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**General Notes**

1. Two Important Precautions
   a) Operation of Handwheel
      The speed change handwheel must not be turned unless the Variator is running. Otherwise, serious damage may occur. The discs are always in firm mesh with each other even when the unit is not running because the spring always produces a constant thrust. Any forcible dislocation of mesh can cause serious damage to the discs and spline shafts. (Therefore, remove handwheel from the drive whenever possible to prevent this occurrence.)
   b) Lubrication
      Maintenance of the lubrication oil is extremely important. It is the life blood of the wear life of all rotating components. The power is transmitted through the "contacts" of the flange and cone discs by means of hydrodynamic shear of an oil film. The breakup of an oil film due to distorted oils results in "galling" of the discs due to metal to metal contact. To maintain correct lubrication, please carefully study the chapter covering "Lubrication" on pages 6 and 7 before operating the drive.

2. How to Identify Models
   The Beier Variator is a fully standardized mechanical variable speed (VVS) drive and offers many various types and capacity models. Therefore, the identification of the drive in question is essential for after-sale service. All necessary information is written on the name plate which is secured to the casing. By reading both Model No. and Serial No. our records tell us everything about the drive and the correct spare parts can be issued.
   a) Description on Name Plate
      (Example of Description for Model 15 AGY)

---

**Nomenclature**

The basic nomenclature of the Beier and Beier-Cyclo Variator indicates shaft orientation, rated input power, unit size and input mounting: typical frame size designations follow:

**Notes:**
1. For vertical Beiers, replace "H" with "V" designation.
2. C designation is replaced by M when TEFC motor is supplied by factory.
3. ¾ HP, 1 HP, 1½ HP and 2 HP Beiers have similar nomenclature. Add SUFFIX -1 to distinguish between ¾ HP (No -1) and 1 HP (which has -1). Same for 1½ and 2 HP. No Dash 2 = 1½ HP, -2 = 2 HP.

<table>
<thead>
<tr>
<th>Beier Variator</th>
<th>Beier-Cyclo Variator (Single Reduction)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N3 AX C Y - C</td>
<td>H A C N2 -3145-2 17:1</td>
</tr>
<tr>
<td>SMA Code</td>
<td>Reduction Ratio of Cyclo Drive</td>
</tr>
<tr>
<td>with C Face Motor Adapter</td>
<td>Donated HP, See note 1C</td>
</tr>
<tr>
<td>AX Series Beier Variator (1750 RPM top output speed)</td>
<td>Size of Beier Variator (2 HP)</td>
</tr>
<tr>
<td>Size of Beier Variator (3 HP)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Beier Variator</th>
<th>Beier-Cyclo Variator (Double Reduction)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N15 A G Y - BP 2:1</td>
<td>H A C N10 -3245/18 121:1</td>
</tr>
<tr>
<td>SMA Code</td>
<td>Reduction Ratio of Cyclo Drive</td>
</tr>
<tr>
<td>with Motor Adapter</td>
<td>Size of Beier Variator (10 HP)</td>
</tr>
<tr>
<td>A Series Beier Variator</td>
<td></td>
</tr>
<tr>
<td>Size of Beier Variator (15 HP)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Beier-Ulysses Right Angle Variator</th>
<th>Beier-Cyclo Variator (Wide Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1 AX C Y - 1 C + GTS918 L - 10:1</td>
<td>D Y C N2 - C Y ...</td>
</tr>
<tr>
<td>SMA Code</td>
<td></td>
</tr>
<tr>
<td>with D Face Motor Adapter</td>
<td></td>
</tr>
<tr>
<td>AX Series Beier Variator (1750 RPM top output speed)</td>
<td></td>
</tr>
<tr>
<td>Size of Beier Variator (1 HP)</td>
<td></td>
</tr>
</tbody>
</table>

