

TABLE OF CONTENTS

1. Features of Te Shin Cam Index:	2
1-1 Indexing Operation:.....	2
1-2 Swing Operation:	2
2. Features of Index:	2
2-1 Features of the Roller Gear Cam Mechanisms are:.....	2
2-2 Reason Causing Efficiency Degradation:.....	2
3. Operating Environment of the Index:	3
3-1 Temperature:.....	3
3-2 Moisture:	3
3-3 Dust:	3
3-4 Electric Current:	3
4. Factory Delivery and Installation:	4
4-1 Factory Delivery:.....	4
4-2 Installation:.....	4
5. Run Index Test-run:	5
5-1 Boost Run:	5
5-2 Constant Run:	5
6. Use the Input Shaft:	6
6-1 Conditions of Driving System:.....	6
6-2 Datum Line Position of Indexing Angle:	7
6-3 Sizes of Input Shaft and Key:.....	7
6-4 Installation:.....	7
7. Use the Output Shaft:	8
8. Lubricate the Index:	9
8-1 Select the Lube Oil:.....	9
8-2 Lubricating Method:	10
8-3 Lubrication Period:	10
9. Maintenance and Repair:	10

1. Features of Te Shin Cam Index:

1-1 Indexing Operation:

Contain the indirect rotation, up/down or the combination of both.

1-2 Swing Operation:

Apply the highly reliable roller gear cam, making the swing-turn to meet the high-speed positioning and durability.

2. Features of Index:

2-1 Features of the Roller Gear Cam Mechanisms are:

- (1) High-speed run.
- (2) High-precision positioning.
- (3) Meet the kinematic characteristics of mechanism.
- (4) Smooth runs; able to perform long-period rotation.
- (5) Brief mechanism construction; space requirement is small; and simple control system configuration.
- (6) Simple power-transmission arrangement.
- (7) Pre-stressed structure; high rigidity.
- (8) Freely installed.
- (9) Standardized series of products from small size to large one.
- (10) High-efficiency transmission with power-saving characteristic.

2-2 Reason Causing Efficiency Degradation:

- (1) Gap between transmission pairs.
 - (2) The input driving system makes unstable spinning.
 - (3) The output transmission system is bent or twisted.
 - (4) The friction torque of output transmission system.
 - (5) With an impacting, variable load.
 - (6) Run under a rusting environment that contains water, acid or alkali.
 - (7) Under a dusty environment.
 - (8) Devices are energized.
 - (9) Improper maintenance is made.
 - (10) The stiffness of installed datum-surface is insufficient.
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3. Operating Environment of the Index:

The installing location is influential to the cam transmission and device performance; it needs to consider the following data and make inspections:

3-1 Temperature:

The standard operating temperature is within 0~40°C. If unable to meet it, follow the countermeasures listed in below to proceed:

- (1) -20~0°C: the lube oil viscosity is high that the spinning rpm is low and unable to rise up. It should use low-viscosity No. lube oil.
- (2) 40~70°C: the lube oil viscosity is low, which would influence the rising of spinning rpm. It should use high-viscosity No. lube oil.
- (3) 70~100°C: change the oil-seal and o-ring of cam driving device to the heat-resistant synthetic rubber ones.

3-2 Moisture:

Except the installing datum-surface, the other machining surfaces (such as the input/output shafts, etc.) need to be rust-protection painted. If working under a rusty environment, coat grease on the installing datum-surface. If under the environment that will water-spray directly, the input/output shaft must be made by sealing and good water-resisting structure.

3-3 Dust:

The oil-sealing capability of input/output shaft is good that can isolate dust. If dust concentration is high, oil-seal would wear and cause oil-leak, or chemicals penetrate in that would cause corrosion or rusting. Under this circumstance it needs to install the protection cover made of stainless steel or plastic.

3-4 Electric Current:

While electric current flows through the input/output shaft, it will generate sparks between the spinning pairs, which thus would cause tiny corrosion on the sparked surface; resulting in fine notches between the cam shafts and bearing balls; this phenomenon is called the electro-erosion. The sudden current-increasing will cause the electro-erosion even the voltage is lower than 1volt, which makes the rolling surface and bearing ball slot become curved unevenly, and thus generate abnormal vibration and noise to shorten the operating lifetime (especially for the large-current-consuming machine such as the welding machine). Therefore, the coupling connecting the motor and input shaft should be made by high-insulating rubber material. Similar, to prevent from the electro-erosion, the power-transmission device such as the V-belt or timing belt should be rubber-made one.

