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# Service Manual

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## DRIVING AXLE

**Applicable Types:**

**Driving Axles of LG956, LG953, LG952  
Series Wheel Loaders**

**SHANDONG LINGONG CONSTRUCTION MACHINERY CO., LTD**



## **Driving Axle Service Manual**

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# Service Manual

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# PREFACE

This service manual, which shows the structure, principle and the maintenance technology of the driving axle, will help the maintenance persons understand the disassemble and assemble method of the driving axle more deeply and bring the maintenance workers solid technology basis of locating faults and maintaining correctly. Please read the manual carefully to make full use of it completely.

Main contents of the Service Manual include:

1. Structure and working principle of the driving axle

This chapter shows the structures and functions of each kind of part, it is not only the basis of assembling and disassembling axles, but also can be used as the reference of locating faults.

2. Disassembly of the driving axle

The steps how to disassemble the parts correctly and the points for attention in disassembling driving axle are shown in this chapter.

3. Assembly of the driving axle

The steps how to assemble the parts correctly and the points for attention in driving axle are shown in this chapter.

4. Standard criterion of the driving axle for repairing and replacement

The identification methods and standard criterions of consumable parts after worn are prescribed in this chapter.

Special notes:

This service manual is described as example of LG953 axle. It is similar with other serial productions in our Corp on axle principle, only some small differences in connection types and local structures. Those differences will not describe in here and could be executed referred to the relation chapter in this manual.

<b>⚠ ATTENTION</b>
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Forgiving without further notice about the specification's changing of the parts, in this manual, which are caused by the driving axle development, The latest information could be got or consulted from Shandong Lingong Construction Machinery CD., LTD.
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# CHAPTER I INTRODUCTION

## 1.1 Safety Notices



### **IMPORTANT SAFETY WARNING**

It's very important for the loader's safety to keep maintenance and repairing. The related technologies about how to assemble and disassemble the driving axle are described in this manual.

The safety considerations, marked with  as the security label, should be paid more attention when operate it for avoiding hurting relation persons. It should keep themselves safe first and take some necessary measures when the potential dangers coming.



### **Security Attentions**

During assembling and disassembling, parts worn out and lives shortened, properties deterioration and unsafe factors would be caused by the incorrect operation method. Please read the contents carefully in this manual when assembling or disassembling.

1. The parameters, graphs and contents in this manual are suitable to the standard configuration products. Please consult our company and search data about the information for deformed products.
2. In repair shop, the region for assembling or disassembling and placing disassembled parts should be marked obviously. Make sure the tools and parts for special using or are placed in the special region. The clean of operation region must be kept and make sure no oil or pollution in the operation region. Fire extinguishing equipments are necessary and smoking is forbidden in the region except the smoking room.
3. When welding operation is needed, it should be done by expert workers who were trained by professional welding training. Welding gloves, baffles, goggles, hats and other work clothes suitable for welding are essential during welding operation.
4. Before the driving axle assembly is disassembled, the appearance of which must be cleared up to avoid the parts been polluted in the disassembling operation.
5. Make sure wear safety boots, helmets and working clothes coincided with requirements when operating. Goggles should be worn when workers knock the parts with copper rod.
6. The disassembled parts could be cleaned by petrol, gasoline and water-base oil cleaner.

7. Check the spreaders whether were broken before operate the cranes and other hoisting equipments. Make sure use the sufficient hanging up capacity of the spreader. For avoiding collisions between parts, spreaders should be operated slowly and located in the correct region. Make sure no one work under the part lifted.
8. When two or more persons operating together, the operation procedures abided by all persons should be made before operating for avoiding the accident caused by out of steps.
9. All tools should be kept carefully and be familiar with their usages.
10. When align two holes, the workers make sure their hands and figures are not in the holes. Pay attention to whether the hands would be extruded at holding position when assemble parts by hand directly.
11. The disassembled parts need to be checked. The parts which have poor properties should be changed, and the standard of criterion can be found in chapter V--Standard of criterion for repairing and replacing the parts of the axle.
12. There should be no interference after assembling each part.
13. Protection measures must be taken, when the oil seal and seal ring across key seats, screw holes and steps when assembling oil seal and seal ring to avoid damaging the oil seal and seal ring.
14. To avoid damaging the screw fasteners, all the tools must be suitable to the screw fasteners when assembling the parts.
15. **Never** use the gas trigger when tighten the screws. Make sure tighten them by hand to special degree, and then tighten them with some specification wrest wrenches to reach the torque demanded.
16. When removing oil in the axle, Make sure loosen the releasing-screw off slowly to avoid the oil blowout.



## 1.2 Oil and Coating Materials



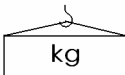




Domestic oil brands	Kinematic Viscosity (100°C) mm <sup>2</sup> /s	The similar foreign oil brands (Be classified by the U.A. API, GL-5 )			
		MOBIL	CALTEX	ESSO	SHELL
Heavyduty motor Auto-oil 85w-90 GL-5 GB13895-1992	13.5~24.0	Mobilube 1 SHC synthetic oil MOBIL Auto-gear oil HD80W-90 (-20~40°C) MOBIL Auto-gear oil HD85W-140 (-10~50°C)	Multi Purpose Thuban EP	Gear oil GX 85W-90	Spirax EP Heavyduty HD90 HD80W-90

Domestic oil brands	The similar foreign oil brands					
	MOBIL	CALTEX	CASTROL	ESSO	BP	SHELL
2# or 3# lithium based grease GB7324-1994	MOBIL grease XHP222	Marfak multi Purpose	LM grease	Ronex MP; Beacon EP 2	Energrease L	Retinax A; Alvania

Name	Code	Application scope and function
Sealant	1545 oxygen-wear type pipe-thread sealant	It's suitable to be used to seal the pipe-thread of Hydraulic system and pneumatic system or be used on the surface with little oil.
	1262 pipe-thread fixed sealant	It's used to fix and seal the M 10~M 20 screws and the ones are endured intense vibration and impact.
grease	2# or 3# lithium based grease GB 7324-1994	It's suitable to be used to lubricate the fiction position, rolling bearing and sliding bearing of any kinds of engineering machinery between -20~120 °C.
Cleaning agent	1755 cleaning agent	It's used to clean the surface of metals and enhance the adhesion strength between repair agent, pope-thread fixed sealant and substrate.

## 1.3 Marker

For communication and memory, those following marks are used in important safety and quality.

Marker	Item	Remark
	Safety	Specially take care of the safety during the operation.
	Notice	Pay attention to the technical requirements and make sure the operations reach the requirements in operation.
	Heavy	Parts and their heavy and disassembling methods Make sure choose the appropriate spreader and the operating posture
	Tightening Torque	Pay more attention to the parts' Tightening Torque in assembly operation.
	Coating	The location where need to be coated with adhesives and greases.
	Oil and water	Inject required volume of lubricating oil, water or fuel oil.
	Outpour	The place of oil-expulsion and water-draining, or the emission volume

## 1.4 Hoisting Explanation

1. When it is not easy to assemble the parts from drive axle assembly, check the following::
  - Check that whether all of fixing bolts are removed on the disassembled parts
  - Check whether some other parts interfered disassembling are laid on the removed parts.

### 2. Wire Ropes

1) Wire rope should be in the middle of the hook.

If it is in one end of the hook, the wire rope may drop from hook and that may cause serious accident. The biggest strength is in the middle of the hook shown in Figure 1-1.

2) **Never** use one single wire rope. Make sure use two or more ropes winding bind on the hoisting heavy.

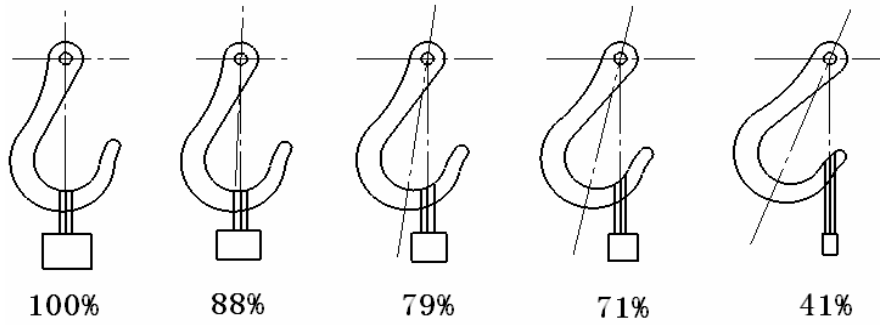


Figure 1-1



Hoisting with one wire rope may cause the heavy rotates, and then the wire rope looses or the heavy slides from the fixed location, which will cause serious accident.

3) The hoisting angle between wire rope and hook should not be oversize when hoist the extremely heavy loading.

When the hook hoists heavy loading with two or more ropes, the bigger of angle between wire rope and hook is, the heavier of each rope loads. The Figure 1-2 shows the changes of allowed loading (kg) in different angles when hoisting with two ropes (The limited vertical hoist loading of each rope is 1000 kg). It can hoist 2000 kg when two ropes in the vertical location. But when the angle reaches to 120°, the ropes can only hoist 1000 kg. Another hand, the force of the ropes would be 4000 kg when the angle reaches 150°, although the loading is only 2000 kg.