1 Please refer to SM-Ulysses Reducer Catalog 1/000/2000 for additional mounting configurations and hallowed bore options.
1. Notes on Application Conditions

a) Shock Loading, Frequent Start/Stop, Reversing, High Inertia Load Application

The Beiler Variator is designed to be usable at rated power and speed under steady, 24-hour-per-day load conditions. If the application includes severe operating conditions such as shock loading, frequent start/stop, reversing, or high inertia, selection of the Beiler Variator should be reconsidered. Please consult our factory or your local distributor.

b) Thrust Load, Excessive Radial Load on the Shafts and Bearings

Thrust or excessive radial load is not to be applied on the shafts of Beiler Variator. A quick way to check the Pitch Circle Diameter (P.C.D.) of a drive or sprocket is that the P.C.D. MUST NOT BE LESS THAN 5 TIMES THE SHAFT DIAMETER. For allowable thrust and radial load capacity for each frame, please consult our factory.

c) Ambient Temperature, Outdoor, Dusty Atmosphere

Standard Beiler Variator are designed to be used from below 17°F to 129°F ambient, indoor and normal atmospheric conditions. For any other atmosphere, some consideration or modification is required. Consult our factory or our local distributor.

d) Allowable Input Power

The power rating for Beiler Variator is determined on the basis of 4 pole, 6 pole or 8 pole electric motor drives, subject to the size. The rated input speeds are fixed at a maximum permissible, and under any circumstances, higher input speeds than specified on the name plate are not to be applied.

When the drive must be used at certain input speed lower than the catalogue standard rated input speed, the Input Power to the Beiler Variator must be reduced in proportion to the input speed.

Under such condition, the following applies:

\[
\text{ALLOWABLE INPUT} = \frac{\text{Rated input speed}}{\text{Rated input speed}} \times \text{Input Power} \]

Please note that the above will not apply to certain extremely low input speeds.

When the input speed goes lower than 500 RPM, the lubrication system must be reconsidered. Please consult factory or distributor, as forced lubrication may be necessary.

2. Installation

a) Mounting and Alignment

The base on which the Beiler Variator is to be mounted must be rigid and smooth. Otherwise, torsional external stress will be transmitted onto the casing, causing vibration and possible lubrication failure to the Beiler components and bearings, etc. A suitable clear location for maintenance and ventilation is also an essential consideration for the installation. Shaft alignment and sheave/sprocket mounting should be done properly to minimize the shaft misalignment and overhung load.

b) Inclined Mounting

The DRIVE MUST BE INSTALLED ON A HORIZONTAL PLANE. Installation on inclined plane may cause oil leakage through labyrinth seals or lubrication failure to some bearings.

For inclined mounting, standard unit requires some modifications in sealing or oil level index or sometimes different lubrication system. Please consult factory or distributor where necessary.

c) Lubrication Oil

Our Beiler Variators are shipped without lubrication oil. CAUTION: FILL DRIVE WITH LUBRICATION OIL BEFORE STARTING OPERATION. Lubrication systems vary as does the appropriate amount of oil in the varying models, types and capacities. Please refer to Chapter "Lubrication" for appropriate lubricant, amount, etc.

The rotation direction of the oil pump for the forced lubrication models is one directional and fixed. Please make sure of this rotation by checking the gauge before starting main drives.

For the forced lubrication with external oil cooling tank, instructions for this piping are given in the attached information on page 18.

d) Electrical Wiring - remote control and oil pump for "fail safe operation" into main motor circuit.

Other than the wiring to the main motor, when the Beiler is equipped with electric remote control or requires external pump lubrication (horizontal type of 50A and larger, vertical type of N6A and larger), interlocking of wiring connection of the main motor and auxiliary motor(s) is always recommended to avoid any accidental operation. Please refer to information for wiring on page 16.
1. Lubrication System

According to the sizes and types, standard lubrication systems for Beier Variators are designated as the table below shows.

