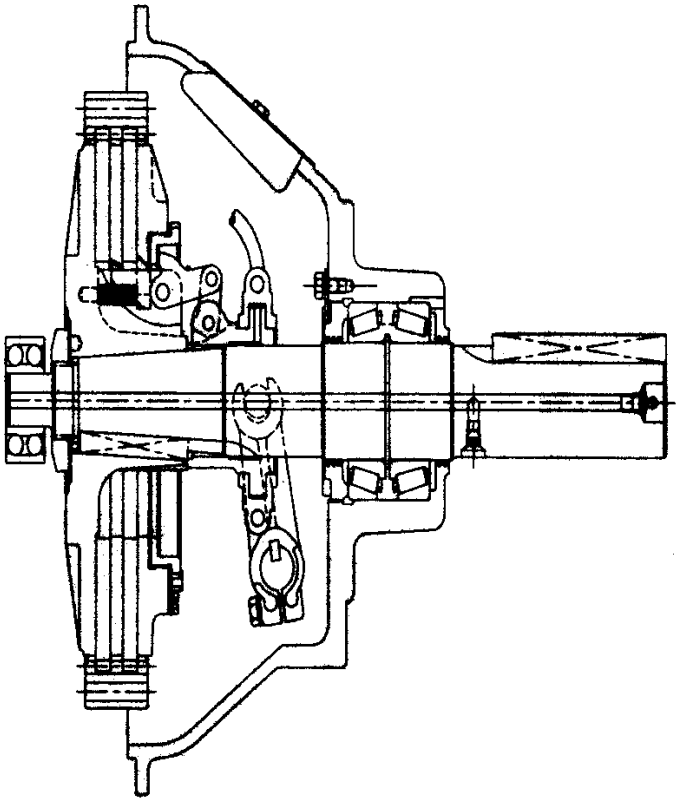
NACD®

North American Clutch & Driveline

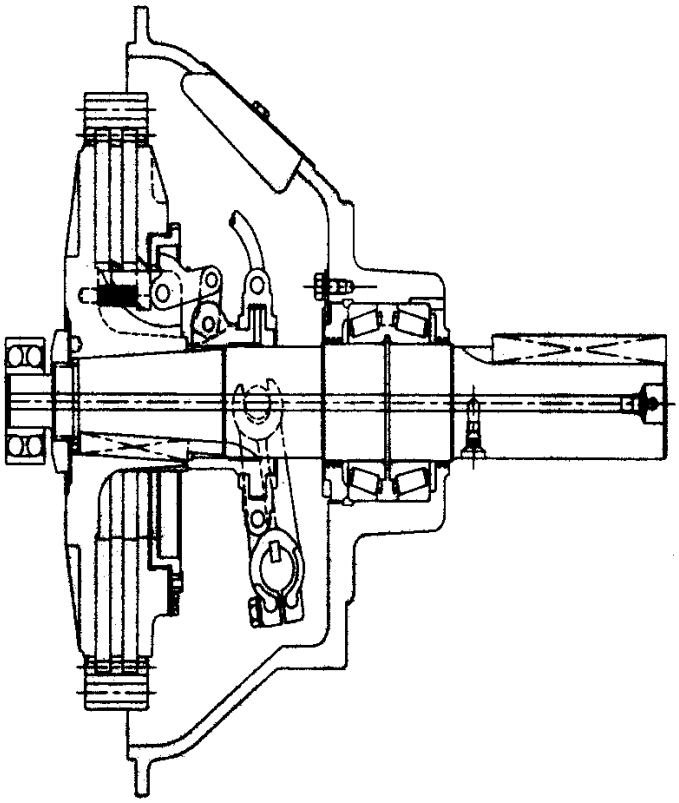


NACD Power Take-Off Service Manual

1019021AM

6.5", 7.5", 8", 10", and 11.5" HE Clutches

Includes Installation, Operation, Maintenance and Overhaul Instructions



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Phone: (800) 383-9204
(815) 282-7960
Fax (815) 282-9160
www.naclutch.com

North American Clutch & Driveline
Rockford, Illinois

NOTICE
IMPORTANT INFORMATION

It is imperative that proper installation, maintenance, operation and safety procedures be followed explicitly regarding products by North American Clutch & Driveline.

GENERAL:
Safe working and operating practices must be employed by all personnel working on, with, or near NACD products. NACD will not be responsible for personal injury.

SAFETY NOTICE:
Accidents may result from use of manufactured products, resulting in possible danger to person(s) or property. Therefore, it is important and imperative that correct, safe procedures be followed. Products must be installed, maintained, operated and used in accordance with the engineering information specified. Continual and repeated inspections and observations should be employed as necessary to assure that safe operations and a safe environment exist under prevailing conditions. Use proper guards and other suitable safety equipment, devices and procedures that may be desirable or specified in safety codes, or as necessary to prevent accidental injury to person(s) or property. These devices are neither provided by NACD nor are they the responsibility of NACD.

OWNER / OPERATOR / USER RESPONSIBILITIES:
Knowledge of and performance of the procedures specified in this publication are the responsibility of the owner(s), operator(s), user(s) and all person(s) working on or near the products described herein. Following these procedures and explicit adherence to the information described should ensure safe and reliable use, repair, and operation of products provided by NACD.

WARRANTY:
NACD's limited Warranty is described in detail in this publication. It is the responsibility of the original purchaser or manufacturer, successive buyers, users, third parties or employees to make themselves aware of this warranty and all conditions it contains.

TABLE OF CONTENTS

1.0 INTRODUCTION

Performance of the following procedures by the owner and operator should ensure reliable PTO operation.

1.1 Part Numbering System

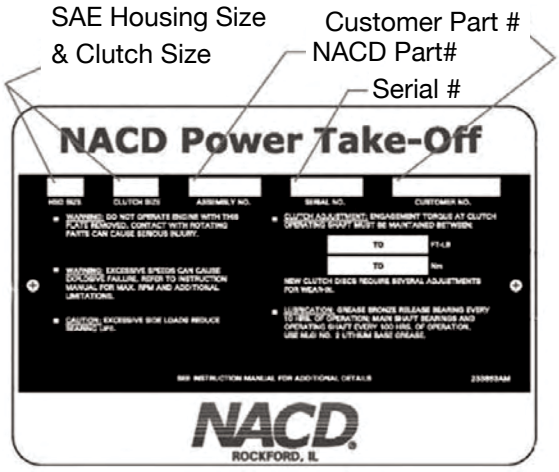
NACD Power Take-Off part numbers have changed in the way they were displayed in print over the years, primarily due to advances in technology.

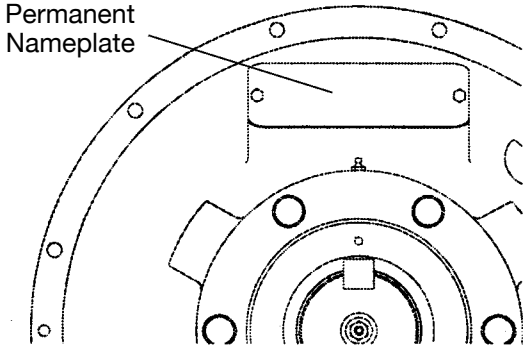
The part number format for the NACD Power Take-Off is 4XXXXXAM, where XXXXXX is a 5 digit alpha number unique to that particular assembly. Sub-assemblies or Kits are designated 3XXXXXAM and individual components are designated 2XXXXXAM, where XXXXX is a 5-digit alpha number unique to that particular sub-assembly, kit or component.

Previous numbers may have been displayed as:
4-XXXXX, 40XXXXX, 04XXXXX, or 4-0XXXXX. The unique 5-digit number remains unchanged, regardless of how the prefix may have been written at one time or another.

1.2 Locating the Part Number & Serial Number

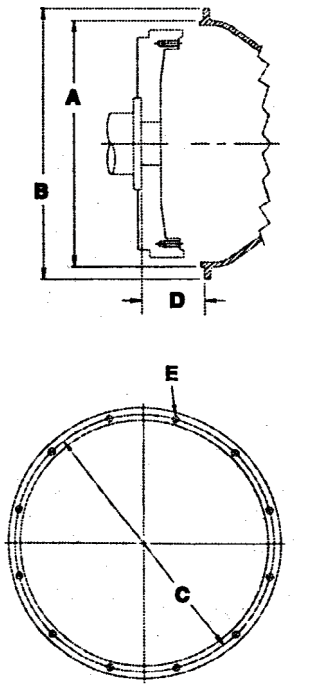
Refer to the nameplate for part number and serial number information. The serial number will be stamped into the bell housing in the location shown in the bottom picture.





2.0 GENERAL INFORMATION, SPECIFICATIONS & RECOMMENDATIONS

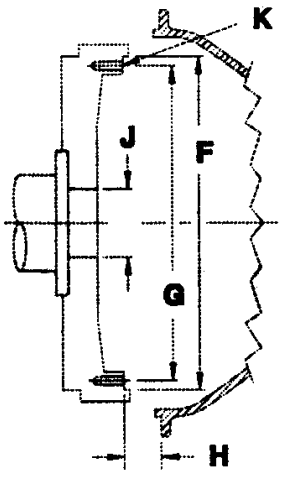
2.1 Basic Dimensions for SAE Housings



SAE Hsg No.	Pilot Diam.	O.D.	Bolt Circle	(See Note Below)	Flywheel Housing Bolts & Bolt Holes "E"		
	"A"	"B"	"C"	"D"	Qty	Hole Dia.	Bolt Size
"1"	20.125	21.75	20.875	3.94	12	.484	7/16
"2"	17.625	19.25	18.375	3.94	12	.433	3/8
"3"	16.125	17.75	16.875	3.94	12	.433	3/8
"4"	14.250	15.88	15.000	*	12	.433	3/8
"5"	12.375	14.00	13.125	*	8	.433	3/8
"6"	10.500	12.12	11.250	2.81	8	.433	3/8

All dimensions are in inches unless otherwise specified.
*3.94 for 8" clutch; 2.81 for 6" and 7" clutch
"D" = Depth of pilot bore from housing face shoulder on flywheel or to crankshaft flange face.

2.2 Basic Dimensions for SAE Flywheels



Clutch Size	Drive Ring Pilot	Bolt Circle	Bolt Circle	Pilot Bearing Bore	Bolt Hole "K"	
	"F"	"G"	"H"	"J"	Qty	Size
6.5"	8.500	7.875	1.19	2.0472 (52mm)	12	.484
7.5"	9.500	8.750	1.19	2.0472 (52mm)	12	.433
8"	10.375	9.625	2.44	2.4409 (62mm)	12	.433
10"	12.375	11.625	2.12	2.8346 (72mm)	12	.433
11.5"	13.875	13.125	1.56	2.8346 (72mm)	8	.433

All dimensions are in inches unless otherwise specified.

2.3 Application Guidelines

2.3a In-Line (torsional) vs. Side Loaded Applications

NACD Power Take-Offs with 6.5" HE, 8" HE, 10" HE, 11.5" HE, and 11.5" HE(DP) clutches are approved for either in-line drive or side-loaded applications within allowable limits.

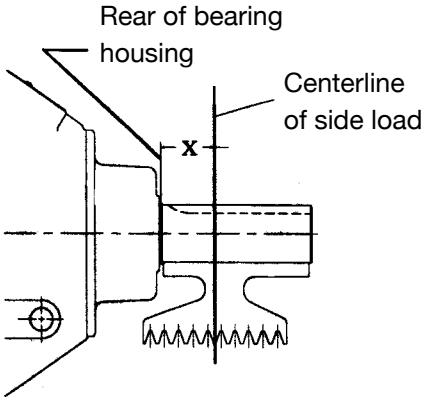
2.3b Segmented Facings in 2-Plate (DP) Clutches

NACD does not approve the use of segmented facings in 2-plate (DP) clutches.

2.4 Allowable Side Load Pulls

The following formula can be used to estimate applied side loads. Loads are calculated on proper tensioning of belts. If belts are tightened excessively, the resulting side load can exceed the calculated valve. If belts are under-tightened, belt "whip" and other resultant factors can cause intermittent side load pulls which exceed allowable limits.

$$L = \frac{126000 \times H.P.}{N \times D} \times F \times A$$



L = Predicted Side Load
H.P. = Horsepower
N = Shaft Speed (rev./min.)
D = Pitch Dia. of Pulley (in)
F = Load Factor (see below)
1.0 for Chain or Gear Drive
2.5 for V-Belt Drive
3.5 for Flat Belt Drive
A = 1.0 for Low & Moderate Duty Drives
1.4 for Severe Shock Loads or Large Inertia Loads (Reciprocating Compressors, Crushers, Chippers, Planers, etc)

Note: Side load charts are not furnished for some Power Take-Offs because the pilot bearing is provided by the customer. Pilot bearing size and type are integral to allowable side load pull calculations. Therefore allowable side load charts cannot be furnished unless bearing information is known.

NACD's Application Engineering Department can furnish side load charts for those Power Take-Off part numbers if the exact pilot bearing information is furnished.

2.5 Maximum Safe Operating Speeds

Maximum safe operating speeds of NACD Power Take-Offs with HE or HE (DP) clutches used for either in-line or side load drives are shown below:

6.5" HE	3700 RPM
7.5" HE	3400 RPM
8" HE	3250 RPM
10" HE	3000 RPM
11.5" HE	2800 RPM
11.5" HE (DP)	2800 RPM

2.6 Required Clutch Torque Capacity

To determine the actual torque capacity required of a clutch used for any given application the maximum engine torque and torque service factor must be considered. See the following chart and formula to calculate the proper clutch capacity required for the application.

Required Clutch Torque Capacity Calculation:

Torque Service Factors	
Blower or Vacuum	
Centrifugal with free flow of air	1.7
With high start-up inertia or subject to choking of air supply	4.0
Compressors	
Reciprocating, 1 or 2 cylinders	4.0
Reciprocating, 3 or more cylinders	2.5
Roto screw or turbine	2.0
Conveyor	
Fed uniformly	1.5
Not fed uniformly	2.0
Reciprocating	3.0
Drills	2.0
Generator	2.0
Pump	
Centrifugal	1.5
Dredge	2.0
Mud or reciprocating	3.0
Rock Crusher, Hammer Mill	3.0
Snow Blower	2.0
Wood Chipper, Saw Mill	3.0

Ratings: Shafts, bearings and clutch capacities are rated on a conservative basis. For usually heavy starting loads, frequent engagement service, or if prime mover is engine of less than 4 cylinders, consult NACD's Application Engineering Department for recommendations. Extremely low speed engines require special consideration.

Required Clutch Torque= Maximum Engine Torque x Service Factor.

2.7 Alignment Tolerances for Flywheels and Flywheel Housings

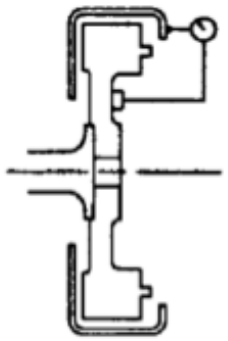
NOTE: NACD recommends that engine flywheel housings used with NACD PTOs be made of quality cast iron or other material of equal or better strength. Aluminum flywheel housings have been found to provide insufficient strength to properly maintain bearing alignment and support the weight and forces related to the application.

Check the alignment of the engine flywheel and the engine flywheel housing. Excessive bore and face run out of the flywheel, flywheel housing, and flywheel housing adapters, if used, can adversely affect the performance of the PTO and the system of which it is a part. A dial indicator will be required to measure alignment.

2.7.a Flywheel housing face runout deviation check

Mount the indicator base on the face of the flywheel and position the dial indicator tip perpendicular to the flywheel housing mounting flange face. Rotate the flywheel through 360 degrees.

NOTE: The flywheel and crankshaft of the engine must be held against either the front or rear of the crankshaft thrust bearing while the total indicator sweep (TIR) measurement is being made.

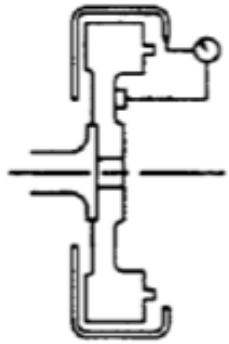


The total indicator reading should not exceed:
SAE #1, #2, #3 Housing .008 (.203mm)
SAE #4, #5, #6 Housing .006 (.152mm)

NOTE: Identify SAE housings. See Basic Dimensions for SAE Housings section 2.1 for identification of SAE Housings.

2.7.b Flywheel housing bore runout deviation check

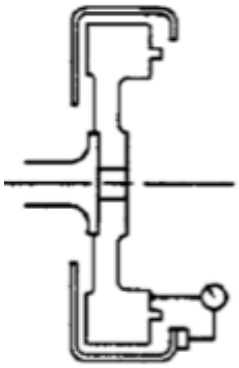
Mount the indicator base on the face of the flywheel and position the dial indicator tip so its movement is perpendicular to the pilot bore surface of the flywheel housing. Rotate the flywheel through 360 degrees.



The total indicator reading should not exceed:
SAE #1, #2, #3 Housing .008" (.203mm)
SAE #4, #5, #6 Housing .006" (.152mm)

2.7.c Flywheel housing face runout deviation check

Mount the indicator base on the flywheel housing and position the dial indicator tip so its movement is perpendicular to the face of the flywheel. The indicator tip should be positioned near the drive ring mounting bolt circle diameter. Rotate the flywheel through 360 degrees.



NOTE: The flywheel and crankshaft of the engine must be held against either the front or rear of the crankshaft thrust bearing while the total indicator sweep (TIS) measurement is being made.

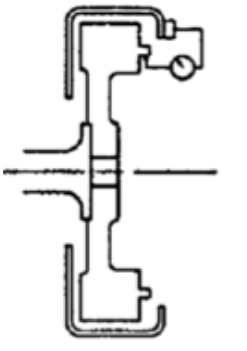
Measure the diameter of the drive ring bore in the flywheel.

Clutch Size (ref)	Drive Ring Bore Dia.	Maximum T.I.R.
6.5" HE	8.5" (21.59cm)	.004" (.102mm)
7.5" HE	9.5" (24.13cm)	.005" (.127mm)
7.5" HE	11.125" (28.26cm)	.006" (.152mm)
8" HE	10.375" (26.35cm)	.005" (.127mm)
8" HE	11" (27.94cm)	.006" (.152mm)
10" HE	12.375” (31.43cm)	.006" (.152mm)
10" HE	13" (33.02cm)	.007" (.178mm)
11.5" HE	13.875" (35.24cm)	.007” (.178mm)
11.5" HE	15.5" (39.37cm)	.008" (.203mm)

2.7.d Flywheel drive ring pilot bore runout deviation check

Mount the indicator base on the flywheel housing and position the dial indicator tip so its movement is perpendicular to the drive ring pilot bore surface of the flywheel. Rotate the flywheel through 360 degrees.