4. Factory Delivery and Installation:

4-1 Factory Delivery:

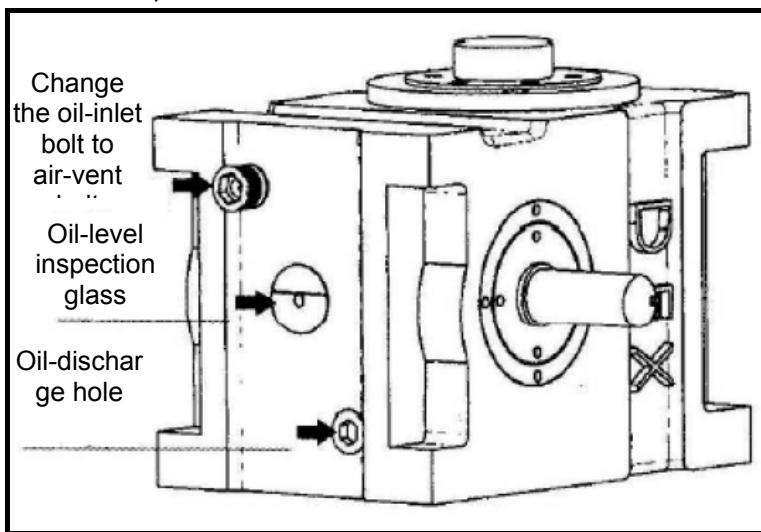
- (1) While delivering the Te Shi index, follow client-selected rotating rpm and condition to put suitable lube oil before delivery.
- (2) After the Te Shi index set is assembled, it should pass our inspection before being delivered out.
- (3) Coat the anti-rust oil onto the outer surface of input/output shafts, keys, air vent bolts and installing surfaces; and packed by plastic bags to avoid colliding damage during the transportation.
- (4) To lift the index, use the lifting ring bolting holes on the outer casing to lift up the index. Do not lift it by touching the index input/output shafts that would influence the index precision and deduce the operating lifetime.

4-2 Installation:

As comparing with ordinary machinery devices, the roller gear cam mechanism has many special characteristics. In order to get high precision, it must fully understand the operating characteristics and correct installing procedure of index. Incorrect installation procedure will make the roller gear cam mechanism disorder earlier than expected and shorten the operating lifetime. So far 90% faults of roller gear cam index are made from incorrect installation, which deteriorates the machinery performance. User should substantially follow the standard installing procedure to build up the cam index, which can prevent most of the faults.

- (1) The index is equipped with oil-inlet hole, oil-discharge oil and oil-level inspection glass, used for regular maintenance purpose. To decide the installing-datum surface it needs to consider the aforesaid holes.
 - (2) While installing, to get good precision, confirm that the outer casing, shafts, set screw holes are all conforming to the drawing. Carefully check the flatness and perpendicularity of installing datum-surface. If there is any scratch, blur, dust or residual paint on the surface, flat and clean it by whetstone or sand paper; next, coat a thin grease layer on it; and then start the installation work. Avoid from installing on the non-specified installing datum-surface.
 - (3) To match with the peripheral machines, note the center position of input/output shafts; coat the locking adhesive on the bolts while fixing them. Follow the standard torque table to lock the bolts by a torque wrench (refer to DIN.8.8 torque tables).
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- (4) To sustain the index under high precision and lifetime, it needs to tighten up the index; the horizontal direction must be stable without vibration. (Incorrect installing process will cause vibration during braking, which would degrade the precision and operating lifetime of index.
- (5) Note! After installation, change the oil-inlet nozzle bolt into the air-vent bolt (attached in the parts package). “If not change it”⇒lube oil inside the index will generate thermo-expansion stress after high-speed run; oil leaks from the weak point (such as the oil-seal).



5. Run Index Test-run:

The cam driving devices are used in automatic machines to link with the peripheral mechanisms. After installation, turn the device by hand to feel if there is any interference. Afterward, follow the phase making fine tuning.

5-1 Boost Run:

After assembling, make preliminary run by hand to check if the run is smooth enough; check the phase angle and precision and friction status; and make proper adjustment on it. If the machine size is too large to turn by hand, start the motor and run in a very low speed to check if the run is smooth.