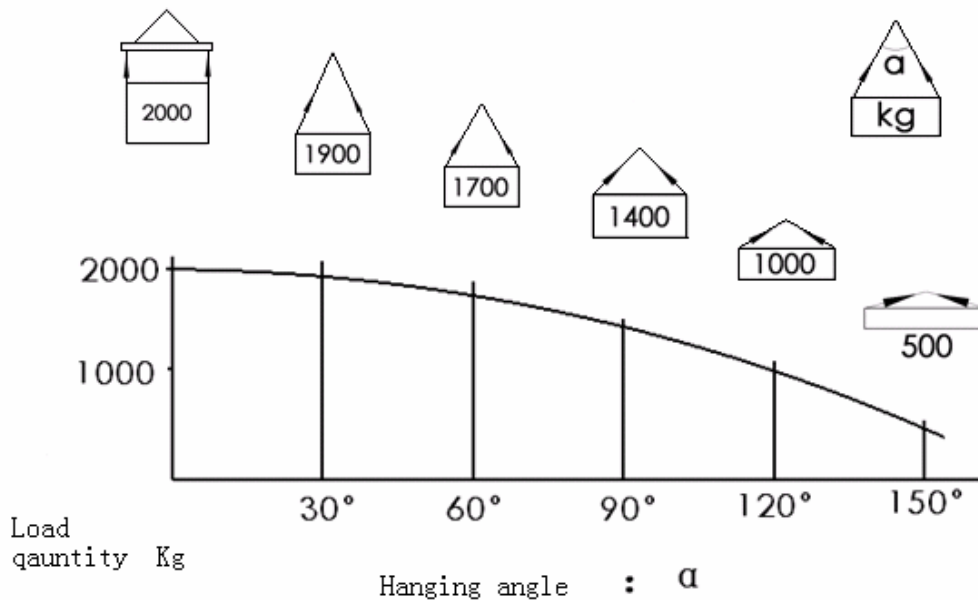


Figure 1-2

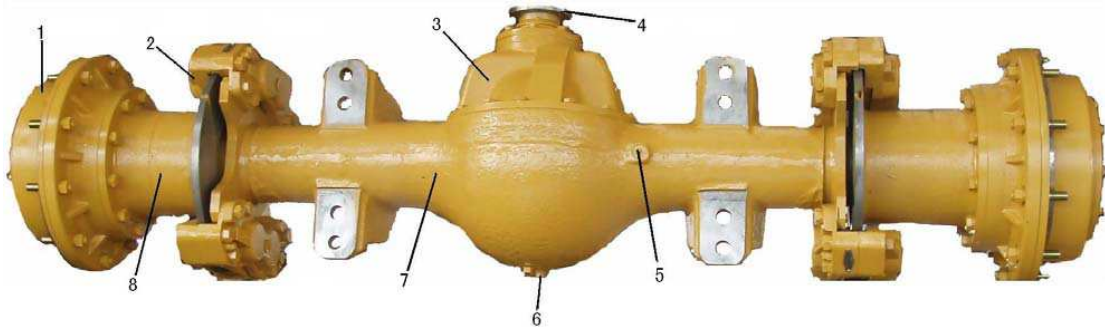
## 1.5 Table of Tightening Torque for Common Bolts

Bolt Strength grades	Yield Strength (N/mm <sup>2</sup> )	Nominal Diameter of Bolts(mm)				
		6	8	10	12	14
		Tightening Torque(N·m)				
4.6	240	4~5	10~12	20~25	36~45	55~70
5.6	300	5~7	12~15	25~32	45~55	70~90
6.8	480	7~9	17~23	33~45	58~78	93~124
8.8	640	9~12	22~30	45~59	78~104	124~165
10.9	900	13~16	30~36	65~78	110~130	180~210
12.9	1080	16~21	38~51	75~100	131~175	209~278
Screw Strength grades	Yield Strength (N/mm <sup>2</sup> )	Nominal Diameter of Bolts (mm)				
		16	18	20	22	24
		Tightening Torque (N·m)				
4.6	240	90~110	120~150	170~210	230~290	300~377
5.6	300	110~140	150~190	210~270	290~350	370~450
6.8	480	145~193	199~264	282~376	384~512	488~650
8.8	640	193~257	264~354	376~502	521~683	651~868
10.9	900	280~330	380~450	540~650	740~880	940~1120
12.9	1080	326~434	448~597	635~847	864~1152	1098~1464
Screw Strength grades	Yield Strength (N/mm <sup>2</sup> )	Nominal Diameter of Bolts (mm)				
		27	30	33	36	39
		Tightening Torque (N·m)				
4.6	240	450~530	540~680	670~880	900~1100	928~1237
5.6	300	550~700	680~850	825~1100	1120~1400	1160~1546
6.8	480	714~952	969~1293	1319~1759	1694~2259	1559~2079
8.8	640	952~1269	1293~1723	1759~2345	2259~3012	2923~3898
10.9	900	1400~1650	1700~2000	2473~3298	2800~3350	4111~5481
12.9	1080	1606~2142	2181~2908	2968~3958	3812~5082	4933~6577

**Remark:** The tightening torque of joint bolts can be executed referred this previous table during the assembling operation. When the tightening torque given in the chapter IV is not accord with the table, it should be executed according with the tightening torque given in the chapter IV.

# CHAPTER II CONSTRUCTION AND WORKING PRINCIPLE OF THE DRIVING AXLE

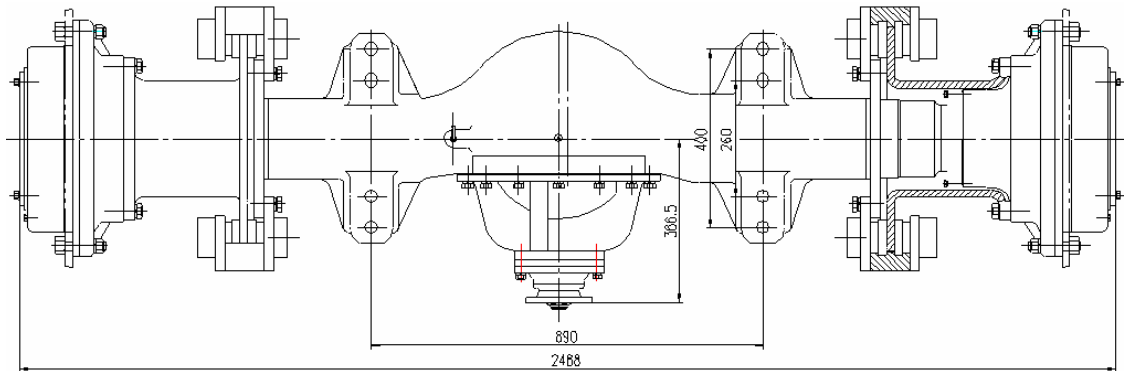
## 2.1 Outside View



1. Wheel-side reducer assembly
2. Brake clip assembly
3. **Main driving axle**
4. Input flange
5. Deflations tap screw-hole
6. Refueling plug
7. Axle shell
8. Wheel hub assembly
9. End cover
10. Oil-discharging plug



## 2.2 General View



### Base parameters of driving axle:

Main Driving axle	Type	Spiral Bevel Gear First-order Deceleration
	Reduction Ratio	5.286
Wheel-side Reducer	Type	First-order Planetary Deceleration
	Reduction Ratio	4.4
Oil for Axle	SAE85W-90 GL-5 Gear Oil	27 L

## 2.3 The Internal Construction of Driving Axle

Driving axle assembly is one of the most important parts in driving axle system. The main functions of driving axle are lowering the rotation speed and increasing torque from driving axle, and have the differential speed function to the two-side wheels, and bearing load and transmitting power as well. Driving axle of the loader is made up of axle shell, main driving axle driver (including differential mechanism), half-axis, wheel-side reducer and brake clip assemblies. The parts with the function of reducing or differencing speed are the **main driving axle** driver and wheel-side reducer. **Main driving axle** driver is made up of input flange, oil seal cover, bearing sleeve, driving spiral bevel gear, following spiral bevel gear, bracket, differential mechanism (planetary wheels, cross shaft, half-axis gear, left shell of differential mechanism, right shell of differential mechanism, gasket), bearings, adjusting shim, stop-pushing bolts and framework oil seal. Wheel-side reducer is made up of internal gear ring, planetary wheel carrier, planetary wheel,

solar wheel and shims. The main internal structures are shown in Figure 2-1.

The power driving axle between **main driving axle** driver and wheel-side reducer is transferred by half axle. The splines on the two end of half axle mesh with the half axle gears in differential mechanism and the solar gears in wheel-side reducer, and it connects the power between **main driving axle** driver and wheel-side reducer.

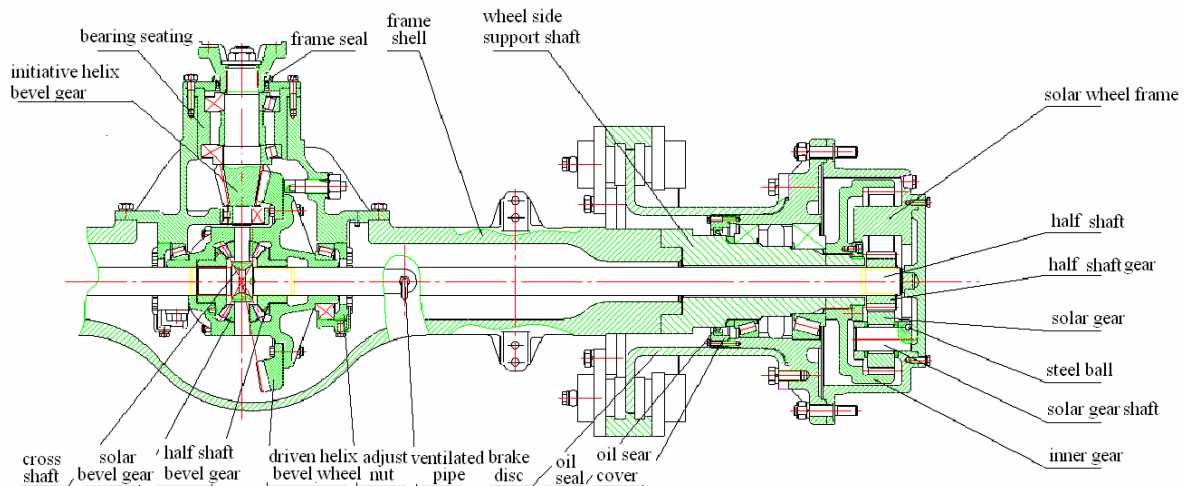


Figure 2-1

## 2.4 Working Principle of the Driving Axle

Driving axle assembly function of increasing torque, reducing speed and differencing speed are carried out by differential mechanism and wheel-side reducer. Its working principle is introduced as follow:

### 1. Working principle of differential mechanism—Motion Characteristic:

The symmetrical bevel gear differential mechanism used in driving axle assembly is a kind of planetary gear mechanism. The planetary is composed with differential gear shell and cross shaft, both of which are connected together. At the same time, the differential gear shell is driving part because it connects with following spiral bevel gear. it is assumed that the angle speeds of the differential gear shell and two-side half axle gears are  $\omega_0$ (revolution per minute is  $n_0$ ),  $\omega_1$  and  $\omega_2$ (revolutions per minute are  $n_1$  and  $n_2$ ), then the following equations will be right:

$$2\omega_0 = \omega_1 + \omega_2$$

$$2n_0 = n_1 + n_2$$

These equations are the motion characteristic equations of symmetrical bevel gear differential mechanism with two same diameter half axle gears. They show that the sum speed of left and right half axle gears is same as two times of the speed of differential gear shell but is not relation with

the speed of planetary gears. So, when the loader turns or drives on other conditions, the planetary gears can rotate themselves on their corresponding speed to make the wheels on two sides rotate in different speed but not slide. The up equations show that:

①When the speed of one side half axle is zero; the speed of the other side is two times of the differential gear shell.

②In the condition that the speed of differential-gear shell is zero, when one side half axle is rotated by external power, the other side will reverse rotate in the same speed.