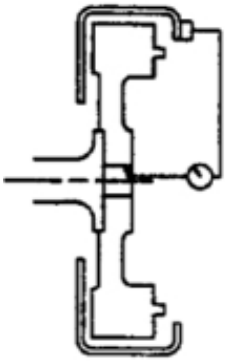
The total indicator reading should not exceed: 0.005 inches (0.127 mm)



2.7.e Flywheel pilot bearing bore runout deviation check

Mount the indicator base on the flywheel housing and position the dial indicator tip so its movement is perpendicular to the pilot bearing bore surface of the flywheel. Rotate the flywheel through 360 degrees.

The total indicator reading should not exceed:
0.005 inches (0.127 mm)



3.0 MAINTENANCE

3.1 Lubrication Requirements

3.1.a Grease Specification

USE ONLY NGLI (National Grease and Lubrication Institute) APPROVED High grade, lithium base #2, short fibre grease with an EP (extreme pressure) additive recommended for use in high speed roller bearings operating at 200 degrees F. (93.3 degrees C.)

3.1.b Grease specifications for special conditions

For ambient temperatures above 100 degrees F (37.8 degrees C), contact NACD for specifications

GREASE CAUTION: Do not mix sodium or calcium based greases with lithium grease. Do not mix different types of greases under any circumstances in NACD Power Take-Offs. Do not use molybdenum disulfide grease.

3.2 Lubrication Intervals

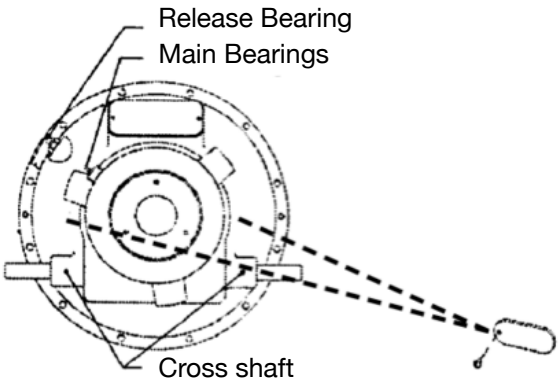
The following lubrication intervals are suggested as the guidelines. The owner/operator is responsible for establishing lubrication intervals appropriate to the duty cycle and environmental operating conditions to which the PTO is subjected

3.2.a Release bearing-bronze:

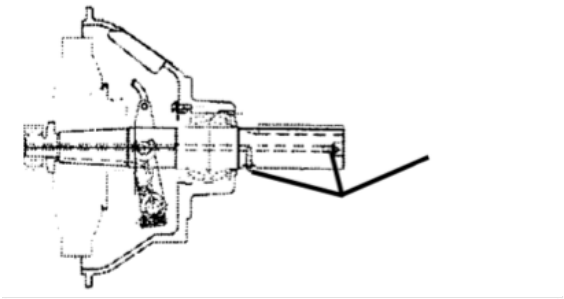
Using a hand operated grease gun, add 1 or 2 pumps of grease every 8-10 hours of operation (or add grease until grease begins to weep from the ID of the bearing and from between the release sleeve and the shaft). Rotate the shaft (by hand) while adding grease. Do not over-grease!

3.2b Release sleeve used with non-greasable bearing:

Using a hand operated grease gun, add 1 or 2 pumps of grease per 500 hours of operation (or add grease until grease begins to weep from between the release sleeve and the shaft). Rotate the shaft (by hand) while adding grease. Do not over-grease!!



NOTE: On some models the grease fitting on the release bearing must be accessed by opening or removing a small cover located on the side of the housing.



Pilot bearing

(Some PTO shafts have 2 possible grease locations; one location will be plugged and the other will have a grease fitting. If the PTO uses a non-greaseable cartridge type pilot bearing, both locations will be plugged or the shaft will have no drilled passageways at all.)

3.2.c Main bearings:

Grease every 100 hours of operation. Add grease until grease is forced out of the labyrinth seal(s) around the shaft. Manually (not by starting the engine) rotate the shaft while adding grease.

3.2.d PTO cross shaft:

Grease every 500 hours of operation. Add one or two pumps of grease from a hand operated grease gun.

3.2.e Clutch linkage and levers:

Lubricate sparingly with engine oil every 500 hours of operation.

3.2.f Pilot bearing: (except non-greasable type)

Using a hand operated grease gun, add 1 or 2 shots of grease per 100 hours of operation.

3.2.g Pilot bearing: (non-greasable type)

Cartridge-type pilot bearings are sealed units and require no additional lubrication.

The lubrication intervals and the amount of grease used should be adjusted to minimize the amount of grease forced out of the housing and the clutch release bearing. A small amount of grease driven from the housing and clutch release bearing is an indication that enough grease is being provided.

3.3 Bearing Operating Temperature

3.3.a Main Bearing:
Operating temperature range is normally between 170 degrees F, and 200 degrees F (76.7 degrees C to 93.3 degrees C). Locations with high ambient temperatures such as desert climates will cause the bearings to operate at a higher temperature. More frequent lubrication intervals and/or specialized grease designed for higher operating temperatures will be required. See following note.

NOTE: There is a tendency to test temperature with the hand. However, it is difficult to hold a hand on a bearing housing operating at 150 degrees F (65.6 degrees C) although that temperature is below the normal 170 degree F (76.7 degrees C) operating temperature of the PTO. Therefore a thermometer (contact type) should be used to make reasonably accurate temperature measurements.

3.4 Methods of Measuring Clutch Engagement Force

The model 6.5" HE, 7.5" HE, 8" HE, 10" HE, 11.5" HE and 11.5" HE (DP) clutches described in this manual do not automatically adjust to compensate for wear of the clutch facing(s), and therefore must be manually adjusted. Maintaining the correct engagement pressure is the responsibility of the owner/operator. The owner/operator must periodically adjust the clutch to ensure correct clutch operation. See section 3.5. The clutch should be adjusted if the force required to engage the clutch drops by 10-15% of the specified engagement force. Destructive damage may have already occurred if engagement force is allowed to diminish to the point where the clutch fails to carry the load (slippage), or if facing(s) have overheated.

CAUTION: Torque wrench readings are in FOOT-POUNDS, which are different values from spring scale readings which are in POUNDS OF FORCE. There is no direct correlation between FOOT-POUNDS and POUNDS OF FORCE. Do not confuse the two different kinds of values.

NOTE: New clutches or new facings usually require several, frequent adjustments until the friction facing surfaces have "worn in". The clutch friction facing plate(s) will become glazed, and possibly permanently damaged if the clutch is permitted to slip excessively.

NOTE: If the facings have been slipped excessively, and enough heat was generated that the facings began to smoke, the clutch material may have been destroyed. Excessive heat normally destroys the friction material. Therefore further clutch adjustment will not remedy slippage problems. Replace "burned" facing

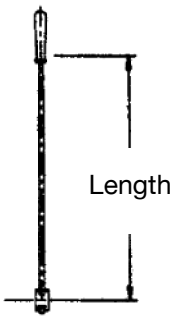
NOTE: See addendum A on page 54 for engagement torque settings.

3.4.a Torque wrench method (preferred method)

A torque wrench should be used at the cross shaft to measure engagement force. The following chart shows torque readings that represent proper clutch engagement force. The clutch should ENGAGE within the torque readings shown.

An adapter, NACD part number 236484AM, may be obtained to provide a 1.5" hex nut at the end of the cross shaft. The adapter may be used in place of the standard handle for the purpose of checking clutch adjustment with a torque wrench, or it may be installed on the end of the cross shaft opposite the standard handle. (Most PTOs have serrations on both ends of the cross shaft.) All NACD handles are cast with this hex.

3.4.b Spring scale method using a standard handle



Determine whether the engagement force is correct. Measure the distance from the bottom of the handle grip location to the center of the cross shaft. Attach a spring scale to the handle at the location specified below and pull the scale perpendicular to the handle to measure the force required to engage the clutch.

Handle Length Cross Shaft to Grip	**Release Yoke Length**	**Engagement Force**	
12” (30.48cm) 6.5" HE SAE #4, #5, #6	3.0" (7.62cm)	45 - 65 lbs (200-289N) 41 lbs. (182 N) 38 lbs. (169 N)	Original Setting 10% decrease 15% decrease
12” (30.48cm) 7.5” HE SAE #4, #5, #6	3.0” (7.62 cm)	45 - 65 lbs (200-289N) 41 lbs. (182 N) 38 lbs. (169 N)	Original Setting 10% decrease 15% decrease
12” (30.48cm) 8” HE SAE #4	3.0” (7.62 cm)	60 - 80 lbs (267-356N) 54 lbs. (240 N) 51 lbs. (227 N)	Original Setting 10% decrease 15% decrease
16” (40.64 cm) 8” HE SAE #3	3.0” (7.62 cm)	45 - 60 lbs (200-267N) 41 lbs. (182 N) 38 lbs. (169 N)	Original Setting 10% decrease 15% decrease
12” (30.48cm) 10” HE SAE #4	3.0” (7.62 cm)	95-120 lbs (423-534 N) 85 lbs (378 N) 81 lbs (360 N)	Original Setting 10% decrease 15% decrease
16” (40.64 cm) 8” HE SAE #2, #3	3.0” (7.62 cm)	70-90 lbs (311-400N) 63 lbs. (280 N) 59 lbs. (262 N)	Original Setting 10% decrease 15% decrease
21” (53.34 cm) 10” HE SAE #1	3.0” (7.62 cm)	55- 70 lbs (245-311N) 50 lbs. (222 N) 47 lbs. (209 N)	Original Setting 10% decrease 15% decrease
16” (40.64 cm) 11.5” HE & HE(DP) SAE #4	3.0” (7.62 cm)	75 - 95 lbs (334-423N) 68 lbs. (302 N) 64 lbs. (284 N)	Original Setting 10% decrease 15% decrease
21” (53.34 cm) 11.5” HE & HE(DP) SAE #1	3.0” (7.62 cm)	60 - 75 lbs (267-334N) 54 lbs. (240 N) 51 lbs. (227 N)	Original Setting 10% decrease 15% decrease
16” (40.64 cm) 11.5” HE(DP) SAE #2, #3	3.75” (9.53 cm)	95-120 lbs (423-534 N) 85 lbs (378 N) 81 lbs (360 N)	Original Setting 10% decrease 15% decrease
21” (53.34 cm) 11.5" HE(DP) SAE #1	3.75” (9.53 cm)	75-90 lbs (334-400 N) 68 lbs (302 N) 64 lbs (284 N)	Original Setting 10% decrease 15% decrease

3.4.c Spring scale method with altered or special handle length

Engagement force for standard handle lengths is shown in 3.4.b. For other handle lengths, use the following formula and refer to the following charts.

$$X = \frac{1.15 \times (A \times Y)}{B}$$

X Engagement force at attachment point	lbs force	(newtons)
Y Engagement force at clutch release bearing	lbs force	(newtons)
A Length of clutch release yoke	inches	(centimeters)
B Length of handle (cross shaft to attachment point)	inches	(centimeters)

Clutch Size and Type	**Value A**	**Value Y**
6.5” HE	3.0” (7.62cm)	175-200# (778-887N)
7.5" HE	3.0” (7.62cm)	175-200# (778-887N)
8” HE	3.0” (7.62cm)	225 - 250# (1001 - 1112N)
10” HE	3.0” (7.62cm)	350-375# (1557 - 1668N)
11.5” HE	3.0” (7.62cm)	375 -400# (1668 - 1779N)
11.5” HE(DP)	3.0” (7.62cm)	375-400# (1668 - 1779N)
11.5” HE(DP)	3.75” (9.53cm)	375-400# (1668 - 1779N)

3.5 Clutch Adjustment Procedure

If the clutch requires adjustment, remove the PTO nameplate, disengage the clutch and rotate it to gain access to the adjusting ring lock.

With a flat blade screwdriver or 7/16" wrench, loosen the adjustment lock bolt (417) and loosen or remove the adjustment lock (419). (See illustration in section 6.2.a)

Rotate the adjusting ring counter-clockwise to tighten the clutch. Rotating the adjustment ring clockwise will loosen the clutch. Adjust to obtain the proper handle engagement force by using one of the methods shown in section 3.4. (Torque wrench method in 3.4.a is the preferred method.)

When clutch is poorly adjusted, reposition the adjustment lock in the notches. Install and tighten the adjustment lock bolt.

Repeat the procedure in 3.4.a, 3.4.b, or 3.4.c, to recheck for proper engagement force.

NOTE: A new clutch installation usually requires several adjustments until the friction facing surfaces have “worn in”. The clutch facing(s) will become glazed, and possibly permanently damaged, if the clutch is permitted to slip excessively.

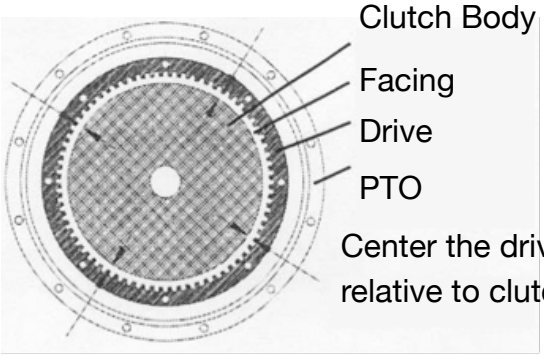
4.0 INSTALLATION INFORMATION

4.1 Preparation

Do not disengage the clutch before installing the PTO on the engine. Disengagement allows the clutch plates to slip out of the correctly aligned positions established at NACD.

4.1.a If the facing plates have become misaligned, they may be realigned by using the drive ring as a gauge. If the plates require alignment, follow the procedure outlined below.

4.1.b Support the PTO unit with the output shaft hanging straight down. Blocks or a hoist can be used to hold the PTO in position.



4.1.c Use the clutch drive ring provided with the PTO or remove the drive ring from the engine flywheel to use as an alignment gauge. Place the drive ring over the clutch facings with the clutch disengaged. Mesh the drive teeth of the facings with the drive ring and align the facings by centering the drive ring relative to the OD of the clutch body. While holding the drive ring and facings centered, engage the clutch.

4.1.d Remove the drive ring.

4.2 Flywheel and Flywheel Housing Alignment Checks
It is strongly recommended that the dial indicator checks be made (as shown in section 2.7) prior to installation of the PTO, especially on new engines or when bearing failures or shaft wear were found after the previous PTO was removed and examined for cause of failure.

4.3 Lubrication Required Before Installation

4.3.a See section 3.1 for information on the type(s) of lubricant(s) required.

4.3.b Lubricate as follows before installation.
(See illustration in section 3.2 for locations of grease fittings.)
Release bearing: (except non-greasable type)
Bronze and greasable ball-type release bearing:

With a hand operated grease gun, add 1 or 2 pumps of grease per 8-10 hours of operation (or until grease begins to weep from the I.D. of the bearing and the release sleeve. Rotate the shaft (by hand) while adding grease. Do not over-grease!!

Release bearing: (non-greasable type)
Non-greasable ball bearing type release bearing:
Sealed bearing- no lubrication required.
Release sleeve used with non-greasable bearing:
Using a hand operated grease gun, add 1 or 2 pumps of grease per 8-10 hours of operation (or add grease until grease begins to weep from between the release sleeve and the shaft). Rotate the shaft (by hand) while adding grease. Do not over-grease!!

Main bearing:
With a hand operated grease gun, add 1 or 2 pumps of grease while rotating the shaft (by hand), or until grease weeps from the labyrinth seals around the shaft at either end of the bearing housing.

Pilot bearing lube passage:
Some PTOs have a hole drilled through the length of the shaft to provide lube to the pilot bearing. The grease fitting may be located either at the end or to the side of the output shaft. Add grease until the center passage is filled with grease. Be sure that the shipping plug is removed from the pilot bearing end of the shaft prior to installation.

Cross shaft:
With a hand operated grease gun add 1 or 2 pumps of grease into each of the grease fittings located in the PTO housing, near each end of the cross shaft.

4.4 Install the PTO on the Engine

4.4.a Install the drive ring on the engine flywheel.
Be sure that the ring is seated in the locating bore. Use USA SAE Grade 5 bolts (or equivalent) with lock washers. Torque the bolts according to the chart below.

Clutch Size and Type	Bolt Size	Torque Specification
6.5” HE	5/16-18	15-18 ft-lbs (20 - 24 Nm)
7.5” HE	5/16-18	15-18 ft-lbs (20-24 Nm)
8" HE	3/8-16	26 - 35 ft-lbs (35 - 43 Nm)
10” HE	3/8-16	26 - 35 ft-lbs (35 - 43 Nm)
11.5” HE	3/8-16	26 - 35 ft-lbs (35 - 43 Nm)
11.5” HE(DP)	3/8- 16	26 - 35 ft-lbs (35 - 43 Nm)

Use the engine manufacturer's torque specifications if different from the above.
Some engines use metric bolts. Refer to engine manufacturer's torque specifications.

4.4.b (For greasable pilot bearing ONLY). If a pilot bearing adapter is used on the flywheel, be sure the mating surfaces between the adapter and the flywheel face are sealed, to prevent loss of grease from the pilot bearing grease cavity due to vacuum or centrifugal force. Loctite 515 or equivalent is suggested.

4.4.c Proceed as follows:
For greasable pilot bearing ONLY: (bearing has a grease shield on 1 side only)
Pack the flywheel pilot bearing cavity with grease. Install the pilot bearing in the flywheel or adapter with the grease shield of a greasable bearing towards the PTO and clutch. Be sure that the pilot bearing spacer, if used, is in place. Two types of spacers may be used. Spacers may be installed in the flywheel to keep the pilot bearing from going too far into the bore in the flywheel, and a spacer may be used on the pilot end of the PTO shaft between the pilot bearing and the PTO to help maintain proper pilot bearing location in the flywheel bore.

For non-greasable pilot bearing ONLY: (bearing has 2 grease seals.)

