FERRIS

Setting Up and **P**re **D**elivery **I**nspection with Shortcuts of:

WHERE ARE WE? – The Next Step

Ferris anno 2017~2018 offering:

What can we say more….

<u>Unique, exclusive, patented…sets Ferris completely aside from all others!</u>

- Highest mowing speed = Highest efficiency = Lowest Cost of Ownership
- Highest comfort = Smoother drive = Less operator fatigue
- Absorbs HAVS and Whole Body Vibrations = No limitations m/s2!
- Contour following technique = Consistent cut
- Minimizing breaks in ground contact = Maximizing traction
- Full advantage of available horsepower
- Benefits chassis by reducing shock load = Extended mower life

Increased speed

- Operators slow down to compensate for rough terrain
- When protected from the effects of rough terrain:
  - Operator takes full advantage of available horsepower
  - Operator naturally increases speed
- Result:
  - More square meters covered per hour
  - Lower operational cost
  - Means more money in your pocket

IS®PRODUCTIVE

INCREASED SPEED = INCREASED PRODUCTIVITY

Consistency of cut

- Mower deck follows the movement of the wheels (and flow of the terrain)
- Deck is connected to the moving A-arms, not the chassis
- The result is a beautiful, clean and consistent cut
- Suspension works as a pro-active anti-scalp function

IS®*REACTIVE*

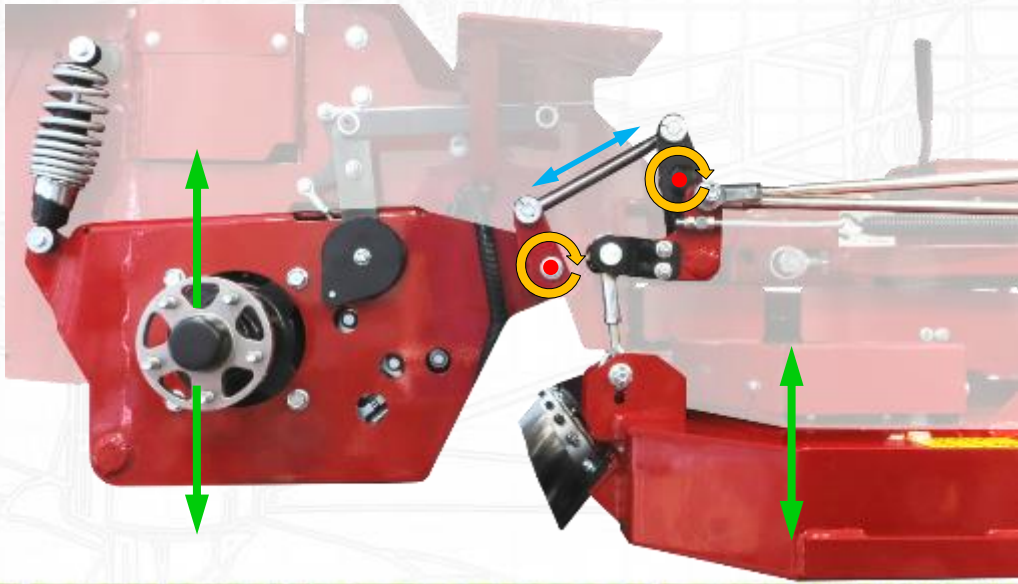
GROUND FOLLOWING AND PRO-ACTIVE ANTI SCALPING

Ground following construction

- Front suspension through single A-Arm construction
- Front wheels can move independent
- Mower deck directly connected to the A-arms
- When front wheel moves up, the respective deck corner will be lifted, following exact movement of the wheel
- When front wheel moves down, the deck hanger chain will collapse
- Deck will remain level,hanging on the remaining three deck hanger chains

Ground following construction

- Transmission cradle hosting RH and LH transmission
- Cradle moves independent from the main frame
- Mower deck is connected to a deck lift pivot
- When the transmission cradle moves up, the mower deck will be lifted upwards
- When the transmission cradle moves down, the mower deck will be lowered
- Compensates suspension movement



Extended mower life

- Suspension protects body and machine
- Suspension benefits chassis by reducing shock load
- Mower with suspension will last longer and requires fewer repairs than similar non-suspension mower
- Ferris frame rails are made of much heavier material; No rely on frame flex to keep all four wheels on the ground
- Minimizing breaks in ground contact = Maximized traction

IS®PROTECTIVE

PROTECTS BODY AND MACHINE

Maximum productivity

Experience Suspension™

Benefits of suspension technology all add up to increased productivity

By Ferris IS® suspension:

- ✓ The operator is better protected for shock loads and vibrations (Ferris ZTRs NO Limitations!)
- ✓ The operator is less tired and has less risk of physical complaints
- ✓ The operator stays focussed and allows for fewer driving errors
- ✓ The driver is able to stay seated at higher ground speeds
- ✓ The mower is protected shock loads as a result of rough terrain
- ✓ Taking full advantage of available horse power
- ✓ Higher cutting speeds can be achieved
- ✓ Maximum productivity can be achieved

IS®SMART

IS SUSPENSION = INCREASED PRODUCTIVITY

THE HAVMETER

Automated & easy to use, realtime HAVS monitoring & reports

Hand Arm Vibration Syndrome

How to **reduce the risks** and recognise the symptoms

FERRIS®

Vibration Awareness

- Focus on vibrations by European governments
- Hand/Arm vibration → Hand-Arm-Vibration Syndrome
- Whole body vibration → Problems back and neck
- Vibration exposure crucial for purchase and deployment of machines

FERRIS®

Vibration Exposure Limits

- Whole body vibration threshold → max. 1,15 m/s^2
- Whole body vibration action level → ≥ 0,5 m/s^2

- Hand-Arm vibration threshold → max. 5,0 m/s^2
- Hand-Arm vibration action level → ≥ 2,5 m/s^2