5-2 Constant Run:

After the boost run is found normal, perform a constant run to test the cam index machine (keep hand at the power on/off switch to stop the run immediately when requires); speed up from low rpm up (slowly increase rpm); observe if there is any abnormal noise, vibration, oil flow-back, oil-leak or temperature rise of motor or driver. After confirming no any abnormal status, make long-period constant run to check and ensure the preliminary wear status and is there any precision change.

6. Use the Input Shaft:

To fully express the driving performance of Te Shi index set, it should reduce the instability of input shaft to its minimum; it is the essential key-point that should not be ignored.

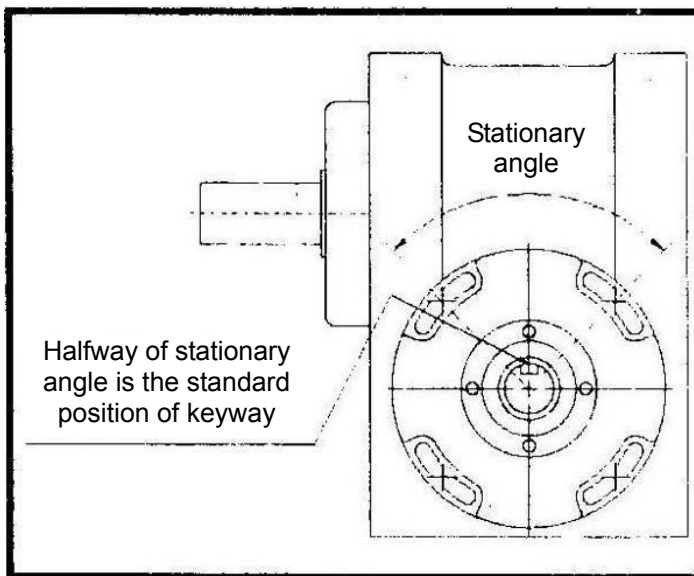
6-1 Conditions of Driving System:

Calculate the data from the model-selection formula. For the driving system, it not only needs to consider the bending deformation of clearance screw. To reach the ideal run, the output shaft needs to be expressed by torque; the actual run unavoidably will cause unstable rotation that result in torque change. There are three major reasons that will cause unstable rotation:

- (1) Made from gap.
 - (2) Made from chain transmission of polygonal motion.
 - (3) Made from the bending of screw or loading that causes the rpm changes.
- ※ The unstable-rotation reason mentioned above will degrade the cam index operating lifetime and precision; on particular, it should avoid from generating the back-gap. If both (1) & (2) above are generated together, both noise and vibration will appear. Be sure to avoid from using the chain transmission.
- a. Worm gear works with index⇒while pulses and constant-rpm run are transmitted to the index from motor; the best match is to use the high-efficiency output worm-gear reducer.
 - b. Timing belt works with index⇒timing belt is the best match condition; while transmitting power to the index input shaft, the following conditions can be alleviated:
 - (1) No slip; synchronized run with the other machine.
 - (2) Small initial tension; and tiny shaft loading.
 - (3) Maintenance-free; low noise as compared to spur gear chain.
- ※ For the advantages mentioned above while working with timing belt, the index driving has a very good result.
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6-2 Datum Line Position of Indexing Angle:

The centerline position of input shaft key is to keep the keyway up at halfway of the stationary angle. For the cam driving, turn the input shaft in CW or CCW direction to the halfway of stationary angle; index starts indexing per the θ (indexing angle). The phase angle of cam driving device is the index of input shaft rotating angle to the output shaft. It is all up to client's requirement. To run synchronized with the other device it needs to fully confirm the datum position and turning direction.



6-3 Sizes of Input Shaft and Key:

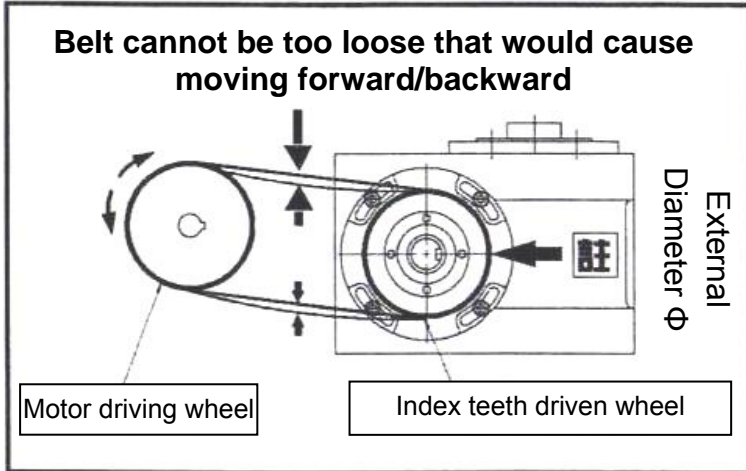
The standard cam driving device: the external allowance (h6) of input shaft matches the internal allowance (H7) of shaft hole. While heating to make the match, the tightening torque and displacement should be discussed. The input shaft key and keyway should follow JIS B 1301-1976 Spec to proceed. The keyway allowance is (N9); the key allowance is (h9).

6-4 Installation:

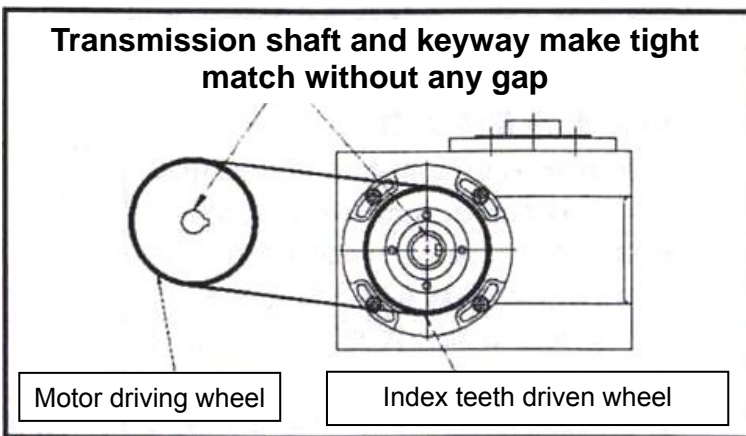
While inserting the input/output shaft into the complex bench, chain wheel, belt ring, gear or flywheel, do not use steel hammer to knock directly. If knocking the cam surface or bearing, it would damage them.

- (1) The wheel hub inner diameter chain slot size follows JIS B 1303-1976 Spec to machine; this Spec is generally applied on the sliding key. Move the key to the wheel hub shaft slightly and the key thus can be inserted into the hub shaft easily.
- (2) The purpose of using the key is to position it and introduce impact load in to make safe transmission. If unable to transmit smoothly and safely, it must reselect another way to process.

- (3) No gap is allowed between the input shaft and wheel hub (see the figure below). If a gap exists, it will make tiny-moving wear. To avoid from the tiny-moving wear, apply taper pair to lock it, or grease the input shaft to get the purpose.



- (4) The importance of belt, core and key: no loose is allowed between the belt wheel and input shaft core; otherwise, the belt wheel would move forward/backward that cause the inertia force: vibration and jerk, etc.



Note: the outer diameter of index input shaft is shown in below: (mm)
 4.5D⇒65Φ、6D⇒80Φ、7D⇒90Φ、8D⇒100Φ、11D⇒130Φ

7. Use the Output Shaft:

The positioning of cam driving output shaft should sustain its precision along with the inertia loading torque made from start/stop. The rigidity of mounting screws is important. Per the cam driving device type, the selected output shaft varies. The characteristics and purposes of each device should be applied properly. To install the work piece and fixture, follow the allowable loadings specified in the list. Do not overload them in use. To assemble the output shaft it needs to note the following two points:

- (1) While using gear, chain wheel or timing belt to make indirect transmission; try to keep the acting points of power transmission closer and less suspending load.
- (2) If bench is installed, the mounting bolts of output shaft have relatively low rigidity; the locking location should be as closer as possible. For the bench design case, use high-rigidity bolts to tighten the bench flange.

8. Lubricate the Index:

Lubricating period: the lubrication of cam driving device is crucial; it can reduce the friction on the transmission portion, remove heat from it, prevent the rust and reduce the wear. The lifetime of cam driving device will be shortened from the wear that degrades the precision and thus might cause vibration or burnt. The slide-wear portion of cam driving device include the surface between the roller taper bearing holder and rotating part, the outer wheel and thrust washer and the rollers of needle bearing; and the sliding between the 3D cone groove of roller gear cam and the follower, and the groove sliding of other sealing devices, etc. If lacking of lubrication, wear would occur just within a short time. Even under good lubrication condition, if the lube oil viscosity is too low, the dynamic viscosity will decrease along with the temperature rise; the lube oil thus cannot get the minimum dynamic viscosity required to form the oil film. This case will make direct contact of a metal pair that causes wear and shorten the machine's operating lifetime. Therefore, the lubrication must perfectly fit the operating condition.