Non-greasable, double-sealed pilot bearings require no re-lubrication and may be installed in the flywheel or adapter with either side toward the PTO and clutch. The shaft should have no grease fittings. If it does, remove the grease fitting(s) and replace with pipe plugs as a precaution to insure grease is not forced into the pilot bearing cavity of the flywheel. A build-up of pressure caused by forcing grease into the cavity can cause the pilot bearing to be forced out of the flywheel, resulting in a bearing or shaft failure.

4.4.d Install the PTO with the cross shaft in a horizontal position.
Install two 5" long guide bolts in the flywheel housing holes, located approximately at the 3 o'clock and 9 o'clock positions. Position the PTO on the guide bolts to help align the unit and support the weight while the mounting bolts are installed.

Start the PTO shaft in the pilot bearing. Carefully align the clutch facing teeth with the teeth in the drive ring. Temporarily install longer bolts in 4 bolt holes 90 degrees apart, and tighten the bolts alternately and evenly to draw the PTO housing toward the flywheel housing. Replace the longer bolts with shorter ones as necessary, and tighten to draw the PTO into place. Then remove the temporary bolts and guide bolts, and replace them with proper mounting bolts. Install bolts and lock washers. Use USA SAE Grade 5 bolts (or equivalent) with lock washers. Torque bolts according to the following chart.

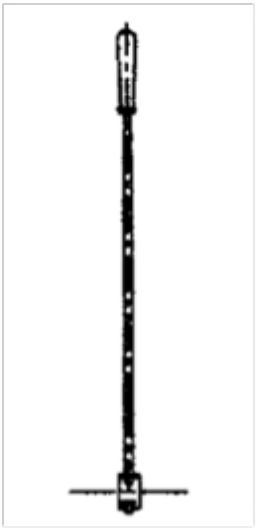
NOTE: Many engines use metric threads, so the below chart would not be applicable. Do not use bolts made with U.S. threads in holes with metric threads. The threads will be damaged, rendering them unusable.

SAE Housing Size	Bolt Size	Torque Specification
#1	7/16 -14	42-50 ft-lbs (57 - 68 Nm)
#2	3/8 - 16	26-35 ft-lbs (32 - 43 Nm)
#3	3/8 - 16	26-35 ft-lbs (32 - 43 Nm)
#4	3/8 - 16	26-35 ft-lbs (32 - 43 Nm)
#5	3/8 - 16	26-35 ft-lbs (32 - 43 Nm)
#6	3/8 - 16	26-35 ft-lbs (32 - 43 Nm)

Use the engine manufacturer's torque specifications if different from the above torque recommendation.

4.4.e Rap the output end of the shaft with a soft mallet to relieve any pre-load on the engine crankshaft that may have built up as a result of the pilot bearing's fit on the shaft pilot

4.5 Correct Handle Installation Position



Install the clutch handle or release mechanism. Position the handle so that it is pointing either straight up or straight down when the clutch is in the engaged position. Positioning the lever vertically minimizes loading on the release bearing.

If an altered or special clutch engagement mechanism is used (remote linkage mechanism is not recommended), be sure there is not pre-load on the release bearing either sideways or toward the engaged or released position. There should be no pre-load on the cross shaft in any direction, forward, rearward or sideways. A torsional and forward or rearward load (only) will be applied (only) during the engagement or disengagement cycle.

4.6 Check Clutch Engagement Pressure

The clutch was properly adjusted at the factory. However, due to variables created by first-time engagements, the clutch engagement pressure should be rechecked to insure proper clutch engagement pressure at the time of installation. See sections 3.4 and 3.5

NOTE: New clutches or new facings usually require several, frequent adjustments until the friction facing surfaces have "worn in". The clutch friction facing will become glazed, and possibly permanently damaged if the clutch is permitted to slip excessively.

4.6.a Adjust the clutch if necessary.

4.7 Attaching and Shimming an Outboard Shaft Support Bearing (OPTIONAL SUPPORT SPECIAL APPLICATIONS ONLY)

NOTE: Perform the following procedure carefully and precisely.
Misaligned bearings result in PTO failures.

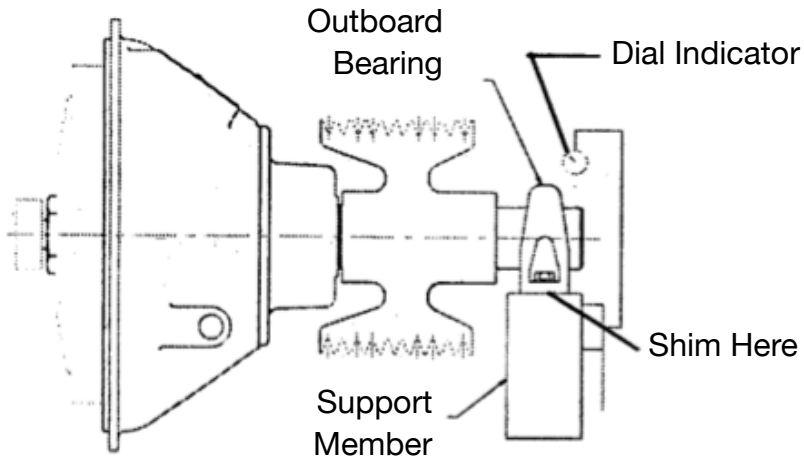
The following shimming procedures for shimming the outboard bearing must be carefully followed. It is imperative that the three (3) support bearings (pilot bearing, PTO main bearings(s) and outboard bearing) be in close alignment. The outboard bearing will help support the side loads imposed on the PTO shaft by the belts. If the three bearings are not installed so that the center of the PTO shaft is in a straight line, reduced bearing life will occur. It is therefore important that the internal PTO bearings be properly installed and adjusted, and that the outboard bearing NOT impose a load which would tend to bow the center line of the PTO shaft.

NOTE: NACD does not supply outboard bearings.

4.7.a The power take off must be bolted to the engine.

4.7.b Bolt and torque the outboard bearing support member to the frame.

4.7.c Install the outboard bearing on the PTO shaft in the position where it will later be tightened to the outboard bearing support member, but leave a small gap in the shim slot at this time.



4.7.d Secure (2) dial indicators to a solid base.
Place the points of the indicators on top and side of the shaft, as close as possible to the outboard bearing. Set the dial indicators to "0".

4.7.e Properly torque the bolts securing the outboard bearing to the support member.

4.7.f Read the dial indicator.
Add shims until the indicator reads 0+ 0.001 inches (0.0254mm) after installing and properly torquing the mounting bolts.

4.7.g Tighten the belts using accurate tensioning methods and an accurate belt tensioning gage. The belts should not be tightened until all the mounting bolts have been tightened. Make sure that the side loads are lower than those listed in the allowable side load tables in section 2.4.

5.0 OPERATION

5.1 Clutch Engagement Procedure

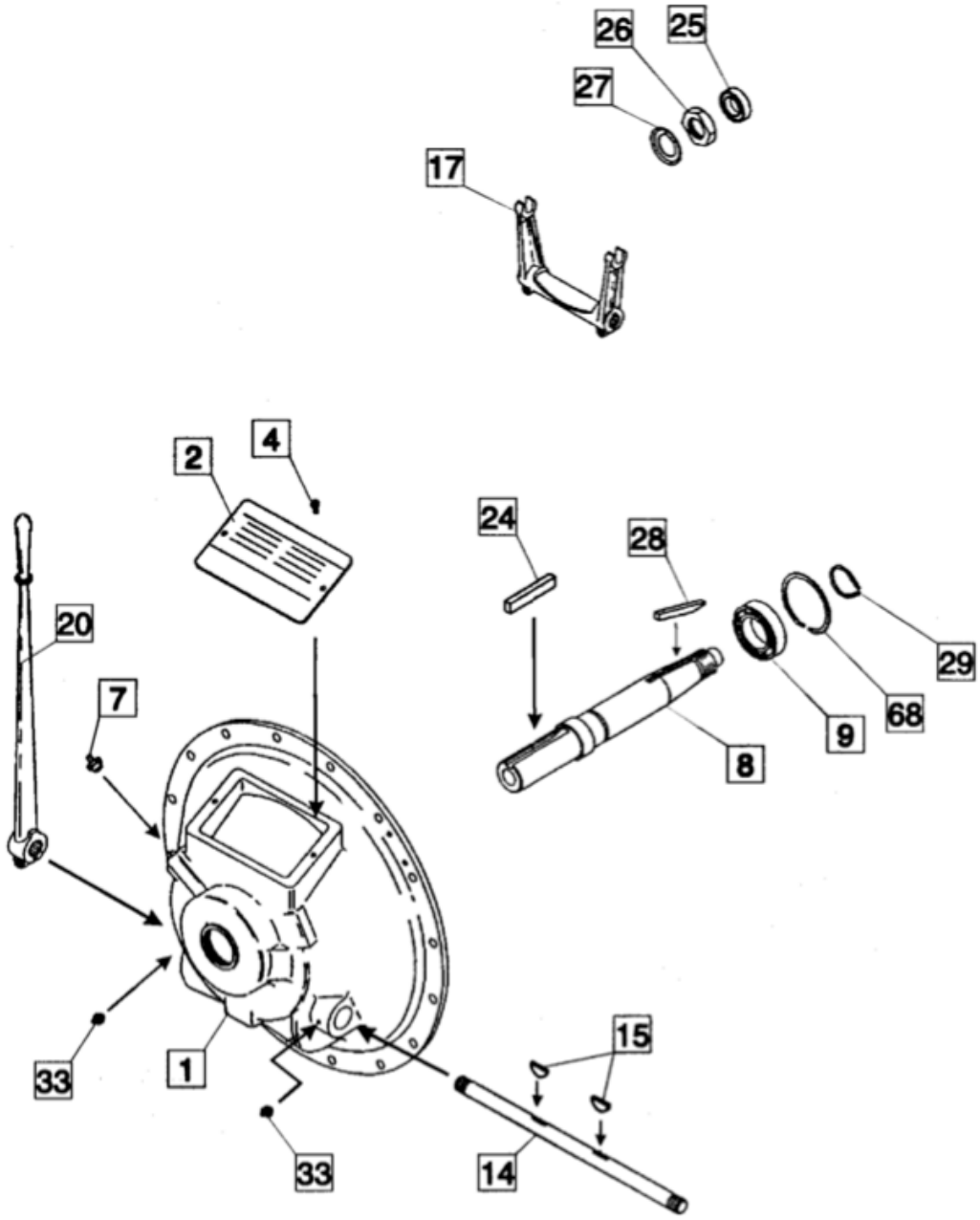
5.1.a The PTO clutch should normally be engaged with the engine operating below 1,000 RPM.
After the load has been brought up to engine speed, and the clutch is no longer slipping, the engine speed may be increased to operating speed.

5.1.b Where high inertia loads must be picked up, engaging the clutch at 1,000 RPM may result in stalling the engine.
Heavy inertia loads may be brought up to speed by a series of short engagements and disengagements at intervals long enough to prevent excessive heat build up in the facings. Under extreme circumstances, the engine may have to be operated at higher speeds while engagement occurs, but UNDER NO CIRCUMSTANCES should the clutch be slipped for more than a second or two without either fully engaging the clutch or completely disengaging the clutch to permit it to cool.

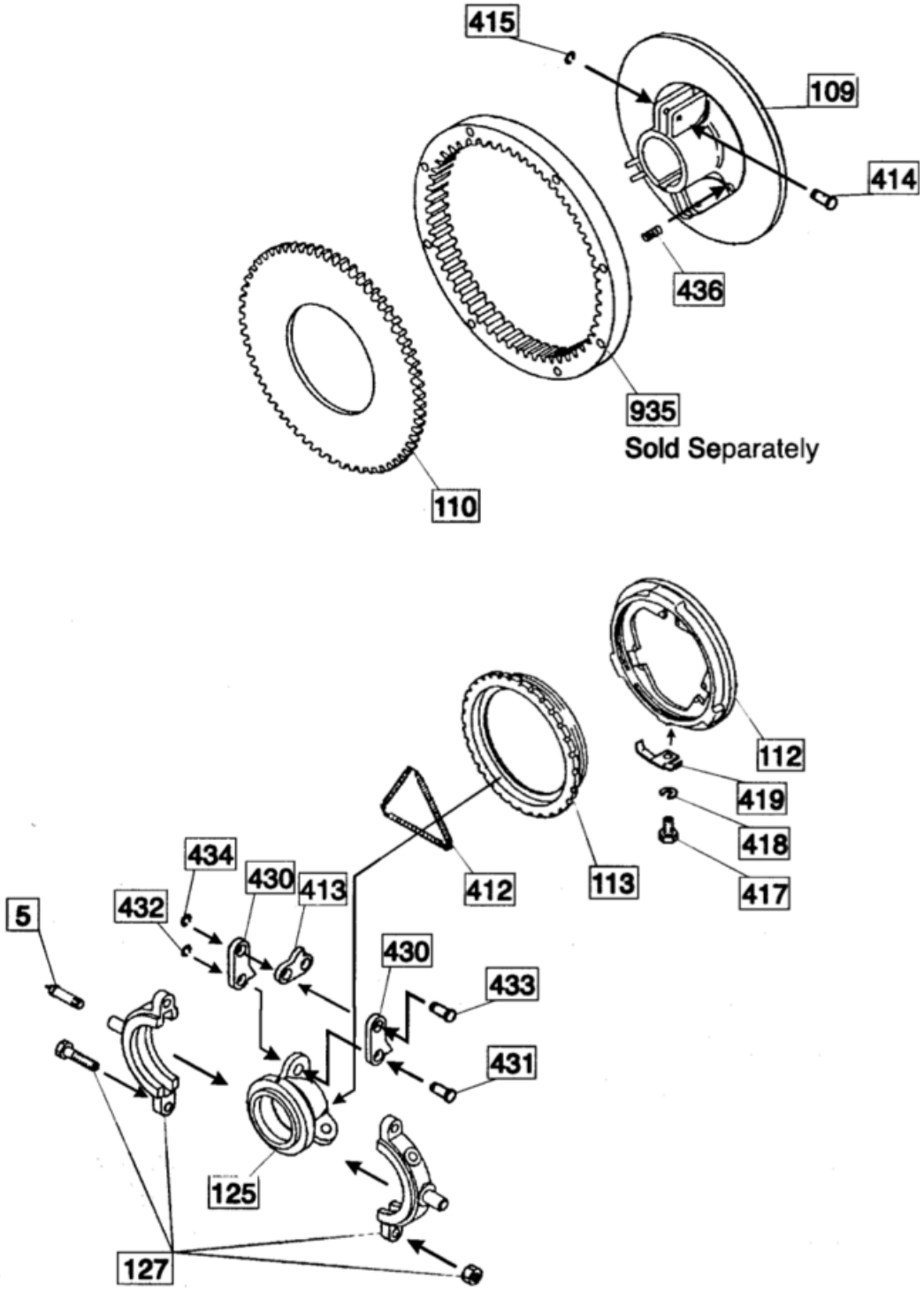
5.1.c Do not operate the power take-off with the clutch in the disengaged position for extended periods of time.

6.0 EXPLODED VIEWS - TYPICAL POWER TAKE-OFFS

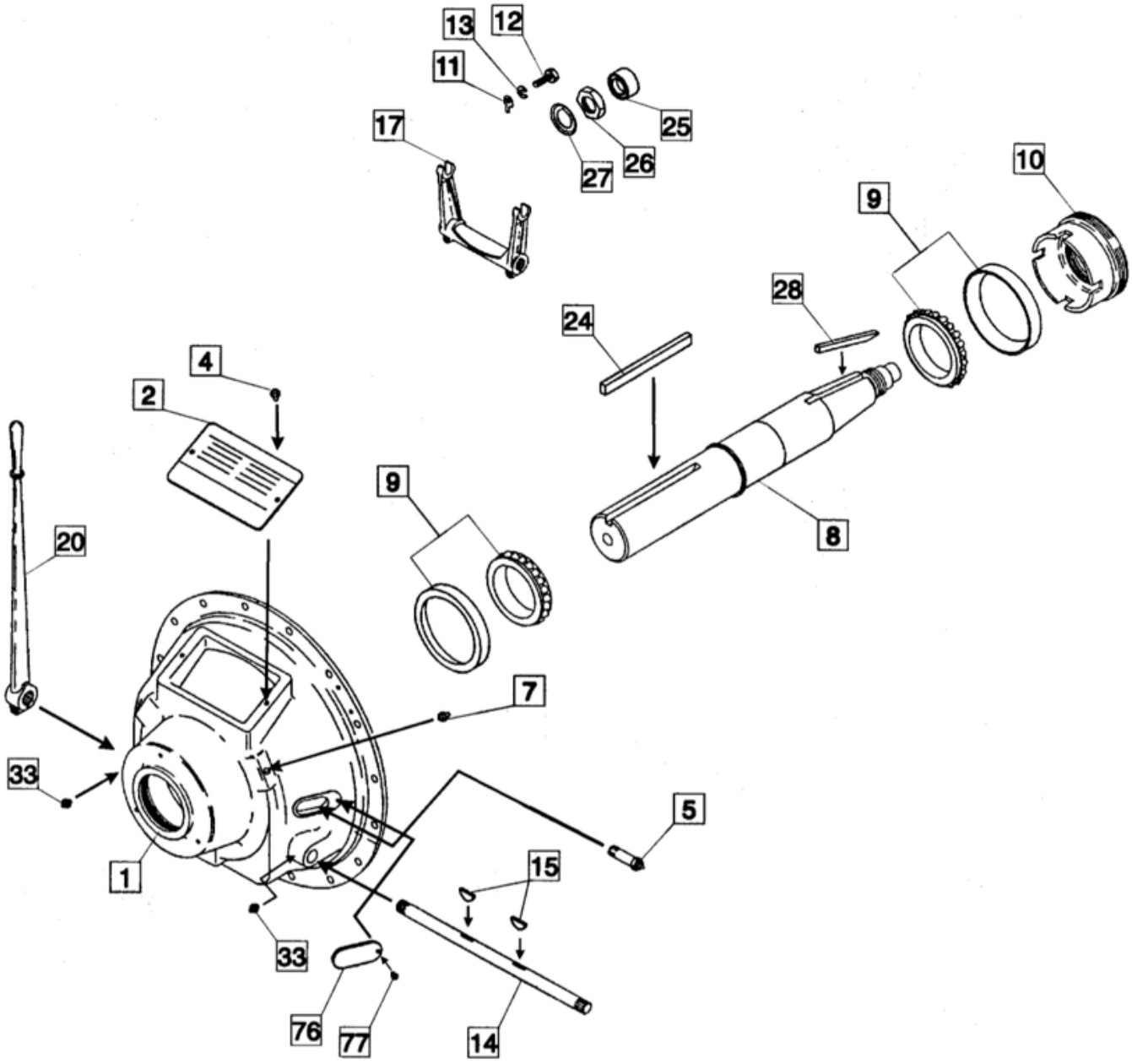
6.1 Typical configuration for SAE housing size 4, 5 or 6 with 6.5” or 7.5” clutch illustrated



