

Demonstrate Carrying Out Jacking, Blocking and Lifting of Heavy Equipment and Components Safely

Skill Number CO-OP15GN108

Full Name: Gydon Kapay Kapay

SNISAP ID:

Job Title:

Branch/Area:

STEM 1 Singapuri

PERFORMANCE TASK:

Given a large machine component, the necessary lifting equipment and lifting chains/slings, the student is to lift and move the component from one location to another. The component is to be correctly supported once placed on the ground or workbench. The component is to be supported in a manner that will enable service work to be carried out.

The student must be able to:

- Selecting tools used and identify SWL correctly
- Jack and block Heavy Equipment correctly and safely
- Lift and support engine or machine component correctly
- Follow service procedure on Service Manual correctly
- Follow standard safety & contamination control procedure related to the job
- Perform communication & etiquette manner

Students are to be given a copy of TOL005 Practical Activity 2 – Student Performance sheet and fill out appropriate areas. It is recommended that Facilitators put questions to students regarding the findings of their inspections and subsequent report. The student will also be required to complete relevant workplace documentation and is to observe the correct safety procedures at all times

Safety and Contamination Control must be applied to this process at all times.

Prerequisite	Yes	No	N/A	Hints
The Student must complete the knowledge assessment. Minimum passing grade 80%.	✓			Score jacking, blocking, and lifting course or subject.

Tasks	Completed			Observation
	Yes	No	N/A	
Preparation Prepare related literature Work instructions are used to determine job requirements, including method, process and equipment Job specifications are read and interpreted. Information is accessed from manufacturer/component supplier specifications and correctly incorporated. Information is accessed from manufacturer/component supplier specifications and correctly incorporated	✓			Practical Activity 1 Observe if candidate to Manufacturer's and/or service intervals Observe if candidate to and observing M specifications and intervals
Prepare required equipment	✓			
Prepare related tools Materials, components, equipment and tooling are identified and checked for safe and effective operation	✓			Refer to MOD re Material, compon and equipment work are identified, prepared in accord procedures
Prepare Safety & Contamination Control equipment	✓			

Tasks	Completed			Observation
	Yes	No	N/A	
Perform etiquette/manner when starting the job	✓			
Meet the customer / assessor	✓			
Perform etiquette/manner when opening the interaction.	✓			• Perform smile & • Introduce Student
Explain the purpose of Student's activity.	✓			
Ask permission to perform the job.	✓			



Tasks	Completed		Observation / Hints
	Yes	No	
Visual Check			
Pre-inspection procedures	✓		Location of site to move component, personnel in the area, support material available at site
Cranelifting apparatus inspection	✓		Inspection of crane or lifting apparatus
Lifting equipment	✓		Inspection of chains/slings or other lifting apparatus.
Support materials	✓		Serviceable and will complete the task safely.

Tasks	Completed		Observation / Hints
	Yes	No	
Visual Check			
Site location selected	✓		Safe and secure area, will not affect other Personnel
Supports in place	✓		Tail rope, if required
Jacking and Blocking			
Jacking procedures	✓		Type of load, center of gravity, jacking points, SWL equipment and jacking tool, area ideal for jacking procedure.
Jack conducted	✓		Jack in correct position
Blocking procedure	✓		Type of blocking that use, SWL, Blocking points.
Blocking conducted	✓		Lowered correctly, supports in place, load secured and not moving once placed on ground or bench, jacking tool removed and moved out of the way
Blocking allows for service work to be conducted	✓		Job supported to allow work to be conducted.
Lifting			
Hook up procedures	✓		Check as per 10 steps of safe lifting in Student/Facilitator Guide, type of load, center of gravity, hook up points, hook up

Tasks	Completed		Observation / Hints
	Yes	No	
Lift conducted	✓		points checked, F hooks, hook-up secure
Load moved to chosen site	✓		Checked security of points, load lifted site center of gravity, twisted, kinked, bind and not jerky, lift straight down - no angle on or
Load lowered and supported	✓		Minimum distance of to complete. Personnel, consider of the load controller
Support allows for service work to be conducted	✓		Lowered correctly, place, load secure moving once placed or bench, lifting tack and moved out of the
			Job supported to allow work to be conducted.
			Use of Tools and Equipment

Tasks	Completed		Observation / Hints
	Yes	No	
Use of Tools and Equipment			
Tests and adjustments carried out according to manufacturer's specifications and procedures	✓		
Service is completed without damage to equipment and tools	✓		Tooling is checked for serviceability and found unserviceable
Equipment and tooling is cleaned and returned to its correct location	✓		Unserviceable equipment tooling is tagged identified in accordance with workshop requirements
Work area left clean and tidy	✓		



Tasks	Completed			Observation / Hints
	Yes	No	N/A	
Reporting All relevant documentation completed correctly, and approved by customer (if required).	✓			<ul style="list-style-type: none"> • Completing the Task List • Completing Measurement Form/Related Check Sheet, if required • Create Service Report (SIMS), if required • Create SPR, if required • Documenting the failed or damaged parts, if required • Provide Technical Analysis Report/Failure Analysis Report, if required.

Tasks	Completed			Observation / Hints
	Yes	No	N/A	
Safety				
Using PPE related to the job	✓			
Follows relevant Workplace Safety Guidelines (LOTO, Safety Equipment)	✓			<ul style="list-style-type: none"> • Comply with safety regulation that applied on the workplace
State and follow Safety Precautions	✓			<ul style="list-style-type: none"> • Create Job Safety Analysis • Student must follow safety procedure refer to service manual or SIS related to job
Student completes job without accident due to incorrect procedure using hand tools.	✓			<ul style="list-style-type: none"> • Correct working position • Correct hand tool related to the job
Tasks completed without damage equipment and tools	✓			

Tasks	Completed			Observation / Hints
	Yes	No	N/A	
Contamination Control Environmental Practices & Housekeeping	✓			<ol style="list-style-type: none"> 1. Waste is minimized, waste including sludge, solids and wastes are sorted and stor recycling or disposal 2. Packaging of goods receive and reused or disposed of 3. Materials that can be reuse cleaned and stored 4. Waste and scrap is remove workplace procedures 5. All fluids are disposed of if with enterprise policies and

Tasks	Completed			Observation
	Yes	No	N/A	
Perform etiquette/manner after completing the job Perform etiquette/manner when dosing the communication.	✓			<ul style="list-style-type: none"> • Perform smile & g • Ask permission to the interaction.

General Comments

Three horizontal lines for general comments.