## 2. Working principle of differential mechanism—Torque Distribution:

Assumption: The torque from main reducer to symmetrical bevel gear differential mechanism is  $M_0$ ; inside and outside of half axle torques, which are distributed by the differential gear are  $M_1$  and  $M_2$ ; internal friction torque of differential gear is  $M_r$ :

$$M_2 + M_1 = M_0$$

$$M_2 - M_1 = M_r$$

The following conclusions will be drawn from the previous equations:

①When the torques from left and right half axle are different, the difference value of them works on the planetary gears and overcome the internal friction torque of differential gear to drive the planetary gears. This makes the differential action.

②When the speeds of left and right half axle are different, torques on them are different too. Torque on the slower axle is bigger and that on the faster axle is smaller.

③The sum torque on two half axles is the same as the one on differential gear.

Because the friction torque of the popular symmetrical bevel gear differential mechanism is very small, it can be considered as that: the torque is distributed equally whether the speeds of left and right wheel are same. This is the driving axle characteristic—the same torque, but the different speed of common differential mechanism. This characteristic is suitable for loader when operates and drives on the common condition. But under the wicked condition, the passing capacity will be affected seriously.

## 3. Working principle of the wheel-side reducer

Wheel-side reducer is the last increasing torque and reducing speed mechanism. It is a kind of planetary driving axle mechanism. It is made up of solar gear, fixed gear ring, driven planetary carrier and planetary gears. Working principle is shown as Figure 2-30. (This Figure is not complete the same as the actual structure and is just the principle introduction)



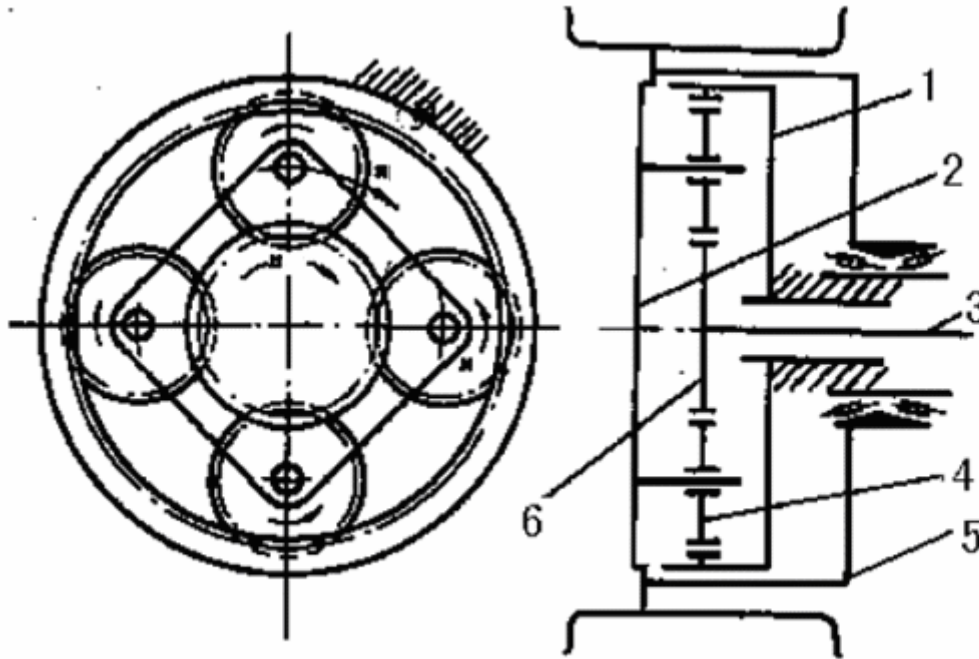


Figure 2-30 Working principle of wheel-side reducer

1. Internal gear ring 2. Planetary carrier 3. Half axle 4. Planetary gears  
5. Wheel hub 6. Solar gear

Solar gear is connected with half axle by spline. Internal gear ring is fixed on the wheel-side supporting axis which on two ends of driving axle shell. Planetary gears mesh with solar gear and internal gear ring. The planetary gears are installed on the planetary gear carrier by steel balls and planetary gear axis. Planetary gear carriers are fixed with hub as one part by bolts. So, planetary gear carriers and hub rotate together.

For improving the meshing condition between solar gear and planetary gears and distributing the meshing load equally, half axle is not fixed to keep in condition of floating state.

#### 4. Driving axle principle of driving axle

From the main internal structure of driving axle shown in the Figure 2-1, it is known that: The left and right shells of the differential mechanism are connected by bolts. The driven spiral bevel gear of the **main driving axle** is fixed on the flange edge of the differential right shell by bolts. Axle journals of the cross axis embed in the holes which are formed by the relevant groove which on the joint face between left and right shells. One planetary gear is floating installed on the journal of cross axis. Both of the gear and cross axis mesh with the two straight tooth conical half axle gears. The journals of the two half axle gears install on the left and right base holes on the differential shell and connect with half axle by splines.

The half axle is a solid shaft between differential mechanism and wheel side reducer. Its inside end connects with half axle gear by splines and its outside end connects with shield ring and solar gear of wheel side reducer by splines. The left and right half axles of loader are full floating structure. Two ends of half axle bear torque mainly because of the kind of structure. For avoiding half axle motions along axis, the end which connects with wheel side reducer solar gear is positive stop by steel balls. The torque and speed are transmitted to half axle by differential mechanism. And then, they will be transmitted to wheel side reducer by half axle.

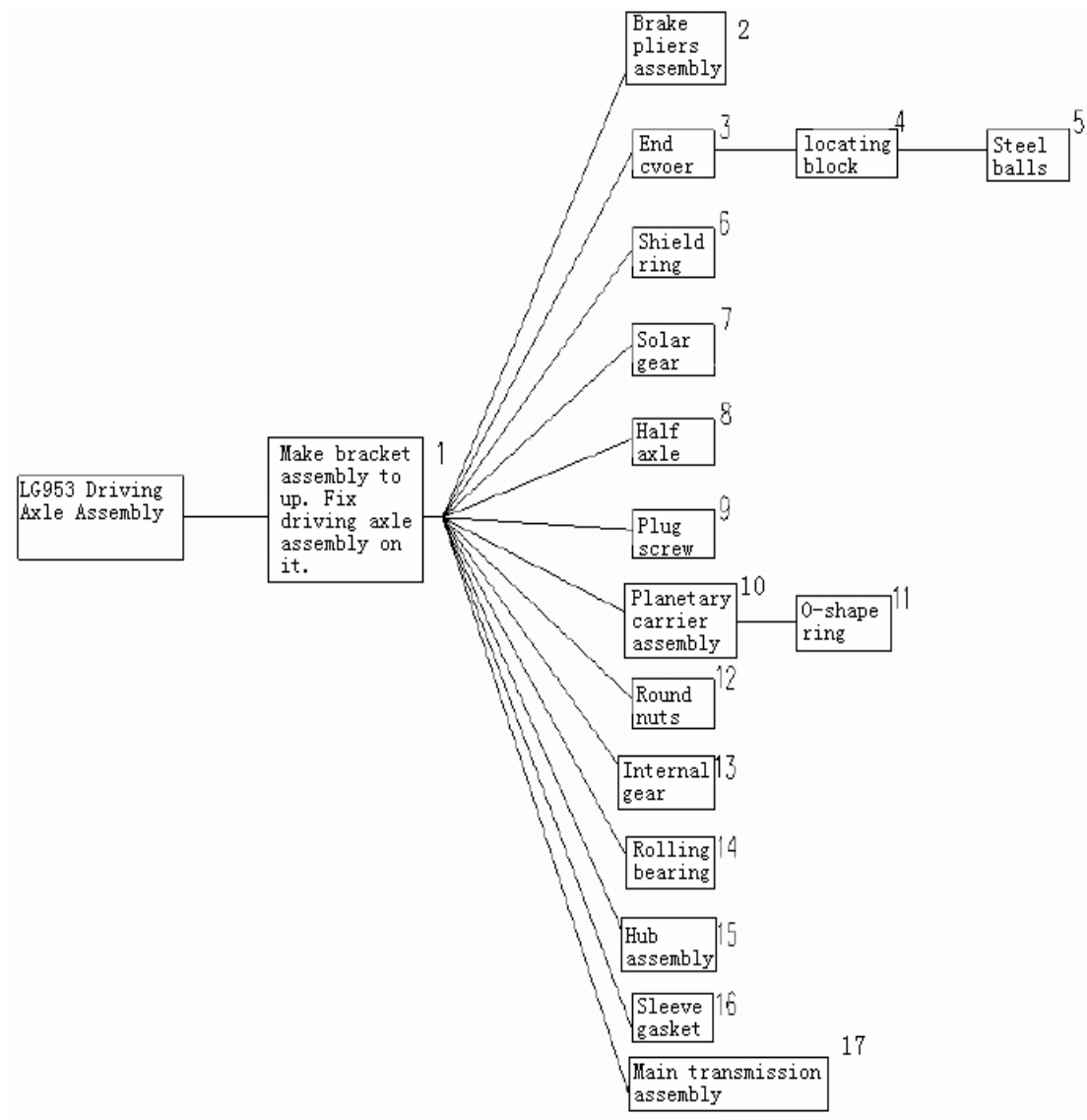
Solar gear connects with half axle by spline. Internal gear ring is fixed on the two ends wheel side bearing shafts of driving axle shell by splines. They are fixed and can not be moved. The planetary gear, which meshes with solar gear and internal gear ring, is installed on the planetary carrier by steel balls and planetary gear axis. Planetary carrier and hub are connected by hub bolts. So, planetary carrier and hub will rotate together.

Driving axle way will be drawn from the above structure:

Driving axle(power) → Driving axle shaft → Input flange → Driving spiral bevel gear → Driven spiral bevel gear → Left and right shells of differential mechanism → Half axle gear → Half axle → Solar gear → Planetary gears → Planetary carrier → Hub assembly → Driving wheels.

# CHAPTER III DISASSEMBLY OF DRIVING AXLE

## 3.1 Network Figure of General Disassembly (corresponding to disassembly of driving axle)



## Disassembly Tools and Equipments

Name of general tools	Specification	Number	Application position (corresponding to the No. of Network Figure or assembly name)
Gas trigger	MI16, MI17, MI18, MI2000P、	1 group	Choose different specification by size of screws
Sleeve	13, 16, 17, 18, 21, 24, 30, 34, 41, 50	1 group	Choose different specification by size of screws
Copper bar		1	During hanging, flick the firm parts by it; Flick bearings when disassembly them
Hexagonal wrench	8	1	12
Name of special tools	Specification	Number	Application position (corresponding to the No. of Network Figure or assembly name)
Assembly carrier of driving axle	Prepare to provide your own assembly platform when without it	1	
Shield ring pliers for axis (hole)		one for each	When Disassembling the shield ring
Round nuts special tools		1	12
Screw pusher	Replace it by common bolts according to size of screw holes		3, 10, 17

### Explanation about Disassembling Parts

1. Never reuse the disassembled parts, and make sure replace them with the new ones;
2. Magnitude of references for partial bearings are relatively bigger because they were assembled by heated and pressed assembling in their corporations, which will bring injury to bearings when disassembling. Those bearings, whose surfaces are damaged in disassembling, could be reused when repaired and satisfied the using standard, otherwise, are dealt as scrap bearings.
3. When the copper bar is used, knock the parts as lightly as possible to avoid the debris splashing into the assembly parts, also you can choose rubber hammer, plastic hammer or other press-assembly methods.