- http://www.hse.gov.uk/vibration/hav/hav.xls

Vibration Exposure Limits

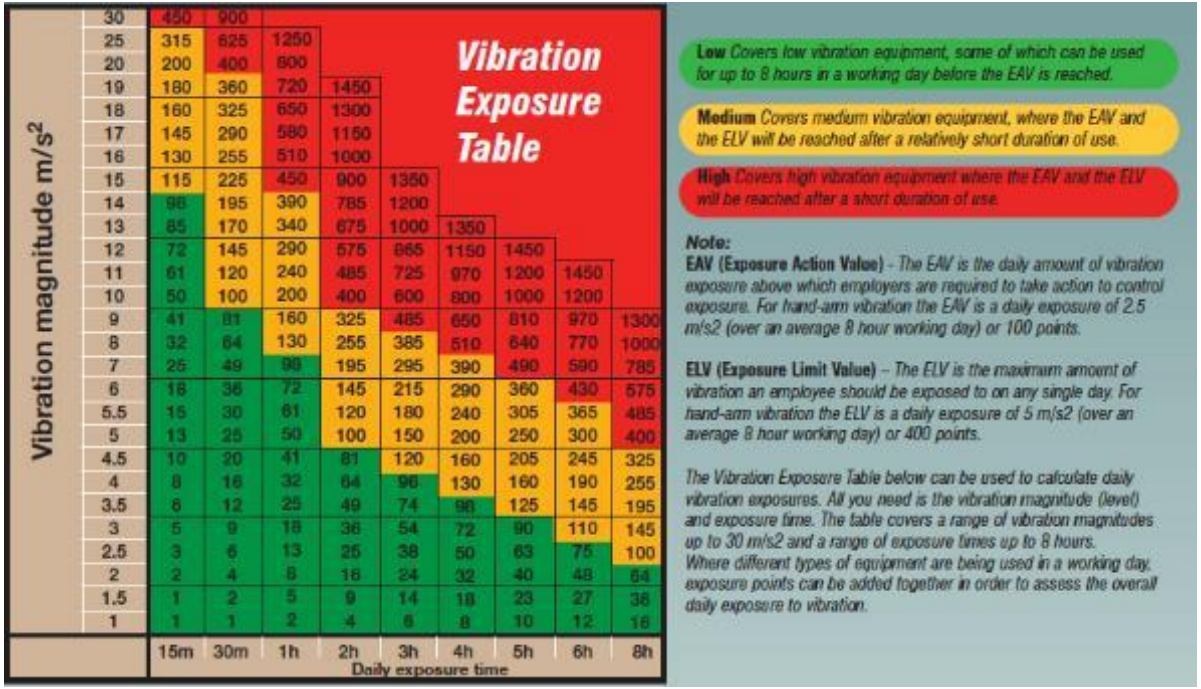
- Whole body vibration

Vibration limit in m/s^2	8 Hours	4 Hours	2 Hours	1 Hour	< ½ Hour	< ¼ Hour
< 0,25 m/s^2						
0,25 m/s^2 - < 0,5 m/s^2						
0,5 m/s^2 - < 0,7 m/s^2						
0,7 m/s^2 - < 1,0 m/s^2						
1,0 m/s^2 - < 1,4 m/s^2						
1,4 m/s^2 - < 2,8 m/s^2						
> 2,8 m/s^2						

FERRIS®

Vibration Exposure Limits

- Hand/Arm vibration
- Maximum of 100 points per 8 hours



FERRIS®

Shocks and vibration reduction

Experience Suspension™

Model	HAV	Permissible Working Limit	WBV	Permissible Working Limit
IS600Z/44	<2.5 m/s²	> 8 hrs	<0.5 m/s²	> 8 hrs
IS700Z/52	<2.5 m/s²	> 8 hrs	<0.5 m/s²	> 8 hrs
IS2100Z/52	<2.5 m/s²	> 8 hrs	<0.5 m/s²	> 8 hrs
IS2100Z/61	<2.5 m/s²	> 8 hrs	<0.5 m/s²	> 8 hrs
IS2600Z/52	<2.5 m/s²	> 8 hrs	<0.5 m/s²	> 8 hrs
IS2600Z/61	<2.5 m/s²	> 8 hrs	<0.5 m/s²	> 8 hrs
IS5100Z/61	<2.5 m/s²	> 8 hrs	<0.5 m/s²	> 8 hrs
IS5100Z/72	<2.5 m/s²	> 8 hrs	<0.5 m/s²	> 8 hrs
SRS-Z1	<2.5 m/s²	> 8 hrs	<0.5 m/s²	> 8 hrs
FW25/36	<2.5 m/s²	> 8 hrs	n.a.	> 8 hrs
FW35/48	<2.5 m/s²	> 8 hrs	n.a.	> 8 hrs
FW35/52	<2.5 m/s²	> 8 hrs	n.a.	> 8 hrs

 # 2-3e
Unique
Selling Points
- Anti Vibration -

IS® PRODUCTIVE

ABSORBS SHOCKS AND VIBRATION

WHERE ARE WE? – The Next Step

Ferris anno 2017~2018 offering:

What can we say more….

<u>Becoming a real alternative for Diesel (banning of polluting Diesels in cities)</u>

- Reduced Fuel Consumption = Between 9% (full load) and 25% savings
- Improved Engine Performance = Governing Control & Load Acceptance
- Increased Power = Higher Torque = Optimum bottom power at full load
- Improved Starting = Cold & hot restart = Choke less starting
- Alcohol & Stale Fuel Resistance, Altitude Compensation
- Easy to Use Diagnostics and Service

Vanguard™ EFI engines

Why EFI over carburated engine?

- Reduced fuel consumption not the only benefit
- Speed sensing → No drop in engine rpm's when engaging deck
- Pressurized fuel for injectors → vaporized fuel burns better
- No choke → effortless starting regardless of engine temperature
- Altitude correction → automatic fuel/air mixture correction
- Better resistant to stale fuel → less oxygen in fuel delivery system

"Hydrocarbons react with oxygen and change chemical composition of fuel which leads to gum and varnish deposits in fuel system"