<table>
<thead>
<tr>
<th>Horizontal Type</th>
<th>Model</th>
<th>Lubrication System</th>
</tr>
</thead>
<tbody>
<tr>
<td>NS4A - 49HA (E, E)</td>
<td>Oil-Splash Lubrication</td>
<td></td>
</tr>
<tr>
<td>NS5D - NI90D</td>
<td>Forced Lubrication by External Pump with Oil Cooler</td>
<td></td>
</tr>
<tr>
<td>NS5A - 400G</td>
<td>Forced Lubrication by External Pump with Oil Cooler</td>
<td></td>
</tr>
<tr>
<td>SG5A - 400G</td>
<td>Forced Lubrication by External Pump with Oil Cooler</td>
<td></td>
</tr>
</tbody>
</table>

2. Recommended Lubricating Oil

Listed below are the only recommended oils to be used in SM-Beier Variable Speed Drives. Use of automotive motor oils or oils containing extreme pressure additives are not recommended. The use of any oil other than those recommended will void all product warranties.

**Recommended Lubricants for NA Type Beier**

---

**Recommended oils for use in SM-BEIER Variators — USE NO SUBSTITUTES**

**WARNING: DO NOT USE OILS CONTAINING E.P. ADDITIVES — OR AUTOMOBILE OILS**

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>14° to 52° (10° to 95°)</th>
<th>32° to 95° (60° to 90°)</th>
<th>50° to 123° (65° to 150°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gulf Oil Corp.</td>
<td>Harmony 65AW</td>
<td>Harmony 68AW</td>
<td>Harmony 100AW</td>
</tr>
<tr>
<td>Exxon Co.</td>
<td>Nuto 645</td>
<td>Nuto 655</td>
<td>Texaco 100</td>
</tr>
<tr>
<td>Mobil Oil Corp.</td>
<td>Mobil DTE 25</td>
<td>Mobil DTE 56</td>
<td>Texaco 100</td>
</tr>
<tr>
<td>Shell Oil Co.</td>
<td>Texaco 45</td>
<td>Texaco 88</td>
<td>Texaco 100</td>
</tr>
<tr>
<td>Texaco Inc.</td>
<td>Rando 46</td>
<td>Rando 88</td>
<td>Regal R&amp;O 150</td>
</tr>
</tbody>
</table>

**Recommended Traction Oils for ND Type**

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Ambient Temperature F (°C)</th>
<th>14°-123° (10°-85°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun Refining</td>
<td>Custom BV 759</td>
<td>Custom BV 759</td>
</tr>
<tr>
<td>Hommel-Knorr</td>
<td>Daphne Alpha DEXO P150</td>
<td>Daphne Alpha DEXO P150</td>
</tr>
<tr>
<td>Mitsubishi Oil</td>
<td>Diamond TD Oil 150</td>
<td>Diamond TD Oil 150</td>
</tr>
</tbody>
</table>

**NOTE:**
1. For lubrication of ND Type BEIER VARIATOR, use recommended traction oil.
2. For CYCLIC, use recommended lubricating oils.
3. Be sure not to mix lubricating oils for ND Type BEIER VARIATOR and CYCLIC or supply incorrect lubricating oils to these units.

3. Amount of Lubricating Oil

Remove the breather and fill with oil until the oil level reaches the upper red line on the oil level sight gauge. The lower red line on the oil gauge is the index for oil level during running. The oil level must always be kept above the lower red line during operation.

Some vertical models of reduction gear types (N605AVG - N10AVG) have two separate reservoirs for variable speed mechanism and reduction gear mechanism. Fill the oil in each separate reservoir to proper level. For your reference, appropriate amounts of oil for each model are tabulated at right.
OPERATION PRECAUTIONS

1. Starting

a) Forced Lubrication Drives
Operation of lubricating pump must precede the operation of main drive. Confirmation of oil circulation is strongly recommended before starting. The oil circulation can be checked by the pressure gauge fitted on the oil piping. To avoid operation without lubrication, interlocking of the electrical wiring is always recommended to avoid damage.

c) Comments on Starting — How to Get Longer Wear Life
Higher torque than normal running torque could be applied to the power transmission components at starting and the acceleration torque generally increases in proportion of the speed to be reached. Therefore, it is always advisable to start the drive down on the slowest speed range of the Beier Variator. The Beier output torque rating at the lower speed range is much greater than that at the higher speed range by approximately twice for A-type.

