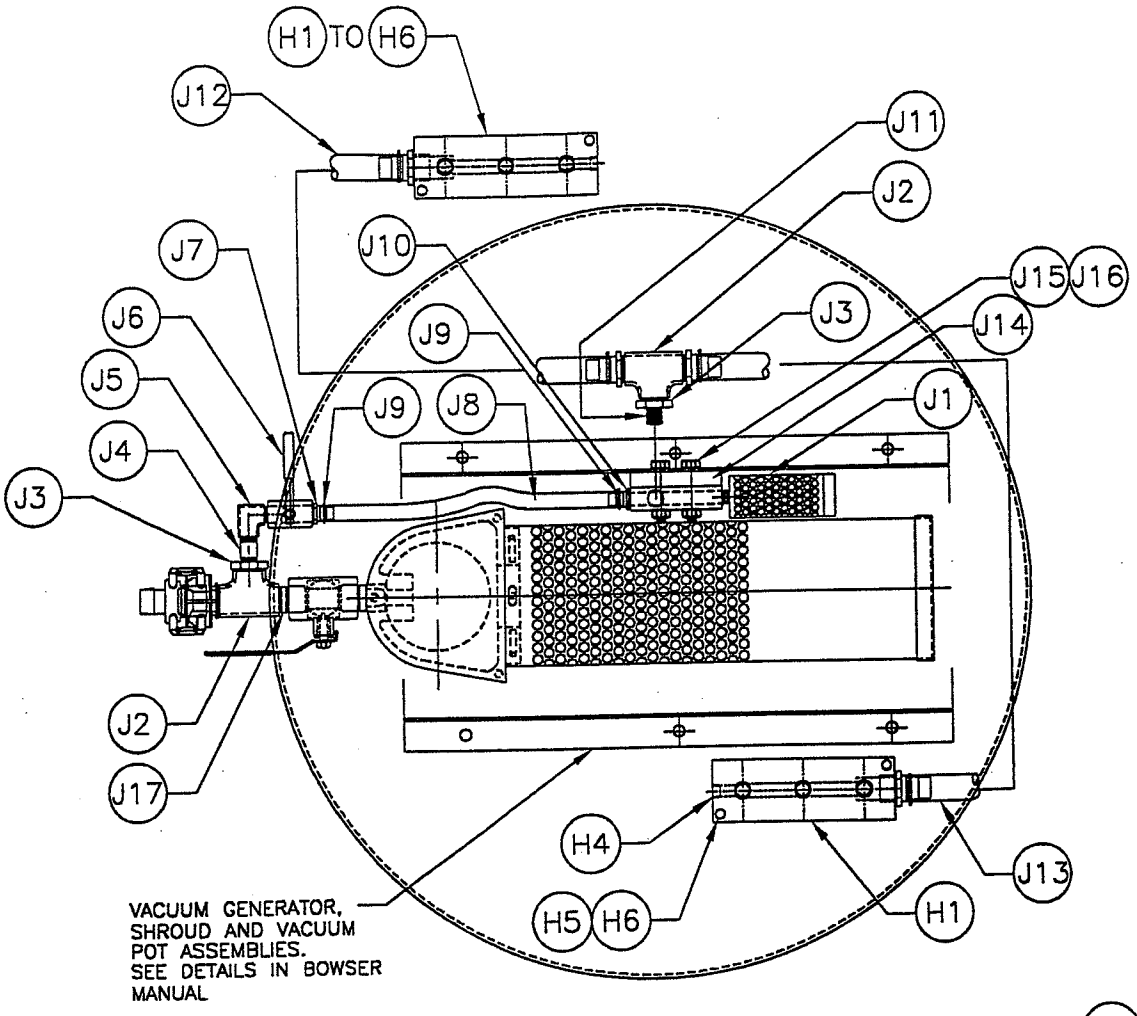
2) All vacuum hoses should be inspected regularly for cracking. Any sudden loss of vacuum suction power may indicate a crack in the hose lines, replace if any cracks, deformation or any leakage is visible.