Vanguard™ EFI engines

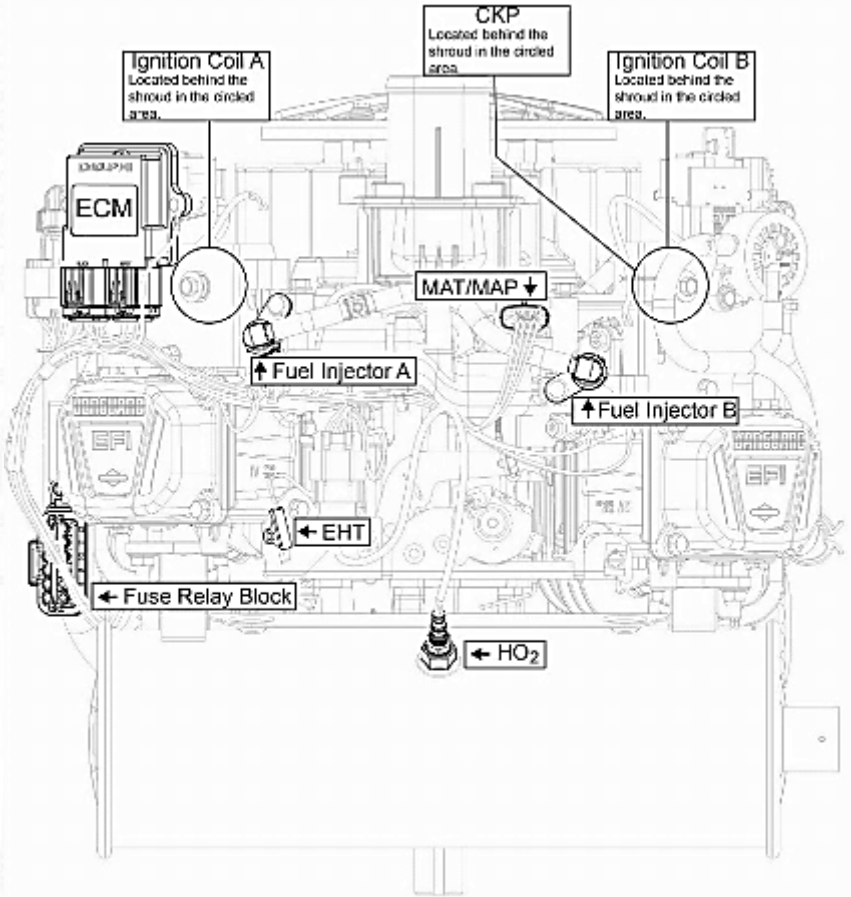
EFI system components

- Delphi MT05 system, originally developed for motor cycles
- Delphi sensors and components
- Fuel injection – Fuel application at optimum timing
- Completely waterproof system, marine grade seals
- 39 PSI (2 Bar) fuel pump to pressurize injectors
- Closed loop system – Heated Oxygen Sensor – Maximum fuel economy
- Variable fuel injection - RPM
- Variable ignition timing - LOAD

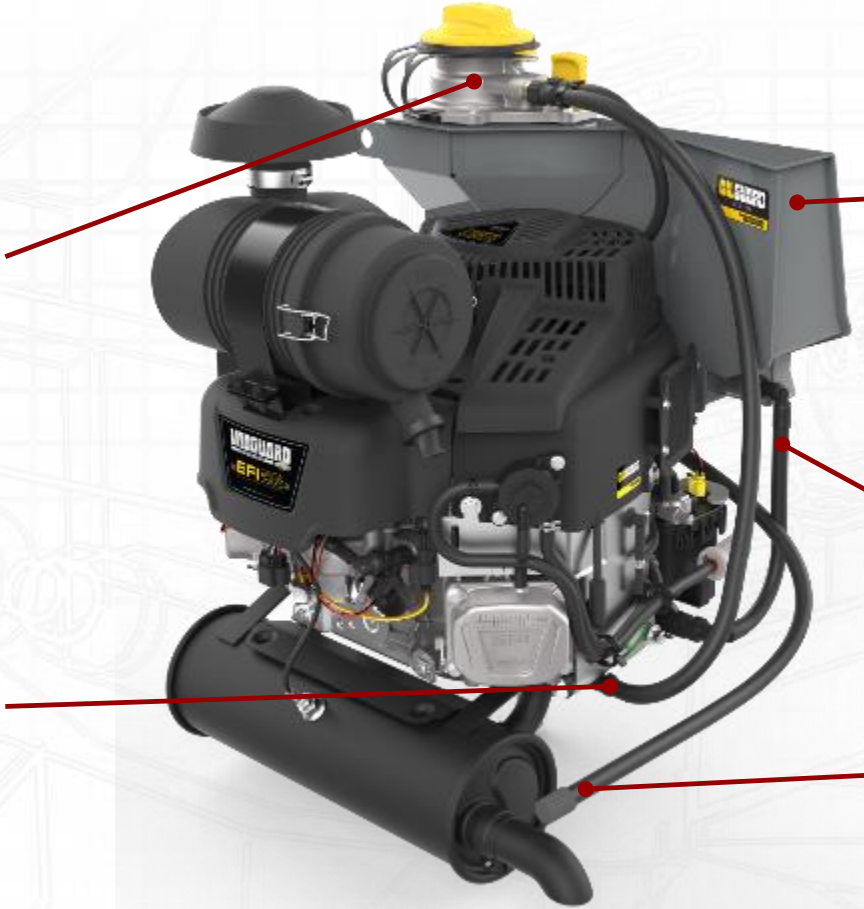
Vanguard™ EFI engines

EFI system components

- ECM (Electronic Control Module)
- MAT (Manifold Air Temperature)
- MAP (Manifold Absolute Pressure)
- CKP (Crankshaft Position)
- EHT (Engine Head Temperature)
- HO_2 (Heated Oxygen sensor)
- Fuel Injectors



Vanguard Oil Guard System



Oil flow through the filter to the base of the tank

Aluminium oil tank holding 4,7 liters of oil. Tank and oil volume help dispersing heat

Oil return line by gravity feed

Second oil pump feeds the oil from engine base to the oil tank

Oil can be drained by remote drain valve

WHERE ARE WE? – The Next Step

Ferris anno 2017~2018 offering:

What can we say more….

We will offer you the **Oil Guard System (dry sump)** for free on the IS2100Z & IS3200Z to reinforce the Sales Power of the Vanguard EFI-engines even more (the only Turf Engine that extends oil change to 500 hours).

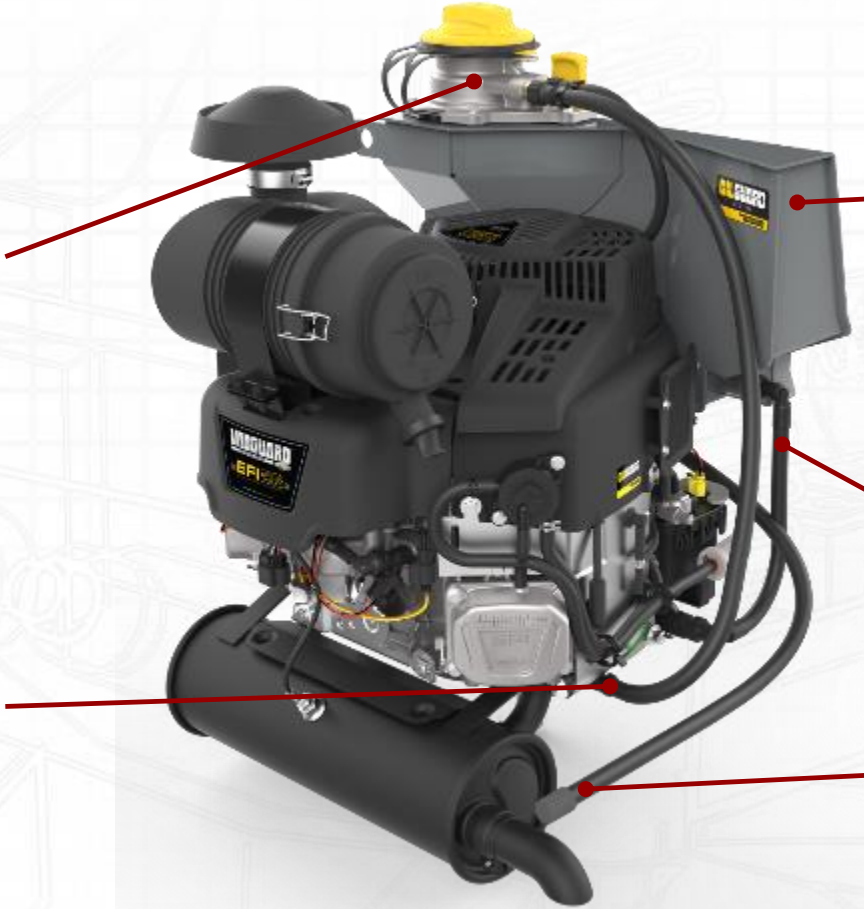
- From 100 hours to a 500 hours oil change interval (80% savings)
- From 2,4 to 4,7 liter system means half the usual contamination in the oil
- Almost twice as large oil filter surface with much finer filtration ability
- Capable of filtering nearly 90% of 20 micron particles from the oil (instead of 50%)
- External tank providing cooling effect to engine oil, helping the engine to run cooler to last longer.
- Consistent bearing lubrication during off angle operation.
- Faster oil changes without need of tools: oil can be drained by the drain valve and filter comes out through the top opening of the reservoir