2. Speed Change Operation

a) Manual Speed Change
Speed change of Beier Variator is performed by simply turning the handwheel and shifting screw. In the standard drive, the relation of operation and performance is as follows:

b) Speed Change Operation by Remote Control System
The Remote Control System for Beier Variator is explained in our separate catalog "SM BEIER & SM BEISTER Mechanical Adjustble Speed Drives," Cat. No. 06.002.00.001. Meanwhile, several important points are to be remembered.
- Appropriate wiring connection to operator’s switch box should be made to ensure proper operation by two push button operator device.
- Speed change can be monitored by watching an external speed indicator.
- Never allow slipping at the slip clutch (safety device for overrun) on the shifting screw.

c) Manual Override for Remote Control System
In case of pilot motor failure, chain failure or slip clutch wear, the remote control system can be bypassed by taking the following steps:

1. Unscrew yellow hub lock nut in center of handwheel and pull handwheel back until the two (2) roll pins disengage handwheel from clutch hub.
2. The handwheel will now operate independently of the remote unit allowing manual speed variation.

2. There are three (3) adjustment bolts on the slip clutch hub to adjust for wear in the friction discs. These should be checked and tightened slightly if the clutch slips.

---

Number of Turns for Full Range Speed Change Operation

<table>
<thead>
<tr>
<th>Models</th>
<th>N6A, N1A</th>
<th>N2A, N3A</th>
<th>N5A, N8A</th>
<th>N10A</th>
<th>15A</th>
<th>20A</th>
<th>25A, 40A</th>
<th>50A, 75A, 100A</th>
<th>150A, 200A</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Turns</td>
<td>27.4</td>
<td>25</td>
<td>33</td>
<td>28.3</td>
<td>24</td>
<td>21</td>
<td>26.5</td>
<td>27.5</td>
<td>24</td>
</tr>
</tbody>
</table>

The table is also applicable to V-type
MAINTENANCE

1. Lubrication
   - a) Observation of Oil Level
      Oil level must be carefully watched as frequently as possible. Keeping the oil at the required level is very important.

      The appropriate oil level is:
      - Upper Red Mark — not operating
      - Lower Red Mark — during operation

      It is recommended to routinely observe the oil level in your daily inspection.

   - b) Oil Change
      Suggested interval for oil change for NA type Beier is 500 hours after initial operation and every 2,500 hours thereafter. This is the recommendation for normal operation. Suggested interval for oil change for ND type Beier is 50,000 hours or 4-5 years after initial operation. Oil should be changed more frequently whenever deterioration is detected, since deterioration occurs in different operation hours subject to brand of oil, conditions of loading and surroundings.

   - c) Oil Selection for Ambient Temperature
      The most important factor for the lubricant for Beier Variator is viscosity. When there are seasonal ambient temperature changes, change oil periodically to meet the viscosity requirement due to the respective ambient temperature.

      For the maintenance b) and c) above, it is recommended that the maintenance records be attached to the drive. Keep record of (1) Date of the last oil change, (2) Brand of oil supplied, (3) Name of personnel who did it, etc.

   - d) Lubrication While the Drive Is Not Running
      When the drive is brought to a halt for a considerable length of time after a period of operation, internal components tend to get rusted because of the deterioration of lubricating oil. Appropriate care should be taken for long periods with no operation.
      - For a half of 1 month or so, preserve the Drive after running-in with new oil.
      - For a half of 6 months or more, preserve after running-in with rust-preventive oil after complete flushing.

      Also note that rust-preventive oil is not suitable for long continuous operation after the drive is restored to normal operation.