3) Check both inner and outer sumping cup seals prior to each usage, Replace if any cracks or deformation is visible.

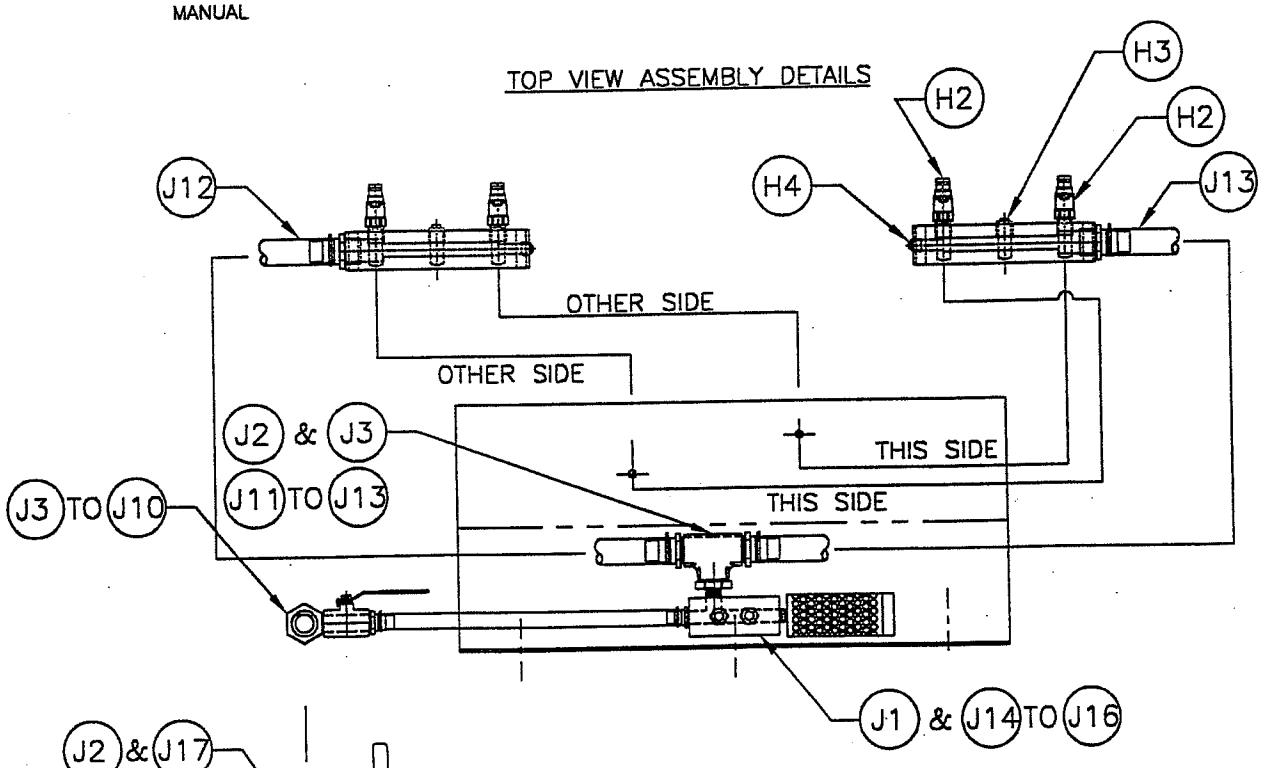
4) Check the "O-Ring" Seal on the probe prior to each usage replace if any cracks or deformation is visible.