Vanguard Oil Guard System

Technical aspects

- Basis is “dry-sump” engine with external oil reservoir
- Main oil pump pressurizes crucial engine parts
- Second oil pump exchanges oil between engine and the external reservoir
- Oil is pumped into the tank through the filter and circulates down in the tank
- External reservoir out of aluminium together with larger oil volume work together to disperse heat
- Resulting in cooler oil temperature and slower thermal breakdown process
- Oil flows back from tank base into engine by gravity feed
- Check valve controls oil level inside the engine

Vanguard Oil Guard System



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Vanguard Oil Guard System

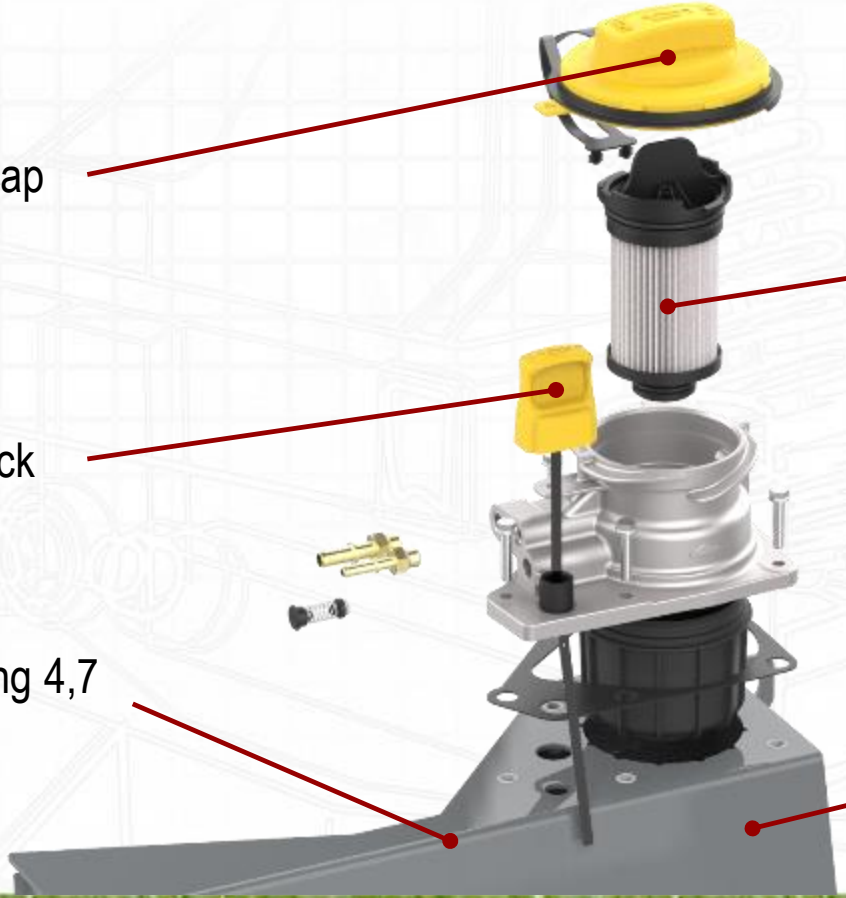
¼ Turn reservoir cap

Automotive style oil filter

Oil reservoir dip-stick

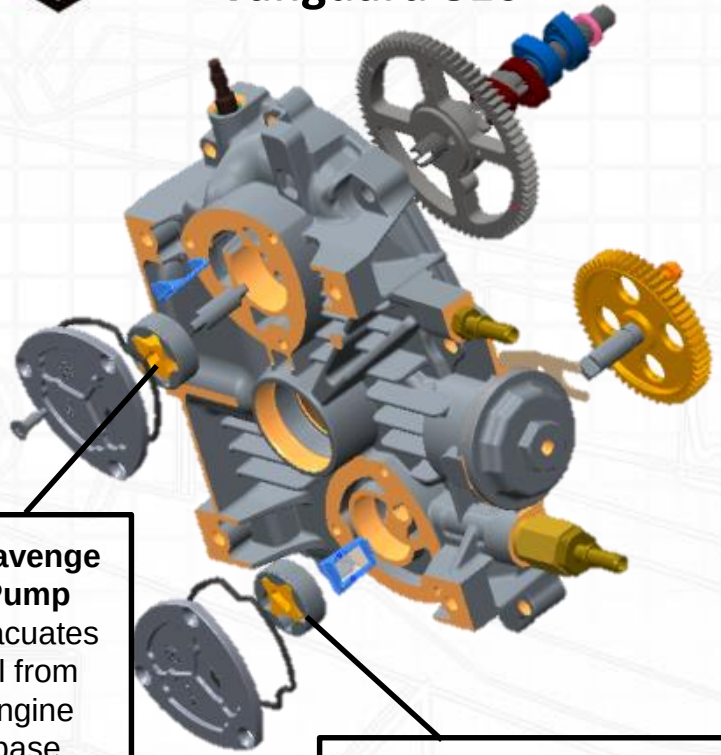
Oil reservoir holding 4,7 liters of engine oil