### Preparative work

1. Clean the soil and fouling on the duplex-driving axle assembly completely.
2. Prepare firmly driving axle assembling carrier.

## 3.2 Disassembly of driving axle

1. Place the driving axle assembly on carrier horizontally.  
Make the **main driving axle** assembly up.



Driving Axle Assembly



2. Disassemble the brake clip assembly

Use corresponding specification tools (Such as sleeve and open end wrench, etc; the following conditions are similar and without explaining again)

Loose off the bolts connect the brake clip assembly and carrier. Disassemble the brake clip assembly.



3. Disassemble end cover

Loose off bolts connect the planetary carrier and cover by corresponding specification tools. Push end cover away from wheel side assembly with M10 pusher screw. Disassemble end cover.



4. Disassemble the locating-block.

Take off the locating-block and steel balls together by hand.

★ Corresponding specifications could be used when the parts are a little tight.



5. Disassemble the steel balls


Remove the locating point of steel balls with tools and make them out.



6. Disassemble shield ring

Take out the shield ring from half axle ring groove by axis shield ring clip.

★ Before disassemble shield ring, partially pull out the half axle and its parts from axle shell.

 Make sure that the pliers be clamped firmly to avoid bouncing off to resulting in potential safety hazard.



7. Disassemble the solar gear

Take off the solar gear from half axle slightly by hand.



8. Disassemble half axle.

Take off the half axle from axle shell slightly by hand.





### 9. Plug screw


Loose plug screw with corresponding specification tools and then unscrew it by hand carefully.

★ Prepare a clean vessel under it to get oil.



### 10. Wheel side reducer

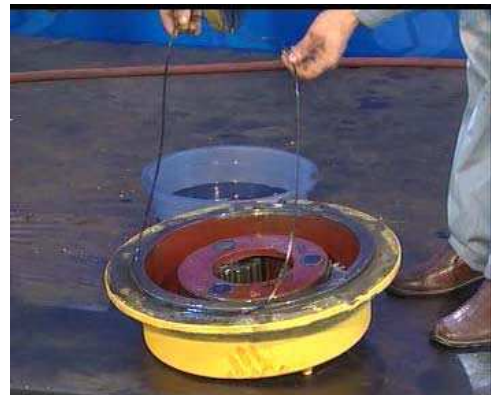
Loose off the hub screws with corresponding specification tools first. And then, Push planetary carrier away from hub with M16 pusher screw. Disassemble planetary wheel carrier assembly.

 When push planetary carrier with pusher screw, the operator must keep away to safe region to work. During this operation, the carrier must be pushed carefully for avoiding too fast to fall it down resulting in potential safety hazard.



### 11. O-shape ring

Take off the O-shape ring from planetary wheel carrier by hand.



### 12. Disassemble round screws.

Loose the round screws off with corresponding specification tools first. And then, disassemble them by hand.



13. Disassemble internal gear ring

Take off the internal gear ring by hand.



14. Disassemble rolling bearing

Take down the internal ring of 32221 bearing by hand.



15. Disassemble hub assembly

Take down the hub assembly from wheel side support axis.

 Hub assembly

★ During hanging-disassembling, keep the axis of hub assembly approximately coincide with the axis of wheel side support axis to avoid hurting the oil sealing cover and its internal parts.



16. Disassemble the sleeve gasket

Take down the sleeve gasket.

**Remark:** Disassemble all the parts on the other side of driving axle with the same method.





### 17. Disassemble **main driving axle** assembly

Loose off the screws connecting the **main driving axle** and axle shell assembly with relevant size tool and hang driving axle assembly off.



**Main driving axle** assembly

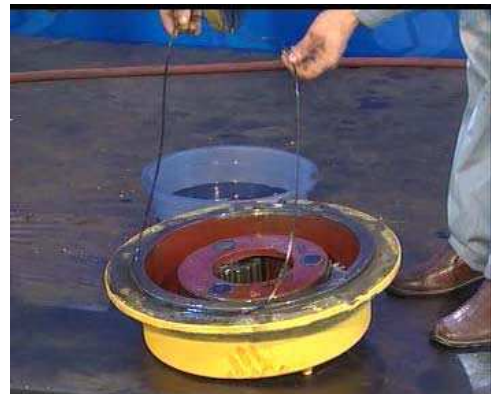


★ When hanging **main driving axle** assembly, make sure keep the hanging tool upright above the driving axle assembly to avoid hurting internal parts during the hanging operation.

## 3.3 Disassembly of assemblies

### 3.3.1 Disassemble planetary wheel carrier assembly

1. Put planetary carrier on working table horizontally.



2. Knock the planetary wheel carrier out lightly by the copper bar



3. Take down the steel balls.



4. Take down the planetary gears and gasket



5. Disassemble the shield ring firstly. And then take down the noodle roller on the internal wall of planetary gears.



### 3.3.2 Disassemble the hub assembly

1. Put hub assembly on working table horizontally.



2. Loose off the bolts connecting brake plate and hub with corresponding specification tools.



3. Take down the brake plate.



4. Loosen the screws connecting the oil seal end cover and hub with the corresponding specification. Take down the oil seal end cover.



5. Take down the gasket



6. Take down the frame oil seal





7. Take bearing out.



### 3.3.3 Disassemble main driving axle assembly

1. Place and fix the main driving axle on the carrier (input flange upward) horizontally.



2. Loosen locking nuts with the corresponding specification. Take down the input flange and gasket.



3. Loosen the bolts connecting the seal cover and bearing sleeve with the corresponding specification tool and take the seal cover down.



4. Take down frame oil seal from seal cover with specific tool.



5. Take down gasket by hand.

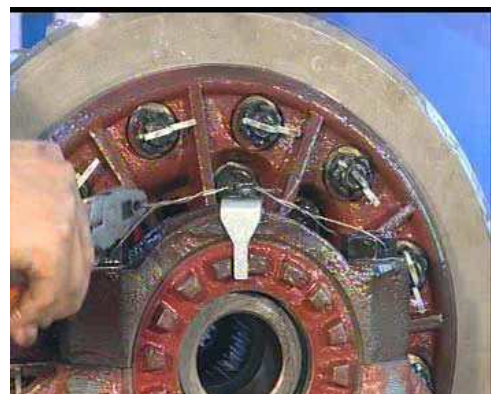


6. Turn over the main driving axle 180° .



7. Disassemble locking iron wire

★ The structure of some machines may be not the same as this Figure. Adjust disassembling contents in actual operations.



8. Loose off the bolts fix locking plate and take down locking plate.



9. Mark the part for reinstalling it to the initial position.



10. Loose off the bolts connecting the bearing seat with corresponding specification tool and dismount the bearing seat.



11. Dismount the adjusting nuts by hand.






12. Knock down the locking plate of stop-pushing bolt and dismount the nuts. Take down locking plate and dismount stop-pushing bolt.



13. Hang out the differential mechanism assembly




Differential mechanism assembly

 Keep balance during the hanging operation to avoid bringing potential safety hazard.



14. Break away the driving spiral bevel gear assembly and bracket with copper bar.

 **Never** knock the spiral bevel gear assembly too abruptly to avoid it falling down to scratch parts or bring potential safety hazard.



### 3.3.4 Disassemble the differential mechanism assembly

1. Put differential mechanism assembly on the working table vertically and firmly.



2. Loose off the nuts connecting driven spiral bevel gear and right shell of differential mechanism. Dismount the driven spiral bevel gear.

★ Before take down driven spiral bevel gear, check or mark the assembly label first to reinstall the part to initial position.



3. Dismount the bearings of left and right shell of differential mechanism.



4. Loose off the nuts connecting left and right shells and separate the left and right shells of differential mechanism.

★ Before separating left and right shells, check or mark the assembly label first to reinstall the part to initial position



5. Take down half axle gear gasket and half axle gear.





6. Take down the cross shaft and differential gears together. Dismount differential gear gasket and differential gears from cross shaft.



7. Take down the half-axis gear gasket and the half-axis gear.



### 3.3.5 Disassemble the active spiral bevel assembly

1. Put the active spiral bevel assembly on the corresponding worktable, and put up the flange of the bearing sleeve, then pull pressure on the thread end of the active spiral bevel with hold-down.

★ When pulling, the pressure should not be so high to prevent harming the cam to let the bearing sleeve pull off the active spiral bevel.