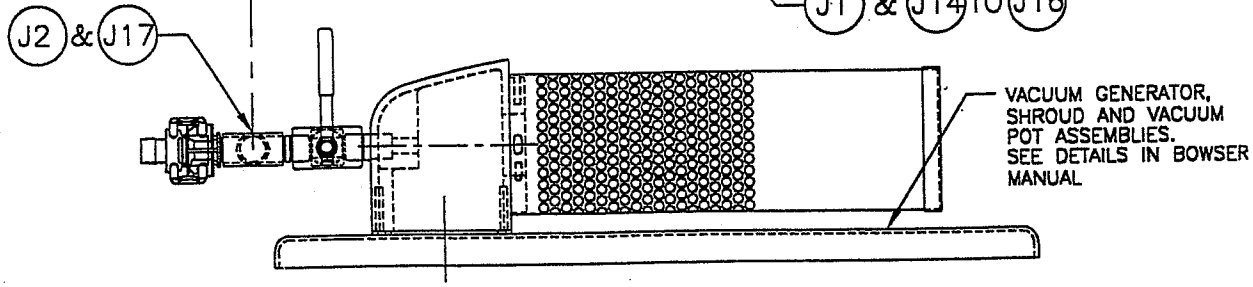
5) Check probe tips to ensure that they are not bent or damaged, replace as required.