Robust 3.2mm thick aluminium reservoir material



Vanguard Oil Guard System

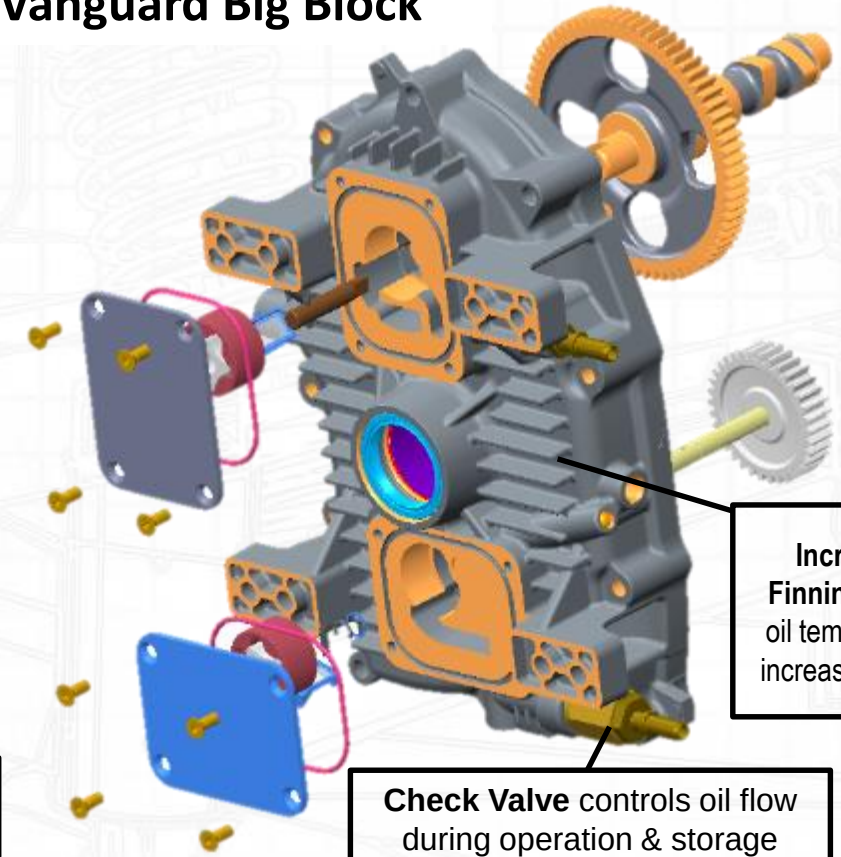
Vanguard 810



Scavenge Pump evacuates oil from engine base

Supply Pump lubricates main bearings just like today's design

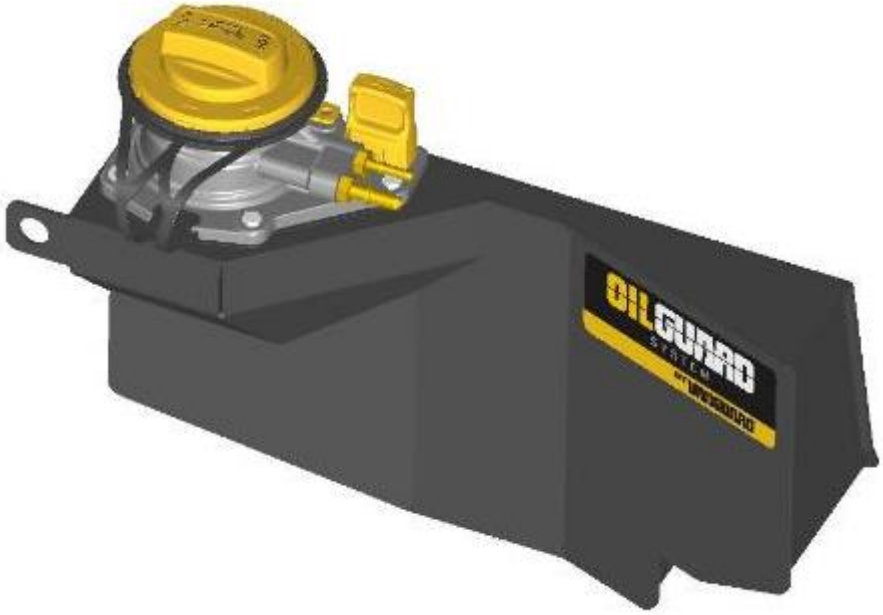
Vanguard Big Block



Increased Finning lowers oil temperature, increasing oil life

Check Valve controls oil flow during operation & storage

Vanguard Oil Guard System



Unique aluminium tank design around Ferris applications

Vanguard Oil Guard System

Your advantages

- From 100 hours to a 500 hours oil change interval
- From 2,4 to 4,7 liter system means half the usual contamination in the oil
- Almost twice as large oil filter surface with much finer filtration ability
- Capable of filtering nearly 90% of 20 micron particles from the oil (instead of 50%)
- External tank providing cooling effect to engine oil, helping the engine to run cooler to last longer
- Faster oil changes without need of tools: oil can be drained by the drain valve and filter comes out through the top opening of the reservoir
- Factory filled with 15W50 synthetic engine oil
- 500 Hours oil change can still be achieved with conventional oil

Vanguard Oil Guard System

Further benefits

- Consistent engine lubrication during off-angle operation
- Up to 45 degrees of angle
- Toolless and mess free oil change procedure
- Saving 4x oil and filter changes per each 500 hours

  Usually: 5x filters and 12 liters of oil per 500 hours

  With Oil Guard: 1x filter and 4,7 liters of oil per 500 hours
- Less down time for oil change: extended interval and quicker oil change
- 3-Year commercial engine warranty
- Exclusively available on 2017 Ferris mowers
- Available on IS2100Z and IS3200Z EFI engines

Vanguard Oil Guard System

The Oil Guard System, Exclusively available on Ferris mowers

Vanguard Oil Guard System

Large fill opening, reducing the risk of spilling oil.

Vanguard Oil Guard System

Draining the oil is mess-free and tool-less with a sealed drain hose.

WHERE ARE WE? – The Next Step

Ferris anno 2017~2018 offering:

What can we say more….

<u>Go for the cleanest Diesel option.</u>

All IS2600Z's are Euro Stage 5 ready, so you might be the only one in your market. Use this unique situation to your benefits and spread it out. All 2017/18 IS2600Z will carry the Stage 5 Ready decal, but also your stock machines are compliant. Please quote us for how many stock machines you need a set and we will provide them free of charge. From 1/1/2019 all EU imported machines have to comply with EURO 5!