8-1 Select the Lube Oil:

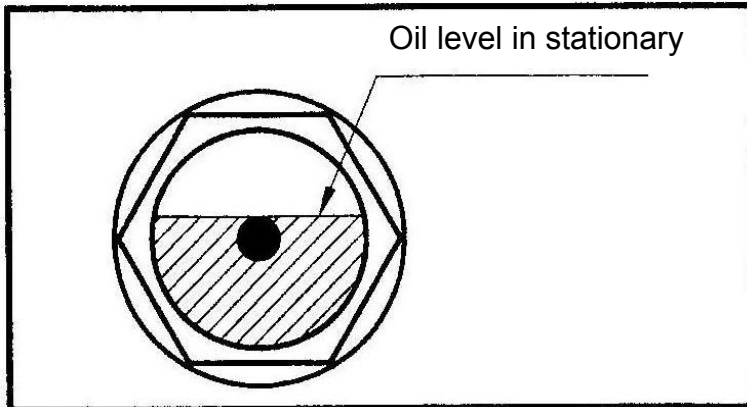
The lubricant can be divided into the solid, liquid and gas type. The lube could work functionally only under suitable operating condition. The cam driving device uses grease or lube oil to lubricate. Recommend using CPC No.90 lube oil or MOBIL#630 or SHELL#320 for the lube oil. To select the lube oil, notes are listed as follows:

- (1) Selecting wrong lube oil will degrade the precision and operating lifetime. Sufficiently consider the operating conditions while selecting the lube oil.
 - (2) The lube is made by adding the extreme-pressure additives into the mineral oil; the oil film tensile strength isn't apparent. To prevent from rust, it needs to use the lube oil with good oxidization-prohibit capability.
 - (3) The extreme-pressure additives are special chemicals, which vary from different manufacturers. For example, lube oil used for specific purpose should not be the combination of different brands.
 - (4) The viscosity of lube oil varies from different rpm and device sizes. Select the lube oil with most suitable viscosity.
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- (5) The viscosity of lube oil is ambient-temperature-dependent. The standard cam driving device is operated in a temperature range within 0~40°C. For other temperature applied beyond this range, it needs to consult the manufacturer first.

8-2 Lubricating Method:

- (1) The oil-inlet is equipped at top of the outer casing. Remove the hex screw and inject lube oil into the inlet hole. Wait till the oil flow stops before checking the oil level.



- (2) The operating interface of oil-inlet plug, oil level and drain level won't be at the raised location. If the rpm is too high, drain the oil after air is vented; or input or discharge oil after the output shaft is installed onto the bench.
- (3) Lube oil viscosity: if the rpm of input shaft isn't constant, the lube oil is selected per the rpm of the geometric mean ($N = \sqrt{N_{max} \times N_{min}}$) of maximum and minimum rpm, and the longest running time interval.

8-3 Lubrication Period:

Oil-input: lube oil quality will decide the device's operating lifetime. If any dust, foreign matter or water is included during the oil-input process, it would get the cam cone groove surface, bearing or follower burnt and thus degrades the precision and operating lifetime. To input oil, clean up the oil-inlet surrounding first.

Renew oil: make the first oil renewal after running 1000 hours from it starts. The second oil renewal is made after another 3000 running hours. Yet, it needs to renew the lube oil at least annually even the run time is rare.

9. Maintenance and Repair:

Regular checks and correct maintenance and prevent from earlier broken or disorder. The respective method is illustrated in below:

- (1) Gap between the input shaft and output shaft will increase along with running time; and it thus needs regular checks.

- (2) Insufficient lube oil will cause wear and broken; on the other side, in-excess lube oil will result in temperature rise and oil-drag. Keep the lube oil at the most suitable amount.
 - (3) Renew the lube oil after every 3000 running hours. If the running time is short, change the oil once per ever one or two years.
 - (4) Supplement grease once per each 2000~4000 hours.
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