6) Check all components regularly

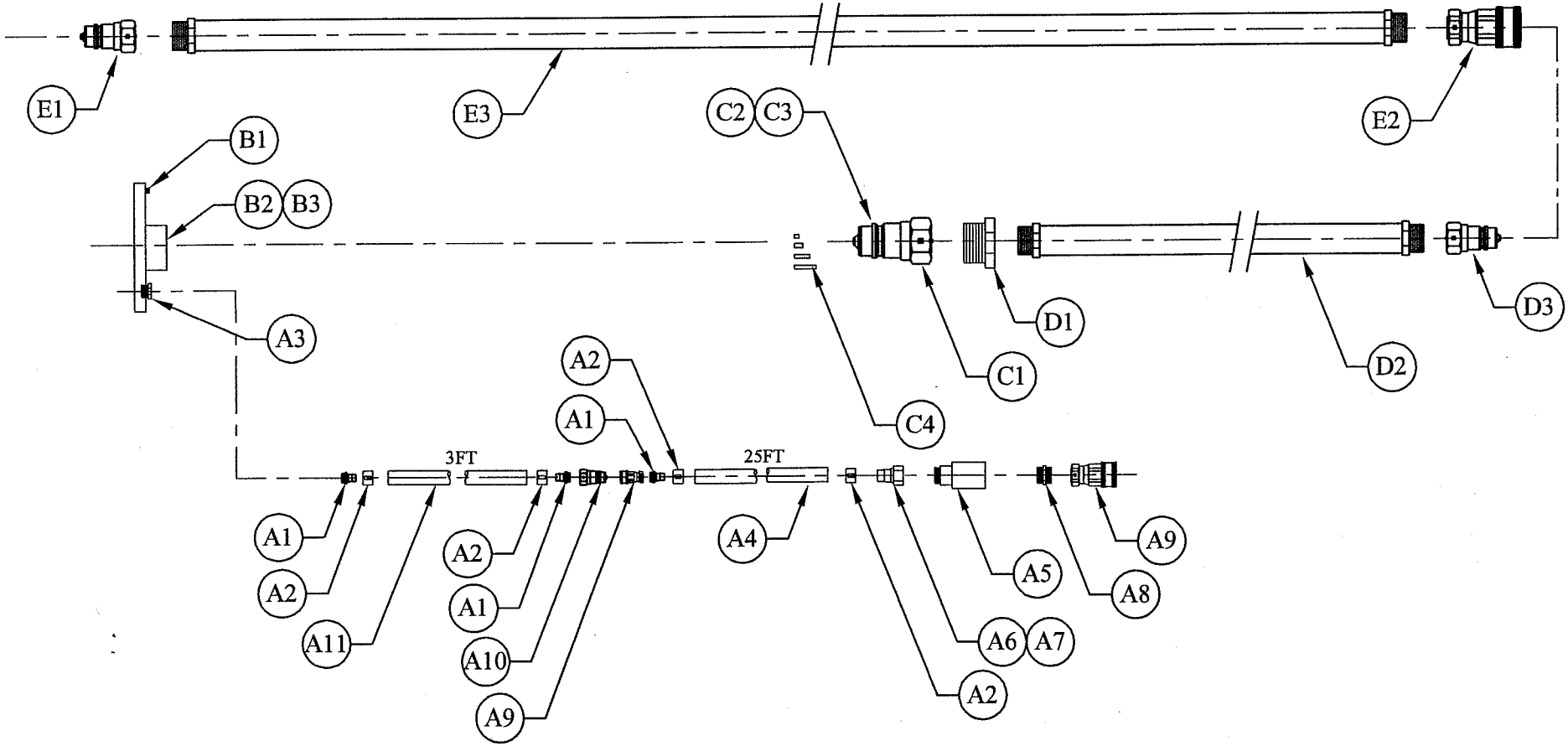


TOP VIEW ASSEMBLY DETAILS





SIDE VIEW ASSEMBLY DETAILS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C3
E2
B1
B2
B3
A3
C1
D1
D2
D3
C4
A2
A1
3FT
25FT
A1
A2
A11
A2
A1
A10
A9
A4
A5
A8
A9
A6
A7
A2

Section 18.0

Assembly Part No. 08-14000

Universal Drain Assembly (UDA)

Item No.	PART #	QTY.	DESCRIPTION
08-14001	**Assembly**	**4**	**Sumping Cup assembly, consisting of :**
A1	03-111334	1	HOSE BARB, BRASS 1/8 NPT x 1/4"Barb #29-42
A2	03-10105	2	CLAMP, OITKER 1/2 #11/13
A3	04-10325	1	Slider valve, 1/8" Brass, #250
A4	06-2526	1	TUBING, 1/4 X 1/2 OD PVC X 25'-0" #510
A5	04-10099	1	CHECK VALVE, BRASS, LINDE #639110
A6	03-111336	1	HOSE BARB ADAPTOR, BRASS, LINDE #17
A7	03-111337	1	NUT, BRASS, LINDE #7
A8	03-111338	1	BUSHING, BRASS, LINDE #32
A9	03-111398	1	QUICK DISCONNECT 1/4 FEMALE #BH2-60
08-0200	**Sub-Assembl**	**1**	**Sumping cup sub-assembly consisting of:**
B1	05-1040	1	SUMPING CUP,MACHINED ALUMINUM
B2	06-0075	1	Seal, 4.75" OD, Viton (40 Dur), 3/16 X 1/2 (R/S 06-0072)
B3	06-0074	1	Seal, 2" ID, Viton (40 Dur), 3/16 X 1/2 (R/S 06-0072)
B4	06-00688	1	O-Ring Part No. 430-B, 5-5/8" OD, 5-1/8" ID
08-14006	**Assembly**	**4**	**3foot pigtail/probe, consisting of :**
08-0100	**Sub-Assembl**	**1**	**Vacuum fuel probe sub-assembly , consisting of:**
C1	05-1037	1	PROBE, MACHINED ALUMINUM
C2	02-1350	2	Roll Pin, .3/32" OD x 1/4" LG. #92373A139 18-8 SS
C3	06-00684	1	O-RING PART NO. 2- 214
C4	01-9187S	5	Probe pins, 8-32 thread /.204/.366/.616/.866/1.50 Lg SS
08-0150	**Sub-Assembl**	1	Hose,probe pigtail sub-assembly, consisting of:
D1	03-10155	1	BUSHING,BRASS, 3/4 TO 1/2 #3220 X 12 X 8
D2	06-10166	1	Aircraft Defueling hose, 1/2" x 3'Lg w/ 1/2" M-NPT ends
D3	03-111395	1	QUICK DISCONNECT, 1/2 MALE, #BH4-61
08-14003	**Assembly**	**4**	**25 foot hose assembly, consisting of :**
E1	03-111395	1	QUICK DISCONNECT 1/2 MALE, #BH4-61
E2	03-111394	1	QUICK DISCONNECT 1/2 FEMALE, #BH4-60
E3	06-10166	1	Aircraft Defueling hose, 1/2" x 25'Lg w/ 1/2" M-NPT ends