Diesel Engine Problematics

- Latest generation diesel engines
  - Tier4i effective 1st January 2011 till January 1st 2013 (interim period)
  - Tier4 Final “non-road” diesel regulations since January 1st 2014
  - <18 kW Slightly less stringent
  - Engine manufacturers capable to deliver compliant engines <18 kW without DPF, catalyst or EGR

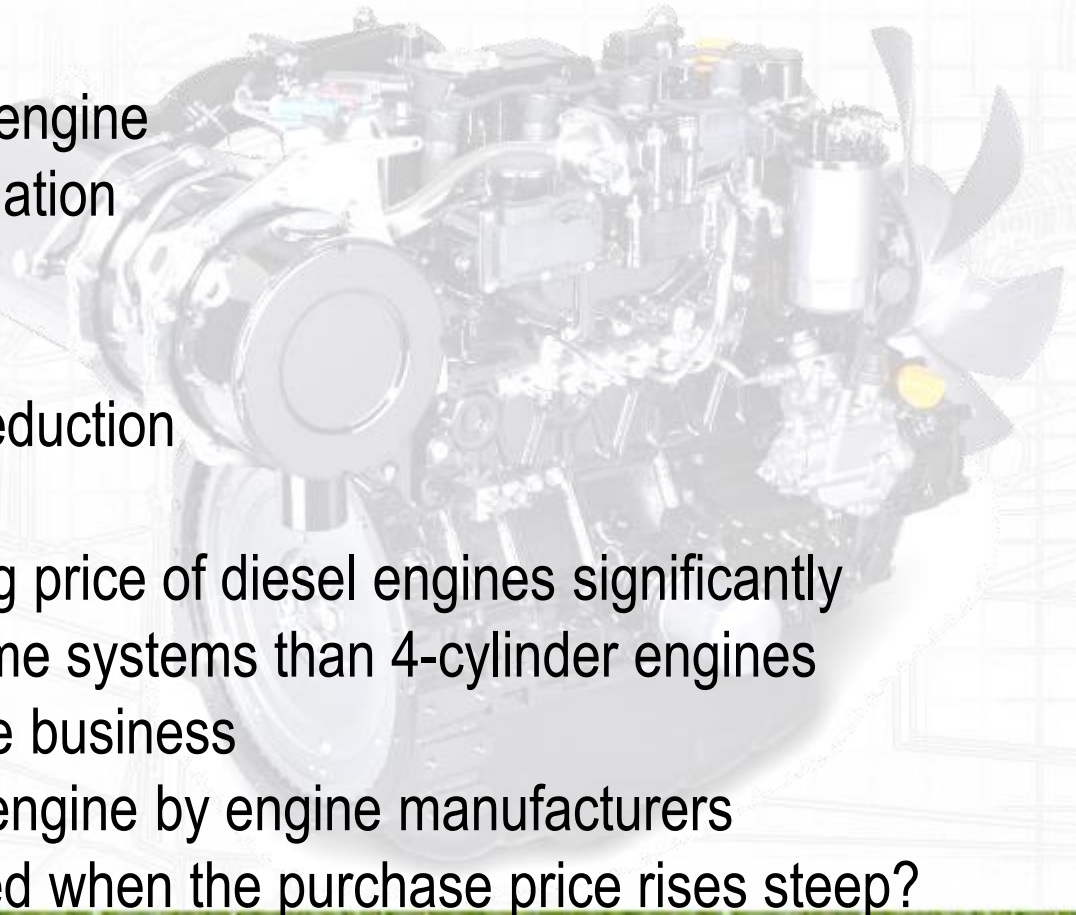
Diesel Engine Problematics

- 1963 “Clean air act”: Look into stationary emissions
- Diesel engines considered to be cleaner than gasoline engines
- Technology has changed with the come of catalyst for petrol engines
- 1970 Regulation of 6 criteria pollutants CO, SOx, NOx, Hydrocarbons, Ozone and Particulate Matter
- VW fiasco strengthened health and pollution concerns that had already began to erode diesel engine’s popularity
- How will real-world emission tests be conducted for diesel engines?
- More stringent requirements may escalate after-treatment costs with selective catalytic reduction and diesel exhaust fluid
- Even on small cost-sensitive engines and vehicles

Diesel Engine Problematics

- 1st of January 2019 effective date Euro Stage 5 non-road emissions
- 8-19 kW → 6.60 g/kW CO
  7.50 g/kW HC + NOx
  0.40 g/kW PM (Particulate Matter)
  No g/kWh restriction for PN (Particle Number limit)
- 19-37 kW → 5.00 g/kW CO
  4.70 g/kW HC + NOx
  0.015 g/kW PM (Particulate Matter)
  $1x10^{12}$ g/kWh PN (Particle Number limit)
- >19 kW, 25.47HP requires after treatment systems to comply

Diesel Engine Problematics



- CRD → Common Rail Diesel engine
- EGR → Exhaust Gas Recirculation
- DPF → Diesel Particle Filter
- CAT → Catalyst
- SCR → Selective Catalytic Reduction
- DEF → Diesel Exhaust Fluid
- After-treatment systems raising price of diesel engines significantly
- 3-Cylinder engines require same systems than 4-cylinder engines
- €/HP will hurt 3-cylinder engine business
- No focus on 3-cylinder diesel engine by engine manufacturers
- Will end-users still be interested when the purchase price rises steep?

IS 2600Z

- IS2600Z with Yanmar 3TNM74F diesel engine
- TIER4F emission compliance
- Identical to Euro stage 5 emission regulations
- Competitors using TIER3A in limited quantities
- Euro stage 5 becomes effective January 1st 2019
- Utilize “clean emissions” message
- Diesel engine restrictions within EU Cities
- Important message to Municipalities, city councils and government agencies

STAGE 5 READY

Machine Setup from Crate

Logical order:

1. Remove crating
2. Remove separately packed parts
3. Cut retaining straps
4. Remove protective sheets
5. Remove seat retainer
6. Charge battery
7. Install seat
8. Install ROPS frame
9. Install drive control levers
10. Check fluid levels
11. Check fuel delivery
12. Close transmission bypass
13. Purge fuel system
14. Drive machine off base pallet
15. Adjust mower deck level
16. Check torque critical parts
17. Adjust drive speed
18. Adjust veering
19. Adjust control levers

Machine Setup from Crate

Remove crating

- Possible to use crowbar
- Easier to use woodsaw
  - Cutting vertical posts
- Pay attention!
  - Side of mower deck
  - Tyres
- Remove plastic cover

Machine Setup from Crate

Remove separately boxed parts

- ROPS frame
- Seat
- Box containing control levers and hardware

Machine Setup from Crate

Cut retaining straps

- Front side
- Rear side

Machine Setup from Crate

Remove hood protection

- Loosen retaining nuts
- Unlatch hood
- Remove protection sheet
- Re-install washer and nut after setup procedure

Machine Setup from Crate

Remove seat retainer

- Loosen nut
- Remove rubber stud
- Re-install after completion setup procedure

Machine Setup from Crate

Battery maintenance

- Charge battery for at least 1 hour
- Machine could have been in storage for a longer period of time (Ferris, distributor, dealer)

Machine Setup from Crate

Install seat

- Take seat out of cardboard protection layer
- Use 4 (four) nuts from hardware bag to retain seat
- Install seat switch connector (if applicable)

Machine Setup from Crate

Install ROPS posts

- Position both LH and RH posts in designated frame pockets
- Put the bolts through frame and ROPS posts and install nuts
- Do not thighten yet!

Machine Setup from Crate

Install ROPS cross bar

- Position ROPS cross bar on both LH and RH posts
- Unfolded position is easiest
- Put the pivot bolts through including ROPS-pin retaining strap shackle
- Install nuts but don’t tighten yet!