2. Take down the bearing.



3. Take down the bearing sleeve.



4. Take down the bearing outer ring.



5. Take down the adjusting gasket.

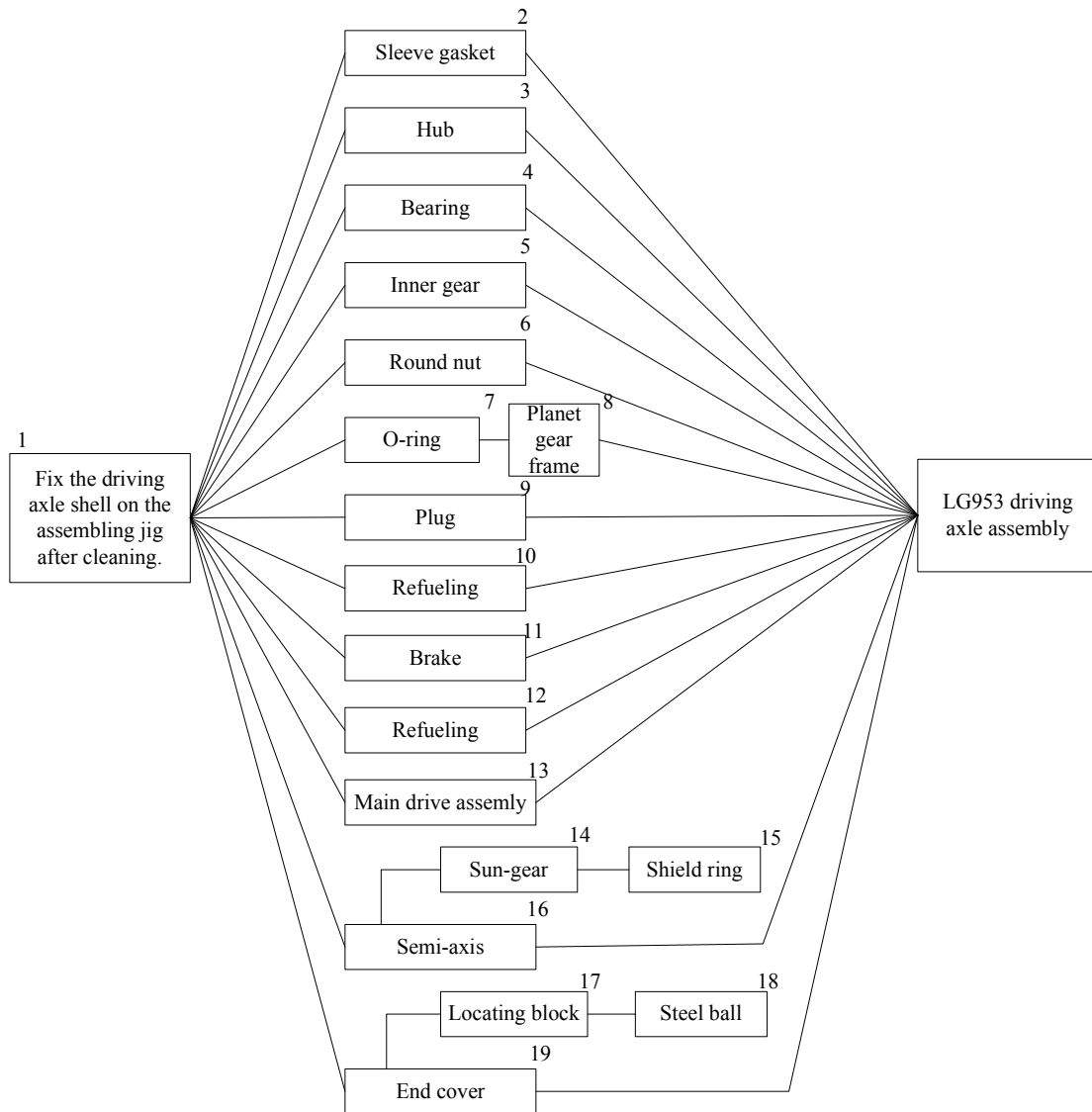


6. Take down the sleeve gasket.



# Chapter IV the Assembly of Driving Axle

## 4.1 The Network Figure of the General Assembly



## Assembly Tools and Equipments

General tool name	Specification	Number	Using Position(corresponding to the serial number of network chart or assembly parts name)
Gas trigger	MI16, MI17, MI18, MI2000P	1 group	Select different specification according to the size of the assembly bolts
Sleeve	13, 16, 17, 18, 21, 24, 30, 34, 41, 50	1 group	Select different specification according to the size of the assembly bolts
Dial Indicator	0.01/0~10	1	Partial assemble the active driving axle assembly and install the input flange
Copper Rod		1	Lightly beat the parts with assembly magnitude of interference
Heating Machine	Please use other methods without it	1	4
Cleaning Machine	Please use other methods without it	1	Clean every parts
Press	Please use other methods without it	1	Partial assemble the active spiral bevel gear assembly
Depth Vernier Caliper	0.02/0~200	1	Install the fixture pin of the half-axis gear gasket and the active spiral bevel
Inter hexagonal wrench	8	1	6
Wrest wrench	0~140Nm, 0~350Nm, 0~800Nm	1 group	Select different specification according to the size of the assembly bolts
Run out measuring instrument		1	Install the input flange
Pull-tensile dynamometer	0~300, 0~100N	1 group	6, partial assemble the active spiral bevel gear assembly
Special Tools Name	Specification	Number	Using Position(corresponding to the serial number of network chart or assembly parts name)
Driving axle assembling jig	Prepare assembly support yourself without it	1	
Circlip Plier for Axis (Hole)		one for each	Assemble the circlip
Special tool for round nut		1	6
Bearing push mounting sleeve		1 group	When Installing the bearing
Oil seal push mounting sleeve		1 group	When Installing the oil seal

## 4.2 Specification of Assembly of Axle and Notices

### 4.2.1 Classifications and tightening methods of screw fasteners of the axle

According to the analysis of the request of assembly performances, processes operations and quality as well as factors such as prevention for oil leakage and importance of quality characteristic in assembling for the axle's serial production, the screw fasteners of the axle are classified into three grades: A, B, and C.

Table for screw fasteners in grade A of the driving axle

No.	Position
1	Bolts for the wheel-side end cover
2	Connecting bolts and nuts for shells on both side of the differential mechanism
3	bolts and nuts of driven spiral bevel gear
4	Bolts of end cover for main drive
5	Connecting bolts for axle housing and bracket
6	Bolts connecting wheel-side oil seal cover

Table for screw fasteners in grade B of the driving axle

No.	Position
1	Bolts for hub and brake disc
2	Bolts of brake clip
3	Bolts and nuts connecting planet carrier and hub
4	Bolts for fastening flanges
5	Bolts connecting bracket and bearing chock

Table for screw fasteners in grade C of the driving axle

No.	position
1	Bolts for racket locking tablets
2	Plug for the center of axle
3	Wheel-side plug

Assembling methods of A-grade screw fasteners

1.1.1 Firstly, screw the bolts by more than 2-3 pitches manually.

1.1.2 Then pre-tighten by gas trigger with low velocity and little torque on the principle of symmetry and cross.

1.1.3 In the end, using a corresponding specification torque wrench, turn 30° at least to reach the median of specification torque.

1.1.4 Step 1.1.3 could be substituted by using an intelligent tightening machine, But make sure reach the median of specification torque and ensure its accuracy of the machine.

Principle for tightening B/C-grade screw fasteners:

1.2.1 Firstly, screw the bolts by more than 2-3 pitches manually.

1.2.2 Secondly, pre-tighten with the same specification or a one-smaller size gas trigger according with cross principle.

1.2.3 At last, tighten the screw to reach the specification ( median ) torque with appropriate gas trigger.

## 4.2.2 Notices in assembling axle

1. Before assembling, the scrap iron, burrs, oil contaminant, sediment on the component must be cleaned out. There must be no corrosion, scratch or damage on the mating surface and friction surface. The oil holes and groove should be clean and unobstructed.

2. During assembling, **never** damage the screw parts on bolts.

3. The head of bolts and end face of nuts should be uniform contacted with the fastened parts. Make sure neither inclination nor hammering makes the faces to contact. and ensure no bending deformation of the screws.

4. The fastener should be under uniform compression, make sure closely joint and connect firmly.

5. It is forbidden to use inappropriate wrench and sleeve when tightening the screws and nuts.

6. Assemble using fastener parts strictly according to the right grade as mentioned . **Never** use low performance fastener instead of high performance ones, or **Never** use high performance fastener

instead of low performance ones.

7. Coat little sealant for locking screws on the external thread cycle by cycle, **Never** coat onto the first two pitches of the screw, Make sure the width of sealant coated with 3 to 5 pitches, then wring the internal screw till to the specification torque . When the internal hole is a blind hole, coat some sealant onto bottom of the hole, and then tighten.

8. When assembling the screws and bolts, make sure wring them by more than 2-3 pitches, and then preload with tools, and finally tighten to specification torque with corresponding specifications torque wrench.

9. When assembling the screws, bolts and nuts, pay more attention to protect such as paint film, coating, etc on the connected components, and also protect such as the head of nuts and bolts, and the grooving of the screws, etc, **never** damage them.

10. Use suitable tap when screw holes need re-screw and keep the axle of the screw holes vertically with the surface of connectors.

11. After tightening the nuts, the bolts and screws should be protruded out 2-3 pitches to the end face of the nuts.

12. When a group of nuts or bolts being preloaded, make sure preload by many times in a certain order taking account into the distribution condition of connecting components and the bolts.

12.1 When tightening a group of nuts or bolts in a rectangle-distribution, make sure tighten them from the middle to the both sides symmetrically. The order is showed in Figure (1).

12.2 When tightening a group of nuts and bolts in a square-distribution or cycle-distribution, make sure tighten symmetrically. The order is showed in Figure (2).

12.3 If having a locating pin, tighten from the bolts near the pin. The order is showed in Figure (3).

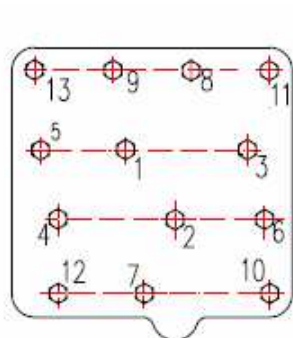


Figure (1)

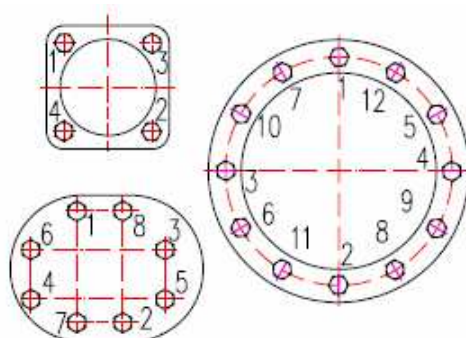


Figure (2)

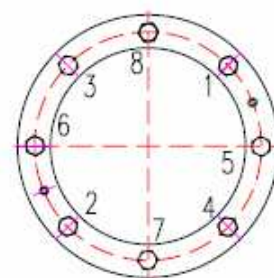


Figure (3)

13. When fixing heated bearings, make sure wear heat-insulating gloves in order not to be scalded.

14. When using copper rods, knock slightly to avoid debris splashing into the cavity of the components, otherwise, use rubber hammer, plastic hammer or the way of press mounting instead.



### 4.3 Driving Axle Assembly

#### 1. The assembly of the driving axle shell

Make sure hang the cleaned axle shell on the special support. Wring the plug with glue spread on the oil-letting and fuel-deliverer of the axle belly.



Driving axle shell



Tightening torque of the plug: 70~100Nm



#### 2. Sleeve gasket

Install the gear sleeve gasket on the wheel-side supporting axle of the axle shell assembly.



#### 3. Hub assembly

Coat the lubricating oil on the wheel-side supporting axle of the axle shell assembly, and then install the hub assembly on the both ends of the support axis of the axle shell assembly.



Lubrication oil



#### 4. Bearing

Heat the inner ring of rolling bearing 32221 to 50~80°C, and then install it on the wheel-side supporting axle.





### 5. Internal gear

Install internal gear of the driving axle on the spline at the end of supporting axle.



### 6. Round nut

Install and fasten round nut.