6.1.a Clutch assembly exploded view



6.2 Typical configuration for SAE housing size 4 with 10” clutch illustrated



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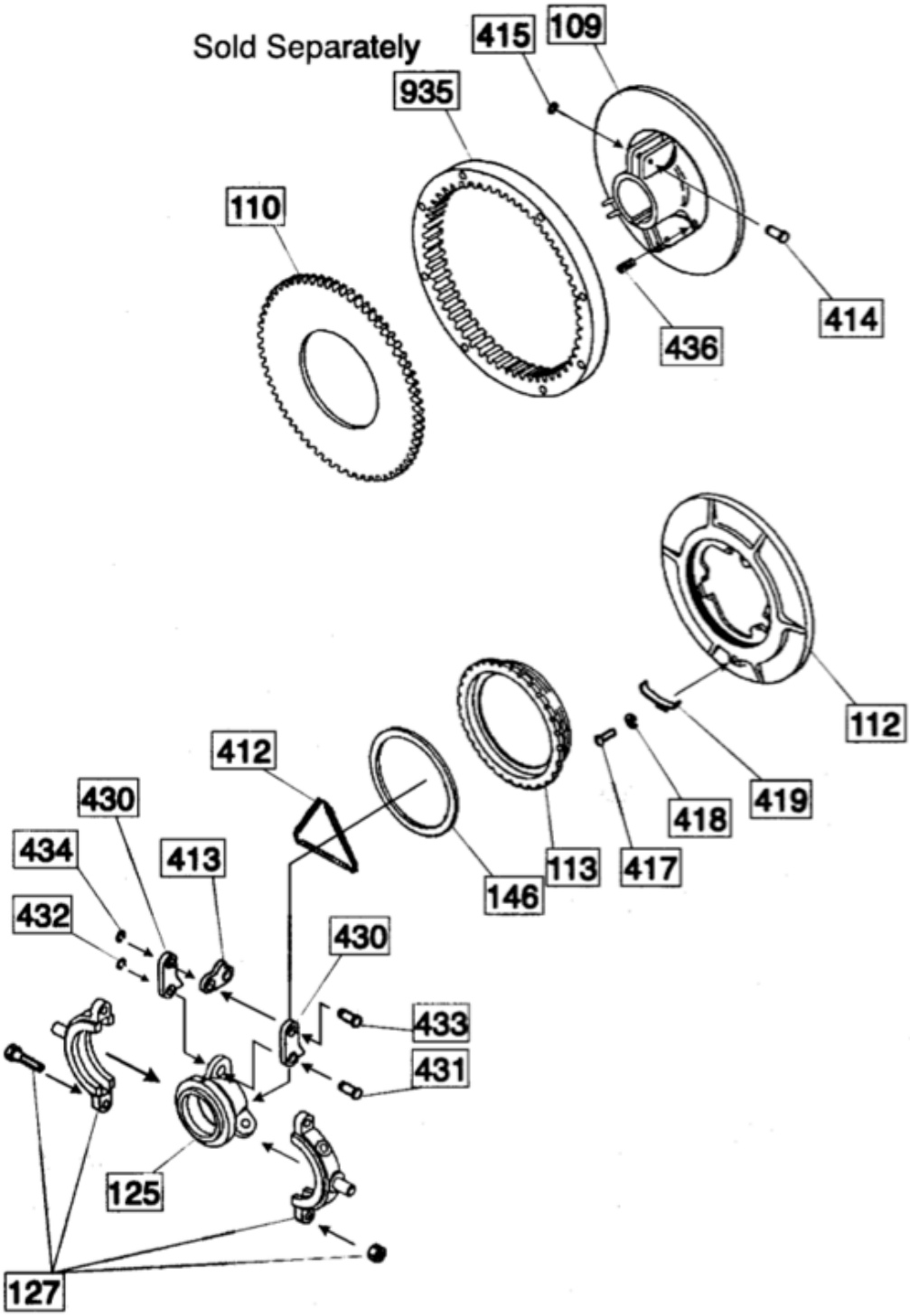
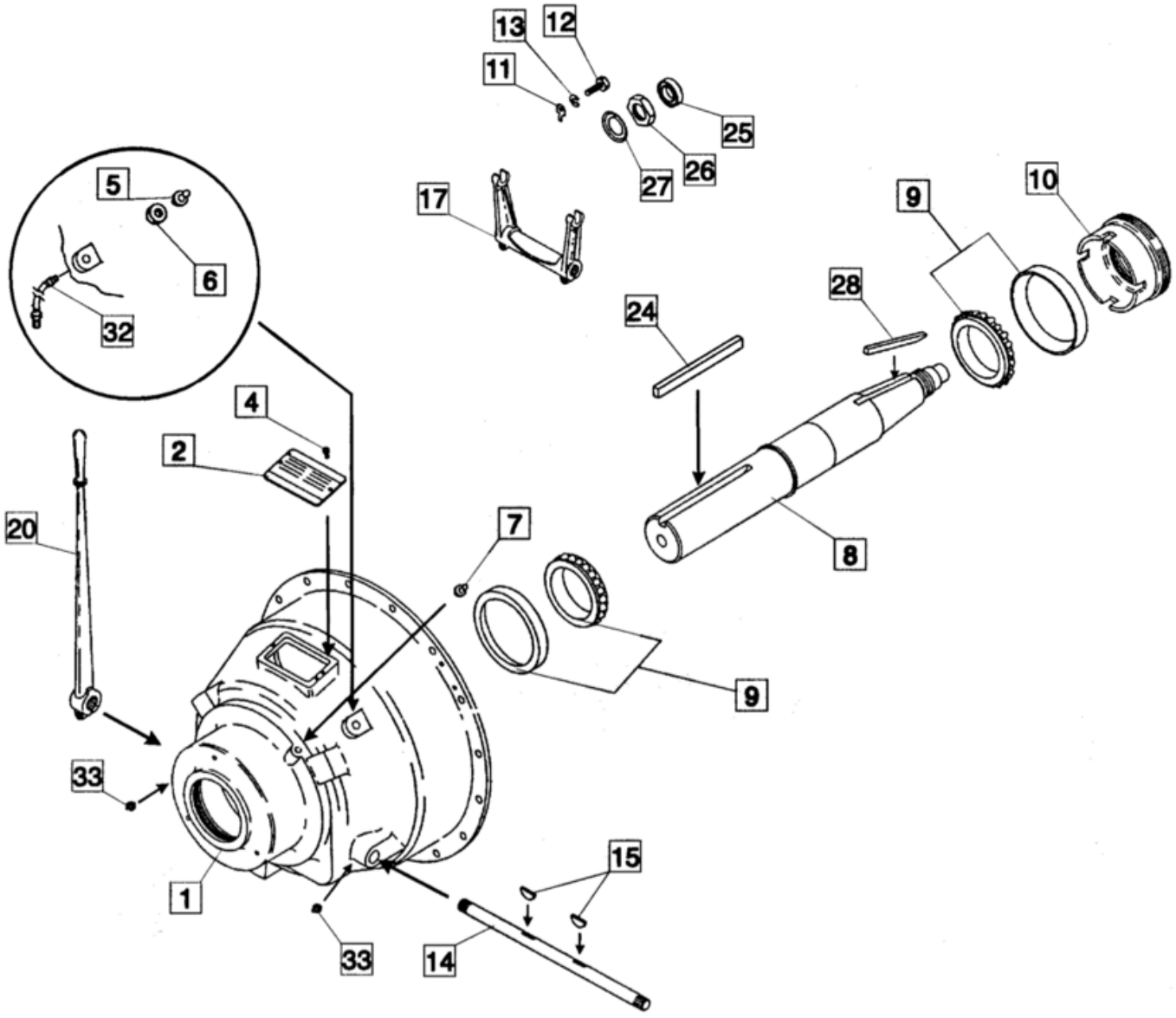
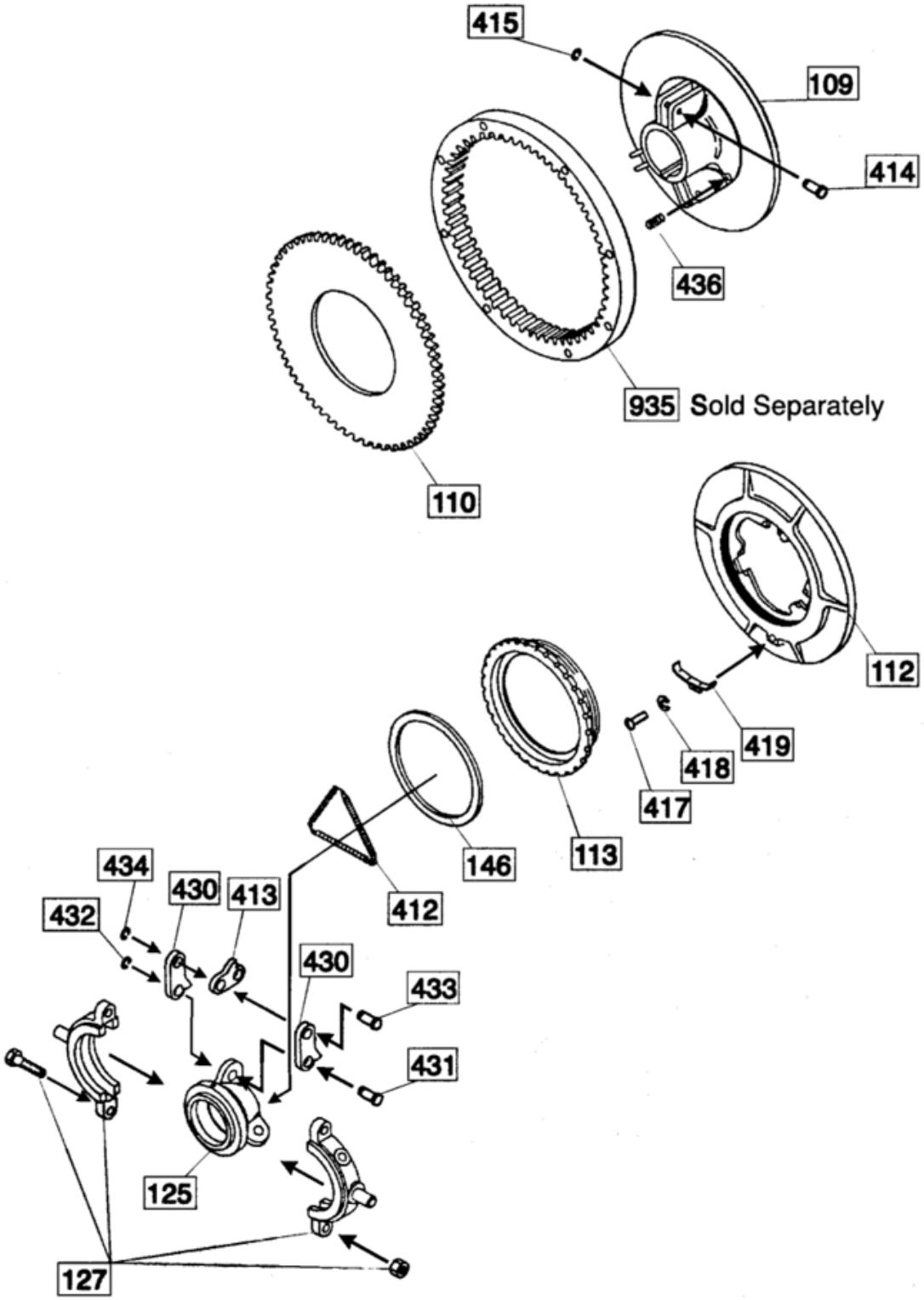
6.2.a Clutch assembly exploded view



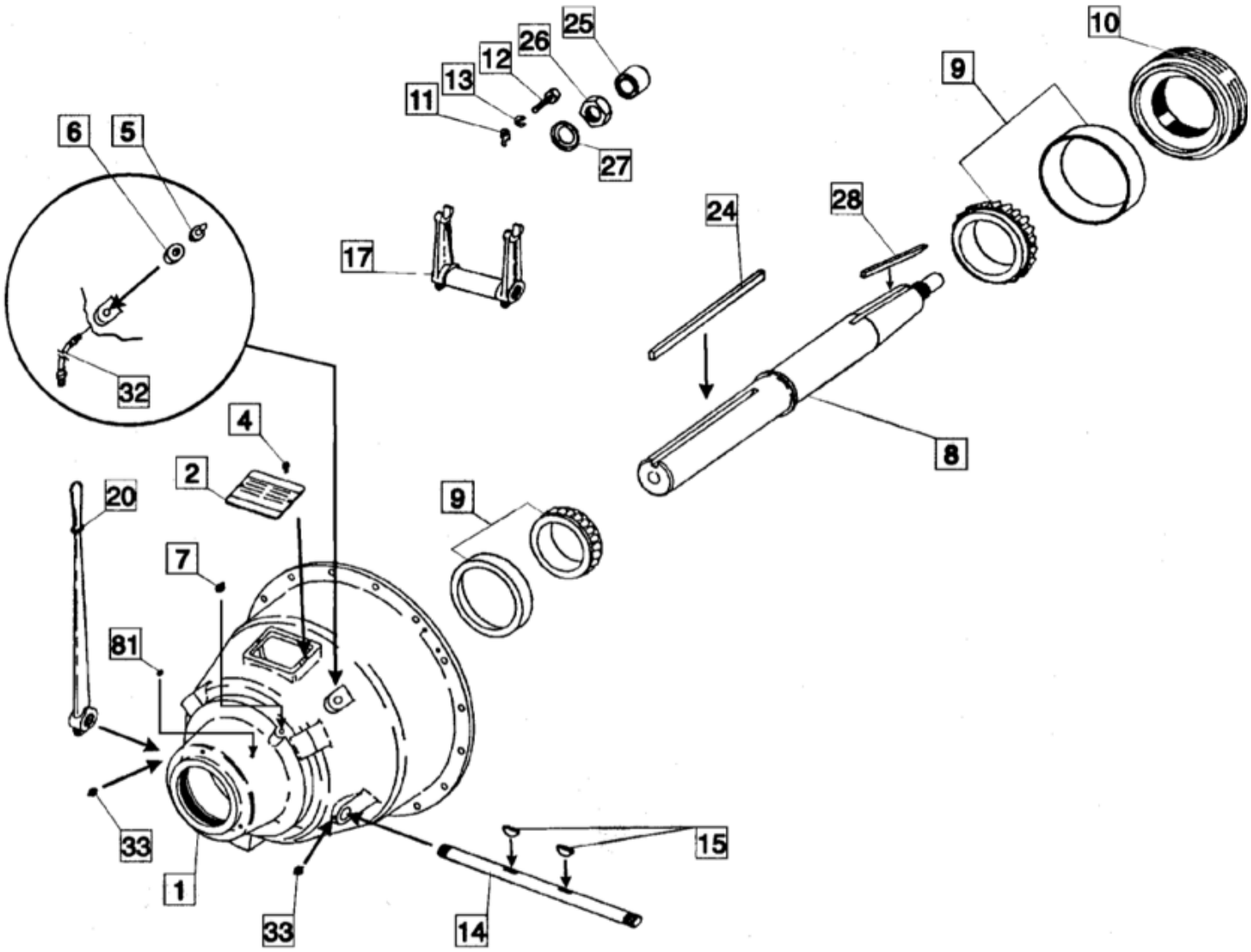
6.3 Typical configuration for SAE housing size 1,2,3 or 4 with 8”, 10” or 11.5” clutch shown



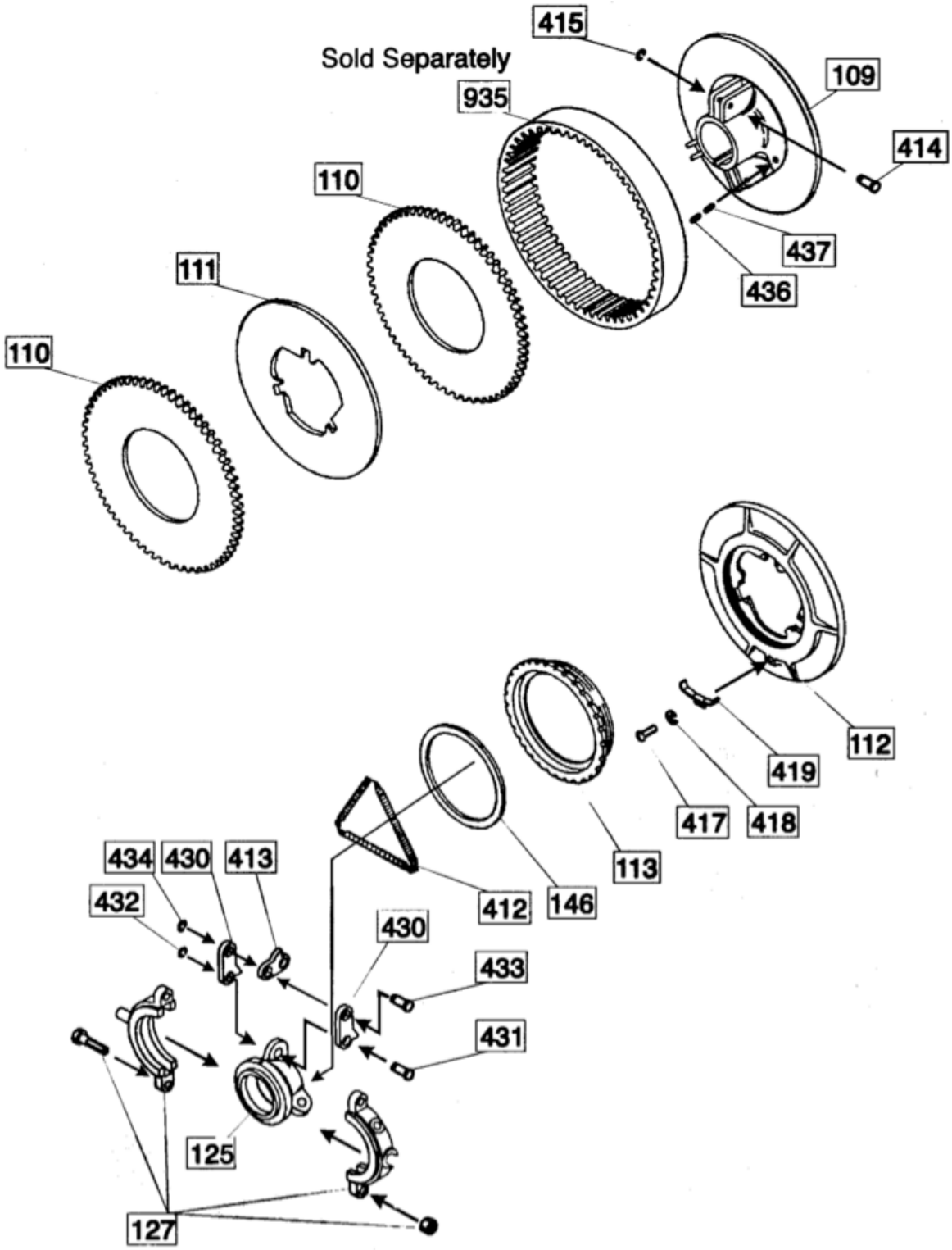
6.3.a Clutch assembly exploded view



6.4 Typical configuration for SAE housing size 1,2 or 3 with 11.5” DP clutch shown



6.4.a Clutch assembly exploded view



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6.5 Universal Bill of Materials