2. Other Check Points
   - a) Excessive Temperature Rise
      Feel or measure temperature on the casing. Allowable temperature rise measured on the surface of the casing is 96°F to 102°F over the ambient temperature. Excessive temperature rise can be attributed to various hidden causes. Please refer to "Trouble Shooting" on page 12 for details.

   - b) Abnormal Sound
      Abnormal sound is the sign of damage or failure of components and it varies with the kind of component damage. Refer to "Trouble Shooting" on page 12 for details.

   - c) Oil Leakage
      Oil leakage arises from various causes such as worn oil seal, loose housing fit, excessive oil, faulty gasket, etc. Since oil leakage causes other troubles, it must be quickly taken care of. For your reference, we show the sealing method for Beier Variator on the attached data on page 20.

   - d) Other Abnormal Performance
      In addition to the above signs, several other abnormal performances may be found during operation though they may occur infrequently. They are increase of power consumption, vibration, fluctuating output speed, inability or difficulty of changing speed, etc. These are fully explained in "Trouble Shooting" on pages 12 and 13.

3. Maintenance Overhaul
   - a) Overhauling Period
      After two years of continuous operation, an entire maintenance overhaul is recommended.
      This includes disassembly of the Beier Variator and inspection of the wear on components. For this purpose, assembly procedures and assembly drawings are explained in the following chapters.

   - b) Recommended Replacement Parts
      The main components, which yield to wear during operation, are cone discs, flange discs, spline shafts, gears, bearings and oil seals. As for numbers and location of spare parts, refer to "Table of Spare Parts" on pages 14 and 15. They must be carefully examined during overhauling, and replaced if necessary.

4. Warning Signals for Replacement
   During overhaul, examine the following components carefully and replace them when the components show symptoms mentioned below.

   - Cone Discs: Erosion, Discoloration due to seizure, Wear (wearing of 20 microns), Flaw, Pitting/Spalling, Galling
     - Flange Discs: Wear of rim, Pitting/Spalling, Galling, Discoloration due to seizure.
     Note: Right pitting, spalling, flake or burn on the rim of flange disc can be corrected by an oil grind lapping stone.

   - Bearings: Wear, Fatigue, Discolor, Broken Finisher.

   - Spline Shafts, Input Shaft with Spline: Fatigue on spline (see fig. below), Discoloration due to seizure, Fatigue of key and keyway.

   - Oil Seal: Wear, Loss of elasticity.

   - Gears: Pitting, Spalling, Discolor due to seizure, Flaw, etc.

   - Casing & Cover: Frequent speed change operation causes wear in the hubs on the casing and cover which supports swing shaft. Creep data to wear exceeding 6.1mm requires replacement.
## TROUBLE SHOOTING

<table>
<thead>
<tr>
<th>Causes</th>
<th>Countermeasures</th>
</tr>
</thead>
</table>
| **PROBLEM 1 — TEMPERATURE RISE**  
(Temperature on the casing exceeding 105°F over Ambient temperature.)  
Heat generation due to shortage of oil or deterioration. | Replenish or change oil.  
Over-slippage due to overload. | Measure input power of motor at the lowest speed, and remove the causes for overload.  
Wear of disc. | Resistance can be felt in manual speed change operation. Replace worn discs.  
Broken component or faulty assembly. | Usually attended by abnormal sound. Disassemble and inspect the drive. |

Other than the above, lack of oil on the tip(s) of oil seal causes temperature rise on the oil seal. Lubricate tip of oil seal.