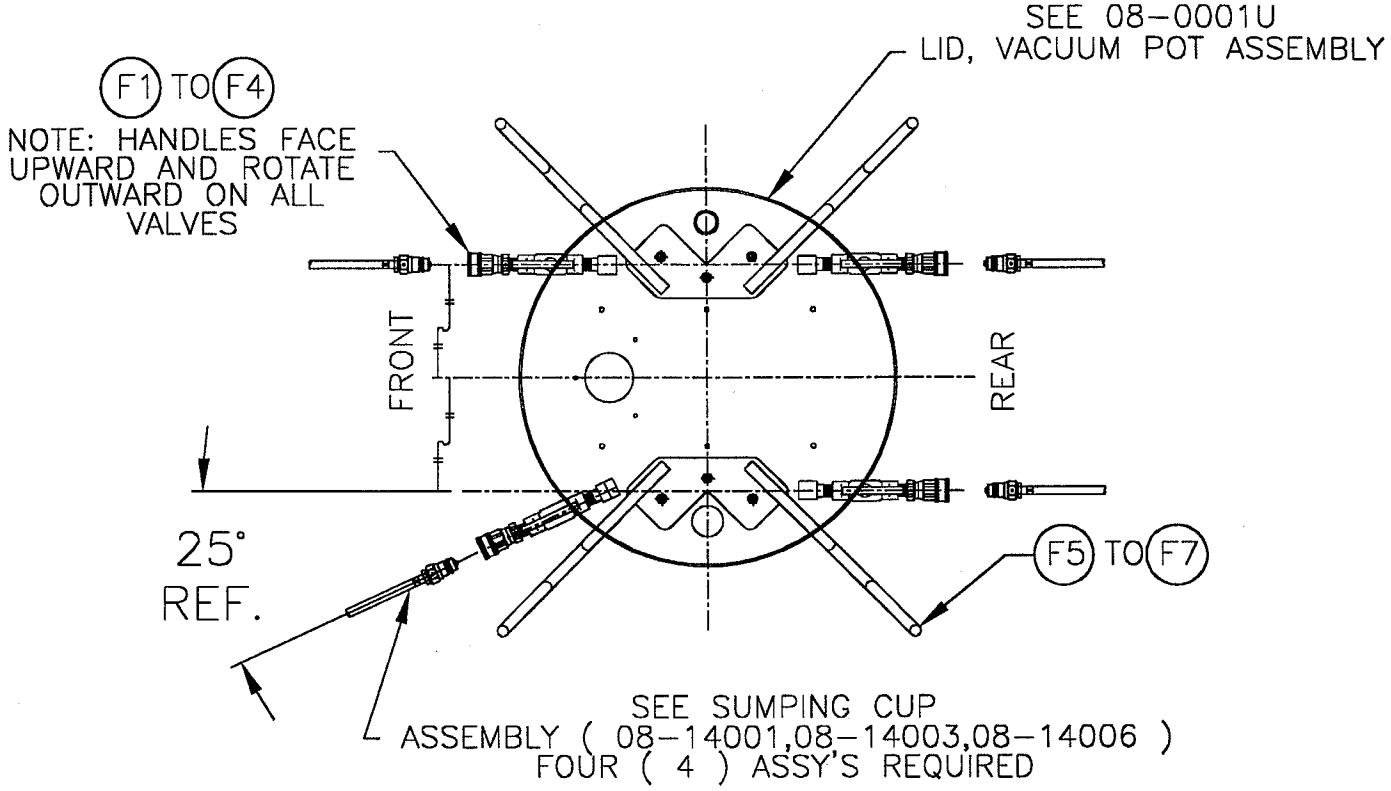
Continued

Section 18.0

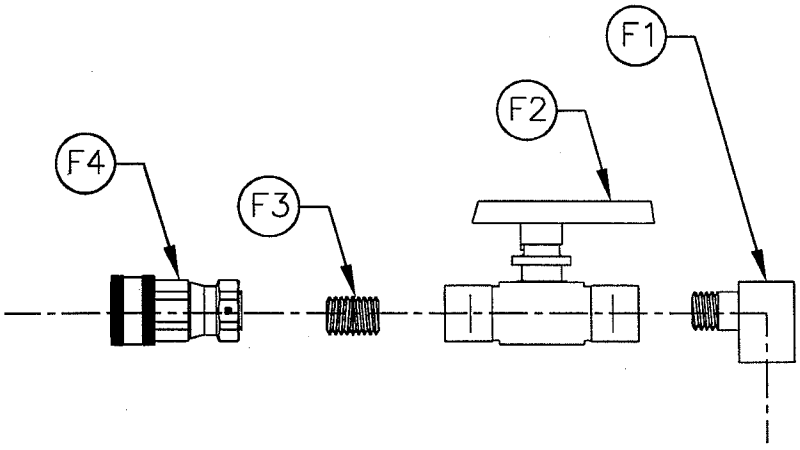
Assembly Part No. 08-14000

Universal Drain Assembly (UDA)

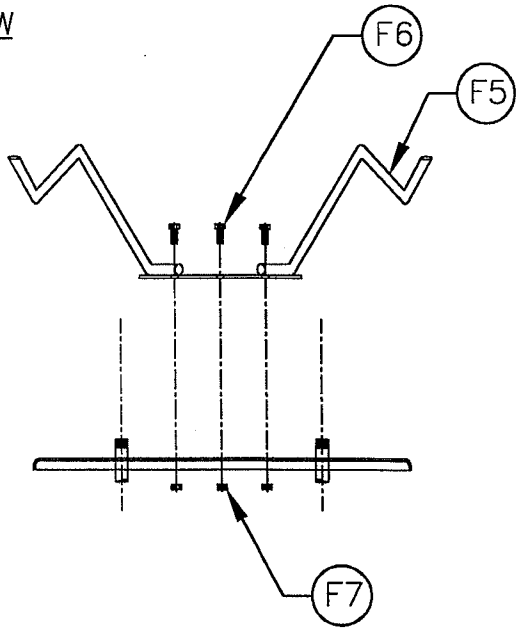
Item No.	PART #	QTY.	DESCRIPTION
08-14004	**Assembly**	**1**	**Sumping probe adaptors, consisting of :**
F1	03-1006	4	Elbow, Brass street, 1/2 #3400-8
F2	04-2507	4	VALVE,BRASS, 1/2 APOLLO BALL #70-103-01
F3	03-10081	4	CLOSE NIPPLE,BRASS, 1/2 #3326-8
F4	03-111394	4	QUICK DISCONNECT, 1/2 FEMALE, #BH4-60
F5	07-1075	2	SUMPING HOSE SUPPORT BRACKET
F6	02-100115	6	BOLTS, 3/8" NC 1" LG.T-304SS
F7	02-1202	6	NUTS. 3/8" NC NYLOC, T-304SS
08-14002	**Assembly**	**1**	**Vacuum Mainfold Assembly, consisting of:**
H1	05-1046	2	Vacuum mainfold blocks, Machined Aluminum
H2	03-111397	4	QUICK DISCONNECT, 1/4 MALE #BH2-61
H3	03-10252	2	PLUG, BRASS, 1/4 NPT #3151-4
H4	03-10015	2	PLUG, BRASS, 1/8 NPT #3151-2
H5	02-10015	4	BOLT, HEX, 5/16 X 1-3/4 LG. T-304 SS