1	Bell Housing
2	Name Plate
4	Bolt
5	Grease Zerk
6	Jam Nut
7	Grease Zerk
8	Drive Shaft
9	Main Bearings
10	Bearing Retainer
11	Adjusting Lock
12	Lock Bolt
13	Lock Washer
14	Cross Shaft
15	Woodruff Key
17	Release Yoke
18	Bolt
19	Washer
20	Shifting Lever Sub-Assembly
21	Shifting Lever
22	Bolt
23	Washer
24	Output Key
25	Pilot Bearing
26	Nut
27	Locking Washer
28	Clutch Key
29	External Snap Ring
32	Grease Tube
33	Grease Fitting (Cross Shaft)
68	Internal Snap Ring
69	Grease Fitting (End of Shaft)
78	Headless Setscrew
79	Clutch Assembly
81	Pipe Plug
109	Clutch Body
110	Facing Plate
111	Center Plate
112	Pressure Plate
113	Adjusting Ring
125	Release Sleeve
127	Release bearing kit
132	Sleeve & Bearing Assembly
134	Name Plate
135	Drive Screw
136	Pressure Plate Assembly
146	Wear Plate
412	Lever Spring
413	Lever
414	Clevis Pin
415	Retainer Ring
417	Lock Bolt
418	Lock Washer
419	Adjustment Lock
430	Link
431	Clevis Pin
432	Retaining Ring
433	Clevis Pin
434	Retainer Ring
436	Separator Spring
437	Roll Pin
935	Drive Ring

7.0 DISASSEMBLE THE POWER TAKE-OFF

(Refer to parts illustrations in section 6.0)

7.1 Remove All Accessories or Drives Attached To the Output Shaft

7.1.a Engage the clutch.

7.1.b Disconnect any linkage which may be attached to the clutch actuating handle.

7.1.c If the handle must be removed to permit removal of the Power Take-Off from the engine, loosen the bolt (22) which fastens the handle to the cross-shaft.

7.1.d Match-mark the handle and cross shaft so that the handle can be reinstalled at the same place on the shaft.

7.1.e Slide the handle off of the cross shaft spline.

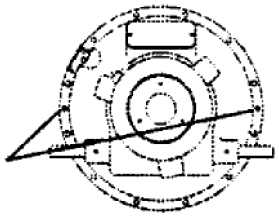
7.2 Remove the Power Take-Off From the Engine

7.2.a Attach a hoist or other suitable lifting device to the power take-off.
Attach at 3 points spanning the center of gravity to hold the shaft in a horizontal position during removal.

7.2.b Remove the mounting bolts, removing those located near the top last.
The PTO should separate from the flywheel housing. If the PTO doesn't separate, install two bolts in the threaded holes in the flange.

Holes are tapped for:

#1 Housing:	7/16” - 14 bolts
#2, #3, #4 Housing:	3/8” - 16 bolts
#5, #6 Housing:	3/8” - 16 bolts



Tighten the bolts evenly until the housing is removed from the engine flywheel housing pilot diameter.

7.2.c Exercise caution when removing the PTO from the engine to avoid damage to the grease fittings, facing(s), and pilot bearing.

7.3 Remove the Clutch From the PTO Shaft

7.3.a Remove the pilot bearing (25) from the shaft using a split-plate bearing puller.

7.3.b If not done in 7.1.b thru 7.1.e, loosen bolt (22) and remove the handle (21).

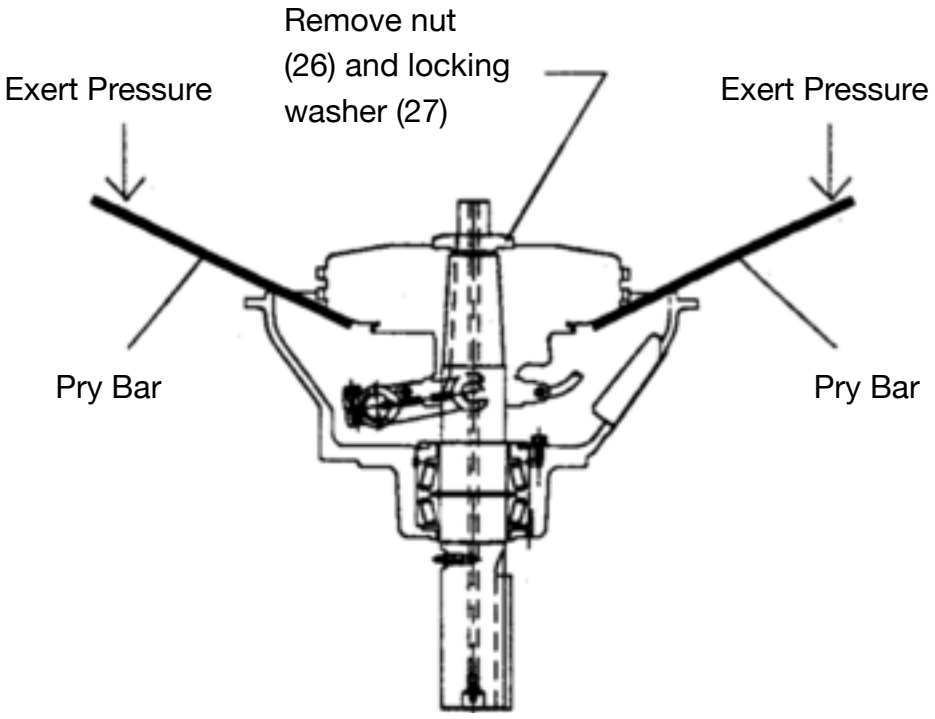
7.3.c Remove jam nut (6) securing the grease hose (if the release bearing is a regreasable type and a grease hose is used) and disconnect the hose fitting from the bell housing. The grease hose may now be removed from the release bearing (127) (or it may be removed after the clutch is removed from the shaft).

7.3.d Position the PTO with the pilot bearing end up, resting with support beneath the end of the output shaft (the impact force of the mallet blow in step 7.3.f will therefore be absorbed through the shaft rather than across the main bearing(s).

7.3.e Bend the locking washer (27) away from nut (26), and remove the nut and locking washer.

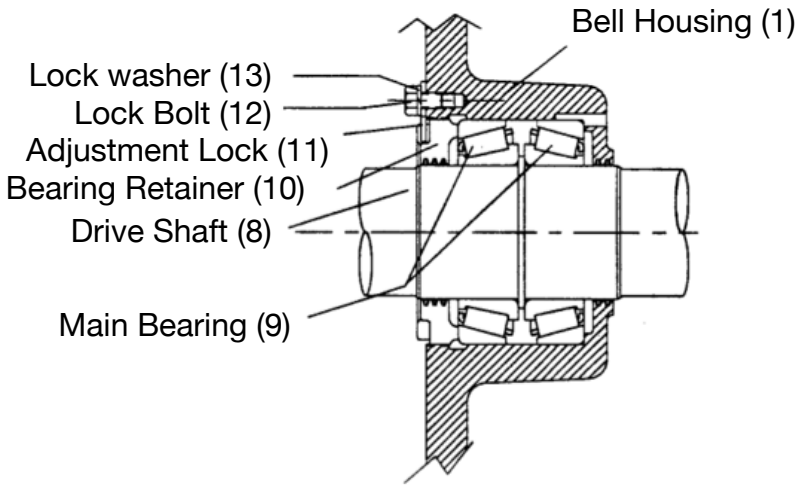
7.3.f Place pry bars under the pressure plate. While exerting pressure on the pry bars, strike the end of the shaft with a soft mallet to "jar" the clutch loose. Pull the clutch from the shaft.

CAUTION: Do not damage the pilot end of the shaft.

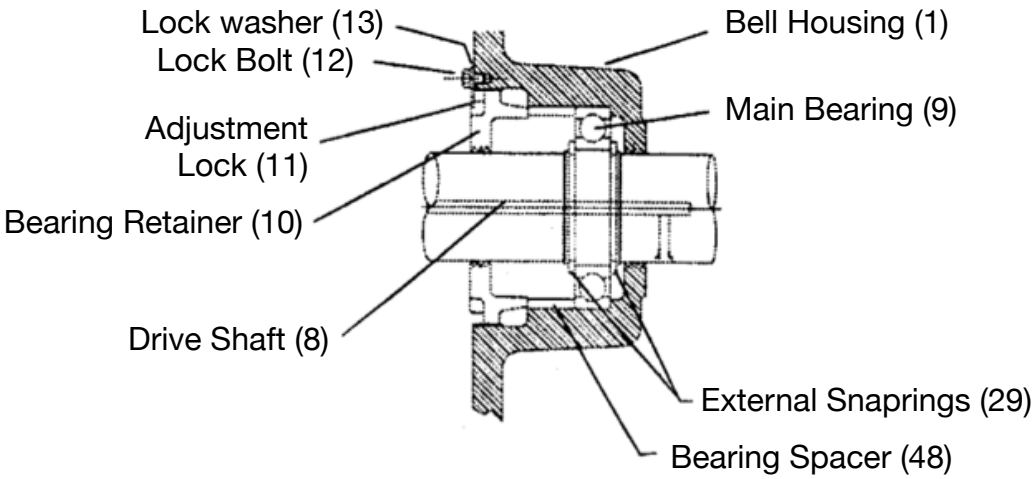


The following illustrate standard bearing and bearing housing configurations found in NACD Power Take-Offs. "Specials" have been designed and sold, but they are only slight variations of these standard configurations.

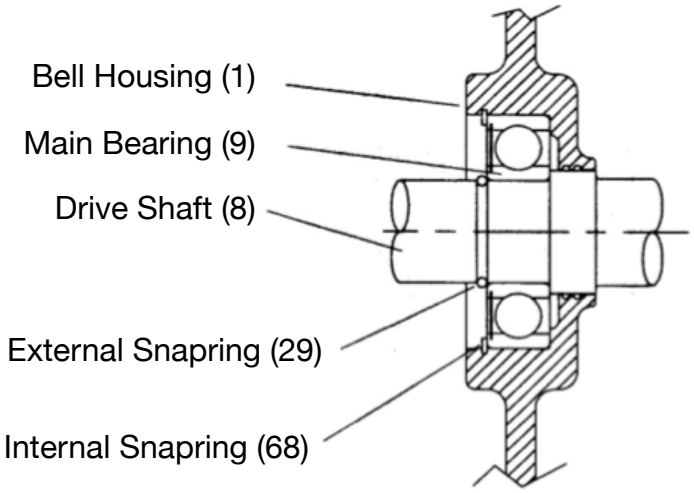
CONFIGURATION A



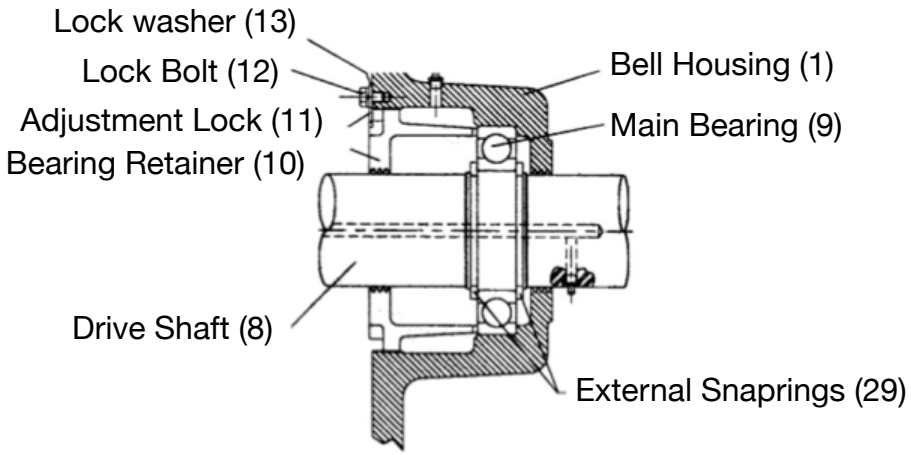
CONFIGURATION B



CONFIGURATION C



CONFIGURATION D



7.4 Remove the Shaft and Bearings From the Housing

CONFIGURATIONS A, B and D only:

7.4.a Remove lock bolt (12), lock washer (13) and adjustment lock (11).

7.4.b Rotate the bearing retainer (10) counter-clockwise and remove it.

7.4.c Lift the drive shaft (8) with bearing(s) (9) from the bearing housing (a hoist may be needed).

7.4.d Configuration A only: One tapered roller bearing cup will have remained in the bearing housing. Remove the bearing cup from the bearing housing.
Insert a small punch through the three holes provided in the rear of the bearing housing and drive the cup out. (Some units have threaded plugs which first must be removed from the holes).

CONFIGURATION C only:

7.4.e Remove internal snapring (68).

7.4.f Lift the drive shaft (8) with bearing (9) from the bearing housing (a hoist may be needed).

7.5 Remove the Main Bearings From the Drive Shaft

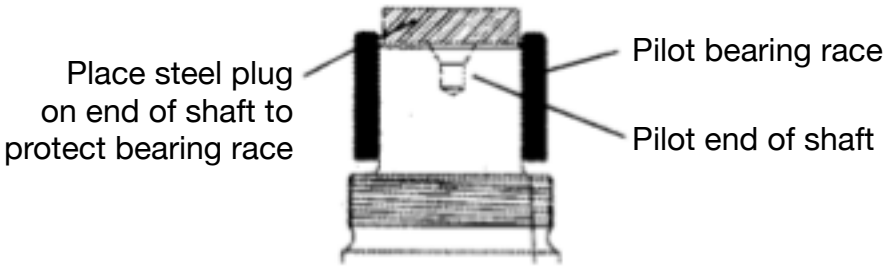
Wash the bearings and bearing cups with clean fuel oil or solvent. Dry and carefully examine for wear, corrosion or rough spots. If it is determined the bearing(s) must be replaced, remove from the shaft.

Configuration A only:

7.5.a Place the shaft in a press with a split-plate resting on the bed of the press, positioned under the top bearing inner race.

7.5.b Press the shaft from the bearing.

CAUTION: Place a block of wood beneath the shaft to prevent it from being damaged as it falls loose.
CAUTION: If the inner race of the pilot bearing is still on the shaft (roller bearing style) place a plug on the end of the shaft to prevent pressing against the pilot bearing inner race.



7.5.c Turn the shaft over and repeat steps 7.5.a and 7.5.b to remove the remaining bearing (9).

CONFIGURATION B, C and D only:

7.5.d Remove 1 or 2 external snapring(s) (29).

7.5.e Support beneath bearing (9) on the bed of a press.

7.5.f Press the drive shaft from the bearing.

CAUTION: Place a block of wood beneath the shaft to prevent it from being damaged as it falls loose.

7.6 Remove the Cross Shaft

7.6.a Loosen two bolts (18) securing the yoke assembly (17) to the cross shaft.

7.6.b Slide the cross shaft through the housing until the yoke rests against a block of wood placed between the yoke and the housing.

7.6.c With a soft mallet, drive the cross shaft out of the yoke just far enough to expose two woodruff keys (15).

7.6.d Remove the woodruff keys.

NOTE: The yoke may be loose enough to slide out without use of a mallet.

7.6.e Slide or tap the cross shaft out of the yoke and housing.

8.0 INSPECT THE POWER TAKE-OFF COMPONENTS

8.1 Ball bearings:

8.1.a Visually examine for indications of wear, corrosion, or pitting on balls and races. Apply clean, lightweight engine oil and slowly rotate the outer race while holding the inner race. The balls must roll free. Rough or sticking spots must be checked to be sure they are not particles of dirt. If they are, clean and check again. If not dirt, replace the bearing.

8.2 Tapered Roller Bearings:

8.2.a Visually examine for indications of wear, corrosion, brinelling or pitting on races or rollers. Rollers must not have flat spots or pitting. Bearing cups and cones must not exhibit signs of pitting, scuffing or tracking.

Lightly oil the races with clean oil, hold one race stationary while slowly rotating the other race against it.

Rough spots or sticking indicate need for replacement. Races must be smooth and unworn.

8.3 Bell Housing:

8.3.a Check the bearing fit. Bearing races usually are designed with a sliding or slightly snug fit in the housing bore. They should not have side movement in the bore. Labyrinth seal bores at the output end of the bearing housing should be round, not worn oval and should be approximately .020:-0.25" (.508mm-.635mm) diameter larger than the drive shaft.

8.3.b Threads for the bearing retainer should not be damaged.

8.3.c If a bearing failure has occurred, be sure the bearing has not spun in the housing, destroying the shoulder or bore contacted by the bearing. Although the moveable bearing retainer will compensate for small amounts of shoulder wear, it is imperative the bearing contact the housing only at the OD of the race, and not anywhere else on the bearing in its assembled and adjusted position.