### ★ Notices:

1. Hook the  $\Phi 22.5$  hole with the pull-tensile dynamometer and pull along with the tangential direction. The reading of the pull-tensile dynamometer is 45~75N. If the reading is not within the scope between the 45~75N, adjust the degree of tightness of the round nut according to the reading. Repeat the above operations until the reading is within 45~75N. Finally, coat the Coat 1262 screw lock-fix sealant



on the thread hole of the inner gear installed the screw from the second tooth to the fifth or sixth pitches (form a liquid level on the 1/3 circle of the screw), then tighten the screw and fix the round nut.

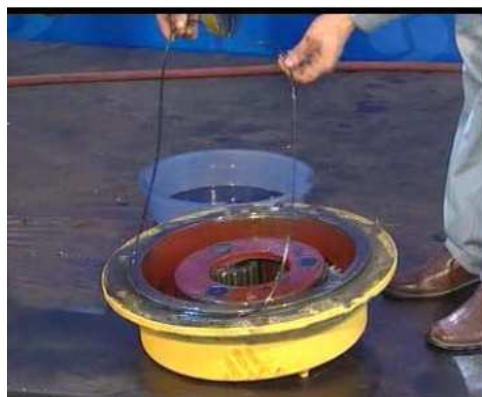
2. Before measuring the pressure, make sure rotate the hub for more than five times forward and backward.

 1262 screw lock-fix sealant

 Tightening torque of the screw: 40~50 Nm


7. Install the O-shape sealing ring


Install the O-shape sealing ring on the planet gear frame assembly.



8. Assemble the planet gear frame assembly

Install the planet gear frame assembly and O-shape sealing ring on the hub with the rim bolts, gaskets and nuts.

 Tightening torque: 500~560Nm


 The planet gear frame assembly



9. Install plugs

Wring plugs with glues in the oil holes at the both wheel-side.


 1545 oxygen-weary type pipe threads sealant

 Tightening torque: 70~100 Nm



10. Refueling

Refuel 5L SAE85W-90 GL-5 gear oil (GB13895-1992) in each two wheel-side reducer (Refuel 3L for each in this process, finally load 2L for each again).

 SAE85W-90 GL-5 Gear oil



### 11. Install the brake

Place the end surface of the axle shell upward horizontally. Install the disk brake at the opposite side of the axle belly on the braking clamp rack, and then fix with the bolt and washer.



Tightening torque: 376~502Nm



Brake



### 12. Refueling

Refuel 17L SAE85W-90 GL-5 gear oil (GB13895-1992) in the axle packet of the axle shell.



SAE85W-90 GL-5 gear oil



### 13 Assemble the main drive assembly

13.1 Coat 1596 silicone rubber plane sealant on the joint surface between the axle shell and the bracket. Coat the sealant which diameter is  $\Phi 3 \sim \Phi 6$  circled closed ring on the bigger end surface of the axle shell and the internal side of the thread hole. Coat this sealant on the thread holes at the both sides of R40 Arc. **Never** place the sealant in the air for more than 10 minutes.



1596 silicone rubber plane sealant





### 13.2 Install the main driving

Hoist the main drive assembly with the joist barrow. Install the final driver in the final driver shell of the axle, and then install the locating pin.



The main drive assembly



### 13.3 Install bolts

Coat proper 1262 screw lock-fixing sealant on the bolts, and the coating position is the 15mm length from the end of the screw. And then fasten the main drive assembly and the axle shell assembly with bolts and washers.



Tightening torque: 193~257Nm



1262 screw lock-fixing sealant

★ Notice: Fasten each bolt according to the symmetric cross method.



### 14. Install the sun-gear

Install the sun-gear on the end with shield ring groove of the half-axis.



### 15. Install the shield ring

Install the shield ring with axial circlip plier.



Make sure the circlip plier is clamped firmly during operating to avoid bouncing off the box body and forming hidden danger.



16. Install the half-axis

Install the half-axis with the sun-gear in the hub (pay attention to the assembly of the half-axis spline and gear).



17. Install locating block

Rivet the steel ball on the locating block to make sure flexibly rotate the steel ball.



18. Install the steel ball

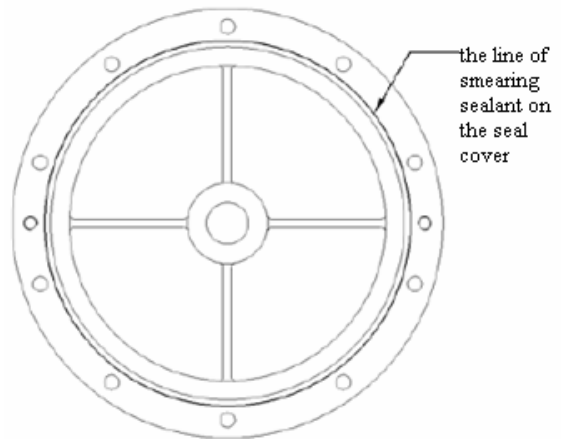
Install the locating block riveted steel ball on the end cover.

★ If the locating block unreached to the desired position, lightly beat it with corresponding tool until the steel ball can rotate flexibly.



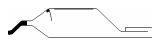
19. Install the end cover

Coat the glue line with diameter 4mm according to the route shown in the right Figure. Coat appropriate 1262 screw lock-fixing sealant in the thread hole at the joint bottom between hole and bolt. Finally, tighten the cover with the bolt and washer.



Tightening torque:  $45 \pm 5\text{Nm}$

★ Notice: Fasten each bolt according to the symmetric cross method.

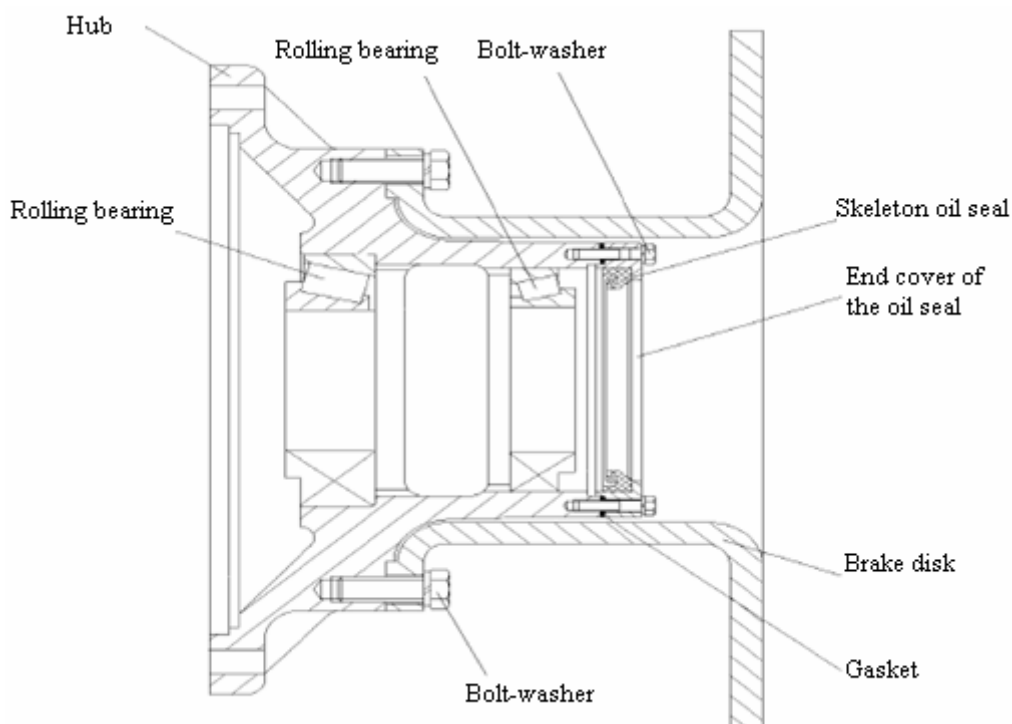


1262 screw lock-fixing sealant



## 4.4 Partial Assembling of the Assembly

### 1. Assemble the hub assembly



1.1 Install the external ring of the bearing 32221 with the bigger end of the hub upward. Then turn over, install the external ring of the bearing 32024 with the smaller end of the hub upward, and install the internal ring of the bearing 32024.



1.2 Coat the lubricating oil on the end cover of the oil-seal, and check the integrity of the oil-seal. Coat uniformly the lubricating oil in the groove of the skeleton oil-seal, and then install the skeleton oil-seal in the end cover of the oil-seal.



1.3 Install the gasket on the smaller end surface of the hub, then install the end cover of the oil-seal on the smaller end of hub, and tighten with the bolt M8\*45 and washer.



Tightening torque: 22~25 Nm

★ Notice: Fasten each bolt according to the symmetric cross method.



1.4 Install the brake disc on the hub, then tighten with the bolts M20\*1.5\*50 and the washer.



Tightening torque: 280~380Nm



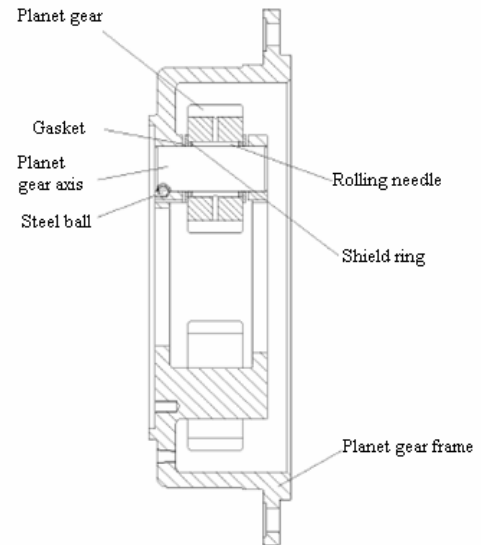
Brake disc

★ Notice: Fasten every bolt according to the symmetric cross method.





## 2. Install the planet gear frame assembly



2.1 Paste the needle roller (31 for each) in wall of the inner hole on the planet gear with lubricating grease. Install the shield ring on the both ends of the needle roller, and install gaskets at the both end of the hole on the planet gear. And finally, install the whole into the seat hole of the planet gear frame.