H6	02-12012	4	NUT, 5/16 T-304 SS
08-14005	**Assembly**	**1**	**Vacuum pump Assembly, consisting of:**
J1	04-100035	1	Vacuum Pump, 1/8" Intake/1/4" Outlet, #41605K14
J2	03-10058	2	Tee, 1/2" Brass #3700-8
J3	03-11135	2	Bushing, 1/2" x 1/4" Brass #3220-8-4
J4	03-10692	1	Nipple, 1/4" x 1.5" lg Brass # 3327-4
J5	03-11136	1	Street El, 1/4" x 90 #3400-4
J6	04-2506	1	Valve, Ball, 1/4" Brass #70-101-01
J7	03-11133	1	HOSE BARB, BRASS 1/4 NPT x 1/4"Barb #29-44
J8	06-2526	1	TUBING, 1/4 X 1/2 OD PVC X 12" #510
J9	03-10105	2	CLAMP, OITKER 1/2 #11/13
J10	03-111334	1	HOSE BARB, BRASS 1/8 NPT x 1/4"Barb #29-42
J11	03-10690	1	CLOSE NIPPLE,BRASS,1/4 #3325-4
J12	06-10166	1	Aircraft Defueling hose,1/2" x 22" Lg w/ 1/2"M-NPT ends
J13	06-10166	1	Aircraft Defueling hose,1/2" x 24" Lg w/ 1/2"M-NPT ends
J14	01-8425	1	Shim Block, 1/2" x 1-1/4" x 3" Aluminum
J15	02-1510	2	Slotted Head Capscrew, #10-32 x 1-3/4" SS
J16	01-1210	2	Hex Nut, #10-32 SS
J17	03-10081	1	CLOSE NIPPLE,BRASS, 1/2 #3326-8