8.3.d The mounting pilot OD and mounting face must be free of protruding metal, rust, corrosion etc., which would prevent the housing from locating properly in the flywheel housing bore or against the flywheel housing face. An improper fit causes misalignment. Misalignment is a major cause of Power Take-Off failure. In Configuration C the snapring should restrict bearing movement to .015" (.381mm) maximum.

8.3.e Cross shaft holes should not be worn more than .015" (.381mm) out of round. A little wear does not ren¬der the parts unserviceable, but excessive wear can cause binding of the cross shaft under load during clutch engagement.

8.4 Bearing Retainer:

8.4.a Threads must not be damaged. A surface that presses against the bearing or bearing shims must be smooth, with no metal protrusions above the surface. A small indentation below the surface is not detrimental.

8.5 Cross Shaft:

8.5.a Be sure the cross shaft moves freely in the bell housing. Remove rust or corrosion from the cross shaft and the holes in the bell housing. Wear on the cross shaft does not become detrimental until it inhibits smooth rotation during clutch engagement (creates a false clutch engagement pressure reading) or allows moisture, dirt, or other corrosives to enter the housing. This can be prevented by ample greasing through the grease fittings to keep the cross shaft lubed.

8.5.b Woodruff key slots must hold the keys straight. If the release yoke has been loose on the cross shaft, the keyways may have one side worn at an angle.

8.6 Clutch Release Yoke:

8.6.a Keyways must not be worn excessively.

8.6.b Replace if width of cradles is over:

6.5", 7.5" and 8" (Bronze Brg.)	.645" (16.38mm)
8" (Ball Brg.), 10" and 11.5"	.765" (19.43mm)

8.7 Drive Shaft:

8.7.a Pilot bearing journal must not be worn. A new pilot bearing should have a sliding-but-snug fit or tight fit. Replace if the diameter of the pilot is less than shown below. Various basic sizes are shown.

Pilot Diameter New	Minimum Dimension (Worn)
.6694” - .6690”	.6690” (16.9926mm)
.7875”- .7871”	.7871” (19.9923mm)
.9844” - .9840”	.9840” (24.9936mm)
1.1812”- 1.1808”	1.1808” (29.9923mm)
1.1822”- 1.816”	1.1816” (30.0126mm)

8.7.b The shoulder between the tapered roller bearings (Configuration A) must not be damaged, and must have straight sides. If a bearing has failed and spun on the shaft, the shoulder may be worn thin, tapered and/or otherwise damaged. Three shoulder widths are used: .130".120", .193".183", and .255".245".

8.7.c Grease or oil passages should be thoroughly cleaned to be sure they are free of dirt and contaminants.

8.7.d Threads must not be damaged.

8.7.e Keyways must not be worn so as to allow side movement of keys.

8.7.f Clutch taper should not be worn, although a small amount of wear, if worn evenly 360 degrees around the shaft, may be serviceable as long as the clutch will seat securely and squarely and the jam nut will tighten against the clutch body. If too much wear has occurred, the clutch will slide too far onto the taper and the jam nut will bottom out on the thread or shoulder before it contacts the clutch body.

9.0 DISASSEMBLE THE CLUTCH

(Refer to parts illustration in section 6.0)

9.1 Preparation for Disassembly

9.1.a Disengage the clutch.

9.1.b Match-mark the clutch body (109), pressure plate (112), release sleeve (125) and center plate (111) on 11.5" HE (DP) clutches.

9.2 Remove the Release Sleeve and Bearing Assembly

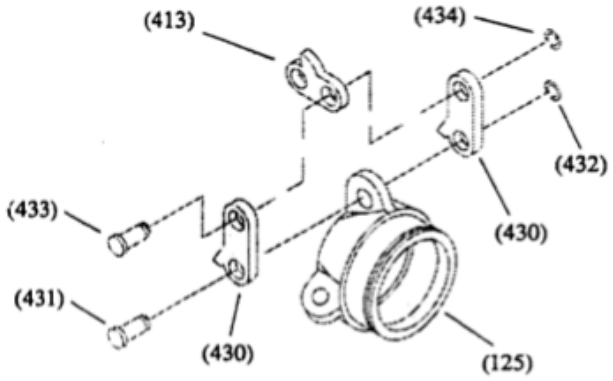
9.2.a Remove the lever spring (412).

9.2.b Notice the direction clevis pins (431 and 433) are installed. Upon reassembly of the clutch, they must be installed from the same side so the head leads the direction of clutch rotation. They should be as shown below.

9.2.c Remove retainers (434) and clevis pins (433) to separate the links (430) from the levers (413).

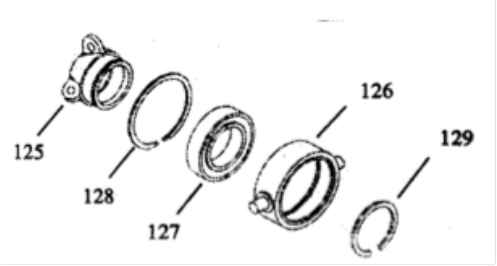
9.3 Disassemble the Sleeve and Bearing Assembly

9.3.a (Ball type release bearing): Remove the grease hose (32) (if the bearing is a regreasable style and a grease hose is used).



9.3.b Remove 3 retainers (432) and clevis pins (431) to remove the links (430) from the release sleeve (125).

9.3.c Remove the external snapring (129) from the release sleeve.



Typical ball-type release bearing configuration

9.3.d Using a split plate as close to the release sleeve as possible, support beneath the release bearing and bearing carrier (126) on the bed of a press. Press the release sleeve from the bearing.

9.3.e Remove the internal snapring (128).

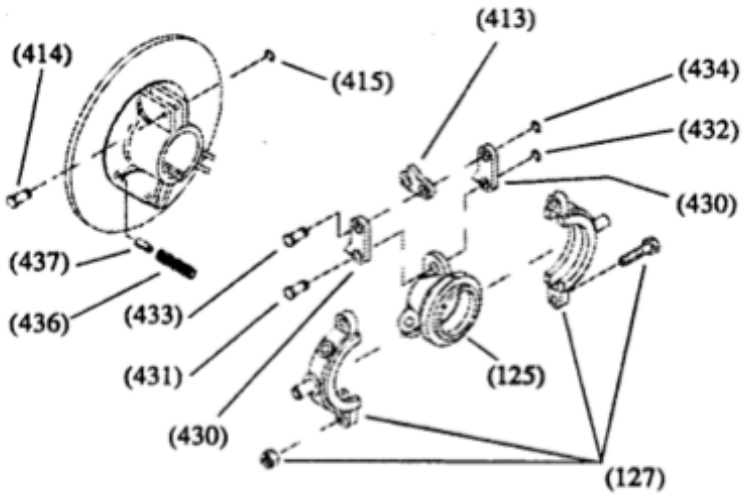
9.3.f Tap the bearing carrier (126) off the release bearing.

9.3.g (Bronze-type release bearing):
Match-mark the two halves of the bronze release bearing (127). Observe whether a machined side is up or down so it may be reinstalled in the same direction.

9.3.h Remove the grease hose (32) (if the bearing is a regreasable style and a grease hose is used).

9.3.i Remove 3 retainers (432) and clevis pins (431) to remove links (430) from the release sleeve (125).

9.3.j Loosen and remove 2 bolts and nuts holding the release bearing together. Remove the release bearing from the sleeve.



9.4 Remove the Levers

Note the direction the clevis pins (414) are installed so they can be reinstalled in the same direction. Remove (3) retainers (415) from the clevis pins (414). Press down on the pressure plate to compress the separator springs (436) and allow removal of the clevis pins. Remove the clevis pins (414) to separate the levers from the clutch body.

9.5 Remove and Disassemble the Pressure Plate Assembly

9.5.a Lift the pressure plate assembly from the clutch body.

9.5.b Remove the wear ring (146) from inside the adjusting ring.

9.5.c Remove the adjustment lock bolt (417), lock washer (418) and adjustment lock (419) from the pressure plate.

9.5.d Rotate the adjusting ring counter-clockwise to remove it from the pressure plate.

9.6 Complete the Disassembly of the Clutch

9.6.a Remove the facing plate (110).

9.6.b Remove 3 separator springs (436) from the pockets in the clutch body.

(11.5" HE(DP)(2 plate) clutches only):
9.6.c Remove the center plate (111) and the remaining facing plate.

9.6.d If the spring pins (437) are worn or damaged, remove them from the clutch body.

10.0 INSPECT THE CLUTCH COMPONENTS

10.1 Clutch Body:

10.1.a Friction surface must not have heat cracks, must be smooth and must be flat within .005" (.127mm).

10.1.b Drive bosses must not have wear marks exceeding .003" (.076mm) depth due to wear from the pressure plate or center plate.

10.1.c Keyway must not be worn.

10.1.d Tapered bore must fit snugly and securely on shaft.

10.2 Pressure Plate:

10.2.a Friction surface must not have heat cracks, must be smooth and must be flat within .005" (.127mm).

10.2.b Drive slots must not be excessively worn. Measure the width of the clutch body drive lug in the worn contact area. Measure the width of the pressure plate drive slot in the (worn) contact area. If the difference between the two readings exceeds .012" (.305mm) the worn component(s) must be replaced.

10.2.c Threads for adjusting ring must not be damaged.

10.3 Release Sleeve:

10.3.a No fractures should exist in the bosses.

10.3.b Clevis pin holes must not be excessively worn. A small amount of wear is normal and will not be detrimental.

10.3.c The release sleeve bore should not be worn beyond the limits shown below.

Basic Size	Maximum Allowable Diameter
.875” (22.23mm)	.883” (22.482mm)
1.250” (31.75mm)	1.258” (31.953mm)
1.375” (34.93mm)	1.387” (35.230mm)
1.750” (44.45mm)	1.759” (44.679mm)
2.000" (50.80mm)	2.012” (51.105mm)
2.250” (57.15mm)	2.259” (57.379mm)
2.500” (63.50mm)	2.509” (63.729mm)

(for use with ball-type release bearing):

10.3.d Snapring groove must not be damaged or worn beyond:

Clutch Size	Maximum Allowable Width
6.5”, 7.5”	.130” (3.30mm)
8”	.145” (3.68mm)
10”, 11.5”	.155” (3.94mm)

10.3.e Ball bearing must fit tight on the release sleeve.

(for use with bronze-type release bearing):

10.3.f Shoulder width should not be worn below:

Basic Size	Minimum Width
5/16” (7.94mm)	.304” (7.72mm)
1/2” (12.70mm)	.493” (12.52mm)

10.4 Release Bearings

10.4.a (ball type):
Clean and lightly oil the bearing. Hold the inner race and slowly rotate the outer race, feeling and listening for rough spots, catches or a sticking condition.

10.4.b (bronze type):
Flat areas are usually worn on the trunnions. Measure the trunnion diameter. Replace if worn to less than:

Clutch Size	Minimum Trunnion Diameter
6.5”, 7.5”, 8”	.605” (15.37mm)
8”, 10”, 11.5”	.730” (18.54mm)

10.4.c Internal slot that straddles the release sleeve shoulder maximum width:

Basic Size	Maximum Width
5/16” (7.94mm)	.319” (8.10mm)
1/2” (12.70mm)	.507” (12.88mm)

10.5 Bearing Carrier: (ball-type release bearing only)

10.5.a Flat areas are usually worn on the trunnions. Measure the trunnion diameter. Replace if worn to less than:

Clutch Size	Minimum Trunnion Diameter
6.5”, 7.5”	.605” (15.37mm)
8”, 10”, 11.5”	.730” (18.54mm)

10.5.b The snapring groove must securely hold the snapring. Measure the dimension from the bearing shoulder inside the carrier to the farthest edge of the snapring groove.

Clutch Size	Maximum Width
6.5”, 7.5”, 8”	.700” (17.78mm)
10”, 11.5”	.814” (20.68mm) or .891” (22.63mm)

10.5.c The bearing fit may be a sliding fit, but must be snug. A slightly tight fit is desirable.

10.6 Facing Plates:

10.6.a Must be free of oil or grease. Must not be burned. Once burned, they normally are incapable of holding torque.

10.6.b Measure the amount of wear which has occurred on each friction surface (2 surfaces per facing disc). Total wear allowable in any clutch (add 2 or 4 surfaces together) is approximately .25" (6.35cm). Thickness of a new facing plate is:

6.5”, 7.5”, 8” clutches	.375” (9.53mm)
10” and 11.5” clutches	.437” (11.10mm)

10.6.c Teeth must not be worn excessively or broken.

10.7 Center Plate:

10.7.a Friction surfaces must not have heat cracks, must be smooth, and must be flat within .005" (.127mm).

10.7.b Drive slots must not be excessively worn. Measure the width of the clutch body drive lug in the slot contact area and the width of the pressure plate drive slot in the (worn) contact area. If the difference between the two readings exceeds .007" (.180mm) the worn component(s) must be replaced.

10.7.c Minimum thickness of the facing contact area must not be less than .365" (9.27mm).

10.8 Grease Hose:

10.8.a Should be pliable, flexible and free of cracks, holes or wear.

10.8.b Braided wire design: Wire should not be crushed (flattened).

10.9 Levers:

10.9.a Clevis pin holes must not be excessively worn. A small amount of wear is normal and will not be detrimental.

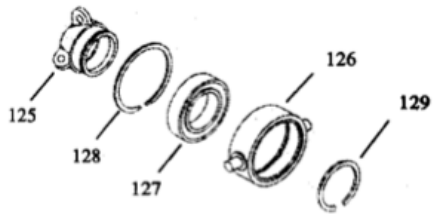
11.0 ASSEMBLE THE CLUTCH

(Refer to parts illustration in section 6.2)

11.1 Assemble the Sleeve and Bearing Assembly

(Ball-type release bearing):

11.1.a Install the release bearing (127) in the bearing carrier (126). The fit should be a snug sliding fit or a light press fit.



Typical ball-type release bearing configuration

11.1.b Install the internal snapring (128).

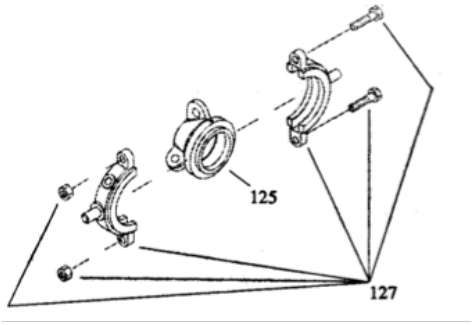
11.1.c Press the release bearing onto the release sleeve with the snapring (128) located on the side nearest the three bosses of the release sleeve. Be sure to press against the inner race of the bearing; do not support, press or tap against the outer race (bearing carrier). Damage to the bearing could result.

11.1.d Install external snapring (129).

Proceed to 11.1.g

(Bronze release bearing):

11.1.e Lubricate the inside slot of the bearing halves (127). Place the two halves of the release bearing in position on the release sleeve (125) (with the machined side up or down as was noted in 9.3.g).

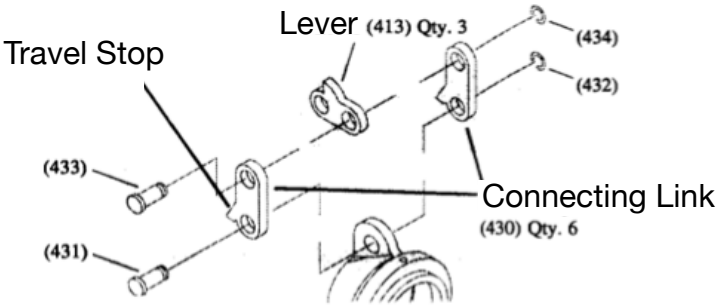


11.1.f Install and tighten the bolts and nuts holding the halves together. Rotate the bearing on the sleeve to be sure it turns freely.

11.1.g Place two connecting links (430) on one of the bosses of the release sleeve (one on either side of the boss). The travel stop protruding from one side of each link should point toward the bottom of the release sleeve and must rest against the release sleeve.

11.1.h Install the clevis pin (431) through both links and the boss on the sleeve.

NOTE: The clevis pin must be installed as shown below so the head will lead the direction of clutch rotation.

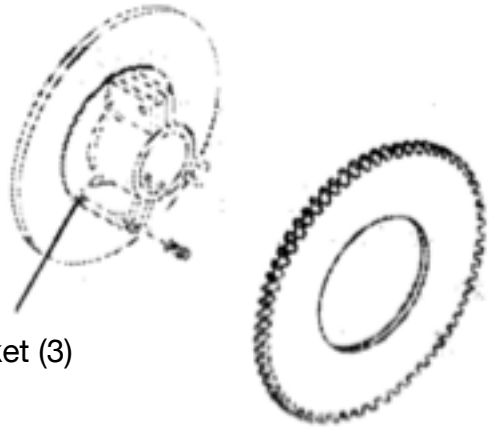


11.1.i Securely install the retainer (432) in the groove of the clevis pin.

11.1.j Repeat 11.1.g thru 11.1.i to install links on the remaining 2 bosses.

11.2 Assemble the Clutch Body Assembly

11.5” HE(DP) Clutches: Proceed at 11.2.d



Spring Pocket (3)

11.2.a Place the clutch body (109) on the bench with the friction surface up.

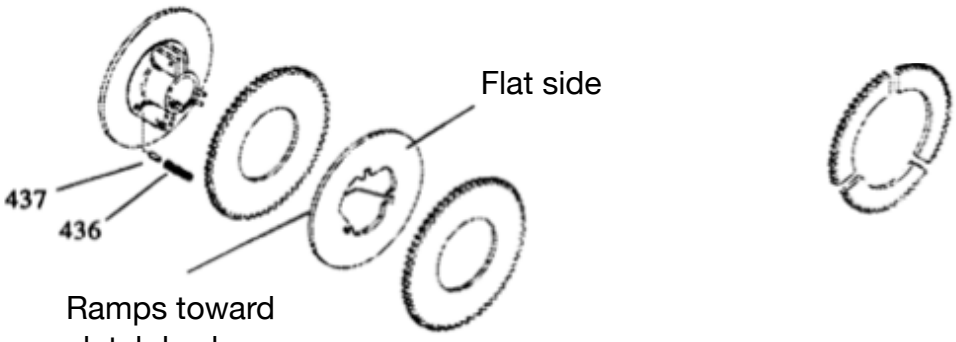
11.2.b Install 3 separator springs (436) in the spring pockets of the clutch body.