RESULT: COMPETENT NOT YET COMPETENT (please check (✓))

Serviceman: Eaten Ruffy Razon Date 27 Januari 2014 Signature 

Assessor: Seliana Ib Date 27 Jan 2014 Signature 

Supervisor: Name _____ Date _____ Signature _____

Data Recorded: Name _____ Date _____ Signature _____

Demonstrate Carrying Out Jacking, Blocking and Lifting of Heavy Equipment and Components Safely

Skill Number CO-OP15GN108

Full Name: Galen Papaty Papan

SNSAP ID:

Job Title:

Branch/Area: CRKEN (Singapore)

PERFORMANCE TASK:

Given a large machine component, the necessary lifting equipment and lifting chains/slings, the student is to lift and move the component from one location to another. The component is to be correctly supported once placed on the ground or workbench. The component is to be supported in a manner that will enable service work to be carried out.

The student must be able to:

- Selecting tools used and identify SWL correctly
- Jack and block Heavy Equipment correctly and safely
- Lift and support engine or machine component correctly
- Follow service procedure on Service Manual correctly
- Perform standard safety & contamination control procedure related to the job
- Perform communication & etiquette manner

Students are to be given a copy of TCU005 Practical Activity 2 – Student Performance sheet and fill out appropriate areas. It is recommended that Facilitators put questions to students regarding the findings of their inspections and subsequent report. The student will also be required to complete relevant workplace documentation and is to observe the correct safety procedures at all times
Safety and Contamination Control must be applied to this process at all times.

Prerequisite	Yes	No	N/A	Hints
The Student must complete the knowledge assessment. Minimum passing grade 80%.	✓			

Tasks	Completed			Observer
	Yes	No	N/A	
Preparation				
Prepare related literature				
Work instructions are used to determine job requirements, including method, process and equipment				
Job specifications are read and interpreted. Information is accessed from manufacturer/component supplier specifications and correctly incorporated.	✓			
Information is accessed from manufacturer/component supplier specifications and correctly incorporated.				
Prepare required equipment				
Prepare related tools				
Materials, components, equipment and tooling are identified and checked for safe and effective operation	✓			
Prepare Safety & Contamination Control equipment	✓			

Tasks	Completed			Observer
	Yes	No	N/A	
Perform etiquette/manner when starting the job				
Meet the customer / assessor	✓			
Perform etiquette/manner when opening the interaction.	✓			
Explain the purpose of Student's activity.	✓			
Ask permission to perform the job.	✓			



Tasks	Completed			Observation / Hints
	Yes	No	N/A	
Visual Check	<input checked="" type="checkbox"/>			
Pre-inspection procedures	<input checked="" type="checkbox"/>			
Crane/Lifting apparatus inspection	<input checked="" type="checkbox"/>			
Lifting equipment	<input checked="" type="checkbox"/>			
Support materials	<input checked="" type="checkbox"/>			

Tasks	Completed			Observation / Hints
	Yes	No	N/A	
Visual Check	<input checked="" type="checkbox"/>			
Site location selected	<input checked="" type="checkbox"/>			
Supports in place	<input checked="" type="checkbox"/>			
Jacking and Blocking	<input checked="" type="checkbox"/>			
Jacking procedures	<input checked="" type="checkbox"/>			
Jack conducted	<input checked="" type="checkbox"/>			
Blocking procedure	<input checked="" type="checkbox"/>			
Blocking conducted	<input checked="" type="checkbox"/>			
Blocking allows for service work to be conducted	<input checked="" type="checkbox"/>			
Lifting	<input checked="" type="checkbox"/>			
Hook up procedures	<input checked="" type="checkbox"/>			
Lift conducted	<input checked="" type="checkbox"/>			
Load moved to chosen site	<input checked="" type="checkbox"/>			
Load lowered and supported	<input checked="" type="checkbox"/>			
Support allows for service work to be conducted	<input checked="" type="checkbox"/>			

Tasks	Completed			Observation / Hints
	Yes	No	N/A	
Use of Tools and Equipment	<input checked="" type="checkbox"/>			
Tests and adjustments carried out according to manufacturer's specifications and procedures	<input checked="" type="checkbox"/>			
Service is completed without damage to equipment and tools	<input checked="" type="checkbox"/>			
Equipment and tooling is cleaned and returned to its correct location	<input checked="" type="checkbox"/>			
Work area left clean and tidy	<input checked="" type="checkbox"/>			

Tasks	Completed			Observation / Hints
	Yes	No	N/A	
Reporting	<input checked="" type="checkbox"/>			
All relevant documentation completed correctly, and approved by customer (if required).	<input checked="" type="checkbox"/>			

Tasks	Completed			Observation / Hints
	Yes	No	N/A	
Safety	<input checked="" type="checkbox"/>			
Using PPE related to the job	<input checked="" type="checkbox"/>			
Follows relevant Workplace Safety Guidelines (LOTO, Safety Equipment)	<input checked="" type="checkbox"/>			
State and follow Safety Precautions	<input checked="" type="checkbox"/>			
Student completes job without accident due to incorrect procedure using hand tools.	<input checked="" type="checkbox"/>			
Tasks completed without damage equipment and tools	<input checked="" type="checkbox"/>			

Tasks	Completed		Observation / Hints
	Yes	No	
Contamination Control	✓		
Environmental Practices & Housekeeping			

Tasks	Completed			Observation / Hints
	Yes	No	N/A	
Perform etiquette/manner after completing the job	✓			
Perform etiquette/manner when closing the communication.				

General Comments

RESULT: COMPETENT NOT YET COMPETENT (Please

Serviceman: Galen Rapor Rapor 27 Januari 2024 [Signature]

Assessor: [Signature] 27 Januari 2024 [Signature]


Supervisor: _____ Date _____ Signature _____

Data Recorded: Name _____ Date _____ Signature _____

ANALISIS LINGKUNGAN KESELAMATAN KERJA / JOB SAFETY ENVIRONMENT ANALYSIS

Pekerjaan / Task	Lifting Differential and Bevel Gear	Nomor JSEA / JSEA Number	Halaman / Page	Dari / Of
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Tanggal Pembuatan JSEA / Date of JSEA	12 Januari 2026	Departemen / Dept	SERVICE	Tempat Kerja / Work Location	Workshop TAB
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Disusun Oleh / Compiled By	Galen	TTD Sign		Review Oleh / Reviewed By		TTD Sign		Atasan Superior		TTD Sign	
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Apakah Anda sudah terlatih untuk melakukan pekerjaan ini? / Are you properly trained to complete these task? Ya / Yes Tidak / No

Apa yang Anda perlukan untuk memastikan bahwa pekerjaan selesai tanpa adanya kecelakaan kerja? / What do you need to ensure this job is completed incident free?