## PROBLEM 2 — ABNORMAL SOUND

<table>
<thead>
<tr>
<th>Causes</th>
<th>Countermeasures</th>
</tr>
</thead>
</table>
| Rolling Noise  
Broken discs or bearings. | Replace discs or bearings.  
High Cyclic Metallic Sound  
Damage to the gears. | Correct or replace gears according to the extent of damage.  
Grinding Noise  
Rotating component in contact with unrelated parts due to faulty assembly. | Reassemble properly and replace parts if required.  
Rattling Noise  
Loose fit of coupling, fan, etc. due to worn key. | Inspect the keys and replace if required.  
Squeaking Noise  
Poor lubrication on the tip of oil seal. | Lubricate seal.  
Sliding Noise  
Excessive corrosion on discs and bearings. | Corrosion tends to occur when oil deteriorates during long periods of no operation without appropriate care. Overhaul is required.  
Sound Difference at certain speeds during speed change operation  
Excessive wear on a certain range of cone disc due to operation at one set speed. | Occurs with resistance for speed change operation. Operate drive at other speeds or replace discs.  
Sound Difference according to load condition  
Usually no trouble. | Meshing sound of gears varies subject to load intensity. Care should be taken that no overload is applied to the drive. |

## PROBLEM 3 — INCREASE OF INPUT POWER

<table>
<thead>
<tr>
<th>Causes</th>
<th>Countermeasures</th>
</tr>
</thead>
</table>
| Sudden increase at certain speed during speed change due to excessive wear at a certain range of cone discs. | Select other speed for operation or replace discs.  
Higher viscosity of oil or more oil than required. | Replace oil or reduce oil to the proper level.  
Rotating component in contact with other unrelated parts. | Occurs with noise. Reassemble properly.  
Overload. | Disengage with load and measure the no load input power. |

## PROBLEM 4 — VIBRATION

<table>
<thead>
<tr>
<th>Causes</th>
<th>Countermeasures</th>
</tr>
</thead>
</table>
| Weak foundation or loose mounting. | Reinforce the foundation and tighten the bolts.  
Misalignment. | Correct misalignment.  
Loose fitting or broken coupling, sheave or fan. | Replace key or coupling, sheave or fan itself.  
Pulsation of belt or chain. | Determine the cause of pulsation.  
Resonance caused by the vibration of other element. | Reduce or isolate the vibration of other element. |

## PROBLEM 5 — FLUCTUATION OF SPEED

<table>
<thead>
<tr>
<th>Causes</th>
<th>Countermeasures</th>
</tr>
</thead>
</table>
| Overload or lack of capacity. | Detect the cause for overload.  
Wear of iron on flange disc. | Replace disc.  
Movement of shifting screw by vibration. | Lock the hand wheel. |

## PROBLEM 6 — OIL LEAKAGE

<table>
<thead>
<tr>
<th>Causes</th>
<th>Countermeasures</th>
</tr>
</thead>
</table>
| Fatigue or wear of oil seal. | Replace oil seal.  
Oil is overfilled. | Reduce oil to appropriate level.  
Improper fitting of housing, cover, etc. | Check fit and fasteners.  
Oil return hole clogged. | Clear the hole. |

## PROBLEM 7 — INABILITY OR DIFFICULTY OF SPEED CHANGE OPERATION

<table>
<thead>
<tr>
<th>Causes</th>
<th>Countermeasures</th>
</tr>
</thead>
</table>
| Broken disc (impossible to keep running). | Replace discs.  
Fatigue of splined shaft or input shaft, where cone disc slides. | Correct or replace subject to the extent of fatigue.  
Disengagement of disc meshing. | This tends to occur when severe peak load is applied under extreme high speed running. Reassemble is required.  
Shifting nut is locked at extreme low or high speed. | Release shifting nut. |
TABLE 1. (REFERRING TO FIG. 1, 2)