11.2.c Place one facing plate (110) on the clutch body.

(11.5" HE(DP) Clutches):

11.2.d (If they were removed) install the three spring pins (437) in the clutch body holes to support the separator springs. Drive them to the bottom of the holes.

11.2.e Install 3 separator springs (436) over the spring pins in the clutch body.



CAUTION: NACD DOES NOT APPROVE the use of segmented facings in 2-plate (DP) clutches.

11.2.f Place on (whole ring style) facing plate (110) on the clutch body.

11.2.g Place the center plate (111) on top of the facing with the machined "ramps" located along the sides of the drive slots facing down (away from the pressure plate). Then place a second (whole ring style) facing plate on top of the center plate.

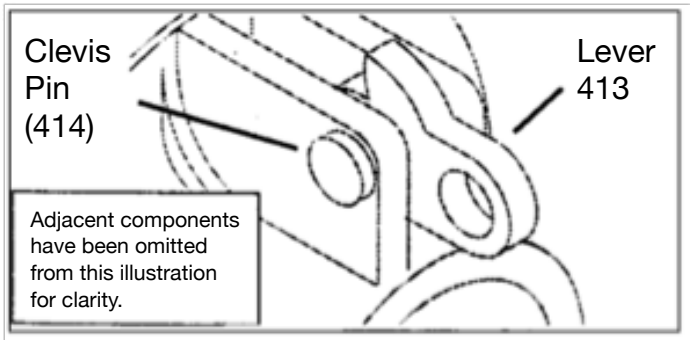
11.2.h Thread the adjusting ring (113) into the pressure plate (112) almost to the bottom of the thread.

11.2.i Place the wear ring (146) in the adjusting ring.

11.2.j Place the pressure plate assembly on top of the facing plate, aligning the drive slots on the drive bosses of the clutch body.

11.3 Install the Release Levers

11.3.a Position the 3 levers (413) in the lever bosses with the protruding tang against the wear ring up and the "long end" up. (See illustration in section 11.1.)



Adjacent components have been omitted from this illustration for clarity.

11.3.b Press down on the pressure plate to compress the separator springs and allow the clevis pins (414) to be inserted through the lever and clutch body.

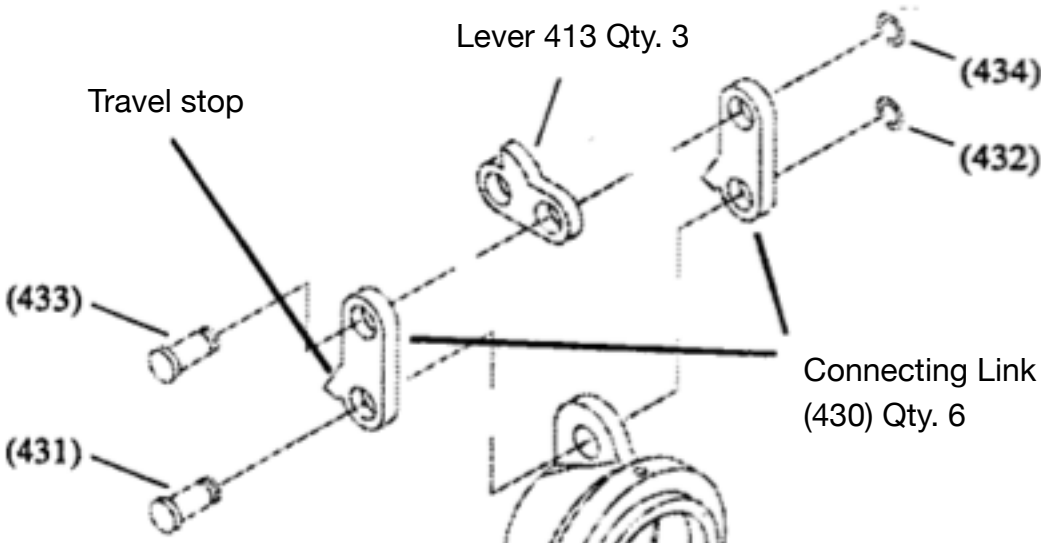
NOTE: Be sure the clevis pins are installed so the heads will lead the direction of clutch rotation.

(See section 11.1).

11.3.c Securely install retainers (415) on the clevis pins.

11.4 Install the Release Sleeve and Bearing Assembly on the Clutch

11.4.a Position the sleeve and bearing assembly on the clutch so the links align with the levers.



11.4.b Align the clevis pin holes and install a clevis pin (433) through the links and levers so the head of the clevis pin will lead the direction of rotation during clutch operation.

11.4.c Securely install the retainer (434) in the groove of the clevis pin.

11.4.d Repeat 11.4.b and 11.4.c at the remaining lever positions.

11.4.e Install the lever spring (412) over the release bearing. Locate one connector of the spring over each of 2 levers, then stretch the spring to get it onto the third lever.

11.4.f Using the drive ring as a gage, perfectly center the facing plate(s) relative to the clutch body.

11.4.g Engage the clutch by pressing the release sleeve and bearing down to the stop. If the facings are not clamped tight, disengage the clutch, rotate the adjusting ring counter-clockwise and reengage the clutch. Repeat until the clutch is adjusted tight enough to hold the facings aligned.

NOTE: If the facings are not perfectly aligned in the clutch, mounting the PTO onto the engine will be restricted by interference between the facing teeth and the teeth of the drive ring.

11.4.h Insert the adjustment lock in the slots of the adjusting ring. Install the lock bolt and lock washer. Tighten finger tight.

NOTE: Do not disengage the clutch until after the PTO has been mounted on the engine. Should the facings become misaligned, see section 4.1 for realignment of the facings.

11.4.i Install the grease hose (32) (if used) in the proper hole in the release bearing. (In some designs a grease fitting (5) is installed directly into the bronze release bearing.)

NOTE: Many bronze release bearings provide more than one position for the grease hose as a standardization measure to reduce inventories. Install the grease hose in the position appropriate for your PTO. Be sure to securely install a pipe plug in the other hole to prevent loss of grease.

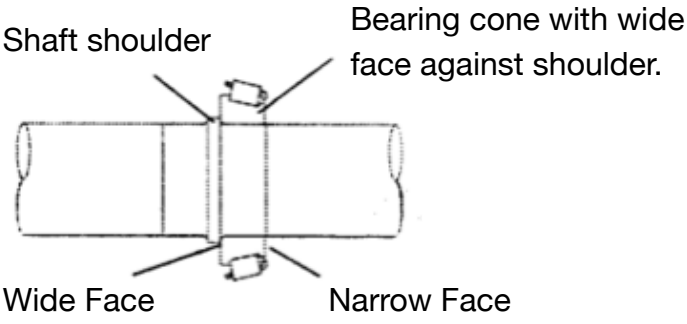
12.0 ASSEMBLE THE POWER TAKE-OFF

(Refer to parts illustrations in section 6.0)

12.1 Install the Main Bearings on the Drive Shaft

Configurations B & D:	Proceed at 12.1. e
Configuration C:	Proceed at 12.1.h

12.1.a (CONFIGURATION A only):
Start one bearing cone (9) on the shaft with the wide face of the inner race facing the shoulder on the drive shaft.



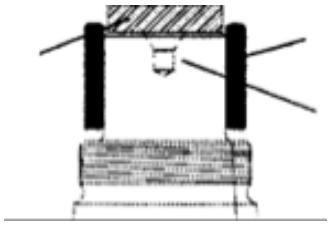
Configuration A

12.1.b Place a steel ring approximately .25" thick over the shaft resting against the narrow race of the bearing cone.
CAUTION: Do not allow any pressure to be applied against the bearing cage at any time. A damaged cage will cause bearing failure.

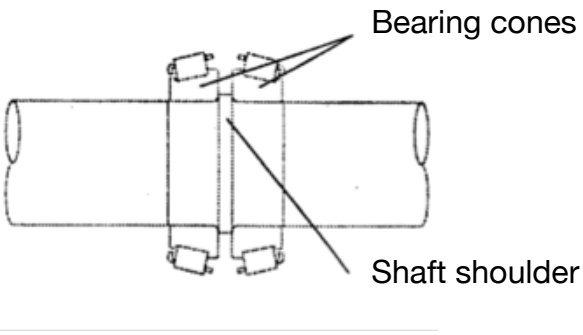
12.1.c Support beneath the steel ring on the bed of a press. Press the drive shaft into the bearing until the shoulder on the shaft is tight against the wide face of the bearing inner race.

NOTE: If the inner race of a roller type pilot bearing is on the shaft, place a plug on the end of the shaft to prevent pressing directly against the inner race.

Place steel plug on end of shaft to protect bearing race

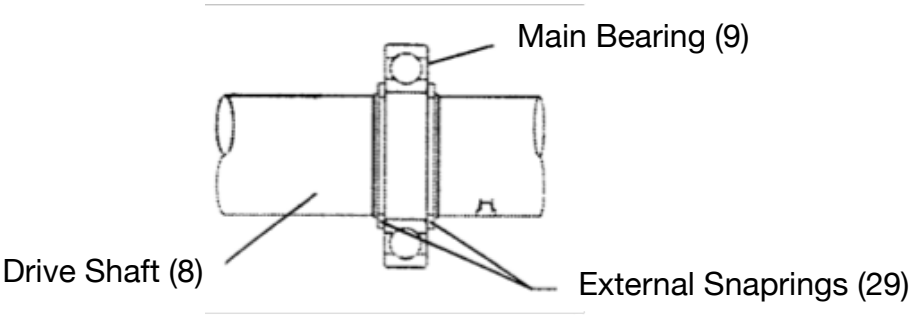


12.1.d Turn the shaft over in the press. Press the second bearing onto the drive shaft as in 12.1.a thru 12.1.c.



Proceed to 12.2.a

12.1.e (CONFIGURATIONS B and D ONLY:) Install one snapring (29) in a groove in the drive shaft (8)



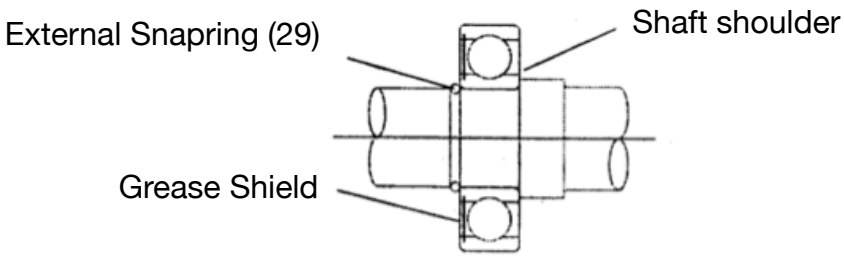
12.1.f Support beneath the inner race of main bearing (9) with a split-plate on the bed of a press. Insert the drive shaft through the bearing (groove without the snapring passing through the bearing first.) Press the shaft into the bearing until the snapring firmly stops against the bearing.

12.1.g Install the remaining snapring (29) in the open groove next to the bearing.

Proceed to 12.2.h

12.1.h (CONFIGURATION C only):
Support beneath the inner race of main bearing (9) with a split-plate on the bed of a press. Insert the drive shaft through the bearing, (snapring groove passing through the bearing first). Press the shaft into the bearing until the shaft shoulder firmly stops against the bearing.

NOTE: The grease shield of the bearing must be toward the pilot bearing / flywheel end of the shaft.



Configuration C

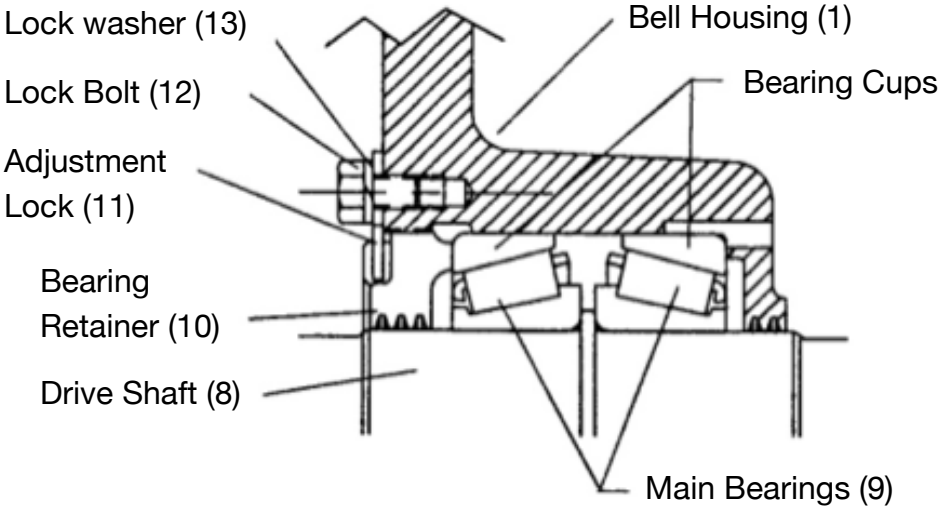
12.1.i Install the external snapring (29).

12.2 Install the Drive Shaft in the Housing

Configurations B & D:	Proceed at 12.2.h
Configuration C:	Proceed at 12.2.m

12.2.a (CONFIGURATION A ONLY):

Support beneath the bearing housing with the bore up.



Configuration A

12.2.b Install one bearing cup in the bore, (if necessary, gently tap the cup to the bottom of the bore.)

12.2.c Install the shaft and bearing in the bore. DO NOT ADD GREASE AT THIS TIME, but the bearings should be lightly oiled.

12.2.d Place the second bearing cup onto the exposed bearing cone. (If necessary, gently tap on the outer edge of the cup to seat the cup against the bearing cone.) Under no circumstances should abusive force be used. Excessive force can damage the roller surface of the bearing cup, causing bearing failure.)

12.2.e Thread the bearing retainer (10) into the bearing housing until it is snugly tightened against the bearing cup. Rotate the drive shaft while tightening the bearing retainer to determine when "zero" bearing clearance exists. When the bearing cups are seated, the "zero" point will be noted by the increased effort required to rotate the drive shaft.

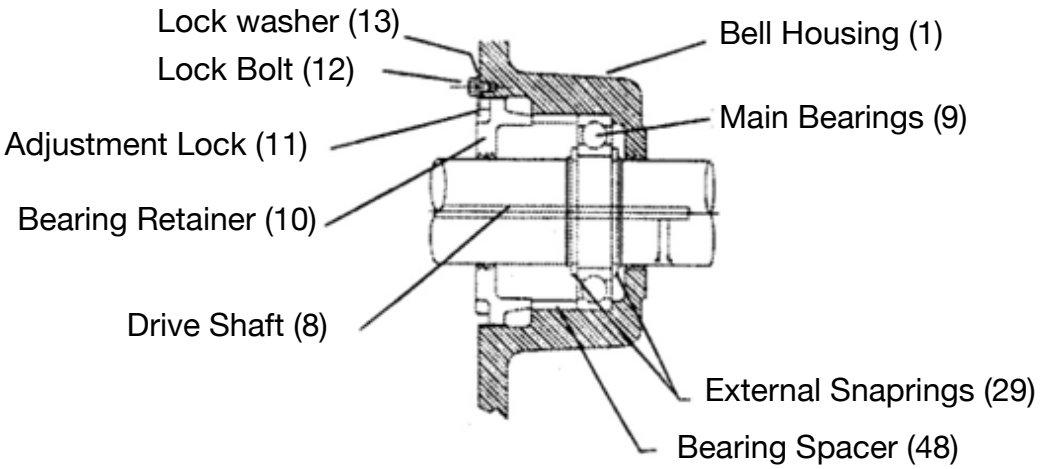
12.2.f After "zero" bearing clearance has been obtained, back the bearing retainer out 2 or 3 notches, using the adjustment lock bolt hole as a reference point.

NOTE: This is a preliminary adjustment. Final measurement and adjustment will be made in 13.2.

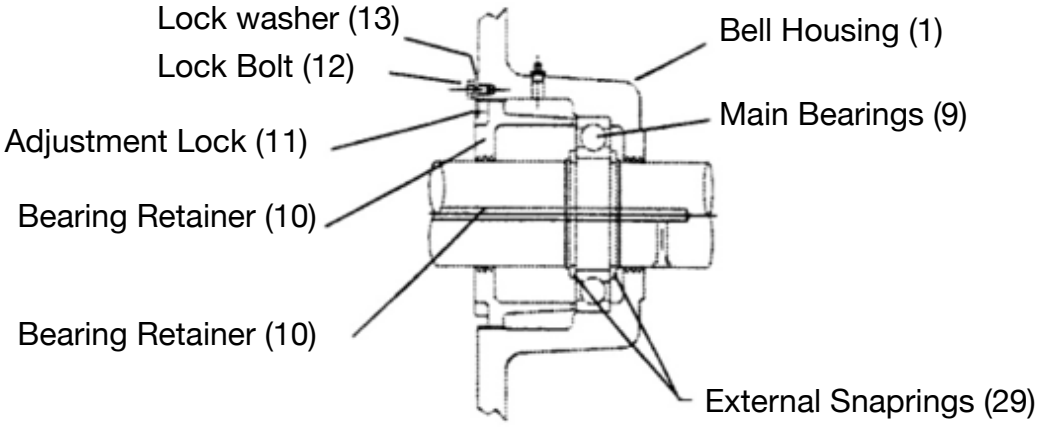
12.2.g Position the adjustment lock (11) tab in a notch, align the bolt hole with the hole in the housing, and install the adjustment lock bolt and lock washer (12 and 13).

Proceed to 12.3

12.2.h (CONFIGURATIONS B and D ONLY):
Support beneath the bearing housing with the bore up.



Configuration B



Configuration D

12.2.i Install the shaft in the bore.