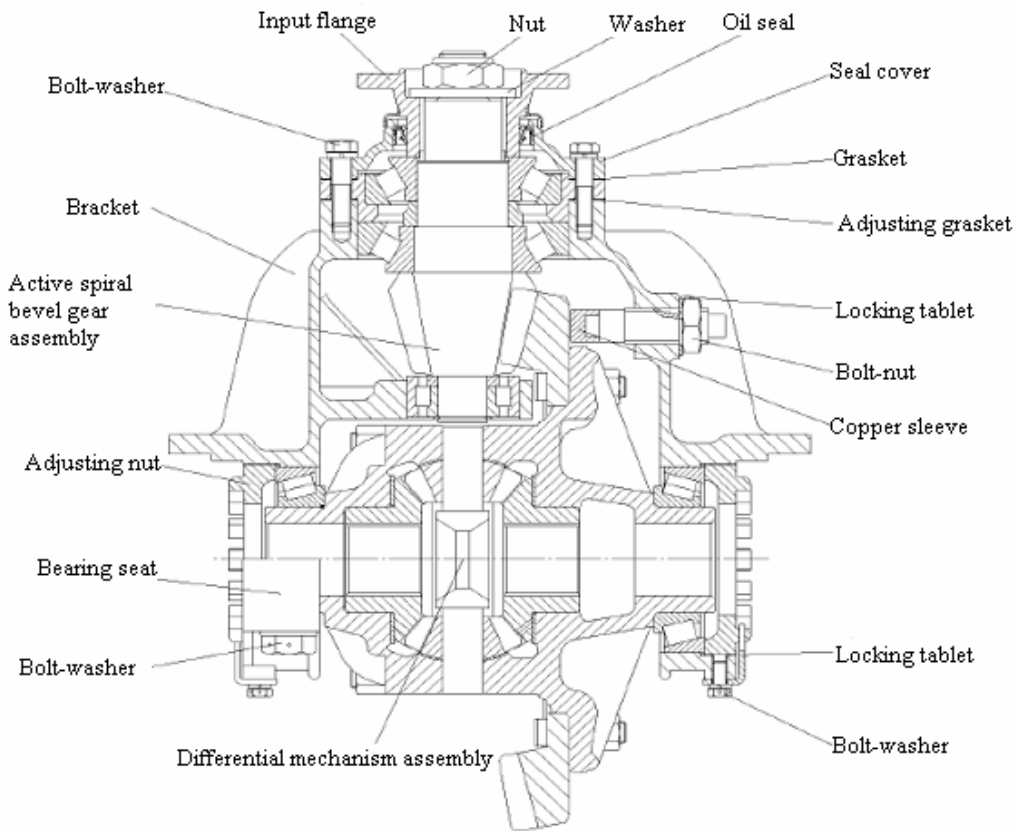
★ Notice: Select the needle rollers when assembling to ensure the deviations of max diameter and min diameter are less than 0.005 in the same group. The qualified fitting bought from Lingong of Shandong can satisfy the requirement to assemble directly.



2.2 Install the steel ball, which is aligned to the semicircular cavity of the planet gear frame, into the hole of the planet gear axis. Then install them and planet gear axis on the planet gear frame passing through the inner hole of the planet gear and gasket. After assembling completely, the planet gear should rotate flexibly and has no jamming.



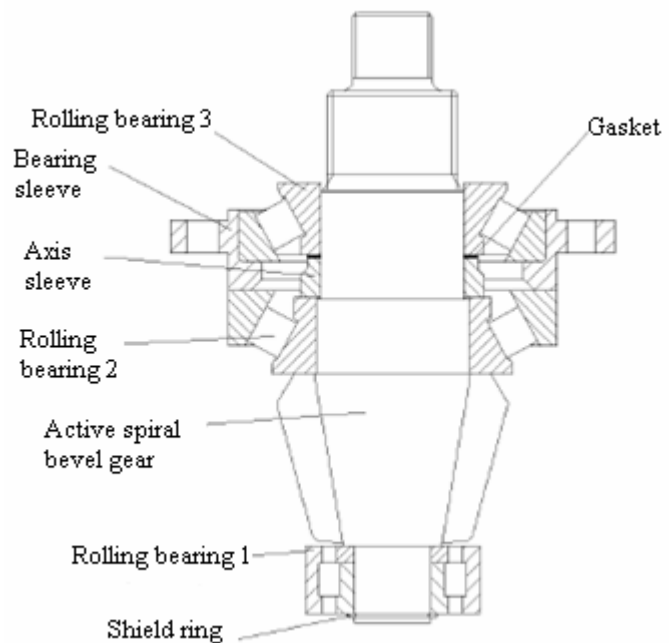
### 3. Install the main driving assembly



3.1.1 Press the external ring of the rolling bearing 3 in the seat hole of the bearing sleeve.

3.1.2 Install the rolling bearing 1 on the end journal of the active spiral bevel gear (divided into left and right lateral, front axle is left lateral and back axle is right lateral) with mechanical press, and then install the shield ring in order.

3.1.3 Turnover, press the rolling bearing 2 on the other end of the active spiral bevel gear with mechanical press.



Install the axis sleeve in order.



Install the gasket.



Then install the bearing sleeve (include the external ring of the bearing 31313).



Finally, press into the inner ring of the rolling bearing 31313.



★ Notice: When assemble the main reducer, the tapered roller bearing should be preloaded as certain assembly degree, that is to say, after eliminating clearance between the bearings, tighten with a certain pre-tightening force, in order to reduce axial displacement caused by the axial force produced during the driving axle, in order to increase the brace stiffness of the axis to assure the normal mesh of the bevel gear pair. But too tight will lowered the wear resistance of the tapered roller bearings. Load and keep the pressure  $P=5420\text{kg}$  on the up end of the inner ring of the rolling bearing 31313, then hook the hole  $\Phi 14.5$  on the bearing sleeve with pull-tensile dynamometer which is pulled along the tangential direction. The reading of the pull-tensile dynamometer is  $5\sim 35\text{ N}$ . If the reading is not within  $5\sim 35\text{ N}$ , increase and reduce the thickness of the gasket. Repeat the above processes until the reading scope is within  $5\sim 35\text{N}$ .



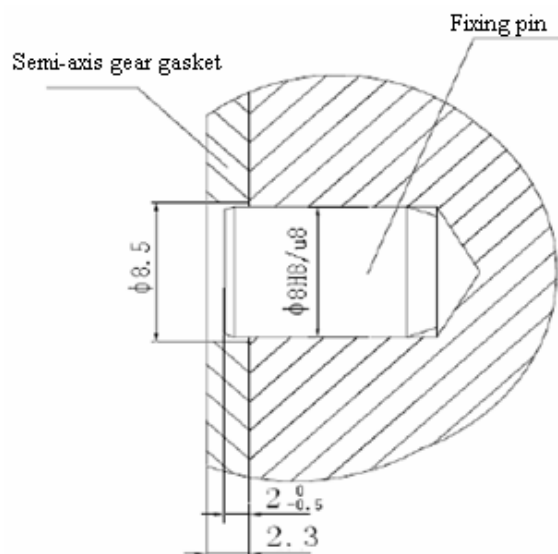
### 3.2.1 Install the half-axis gear

Install two fixed pins and the half-axis gear gaskets in the left shell of the differential mechanism in order.

★ Notice: Beat lightly when install the fixed pin to prevent the range of dimension tolerance out of  $2^0_{-0.5}$  (measure with the caliper while beating)

Install the half-axis gear

It is necessary that coat the lubricating oil when install the half-axis gear gasket and the half-axis gear. The surface with oil groove of the half-axis gear gasket combines with back of the half-axis gear.







Lubricating oil

### 3.2.2 Install the half-axis gear

Install two fixed pins, the half-axis gear gasket and half-axis gear in the right shell of the differential mechanism in order.

★ Notice: Beat lightly when install the fixed pin to prevent the range of dimension tolerance out of  $2^{0}_{-0.5}$  (measure with the caliper while beating)



### 3.2.3 Assemble the cross assembly

Install bevel gears (smaller end inward) and bevel gear gaskets on the four axis ends of the cross.

★ Notice: Coat the lubricating oil when install the bevel gear and the bevel gear gasket.



Lubricating oil



### 3.2.4 Install the differential mechanism shell

Install the cross assembly in the right shell of the differential mechanism and let bevel gear mesh with the half-axis gear.

Turnover the differential mechanism left shell assembly and install it with the differential mechanism right shell assembly, then joint the left and right shell of the differential mechanism with bolts, and tighten with washers and nuts.



Tightening torque of the nut:  $305 \pm 25$  Nm

★ Notice: 1. Make sure the assembly mark on the right



shell of the differential mechanism aligns to the left shell of the differential mechanism.

2. Coat the suitable 1262 screw lock-fixing sealant within the 10mm length from the screw bottom of the bolt.



1262 screw lock-fixing sealant

3. The half-axis gear and the bevel gear can rotate flexibly by hand and have no jam after assembling.

### 3.2.5 Install the driven spiral bevel gear

Align the assembly mark, fasten the driven spiral bevel gear (front axle is left lateral and back axle is right lateral) on the right shell of the differential mechanism with the bolt, washer and nut, then tighten the nut.



Tightening torque of the nut:  $305 \pm 25$  Nm

★1. Coat the suitable 1262 screw lock-fixing sealant within the 10 mm length from the screw bottom of the bolt.



1262 screw lock-fixing sealant

2. The judgment methods of the left and right lateral: Face to the front of the gear, the helical teeth extends from smaller end to bigger end according to clockwise named right lateral. On the contrary, extend from smaller end to bigger end according to anticlockwise named left lateral.



### 3.2.6 Install the bearing

Install rolling bearing on the external end bearing of right shell of the differential mechanism.

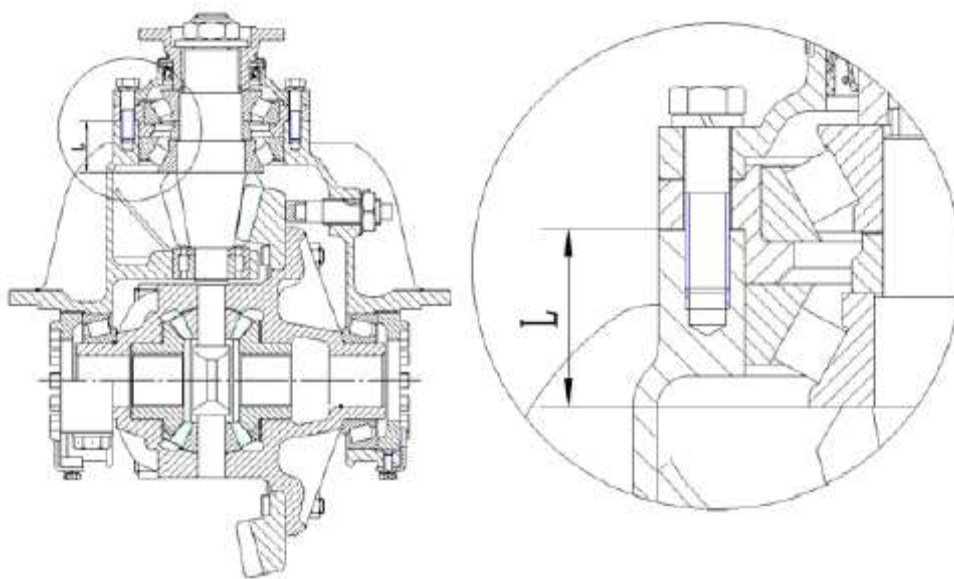


Install rolling bearing on the external end bearing of left shell of the differential mechanism.