Tools yang digunakan sudah sesuai dengan Manual

Siapa yang bertanggung jawab untuk menghentikan pekerjaan jika terjadi perubahan pekerjaan atau gangguan kondisi lingkungan kerja? / Who is responsible for Stop Work Authority if change job or workplace distraction could?

ABCD-1 (Technician Leader) / Mr. X (Customer)

Apakah Anda memerlukan peralatan LOTO? / Are you need LOTO Equipments? Ya / Yes Tidak / No

Apakah Anda mengetahui ERP/MERP dari pekerjaan yang sedang dilakukan? Ya / Yes Tidak / No *Jika tidak, silahkan tambahkan dalam urutan langkah tugas di awal*

Kondisi Lingkungan / Environmental Conditions	Cuaca / Weather	BERAWAN	Medan / Terrain	RATA
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Pengendalian Sumber Bahaya / Hazardous Energy Control	<input type="checkbox"/> Listrik / Electrical	<input checked="" type="checkbox"/> Gravitasi (Benda jatuh, tertimpa) / Gravitation (Falling objects, struck down)	<input type="checkbox"/> Pneumatik / Pneumatic
	<input type="checkbox"/> Hidraulik / Hydraulic	<input checked="" type="checkbox"/> Mekanis / Mechanical	<input type="checkbox"/> Panas / Thermal

APD yang diperlukan / Required PPE	<input checked="" type="checkbox"/> Helm / Safety Helm	<input type="checkbox"/> Pelindung Muka / Face shield	<input checked="" type="checkbox"/> Kacamata / Safety Glass
	<input checked="" type="checkbox"/> Sarung Tangan / Hand Gloves	<input type="checkbox"/> Pelindung Pernafasan / Respiratory Protection	<input type="checkbox"/> Perlindungan Kejatuhan / Fall Protection
	<input checked="" type="checkbox"/> Sepatu / Safety Shoes	<input type="checkbox"/> Pelindung Telinga / Hearing Protection	<input type="checkbox"/> Lain-Lain / Other

Hal yang perlu dipertimbangkan dalam mengidentifikasi bahaya / These to consider in identify hazards :

- 1 **Bahaya Keselamatan** : Kondisi tidak aman yang dapat menyebabkan injury atau kematian seperti terpelesep, terjerjat, tertimpa dll.
Safety Hazard : unsafe conditions that can cause injury or even death, such as spill/falls, pinch point, struck by, etc.
- 2 **Bahaya Fisik** : Listrik, Api/ledakan, Kebisingan, Radiasi, Panas, Tekanan, Terjepit, Tersandung/Terjatuh, Tertimpa, Getaran.
Physical Hazards : Electrical, Fire/Explosion, Noise, Radiations, Thermal, Pressure, Pinch Point, Slips/Falls, Struck by, Vibration.
- 3 **Bahaya Kimia** : Terhirup, terkena kulit, injeksi, tertelan, terserap.
Chemical Hazards : Inhalation, skin contact, injection, ingestion, absorption.
- 4 **Bahaya Biologi** : Patogen yang ditularkan melalui darah, jamur, tanaman/serangga/hewan.
Biological Hazards : bloodbone pathogens, mold, Plant/Insect/Animals
- 5 **Bahaya Ergonomi** : Gerakan berulang-ulang, beban yang berlebihan, Postur janggal, Durasi kerja, Desain area kerja.
Ergonomic Hazards : Repetitions, Forcefull extention, Awkward Posture, Duration, Work area desain.
- 6 **Bahaya Organisasi** : stres atau bahaya terkait dengan masalah tempat kerja yang menyebabkan efek jangka panjang atau pendek, beban kerja yang berat dan kekerasan ditempat kerja.
Organizational hazards : stressors or hazards associated with workplace issues that cause long or short tem: effects heavy workloads, stressful interactions and workplaces violence.

No	Urutan Dasar Langkah Tugas / Job Steps (* Maksimum 15 Langkah / Maximum 15 Steps)	Bahaya Yang Terkait / Potential Hazard(s)	Tindakan Perbaikan / Recommended Action
1	Walk Around Inspection	1.1 tersandung tatalakan komponen	1.1.1 Hati-hati saat walk around inspection 1.1.2 Gunakan Safety Glove
2	Prepare Tools	2.1 tertimpa pallet	2.1.1 Berhati-hati saat membawa pallet. 2.1.2 Gunakan APD yang sesuai.
3	Doing Lifting Differential	3.1 terjepit komponen 3.2 terbentur tiang crane 3.3 tertimpa komponen 3.4 terbentur crane 3.5 tangan terjepit peralatan lifting	3.1.1 Hindari titik jepit. 3.1.2 Berhati-hati saat pembebanan. 3.2.1 Fokus saat bekerja. 3.2.2 Gunakan safety helmet 3.3.1 partikan komponen seimbang 3.3.2 Gunakan APD lengkap. 3.4.1 jaga jarak aman dengan crane 3.4.2 Gunakan APD yang sesuai 3.5.1 perhatikan titik jepit. 3.5.2 perhatikan kontak jari.
4		3.6 sling tergelincir	3.6.1 partikan sling terparang dengan benar 3.6.2 gunakan pengikutan yang benar 3.6.3 partikan sling dengan partibeban





SMCS - 3256, 3258

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Disassembly Procedure

Table 1

Required Tools			
Tool	Part Number	Part Description	Qty
A	1U-7502	Repair Stand	1
B	439-3938	Link Bracket As	2
C	456-4371	Lever Hoist	1
D	1P-5546	Crosslock	1
E	6V-3160	Double Acting Cylinder	1
F	1P-0520	Driver Group	1
H	6V-4070	Spanner Wrench	1
J	88-7551	Bearing Puller	1
K	5F-7343	Bearing Puller Gp	1

Start By:

- a. Remove the front or rear differential assembly. Refer to [Differential and Bevel Gear, Front and Rear](#), [Remove and Install](#).

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

1. Apply location marks on all housings and case assemblies for assembly purposes.

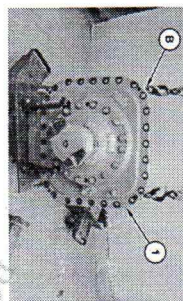


Illustration 1

2. Attach Tooling (B) and a suitable lifting device to differential and bevel gear assembly (1). The weight of differential and bevel gear assembly (1) is approximately 322 kg (710 lb).



Illustration 2

3. Position and place differential and bevel gear assembly (1) onto Tooling (A). Remove Tooling (B) and the suitable lifting device.

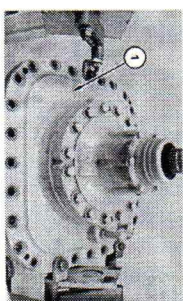


Illustration 3

4. Rotate differential and bevel gear assembly (1) by 90 degrees.

*metode alat lifting
 swe yang dipert...*

gunakan Direct Hitch

, Hoot, Eye bolt.