TOP ASSEMBLY VIEW



VALVE ASSEMBLY



HOSE HANGER SUPPORT BRACKET

SPOKANE INDUSTRIES, INC.

SPOKANE METAL PRODUCTS DIVISION
Spokane Washington

VACUUM GENERATOR AND UNIVERSAL SUMPING CUP ASSEMBLY ONE YEAR LIMITED WARRANTY

Seller warrants its "Vacuum Generator and Universal Sumping Cup Assembly" to be free from defects in material and workmanship under the normal use and service for which the unit is intended if, but only if the unit has been properly operated, maintained and stored in accordance with printed directions contained in the product manual. Our obligation under this warranty shall be limited to the repair or exchange of equipment and parts which may prove defective within one year of the date the unit is put into service but shall in no event extend beyond a date two years from the date the unit is shipped from our plant. All transportation charges on parts returned to us for replacement under this warranty must be returned pre-paid.

This warranty does not extend to damages caused by environmental factors varying from normal design conditions, whether natural or man-made, or to units subjected to misuse, negligence or accident. This warranty likewise does not extend to the unit or any parts thereof which have been repaired or altered improperly or in any way so as to effect adversely its stability or reliability. This warranty does not cover parts or labor required to repair or replace parts whose usefulness is exhausted due to normal operation of this unit.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE NOT SET FORTH IN A WRITING SIGNED BY AN AUTHORIZED REPRESENTATIVE OR SELLER. SELLER SHALL IN NO EVENT BE LIABLE FOR ANY CONSEQUENTIAL LOSS OR DAMAGE RESULTING FROM THE USE OR LOSS OF USE OF THIS UNIT.

VOIDED 11-2003

OBSOLETE

PRIOR TO 11/03

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UDA)