<table>
<thead>
<tr>
<th>Name</th>
<th>BEARING</th>
<th>OIL SEAL</th>
<th>DISC</th>
<th>GEAR</th>
<th>SPLINE SHAFT</th>
<th>BUILT-IN GEAR TYPE A (Fig. 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>INPUT SHAFT</td>
<td>OUTPUT SHAFT</td>
<td>SWING SHAFT</td>
<td>SPINE SHAFT</td>
<td>INPUT SHAFT</td>
<td>SWING SHAFT</td>
</tr>
<tr>
<td>Part No.</td>
<td>B-1</td>
<td>B-2</td>
<td>B-3</td>
<td>B-4</td>
<td>B-5</td>
<td>B-6</td>
</tr>
<tr>
<td>N50A</td>
<td>6003</td>
<td>6003</td>
<td>6003NR</td>
<td>6003NR</td>
<td>6003</td>
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Table 1-2

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<td>6003NR</td>
<td>6003NR</td>
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Remarks:
1. Figures in above tables show the number of the part used for one complete unit or the size No. of bearings and oil seals, whose number varies per unit is one (1) unless otherwise specified or permitted.
2. A-G type bearings are replaced with B-G type bearings.
3. For vertical type, the above table applies except for bearings and oil seals or input and output shaft.
1. Wiring Charts

a) Beier Variator with Electrical Remote Control
Speed change operation, while the main drive is not in use, will damage the internal mechanism of Beier Variator. To prevent misoperation, wiring shown below assures "fail safe" operation.

b) Beier Variator Lubricated with External Pump
As mentioned in previous chapters, vertical units of N8A or larger and horizontal units of 50A or larger are lubricated by an external pump. In these drives, lubrication system must be put into operation prior to the starting of the main drive. Following is an example of wiring for fail safe operation.

2. Lubrication System — Piping and Flow Chart

a) Vertical Drives N8A and Larger
These units are shipped fully equipped with a pump incorporating a motor, a filter, an oil flow gauge and piping. The flow chart below shows a typical arrangement of the lubrication system. Oil distribution ring and oil effusion holes marked below play important roles in lubricating all parts of the mechanism.
b) Extra-Large Units Incorporating Oil Cooler — 50A and Larger

These units, including horizontal and vertical types, are shipped with a separate oil cooling water jacket equipped with an oil pump driven by an electric motor.

Installation and Pipe Arrangement

1) The cooling tank should be installed on a horizontal plane close to the main unit. If installed remote from the main drive insufficient pumping of oil or bad lubrication will result. Appropriate position of the cooling tank is within 0.5 m above or 1.5 m below the level of main drive and within 3 m of the drive.

2) Referring to the schematic diagram shown below, pipe arrangement should be done between the main drive and the cooling tank and to water inlet and outlet properly.

Use pipe and assemble with minimum angle. The thread size at the joints of the main drive and oil tank are also tabulated below.

![Diagram](image)

Piping shown by dotted line to be done at installation site.

<table>
<thead>
<tr>
<th>Frame Size</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
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<tr>
<td>50 - 100A</td>
<td>PS 3/4 x 20 (depth)</td>
<td>PS 1/2</td>
<td>PT 1</td>
<td>PT 3/4</td>
<td>PT 3/4</td>
</tr>
<tr>
<td>150, 200A</td>
<td>PS 1 x 25 (depth)</td>
<td>PS 2</td>
<td>PT 1/4</td>
<td>PT 1</td>
<td>PT 1</td>
</tr>
</tbody>
</table>

3. Positions of Oil Filler, Drain and Grease Fitting

a) Horizontal Unit

![Diagram](image)

Oil gauges and drain plugs are mounted on both sides of casing.

b) Vertical Unit

As mentioned in the previous chapter, some of the bearings of vertical types are lubricated with grease separately from main oil lubrication system. The sketch below shows the positions of grease fittings together with the positions of oil filler and drain plugs.

(i) Oil Splash Lubrication for N05 - N6AV(G)

![Diagram](image)

*1 grease fitting only for N3 and N6AV(G)
*2 grease fittings are not on N06AVG

(ii) Forced Lubrication for N8 - 40AV(G)

![Diagram](image)

Each fitting takes slightly different position in various types.
4. Sealing Mechanism of Beier Variator

Sealing mechanism around the shaft varies in accordance with the sizes and types of Beier Variator as shown in the tables below. The cross-sectional view of each mechanism is also shown in the sketches below. When oil leakage is inspected, please investigate the problem, referring to the following information.