1. pada track type tractor D8

2. di area yang aman serta rafa

3. ~~chment~~ untuk jacking serta tool untuk membuka oil drain

4. lift untuk mengangkat unit ~~unit~~

5. stand untuk menopang frame bagian bawah unit

6. menggunakan atau perlu diangkat gunakan jack stand

7. gunakan jack stand untuk mengangkat frame tipper ~~apakah~~

8. drain dibawah drain port

9. drain port

10. sudah keluar semua, pasang kembali penutup drain port.

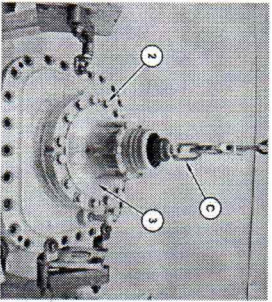


Illustration 4

g03965466

5. Attach Tooling (C) and a suitable lifting device to the yoke. The weight of pinion housing (3) is approximately 75 kg (165 lb). Remove bolts (2).

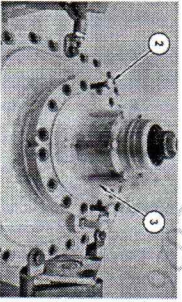


Illustration 5

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6. Install two bolts (2) in the threaded holes of pinion housing (forcing bolt holes). Tighten two bolts (2) evenly to separate pinion housing (3). Remove pinion housing (3).

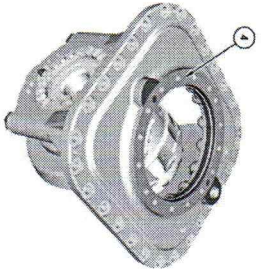


Illustration 6

g03965626

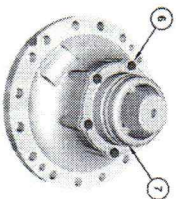
7. Remove shims (4).



Illustration 7

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8. Remove O-ring seal (5).





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Illustration 8

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SIS 2.0

- 9. Position the pinion housing onto suitable cribbing.
- 10. Remove bolts (6) and retainer (7).

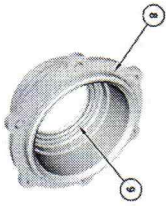


Illustration 9

g03865904

- 11. Remove O-ring seal (8) and lip seal (9).

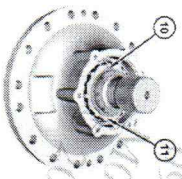


Illustration 10

g03865905

- 12. Remove retaining ring (10) and locking washer (11).

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SIS 2.0

- 13. Use Tooling (H) (not shown) to remove locknut (12). Remove locknut (12) and notched washer (13).

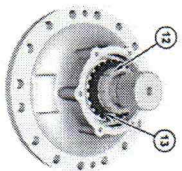


Illustration 11

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Illustration 12

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- 14. Use a suitable press to remove pinion shaft (14) from bearing cone (15).

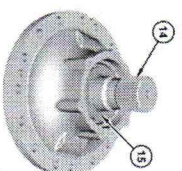


Illustration 13

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- 15. Remove bearing cone (15).

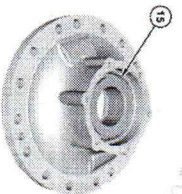






Illustration 14

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Typical Example

16. Use a suitable press and Tooling (J) (not shown) to remove bearing cup (16).

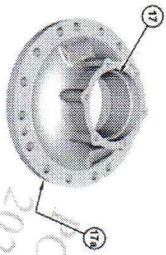


Illustration 15

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17. Remove bearing cup (17) and bearing cup (17a).

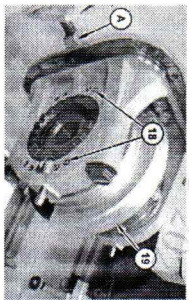


Illustration 16

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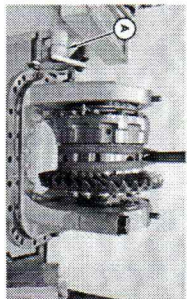


Illustration 17

g03865999

20. Use a suitable lifting device to position the carrier and differential assembly on Tooling (A). The weight of the carrier and differential assembly is approximately 234 kg (516 lb).

21. Rotate the carrier and differential assembly an additional 90 degrees on Tooling (A).

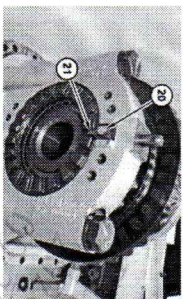


Illustration 18

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22. Remove bolt (20) and lock (21). Repeat for the opposite side.

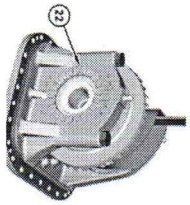


Illustration 19

Do not remove suitable lifting device from the carrier and differential assembly.

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23. Remove adjusting ring (22). Repeat for the opposite side.

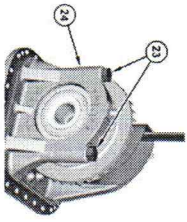


Illustration 20

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24. Remove bolts (23) and bearing cap (24).

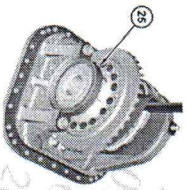


Illustration 21

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25. Remove bearing cup (25).

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2026 Caterpillar

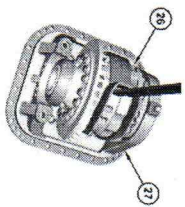


Illustration 22

g03986638

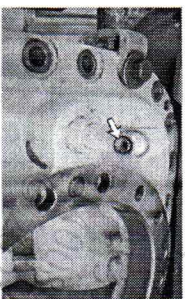
26. Use the suitable lifting device to remove differential assembly and bevel gear (26) from carrier assembly (27). The weight of differential assembly and bevel gear (26) is approximately 115 kg (254 lb).



Illustration 23

g03986635

27. Remove bearing (26a) from carrier assembly (27). Remove bearing race (26b).



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0082513
2026 Car



1/27/26, 4:32 PM

Illustration 24

g03866236

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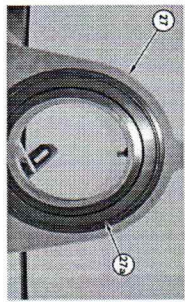


Illustration 25

g03866237

⚠ WARNING

Personal injury can result from air pressure against the piston.

The piston can come out of the housing assembly with force when air pressure is applied.

To prevent possible personal injury, the piston must be retained in the housing assembly when applying air pressure.