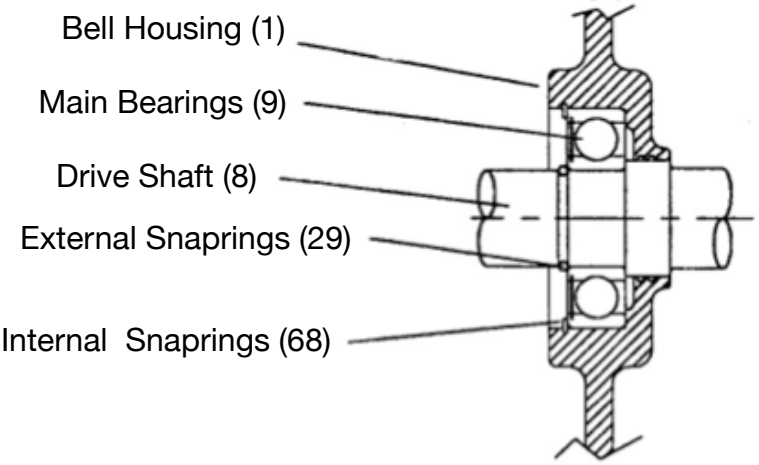
12.2.j (Configuration B only):
Install the bearing spacer (48) in the bore, against the bearing.

12.2.k Thread the bearing retainer (10) into the bearing housing until it is snugly tightened against the bearing spacer or bearing outer race.

12.2.l Back the bearing retainer off a partial notch if necessary to align the nearest notch with the adjustment lock (11) tab. Install the adjustment lock bolt and lock washer (12 and 13).

Proceed to 12.3

12.2.m (CONFIGURATION C ONLY:)
support beneath the housing with the bore up.



Configuration C

12.2.n Lower the drive shaft and main bearing (output end of the shaft first) to the bottom of the housing bore The fit should be slightly snug. (Gently tap on the outer race of the bearing if necessary to seat it in the bot¬tom of the bore).

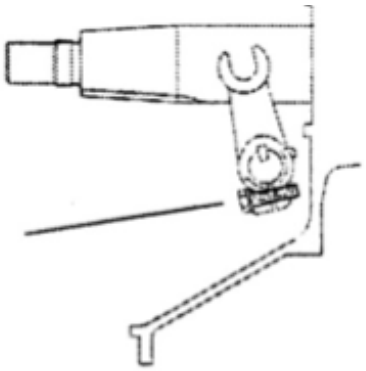
CAUTION: Do not drive the bearing into the housing by tapping on the shaft.
To do so may damage the roller surface of the bearing.

12.2. Securely install the internal snapring (68) in the groove of the bearing housing.

12.3 Install the Cross Shaft and Clutch Release Yoke

12.3.a Lubricate the cross shaft holes in the bell housing. Slide the cross shaft (14) through one hole.

Bolts and lock washers to be installed from this side.



12.3.b Slide the clutch release yoke (17) onto the cross shaft. The bolt holes (unthreaded end) should face outward (toward the flywheel). Slide the cross shaft through the release yoke and into the other cross shaft hole in the bell housing.

12.3.c Rotate and position the cross shaft so one keyway is exposed in the middle of the release yoke. The other keyway will be located outside the yoke. Install two woodruff keys (15) in the cross shaft.

12.3.d Slide the cross shaft and woodruff keys into the keyways of the release yoke until the keys are centered on the yoke.

12.3.e Install two bolts and lock washers (18 and 19) in the clutch release yoke. Tighten and torque to:

Grade 2 bolts		17-20 ft-lbs (23 - 27Nm)
Grade 5 bolts		26-32 ft-lbs (35 - 43Nm)

12.4 Complete the Assembly of the Housing Unit

12.4.a Install all pipe plugs and fittings to complete assembly of the housing.

12.4.b Install remaining fittings in the shaft and housing, (see sections 3.2 and 6.0)

13.0 ADJUST THE MAIN BEARING END PLAY

13.1 (CONFIGURATION B, C and D ONLY):

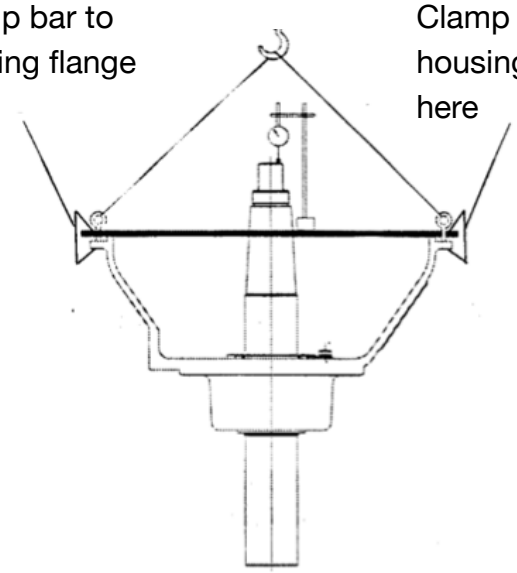
These are ball bearing designs. No adjustment is required.

13.2 (CONFIGURATION A only):

13.2.a Support the PTO with a sling and chain hoist as illustrated.

Clamp bar to housing flange here

Clamp bar to housing flange here



13.2.b Raise the PTO high enough for access to the output end of the drive shaft. Using a soft, but heavy mallet against a hard wood block, strike the ended of the shaft to seat the front bearing cup.

13.2.c Lower the PTO and repeat the procedure in 13.2.b on the front end of the drive shaft to seat the rear bearing cup.

CAUTION: Sufficient force must be used to securely seat the cups, but abusive force can damage the roller surface of the cups, resulting in bearing failure.

13.2.d Insert 4 pieces of shim stock between the shaft and the bearing retainer to fill the gap and minimize sideways movement of the shaft.

13.2.e Attach a dial indicator to a solid bar clamped across the housing as shown. Position the tip of the dial indicator on the nose of the shaft with the direction of indicator tip travel parallel to the shaft. Set the dial indicator to "0".

13.2.f Lower the PTO so the shaft rests on a wood block. Allow a small amount of slack in the lifting strap. Tap lightly on the bell housing to move it downward. Read the dial indicator. The amount of bearing end play will be indicated.

13.2.g Raise the PTO off the wood block. Lightly tap on the pilot bearing end of the drive shaft to move it downward against the rear bearing cup.

13.2.h Again read the dial indicator. It should have returned to "0". If it didn't, repeat 13.2.e thru 13.2.g to obtain an accurate reading.

Main bearing end play should be:
(Grease lubricated bearings:)
Configuration A: .004” - .008” (loose)
(check with bearings lightly oiled, not greased)

13.2.i If adjustment is necessary, proceed as follows: Rotate the bearing retainer clockwise to decrease or counter-clockwise to increase the setting, then repeat 13.2.f thru 13.2.h to verify the proper setting has been attained.

13.2.j Install the adjustment lock.

14.0 INSTALL THE CLUTCH ON THE DRIVESHAFT

14.1 Support the PTO under a hoist, with the output end of the drive shaft resting on a hard wood block.

14.2 Rotate the release bearing so the grease hose is located on the side closest to the hole in the housing.

14.3 Carefully lower the clutch onto the drive shaft. As the release bearing approaches the clutch release yoke, rotate the yoke upwards to engage the bearing carrier trunnions in the cradles of the release yoke.

14.4 Just before the clutch becomes seated on the taper of the drive shaft, rotate the clutch to align the shaft and clutch body keyways and install the key (28) halfway into the keyway.

NOTE: If the key is installed to the bottom of the keyway before the clutch is completely seated, it may restrict proper seating of the clutch.

14.5 Securely seat the clutch on the drive shaft.

14.6 Drive the key further into the keyway, just deep enough to be clear of the tab on the locking washer.

14.7 Place the locking washer (27) on top of the clutch. Locate the tab in the keyway.

14.8 Apply a thin coat of Loctite 271 to the threads of nut (26). Install and tighten nut against the locking washer, taking care not to shear the lock tab. Torque nut to:

HE, 7.5” HE and 8” HE	165 - 170 ft-lbs (224 - 231 Nm)
10” HE and 11.5” HE (single plate)	180 ft-lbs (237 - 244Nm)
11.5” HE(DP) (double plate)	225 - 230 ft-lbs (305 - 312Nm)

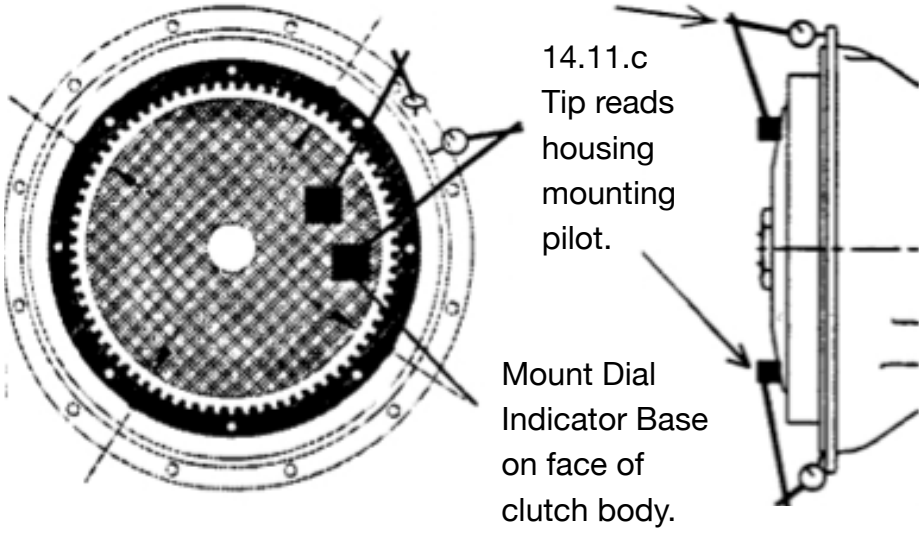
14.9 Using a soft but heavy mallet, strike the clutch body to drive it down onto the drive shaft. Check the torque on the nut to be sure it has not loosened.

CAUTION: Be sure the drive shaft is resting on the wood block before striking the clutch body so the force of the impact can be absorbed by the wood block rather than by the bearing races.

14.10 Bend an edge of the locking washer (27) up flat against one flat of the nut (26).

14.11 Check to be sure the clutch and housing are installed properly and in alignment. If the readings exceed the maximum T.I.R. (total indicator reading), repeat installation of the clutch and/or housings to bring the readings into specifications.

14.1 l.b Tip reads housing mounting face.



14.11.a Securely support the PTO beneath the rear of the housing with the bell housing and clutch end up. The output shaft end must hang free and be suspended on the bearing races.

14.11.b Mount the base of a dial indicator on the face of the clutch body. Locate the tip on the bell housing mounting face. Slowly rotate the clutch and shaft to read face runout. Maximum runout must not exceed:

SAE #1, #2, #3 Housing	.008” (.203mm)
SAE #4, #5, #6 Housing	.006” (.152mm)

14.11.c Move the tip to read the OD of the housing pilot and repeat as in 14.11.b. Maximum runout must not exceed:

SAE #1, #2, #3 Housing	.008” (.203mm)
SAE #4, #5, #6 Housing	.006” (.152mm)

14.12 Install the grease hose (greasable release bearing only) through the hole in the side of the housing (if a grease hose is used). Install and tighten the lock nut (6).

14.13 Install the grease fitting (5) in the end of the grease hose (if used).

14.14 Lubricate the PTO. (See sections 3.1, 3.2, and 4.3.)

14.15 Final clutch adjustment may be made after the Power Take-Off is installed on the engine. Refer to sections 3.4 and 3.5 for final clutch adjustment information.

14.16 Refer to section 4.0 for Power Take-Off installation and lubrication instructions.

15.0 TROUBLESHOOTING GUIDE

15.1 Common Causes for PTO Failures:

Problem	Cause	Correction
Clutch slippage	No adjustment or improper adjustment	Clutch pressure must be set with spring pull scale or torque wrench (See section 3.4 and 3.5.)
Clutch slippage (adjustment was properly set)	Glazed, burned or warped mating components from high engagements.	Replace complete clutch with new assembly. Engage with engine speed less than 1000 RPM. (See section 5.0.)
Clutch slippage (adjustment was properly set)	Clutch disc is oil or grease soaked.	Check for proper grease viscosity & lube intervals. Replace damaged components. (See section 3.0)
Clutch failure (several times)	Clutch does not have torque capacity for engine output.	Review application. Contact NACD.
Failed release bearing (bronze type)	Improper handle position and/or modification.	Position handle vertically up or down when engaged and no pre-load. (See section 4.5)
No output from PTO (clutch feels normal)	Drive teeth worn off clutch disc.	Check for failed pilot bearing, misalignment, and dial indicate bell housing. (See section 2.7)
Failed pilot bearing	Bearing overloaded, lack of lube, improper bearing for application.	Check for proper belt tension, lubrication and application. (See section 2.4 and 3.0)
Failed main bearing(s) (repeated failures)	Improper application (In-line vs. side load)	Review application. Contact NACD.
Failed main bearing(s)	Improper lube intervals, improper grease, incorrect bearing setting if applicable.	Checking for proper lubrication, review lube intervals, set bearings to proper clearance. (See section 3.0 and 13.0)

North American Clutch & Driveline

LIMITED NACD GENERAL WARRANTY, LIMITATIONS OF REMEDIES AND LIMITATIONS OF OTHER WARRANTIES

A. North American Clutch & Driveline warrants all assembled products and parts to the original customer. For Power Take-Off products and parts, such warranty shall extend for a period of twenty-four (24) months from the date of original shipment by NACD to the original customer, but not to exceed twelve (12 months of service or one thousand five hundred (1,500) hours of service, whichever occurs first. The warranty set forth above is exclusive and North American Clutch & Driveline, Inc. makes no other warranty, express or implied. NACD hereby expressly disclaims any and all other warranties including warranties of merchantability or fitness for a particular purpose.

B. Limitation of Remedies and Liability: The remedies provided herein are buyer's sole and exclusive remedies. In no event shall NACD be liable for any direct, indirect, special, punitive, incidental or consequential damages including, but not limited to, loss of revenue or profit, loss of use of the product, cost of capital, cost of substitute equipment or facilities, cost of cover, downtime costs, claims of any third parties, including buyers' customers, or any other costs whatsoever, whether based on contract, warranty, tort (including negligence) or any other legal theory.
The above warranty and remedy are subject to the following terms and conditions:

1. Complete parts or products upon request must be returned transportation prepaid and also the claims submitted to NACD within sixty (60) days after completion of the in-warranty repair.
2. The warranty is void if, in the opinion of NACD, the failure of the part or product resulted from abuse, neglect, improper maintenance or accident.
3. The warranty is void if any modifications are made to any product or part without the prior written consent of NACD.
4. The warranty is void unless the product or part is properly transported, stored and cared for from the date of shipment to the date placed in service.
5. The warranty is void unless the product or part is properly installed and maintained within the rated capacity of the product or part with installations properly engineered and in accordance with the practices, methods and instructions approved or provided by NACD.
6. The warranty is void unless all required replacement parts or products are of NACD origin or are NACD authorized replacement parts, and otherwise identical with components of the original equipment. Replacement parts or products not of NACD origin are not warranted by NACD.

C. As considered for this warranty, the original customer and subsequent purchaser agree to indemnify and hold NACD harmless from and against all and any loss, liability, damages or expenses for injury to persons or property, including without limitation, the original customer's and subsequent purchaser's employees and property, due to their acts or omissions or the acts or omissions of their agents, and employees in the installation, transportation, maintenance, use and operation of said equipment.

D. Only an NACD authorized factory representative shall have authority to assume any cost or expense in the service, repair or replacement of any part or product within the warranty period, except when such cost or expense is authorized in advance in writing by NACD.

E. NACD reserves the right to improve the product through changes in design or materials without being obligated to incorporate such changes in products of prior manufacture. The original customer and subsequent purchasers will not use any such changes as evidence of insufficiency or inadequacy of prior designs or materials.

F. If failure occurs within the warranty period, and constitutes a breach of warranty, repair or replacement parts will be furnished on a no-charge basis and these parts will be covered by the remainder of the unexpired warranty which remains in effect on the complete unit.
*Note: The above constitutes the basic NACD General Limited Warranty and may be supplemented by additional published warranty terms dependent upon the product involved. Supplementary warranty terms are available upon request.

17.0 ADDENDUM A

NACD Clutch Engagement Torque Settings

Clutch Size & Type	Engagement Torque (Measured at Cross Shaft)
6.5 SP HE Bronze 6.5 SP HE Ball 6.5 DP HE Bail	50-58 ft-lbs (68-79 Nm) 70-82 ft-lbs (96-111 Nm) 70-80 ft-lbs (96-107 Nm)
7.5 SP HE Bronze 7.5 SP HE Bail 7.5 DP HE Bail	50-58 ft-lbs (68-79 Nm) 79-92 ft-lbs (108-125 Nm) 83-93 ft-lbs (112-126 Nm)
8.0 SP HE Bronze 8.0 SP HE Ball 8.0 DP HE Bail	65-72 ft-lbs (88-98 Nm) 90-99 ft-lbs (121-135 Nm) 89-99 ft-lbs (121-135 Nm)
10.0 SP HE Bronze 10.0 SP HE Ball 10.0 DP HE Ball	101-108 ft-lbs (137-146 Nm) 139-149 ft-lbs (189-201 Nm) 140-150 ft-lbs (190-205 Nm)
11.5 SP HE Bronze 11.5 SP HE Ball 11.5 DP HE Bronze 11.5 DP HE Ball 11.5 TP Ball	108-115 ft-lbs (146-156 Nm) 130-139 ft-lbs (176-188 Nm) 144-152 ft-lbs (195-206 Nm) 174-184 ft-lbs (236-249 Nm) 240-255 ft-lbs (326-347 Nm)
14.0 HD SP Bronze 14.0 HD SP Ball 14.0 HD DP Bronze 14.0 HD DP Ball 14.0 HD TP Bronze 14.0 HD TP Ball	163-183 ft-lbs (221-248 Nm) 207-232 ft-lbs (280-315 Nm) 163-183 ft-lbs (221-248 Nm) 207-232 ft-lbs (280-315 Nm) 183-208 ft-lbs (250-280 Nm) 232-264 ft-lbs (317-355 Nm)

NOTICE

NACD makes no warranty or guarantee of any kind, expressed, implied or otherwise, with regard to the information contained within this manual. NACD assumes no responsibility for any errors that may appear in this manual and shall not be liable under any circumstances for incidental, consequential or punitive damages in connection with, or arising out of, the use of this manual. The information contained within this manual is subject to change without notice.

North American Clutch & Driveline

P.O. Box 15130
Rockford, IL. 61132

Phone: (800) 383-9204
Fax: (815) 282-9160

www.naclutch.com