			onsisting of :
			NPT x 1/4"Barb #29-42
			/13
			:50
			/C X 25'-0" #510
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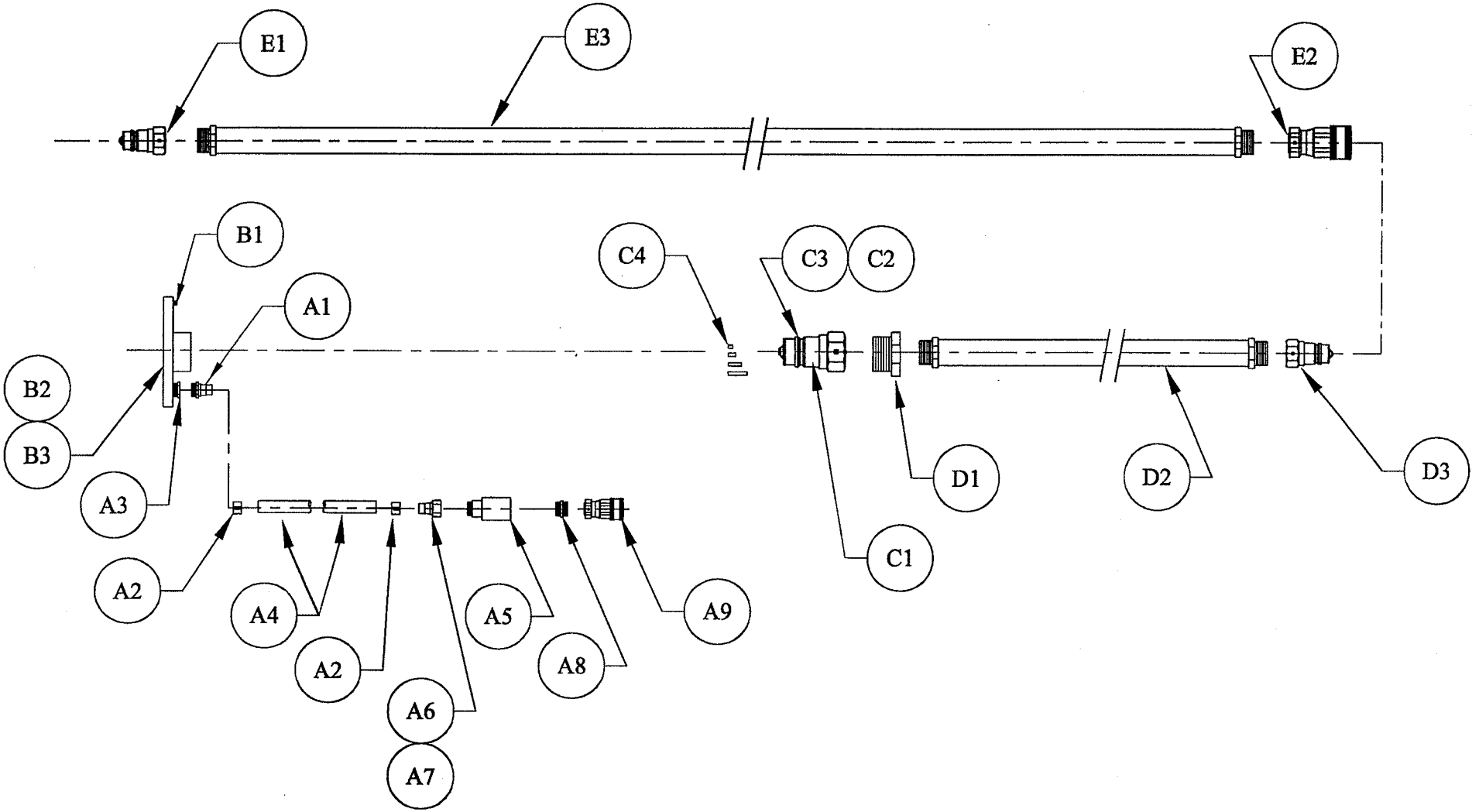
D3	03-111395	1	QUICK DISCONNECT, 1/2 MALE, #BH4-61
08-14003	**Assembly**	**4**	**25 foot hose assembly, consisting of :**
E1	03-111395	1	QUICK DISCONNECT 1/2 MALE, #BH4-61
E2	03-111394	1	QUICK DISCONNECT 1/2 FEMALE, #BH4-60
E3	06-10166	1	Aircraft Defueling hose, 1/2" x 25'Lg w/ 1/2" M-NPT ends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