- 28. Apply air pressure to remove clutch piston (27a) from carrier assembly (27). Remove clutch piston (27a).

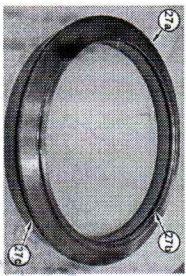


Illustration 26

g03866895

- 29. Remove D-ring seal (27b) and D-ring seal (27c) from clutch piston (27a).

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 09:26:01/27
 08:25:10:07:00

1/27/26, 4:32 PM

Illustration 27

g08536911

SIS 2.0

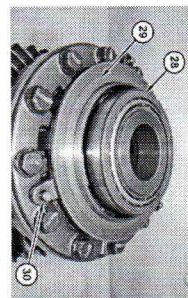


Illustration 27

g08536911

- 30. Position the differential assembly and bevel gear on suitable cribbing (not shown).

- 31. Remove bearing cup (28) and O-ring seals (30).

- 32. Remove thrust ring (29).

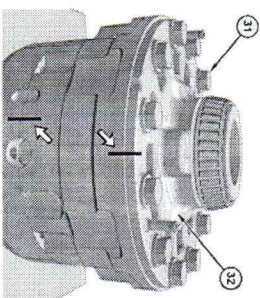


Illustration 28

g08537942

Typical Example

Note: Mark the orientation of the housing joints prior to disassembly for the assembly purposes.

- 33. Remove bolts (31) and top clutch housing (32).

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 08:32:16



Illustration 34

g03866124

30. Remove spider gear assembly (41).

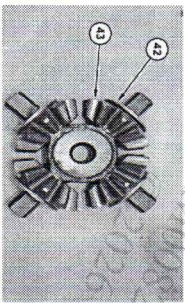


Illustration 35

g03866131

40. Remove thrust washers (42) and gears (43).

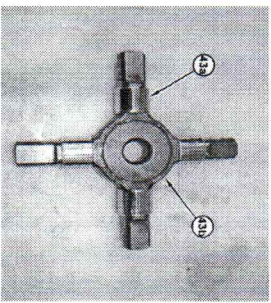


Illustration 36

g03870910

41. Remove gear sleeves (43a) from spider (43b).

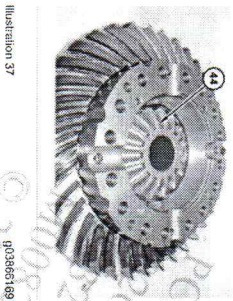


Illustration 37

g03866189

42. Remove gear (44).

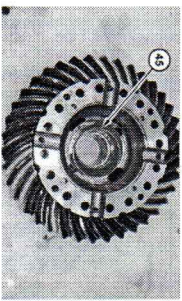


Illustration 38

g03866175

43. Remove thrust washer (45).

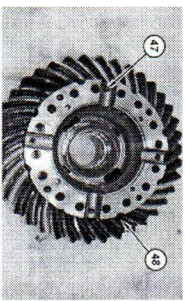


Illustration 39

g03866231

44. Remove roll pins (47) and bevel gear (48).

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2026/01/27
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SMCS - 3256, 3258

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Assembly Procedure

Table 1

Required Tools			
Tool	Part Number	Part Description	Qty
A	1U-7502	Repair Stand	1
B	439-3938	Link Bracket As	2
C	456-4371	Lever Hoist	1
D	1P-5546	Crossblock	1
H	6V-4070	Spanner Wrench	1
L	-	Grease	-
M	9S-8864	Plate	1
	5P-8715	Forcing Bolt	1
	350-7768	Electric Hydraulic Pump Gp (11.5 V)	1
N	350-7769	Electric Hydraulic Pump Gp (230 V)	1
	478-3993	Torque Wrench	1
P	9U-5017	Torque Wrench	1
R	8T-5096	Tool Group	1

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.



Illustration 1

90366985

1. Install D-ring seal (27b) and D-ring seal (27c) in clutch piston (27a). Apply a liberal amount of Tooling (L) to D-ring seal (27b) and D-ring seal (27c).

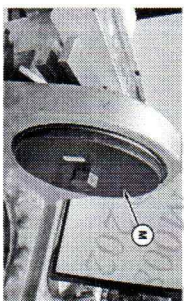


Illustration 2

90366986

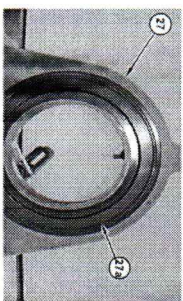


Illustration 3

90366237

2. Use Tooling (M) to install clutch piston (27a) into carrier assembly (27).



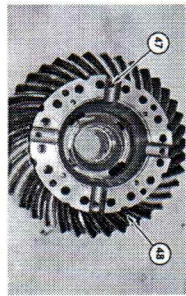


Illustration 4

903986231

3. Install roll pins (47) into bevel gear (48).

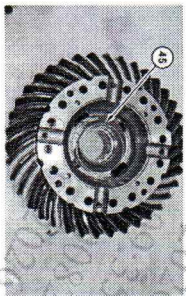


Illustration 5

903986175

4. Install thrust washer (45).

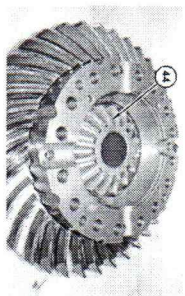


Illustration 6

903986169

5. Lubricate gear (44) with the lubricant that is being sealed. Install gear (44). Make sure that gear (44) turns freely.

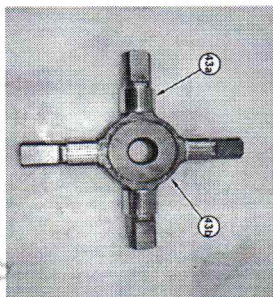


Illustration 7

903970010

6. Lubricate spider (43b) with the lubricant that is being sealed. Lubricate bearing sleeves (43a) with the lubricant that is being sealed. Install bearing sleeves (43a) on spider (43b).

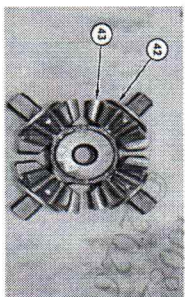


Illustration 8

903986131

7. Lubricate gears (43) and thrust washers (42) with the lubricant that is being sealed. Install gears (43) and thrust washers (42). Make sure gears (43) turn freely.

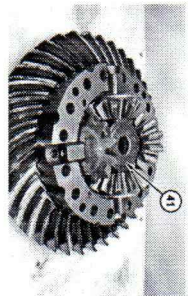


Illustration 9

g03866124

8. Install spider gear assembly (41).

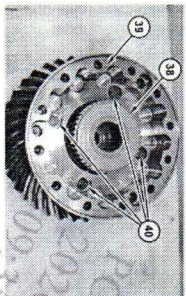


Illustration 10

g03866119

Note: Align the housing to the orientation as marked during the disassembly.