Machine Setup from Crate

Elevate ROPS cross bar

- Fold cross bar upwards and push forward (takes some effort)
- Use guiding pin when neccessary
- Install ROPS cross bar pins through designated holes
- Install R-clips
- Tighten all ROPS hardware

Machine Setup from Crate

ROPS safety decals

- Replace ANSI safety decals with CE decals
- Either remove existing decals or place CE decals over ANSI decals

Machine Setup from Crate

ROPS safety decals

- CE safety decals are supplied with machine
- Located inside literature-pack
- Instal as shown in picture

Machine Setup from Crate

Install drive control levers

- Position levers with control rod forwards
- Adjust to operator height preference (usually lowest position)

Machine Setup from Crate

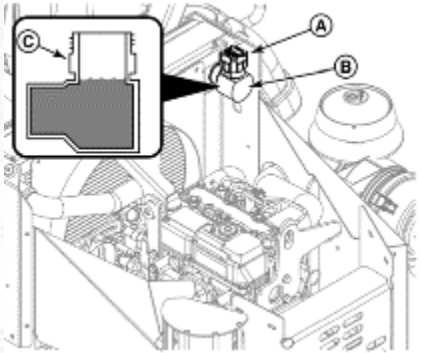
Check engine oil level

- Dip-stick positioned at RH rear of engine
- Check oil level and add oil if neccessary
- DO NOT OVERFILL!
- Kawasaki, Briggs&Stratton, Vanguard, Yanmar: SAE30
- Caterpillar 10-W30
- Oil Guard: 15-W50 synthetic

Machine Setup from Crate

Check engine coolant level

- Open engine cooler screw lid and check fluid level
- Fluid level should be visible till top of fill port's neck



Machine Setup from Crate

Check transmission oil level

- Oil should just be visible at bottom of expansion reservoirs
- FILL TILL “FULL COLD” MARK!
- Overfilling will damage transaxles
- Oil has no room to expand

Machine Setup from Crate

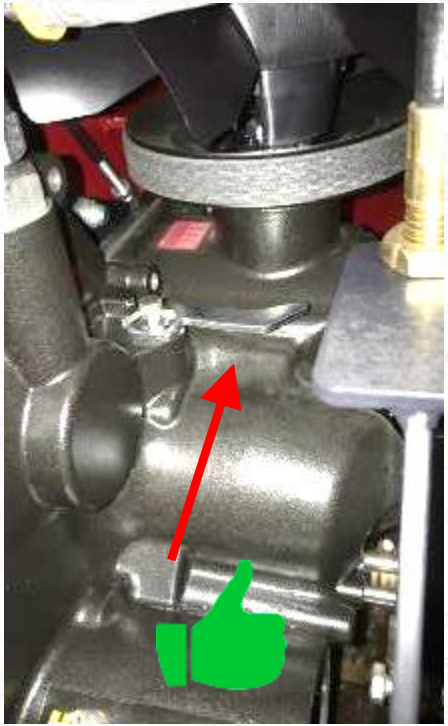
Fuel tank valves

- Check position of fuel tank valves
- In-line with fuel line is “opened”
- Perpendicular with fuel line is “closed”
- Both fuel lines must be opened!

Machine Setup from Crate

Check transmission dump valves

- Close dump valves before operation
- Dump valves require to be pushed forwards to allow transmission to be operational
- Unit can be pushed/pulled when bypass opened
- Move slowly!



Machine Setup from Crate

Drive machine off crate base

- Install battery
- Purge fuel system
  - Put levers in neutral
  - Apply parking brake
  - Switch ignition to run
- Fuel lift pump will engage
- Leave ignition on until return fuel is visible through RH tank opening

Machine Setup from Crate

Drive machine off crate base

- Put throttle at half speed
- Preheat engine
- Start engine
- Keep it running until engine runs normal (all cylinders)
- Reduce throttle to ¼ speed and let the engine warm up a bit
- Drive machine off the base pallet
- **Watch out for STAPLES!** (and flat tyres)

Machine Setup from Crate

Adjust mower deck height

- Check and adjust correct tyre pressure (1.74 Bar front, 1.04 Bar rear)
- Park on flat and level surface
- Set the mower deck adjustment to 2¾“ (depending on spacer height)

Machine Setup from Crate

Blade position in deck housing

- Mower blade is recessed ½” (12,7mm) higher than deck leading edge
- Easiest deck adjustment method is to use gauge spacers
- Deck pitch: Rear of mower deck requires to be adjusted ¼” (6,35mm) higher than front

Machine Setup from Crate

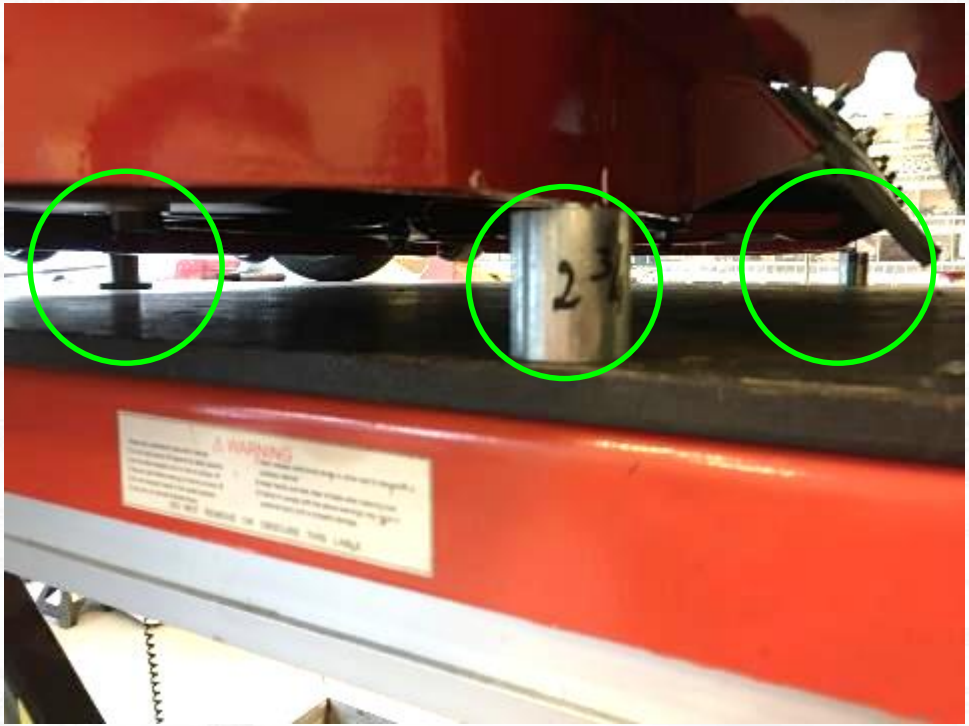
Experience Suspension™

Adjust mower deck height

- Place spacers in triangle formation underneath the rear corners and deck nose

- Front spacer: 2¾“-12,7mm
- Rear Spacer: 2¾“-12,7mm + 6,35mm (Rear requires higher setting for discharge)