Sealing Mechanism

a) Horizontal

b) Vertical

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Input Shaft</th>
<th>Output Shaft</th>
<th>Slow Speed Shaft for G-Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>N05A, N1A</td>
<td>Oil seal</td>
<td>Oil seal</td>
<td>Oil seal</td>
</tr>
<tr>
<td>N2A - 20A</td>
<td>Oil seal</td>
<td>Oil seal</td>
<td>Oil seal</td>
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</table>

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Input Shaft</th>
<th>Output Shaft</th>
<th>Slow Speed Shaft for G-Type</th>
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</thead>
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<td>Oil seal x 2</td>
</tr>
<tr>
<td>N2AV - N5AV</td>
<td>Oil seal</td>
<td>Oil seal x 2</td>
<td>Oil seal x 2</td>
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<tr>
<td>N2AV - 200AV</td>
<td>Oil seal</td>
<td>Dry Well</td>
<td>Dry Well</td>
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<td></td>
<td></td>
<td></td>
<td>+ Oil seal</td>
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ASSEMBLY

1. General Notes for Disassembly and Reassembly

The disassembly or reassembly of a Beier Variator should be performed by an experienced fitter, referring to the procedures and assembly drawing shown in succeeding pages.

a) Guide for Dis/Reassembly Procedures

For dis/reassembly procedures, four typical examples are shown. Each can be a reference to specific models as shown in the list below.

Example 1 (15AM featuring a face cam compression mechanism) N05A to 200A

Example 2 (vertical type; oil bath and forced oil lubrication types)

For 20A, procedures in Example 1 can be a guide but these units incorporate a slightly different type of speed control mechanism called "Link Type" instead of "Shifting Ring Type" shown in the example.

b) Dis/Reassembly Tool Kit

It is strongly recommended to prepare and use special tools for dis/reassembly of Beier Variator. Typical tools are shown on the next page and shipped in a handy container assorted for specific size of Beier Variators.

c) General Precautions for Dis/Reassemble

Before Disassembly:

1. Turn down the handwheel of Beier to extreme low speed before stopping the Beier for disassembly. The Beier is so designed to be easily disassembled under deep disc meshed condition (at low speed).

2. Pour out oil through oil drain situated below the oil gauge.

During Dis/Reassemble:

3. Use a copper head or plastic head hammer in all cases. A steel head hammer could harm components.

4. A complete unit of Beier Variator is made up of several distinct sections, which in turn consist of large numbers of components, as shown in the procedures and assembly drawings. Grouping of each section is the key to fail-safe work.

5. For normal replacement or overhauling, it is not required to disassemble speed control section. Leave the section as assembled unless it should actually be required.

For Reassembly:

6. Gaskets are to be replaced to restore to original oil-tight conditions.

7. For replacement of discs, it is recommended to replace flange and cone discs completely even if damage found is partial. Cone discs or flange discs meshing with the same conical flange disc(s) have to be replaced completely to assure even force distribution between the discs.
2. Assembly Tools

Because of the unique internal mechanism of the Beier Variator, special dis/reassembling tools shown below have been developed for safe and easy work. These tools are classified into several groups by their function and are designed to handle various sizes of Beier Variator. These tools are shipped packed in a steel container to the client requesting them and are assembled for the size of Beier Variator. Usage of those tools is fully explained in the dis/reassembly procedures.

a) Size Classification


Medium size tool kit — 15A, 20A, 30A, 40A

Large size tool kit — 50A, 75A, 100A

b) Typical Assembly Tools by Function

- Spring binding tools of various lengths and extension plugs
- Pliers
- Wedges and combs used for disc meshing
- Test gear
  - Sleeve withdrawer (for output shaft bearing of 3MV and larger)

Specific purpose explained in procedures.
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