9. Align and install housing (39). Lubricate gear (38) with the lubricant that is being sealed. Install gear (38) and bolts (40). Make sure that gear (38) turns freely.

10. Perform the following procedure to control preload accurately and backlash setting:

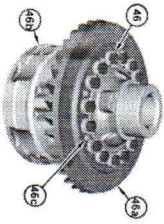


Illustration 11

g03870585

Note: Do not install all bolts (46) until the following procedure is completed.

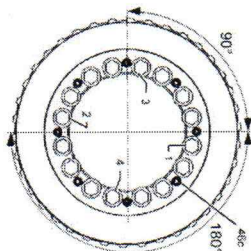


Illustration 12

g03870679

a. Raise bevel gear (46a) to a temperature between 70° C (158° F) and 120° C (248° F). Install bevel gear (46a) to differential case (46b).

b. Install spring pins (46c) to align bevel gear (46a) to differential case (46b).

c. Install four bolts (46) as indicated by callouts (1) through (4) in Illustration 12. To seat bevel gear (46a) to differential case (46b), tighten four bolts (46) in the pattern that is indicated by callouts (1) through (4). Tighten four bolts (46) to a minimum torque of 70 N·m (52 lb·ft).

d. Install remaining bolts (46) loosely (a minimum of one to two revolutions).

e. Confirm bevel gear (46a) is seated in differential case (46b).

f. Allow bevel gear (46a) to cool to a temperature of 30° C (86° F) or less.

g. Loosen four initially tightened bolts (46) as indicated in Illustration 12.

h. Tighten bolts (46) to a final torque of 95 ± 10 N·m (70 ± 7 lb·ft). Turn bolts (46) an additional 180 degrees ± 10 degrees.

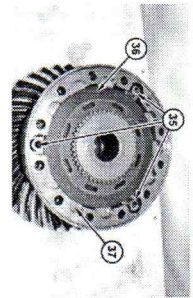


Illustration 13

g03966114

⚠ WARNING

Improper assembly of parts that are spring loaded can cause bodily injury.
To prevent possible injury, follow the established assembly procedure and wear protective equipment.

- 11. Thoroughly coat eight separator plates (37) and eight friction discs (36) with the lubricant that is being sealed.
- 12. First install bottom separator plate (37), then install one friction disc (36). Continue in this way until you install the last friction disc (36) at the top.
- 13. Install springs (35).

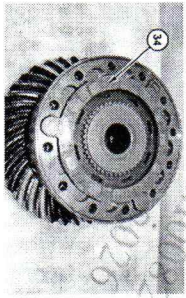


Illustration 14

g03966103

- 14. Install thrust plate (34).

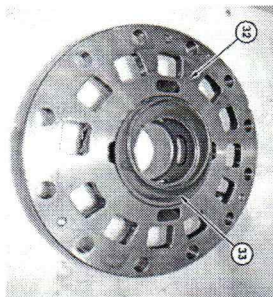


Illustration 15

g06637152

- 15. Lubricate thrust washer (33) with the lubricant that is being sealed. Install thrust washer (33) on back side of top clutch housing (32).

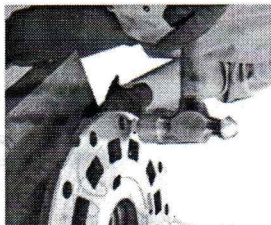


Illustration 16

g06783402

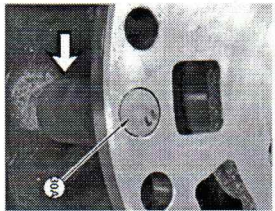


Illustration 17

g036783403

16. Lower the temperature of dowels (30A). Use a suitable hammer to install dowels (30A). Support the housing when installing the dowels.

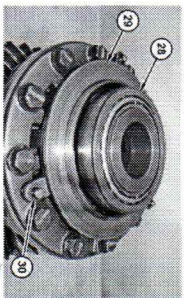


Illustration 18

g036783471

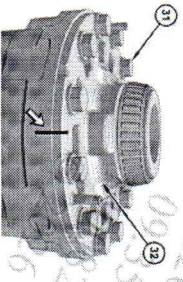


Illustration 19

g03637164

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- 17. Install thrust ring (29).
- 18. Install O-ring seals (30) and bearing cup (28).
- Note:** Align the housing to the orientation as marked during the disassembly.
- 19. Align and install top clutch housing (32).
- 20. Install bolts (31). Tighten bolts (31) to a torque of 270 ± 40 N·m (200 ± 30 lb·ft).



Illustration 20

g03666235

21. Install bearing race (28b). Install bearing (28a) on to carrier assembly (27).

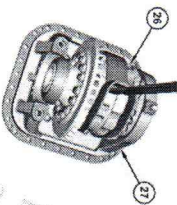


Illustration 21

g03666038

22. Use a suitable lifting device to install differential assembly and bevel gear (26) in to carrier assembly (27). The weight of differential assembly and bevel gear (26) is approximately 115 kg (254 lb).

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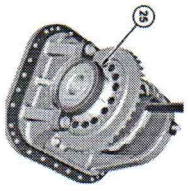


Illustration 22

g03866037

23. Install bearing cup (25).

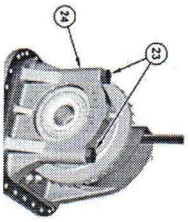


Illustration 23

g03866014

24. Install bearing cap (24). Tighten bolts (23) to a torque of 70 N·m (50 lb ft).

Note: This torque is the initial torque for bolts (23).

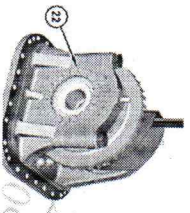


Illustration 24

g03866009

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MG08251

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25. Install adjusting ring (22). Repeat for the opposite side. Ensure that adjusting rings (22) turn freely.

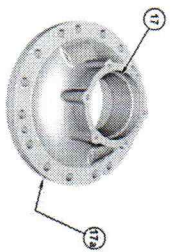


Illustration 25

g03866075

26. Install bearing cup (17) and bearing cup (17a).

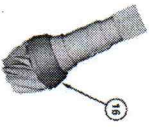
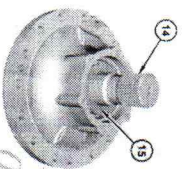


Illustration 26

g03866074

27. Raise the temperature of bearing cone (16). Install bearing cone (16) on pinion shaft (14).



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Illustration 27

- 28. Install bearing cone (15). Install pinion shaft (14).
- 29. Perform the following Steps for setting backlash:

- a. Secure the pinion housing in a suitable holding fixture.