### 3.3.1 Install the active spiral bevel gear

Measure the dimension size of L shown in the Figure. The original selection thickness of recommended adjusting gasket is equal to the measured value subtracts 55.5. Fix the bracket on the assembly frame with the smaller end upward. Coat the sealant on the smaller end surface, and install the adjusting gasket.



Install the active spiral bevel gear assembly after assembling in the bracket.



### 3.3.2 Assemble the seal cover

Press the oil-seal in the seal cover.

★ Notice: Coat suitable lubricating oil on the external diameter when assemble the oil-seal.



Lubricating oil

### 3.3.3 Install the input flange

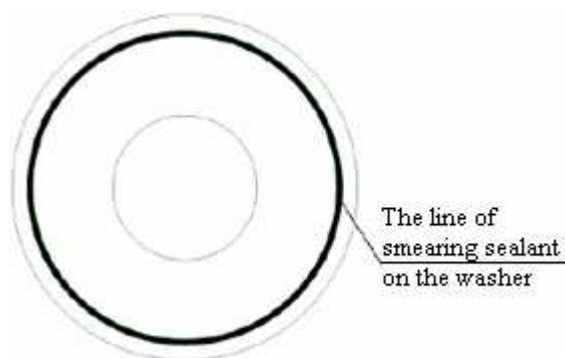
Put the gasket on the end surface of the bracket, then assemble the seal cover assembly (Coat lubricating grease according to the general requirement of the driving axle), and joint to the bracket with the bolt and washer (preload the bolt M14\*55 and M12\*55),

Install the input flange.





Coat the sealant on the end surface of the gasket and then keep the coating surface downward, and then install the gasket.



Install the nut M33\*1.5 and tighten it.



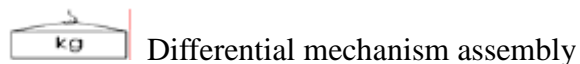
★ Notice:

1. Before installing the flange, install the flange on the spline of the active spiral bevel, and measure the radial pulsation of the flange to assure not more than 0.08, and make matching and assembly marks. If more than 0.08, rotate and install the flange to a certain angle, then measure again until satisfy the requirement. Otherwise, change the flange.

2. Coat a glue line whose coarseness is  $\Phi 2 \sim \Phi 3$  according to the line showed in the Figure on the washer as close as possible to the external circular.

**3.3.4 Assemble the differential mechanism assembly**

Turnover the bracket, install the differential mechanism assembly in the bracket.



Install the bearing seat with the washer and bolts (the bolt is lightly tight), then install the adjusting nut.

Attention:

1. **Never** change the two bearing seats.
2. Coat proper amount of the 1262 screw lock-fixing sealant on the length of 15~25 mm from the end face of the bolts.

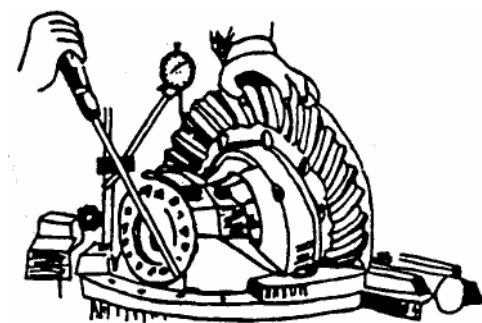


1262 screw lock-fixing sealant



### 3.3.5 Adjust the spiral bevel gear.

Meshing status adjustment of the spiral bevel gear is that: adjusting the meshing area and meshing clearance. When adjusting meshing clearance of the spiral bevel gear pair, press the tooth surface of the larger end edge of the driven bevel gear with the percent meter contact. And then turn the driven spiral bevel gear to measure its clearance directly. The clearance should be within the range of 0.20~0.40 mm.

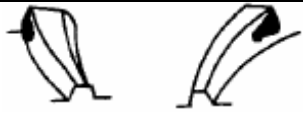
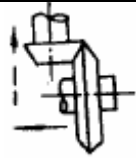

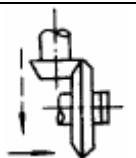
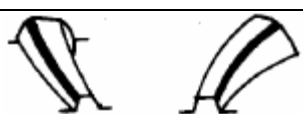
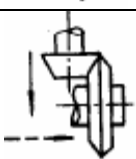
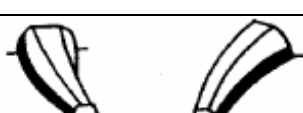



The adjusting way of meshing clearance is: turn the adjusting nuts to change the position of driven spiral bevel gear (move the assembly of driving spiral bevel gear for adjustment if necessarily). If the clearance is greater than the specified value, move the driven spiral bevel gear nearer to the driving spiral bevel gear, on the contrary, it should be got away. To keep the pre-tightening without changing on adjusted tapered roller bearing of the differential. The number of the screwing in adjusting nuts at one side should be equal to that out adjusting nuts on the other side.

When adjusting the contacting area of meshing pair of spiral bevel gears, firstly coat red pigment (red lead powder, etc) on the teeth of driven spiral bevel gear (generally 3 teeth should be coated), then turn the driven spiral bevel gear with reciprocating by hand, and check its touching imprint. Adjust the proper position of the imprint of spiral bevel gear is: no less than 50% along with the tooth depth and tooth length directions, the imprint of the driven spiral bevel gear is near to the centre, and be found on the middle of tooth depth along with the depth direction, partial to the smaller end along with the tooth length. The methods of improving the preload for the differential: after adjusting the meshing clearance of the spiral bevel gear, make sure the clearance between the tapered roller bearing on both sides of differential to zero. The method for adjusting is

shown in the following table.

Adjustment of contacting area and clearance in assembly of spiral bevel gear

Tooth flanks contacting area of driven spiral bevel gear	Adjustment method	The moving direction of gear
	<p>Move the driven gear to the driving gear, if the clearance is too small, move the driving gear to the outside.</p>	
	<p>Move the driven gear away from the driving gear, if the clearance is too large, move the driving gear to the inside.</p>	
	<p>Move the driving gear to the driven gear, if the clearance is too small, move the driven gear to the outside.</p>	
	<p>Move the driving gear away from the driven gear, if the clearance is too large, move the driven gear to the inside.</p>	

The method of adjusting the meshing area is used by adding or removing the adjusting shim and turning the adjusting nuts generally. The service performance and life is greatly influenced by the adjustment of contact area. Make sure be carried out seriously.

★ Notice: After adjustment, clean up the red lead powder.

### 3.3.6 Install the locking tablet

Tighten the fixing bolt of the bearing seat, the tightening torque is 500~600 Nm. Place the locking tablet rightly, then fix the locking tablet on the bearing seat with bolts and the washer, and tighten the fixing bolt of the locking tablet.



Tightening torque: 40~50 Nm  
500~600 Nm



★Notice: Coat suitable 1262 screw lock-fixing sealant within the 5~10 mm length from the screw end of the fixing bolt of the locking tablet.



1262 screw lock-fixing sealant

### 3.3.7 Install the stop-push bolt

Turnover the bracket, press the copper sleeve in the end of the stop-push bolt, then screw them in the bracket, let the copper sleeve contact with the back of the driven spiral bevel gear in the differential mechanism. Then turn 1/6-1/4 circle, and tighten with the nut and locking tablet.



Fold bending one tooth of the locking tablet to avoid the nut losing.



Then tighten the fixed bolts of the seal cover.



Tightening torque of the nut:

M14\*55——125~165Nm

M12\*55——78~104Nm

★ Notice: Tighten the fixed bolts of the seal cover should be according to the symmetric cross method in order.



# Chapter V Standard Criteria of Maintenance and Parts Replacement for the Axle

I After disassembly, the standard criterion of the parts scraped: Whether completely lose their function (service performance) and could not be repaired.

II There has two ways to judge the disassembled parts:

1. watch & touch by hand
2. measure the dimension

III Judge the disassembled parts by watching and touching primarily, make sure replace the parts when under the following condition:

1. **Never** further use those parts with seriously knocked, fracture, crack, or looseness function..
2. Because of low reliability and short service life resulted in repeated reuse, **Never** further use oil seals, dust ring, o-ring and gasket after disassembling by reason of leakage.
3. **Never** further use bolts, nuts, washers, plug screws, pipe joints if there is serious corrosion, and the screw could not wring well in tightening operation, or the screw is damaged, worn out or slipping.
4. **Never** further use the looseness-proof wire for bolts connection after disassembling.
5. **Never** further use those bearings if they could not be turned smoothly by hand, or the crack exists, the ball race is seriously worn or the balls are broken.
6. **Never** further use those gears and splines if there have cracks, sheet exfoliation, collision or over-wearing appears on the teeth.
7. **Never** further use those shells with crack, those mounting holes on the bearing shell with crack, serious wear, or sheet exfoliation, and those shell screws damaged result in operating weakly in tightening.
8. **Never** further use those bearing seats and oil seal seats with crack, serious wear, collision or sheet exfoliation on the touching surface or spigot.
9. **Never** further use those gaskets of the planetary gear and bevel gear, with serious wear, crack, collision or sheet exfoliation.
10. **Never** further use those pins with serious wear, collision or crack.
11. **Never** further use those supporting shafts, half shafts and flanges with collision, serious wear,

and cracks on the spline or teeth, or with cracks on working surface at oil seals and bearings.

12. **Never** further use those parts such as axle shell, supporting shafts, and half shafts with cracks or micro-cracks in transition areas or nearby those areas on their arcs, chamfers, splines.

IV. If it is hard to judge by watching and touching, check it by measurement. The common standard criterions of easily wear parts are listed in the following table.

Parts	Checking Items	Standard Criterions		Oversize Measures
		Dimension Tolerance	Allowable Limits	
Bearings	Internal diameter tolerance	0~ -0.02	+0.02	Replace
	External diameter tolerance	0~ -0.02	-0.04	Replace
Gears	Wear volume of tooth thickness	About 0~0.10	12% of tooth thickness of reference circle (1.2~1.4 generally, 2.0 for spiral bevel gear)	Replace
Bevel gear gasket	Thickness	$1.5 \pm 0.06$	1.2	Replace
Half axle gear	Thickness	$2.3 \pm 0.075$	2.0	Replace
Cross shaft	External diameter $\Phi 28.55$	-0.007~+0.014	$\Phi 28.50$	Replace
Bevel gear	Internal diameter $\Phi 28.7$	0~+0.05	$\Phi 28.65$	Replace
Common parts	External diameter of common fits	The tolerance is denoted as T.	Recommend: 0.3T less than lower limit	Replace
	Internal diameter of common fits	The tolerance is denoted as T.	Recommend: 0.3T more than upper limit	