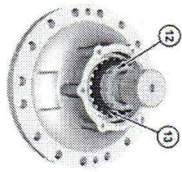


Illustration 28

- b. Install notched washer (13) and locknut (12). Tighten locknut (12) until you attain a rolling torque of 0.67 to 1.35 N·m (6 to 12 lb in).

Note: Rotation of the pinion is critical to achieve a proper seating of all the components.

- c. Rotate the pinion several times to ensure that the bearings are fully sealed.

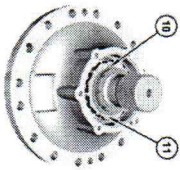


Illustration 29

- d. Install locking washer (11) so the tabs line up with the notches on the notched washer. Locking washer (11) has eight different positions to align the tabs with the notches in the notched washer. If locking washer (11) does not fully align with the notched washer, position locking washer (11) so that locking washer (11) is very close to fitting into the

Illustration 30

- e. Measure the rolling torque again to confirm that the rolling torque is still 0.67 to 1.35 N·m (6 to 12 lb in).
- f. If the rolling torque is still 0.67 to 1.35 N·m (6 to 12 lb in), then install retaining ring (10) into the groove of the locknut that is closest to the locking washer. Make sure that retaining ring (10) is fully seated in the groove.



Illustration 30

- g. Install lip seal (9) with the spring facing up. Lubricate lip seal (9) with the lubricant that is being sealed. Install O-ring seal (8).

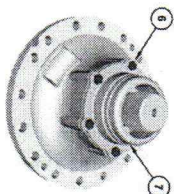


Illustration 31

- 31. Install retainer (7) and bolts (6).



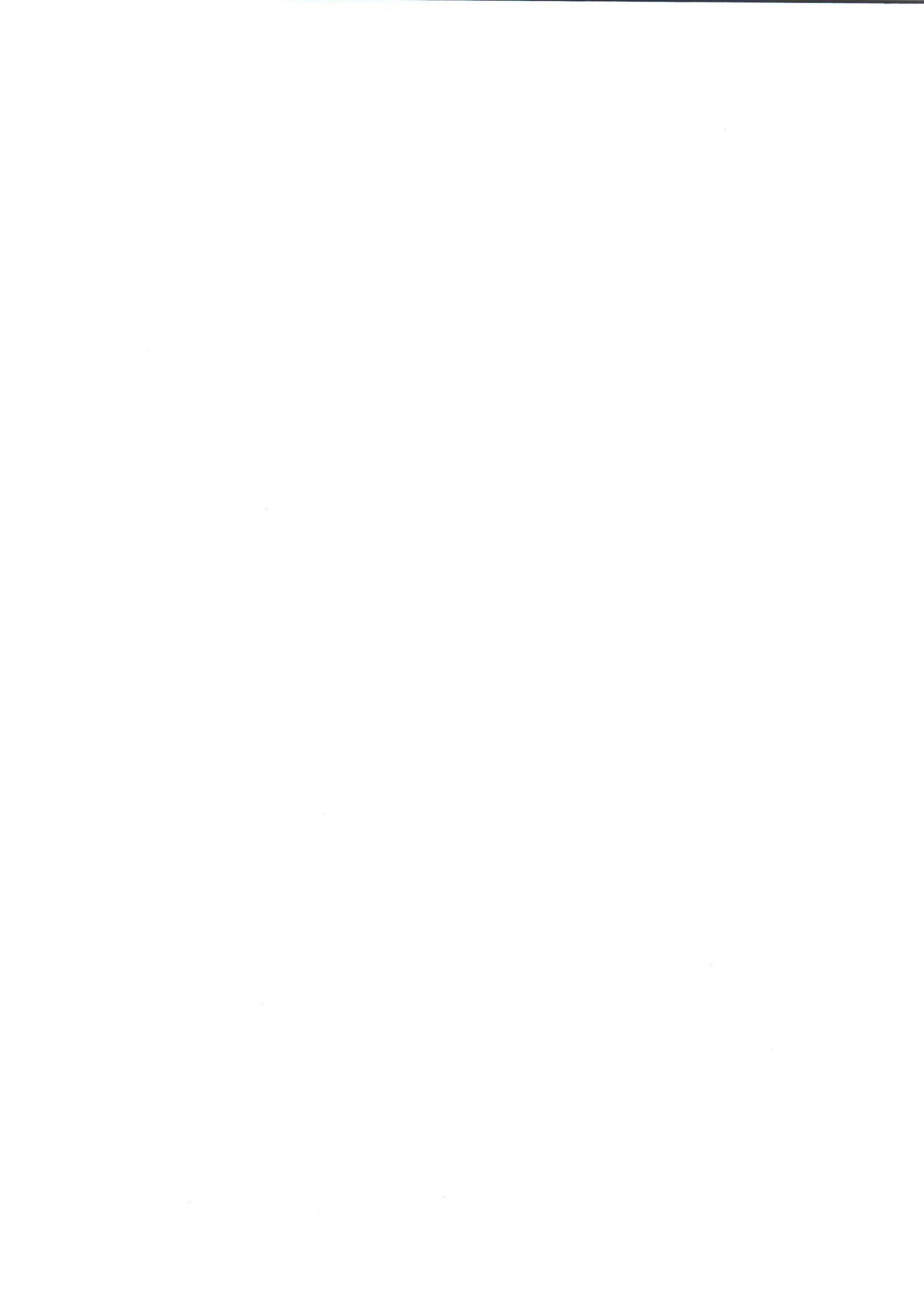


Illustration 32

32. Install O-ring seal (5).

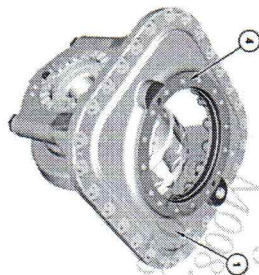


Illustration 33

33. Rotate and reposition differential and bevel gear assembly (1) by 90 degrees.

Note: Use the original shims (4) or provide new shims (4) that are the same thickness as the original shims that were removed.

Note: If original shims (4) are not available, then install 80 percent of the new shim pack. In this case, you will be required to adjust the thickness of shims (4) after you determine the tooth contact pattern.

34. Install shims (4) in the differential and bevel gear assembly (1).

Illustration 34

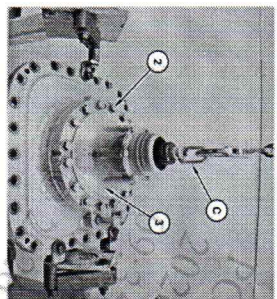


Illustration 35

35. Attach suitable Tooling (C) and a suitable lifting device to the yoke. The weight of pinion housing (3) is approximately 75 Kg (165 lb).

36. Install pinion housing (3) and bolts (2). Tighten bolts (2) to a torque of 270 ± 40 N·m (199 ± 30 lb ft).

37. Perform the following procedure to set bearing end play and to set backlash of the bevel gear.

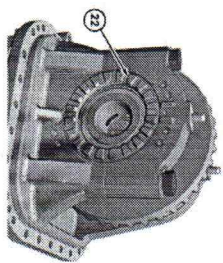


Illustration 35

a. The bearing cups have adjusting rings (22). Adjusting rings (22) are used for setting the bearing end play and for setting the back lash of the bevel gear.



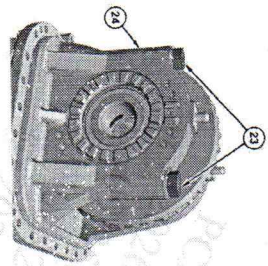


Illustration 36

g00588K25

- b. Ensure that bolts (23) for bearing caps (24) are tightened to a torque of 70 N·m (50 lb ft).
- c. Move both adjusting rings to a position that maintains gear backlash, but not a tight gear mesh. Make sure to maintain a slight bearing end play.

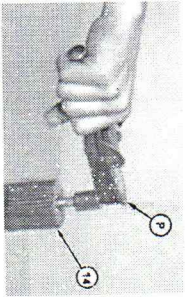


Illustration 37

g03872142

- d. Position the differential and bevel gear so that pinion shaft (14) is in a vertical position. Install a suitable bolt in pinion shaft (14). Use Tooling (P) to tighten the bolt until pinion shaft (13) turns.
- e. Measure the overall rolling torque of the differential and the pinion shaft. Record that number.
- f. Advance the adjusting ring that is next to the bevel gear while you oscillate the bevel gear to a zero backlash position. Then, back off the adjusting ring to the nearest lock position (a

- g. Advance the adjusting ring that is opposite the bevel gear while you rotate the bevel gear set. Monitor the torque that is required to rotate the pinion shaft until a torque is registered over the torque measured in Step 27e.
- h. This position is the seated position. Advance the adjusting ring and rotate the bevel gear until the overall rolling torque is 1.20 to 2.48 N·m (11 to 22 lb in) above the rolling torque achieved in Step 29b.

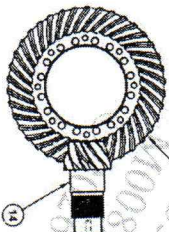


Illustration 38

g00871700

- i. Measure the backlash in three equally spaced positions around bevel gear (48). If any of the three measurements are not equal to the specified backlash of 0.36 ± 0.12 mm (0.014 ± 0.005 inch), then retract the adjusting rings or advance the adjusting rings equally to preserve the preload. Repeat this Step until the backlash at all three locations is 0.36 ± 0.12 mm (0.014 ± 0.005 inch).
- j. Check the tooth contact between the pinion shaft and the bevel gear.

Note: Tip for checking backlash is to hold pinion still while moving gear.



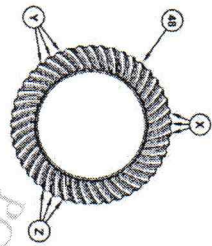


Illustration 39
(48) Bevel gear

K. To check the tooth contact between pinion shaft (14) and bevel gear (48), coat bevel gear (48) with a suitable redge compound in three locations that are 120 degrees apart, as indicated by Locations (X) (Y) and (Z).

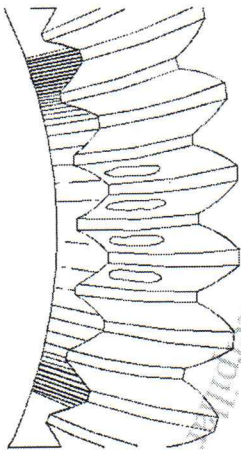


Illustration 40
Acceptable tooth contact pattern

I. Rotate the pinion shaft in both directions. The acceptable bevel gear contact pattern percentages are 60 percent from heel for convex, and 55 percent from heel for concave. Refer to Illustration 40.

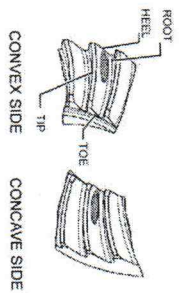


Illustration 41
Unacceptable tooth contact pattern

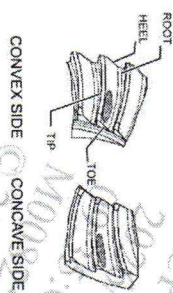


Illustration 42
Unacceptable tooth contact pattern

M. Inspect the tooth contact pattern. If the tooth contact pattern appears like the tooth contact pattern in Illustration 41, then some shims will need to be added and the tooth contact pattern will need to be rechecked. If the tooth contact pattern appears like the tooth contact pattern in Illustration 42, then some shims will need to be removed.

Note: If the shims are adjusted, repeat Step 33 through Step 37M.





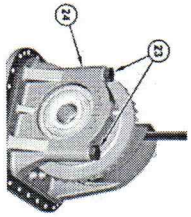


Illustration 44

38. Use Tooling (N) to tighten bolts (23) to a torque of 1800 ± 200 N·m (1328 ± 148 lb ft).

Note: After final torque of bolts (23), re-check the gear backlash. Final torque may reduce backlash and take the backlash out of spec.

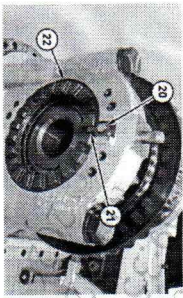


Illustration 45

- 39. Install lock (21) and bolt (20) that secure locking ring (22). Repeat for the other side.
- 40. The rolling torque for the complete system should not exceed 4 N·m (35 lb in).

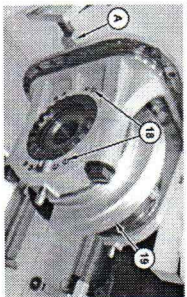


Illustration 46

Illustration used for bolt locations.

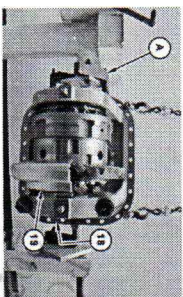


Illustration 47

41. Rotate the carrier and differential assembly by 90 degrees on Tooling (A).

42. Install guard (19) and four bolts (18) as shown in Illustration 47.

End By:

- a. Install the front or rear differential and bevel gear. Refer to Differential and Bevel Gear, Front and Rear, - Remove and Install.

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