- Front spacer: 57mm
- Rear Spacers: 64mm



Machine Setup from Crate

Adjust mower deck height

- Lock height adjustment pedal with bungy strap (to overcome lift assist springs)
- Pedal stop needs to rest against height-of-cut pin

Machine Setup from Crate

Adjust mower deck height

- Loosen lock nuts
- Loosen deck lift adjusters
- All four points require to be completely slack

- Tighten all four lift adjusters finger tight
- Tighten all four points ½ turn more

Machine Setup from Crate

Adjust mower deck height

- Lock all four height adjusters
- Secoure the top of deck lift adjuster with spanner
- Tighten the bottom lock nut

Machine Setup from Crate

Check taper-lock nut torque

- Pulley at angle-gear
- Torque to 10Nm

Machine Setup from Crate

Check taper-lock torque

- Pulley at stub shaft
- Torque to 10Nm

Machine Setup from Crate

Adjust drive control lever spacing

- Loosen the jam nuts of the adjustment bolts

Machine Setup from Crate

Adjust drive control lever spacing

- Center the drive control levers and keep approximately 1” spacing between the levers
- Tighten the jam nuts

Machine Setup from Crate

Drive control lever adjsutment

- Bring machine to operating temperature
- Check the maximum speed by GPS
- SRSZ1: 12,8 km/h
- IS600Z:14,5 km/h
- IS700Z: 16 km/h
- IS2100Z/IS2600Z: 18 km/h
- IS3200Z/IS5100Z: 20 km/h

Machine Setup from Crate

Adjust maximum drive speed

- Too slow: Turn front adjustment screws in
- Too fast: Turn front adjustments screws out

Machine Setup from Crate

Adjust transmission tracking

- After ground speed adjustment unit will veer to left or right
- When unit veers left: adjust right control lever back
- When unit veers right: adjust left control lever back
- Make sure not to change maximum drive speed setting which we have adjusted previously

Machine Setup from Crate

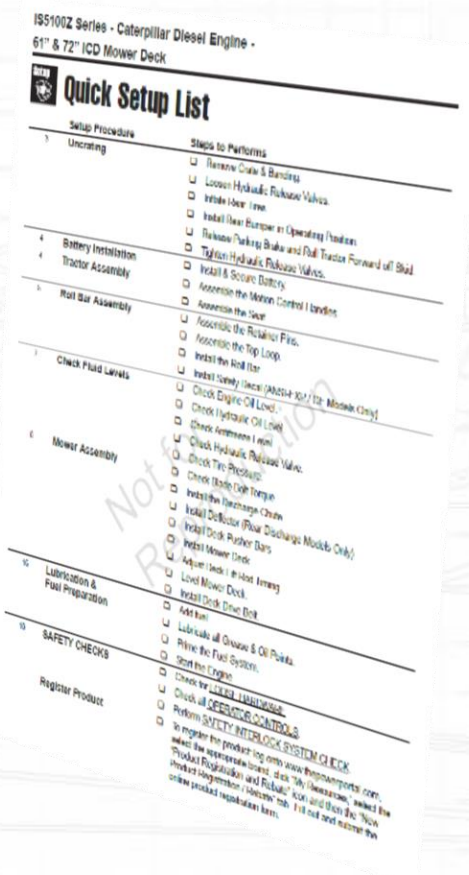
Adjust drive control lever alignment

- Stop engine
- Judge operator length / arm length
- Bring drive control levers completely forward and adjust to operator preference
- Make sure drive control levers are aligned in maximum forward position

Pre Delivery Inspection

Pre delivery inspection (PDI)

- Quick setup check list
- Uncrating
- Machine assembly
- Fluid levels
- Mower adjustments
- Lubrication
- Safety checks



IS5100Z Series - Caterpillar Diesel Engine -
61" & 72" ICD Mower Deck

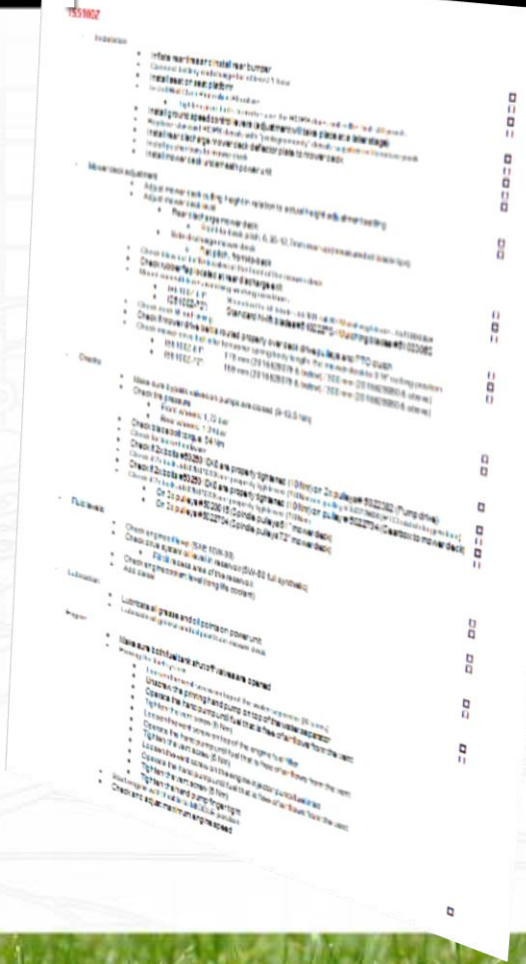
Quick Setup List

Setup Procedure	Steps to Performs
1 Uncrating	Remove Crate & Bandings Loosen Hydraulic Release Valves Inflate Rear Tires Install Rear Bumper in Operating Position Release Parking Brake and Pull Tractor Forward off Skid Tighten Hydraulic Release Valves
4 Battery Installation 4 Tractor Assembly	Install & Secure Battery Assemble the Motion Control Handles
5 Roll Bar Assembly	Assemble the Seat Assemble the Rotation Pins Assemble the Top Loop Install the Roll Bar Install Safety Decal (AM514107 / 128 Models Only)
7 Check Fluid Levels	Check Engine Oil Level Check Hydraulic Oil Level Check Antifreeze Level Check Hydraulic Release Valve Check Tire Pressure Check Blade Bolt Torque
8 Mower Assembly	Install the Discharge Chute Install Deflector (Rear Discharge Models Only) Install Deck Rubber Bars Install Mower Deck Adjust Deck Pitch and Level Level Mower Deck Install Deck Drive Belt
10 Lubrication & Fuel Preparation	Add Fuel Lubricate all Grease & Oil Points Prime the Fuel System
10 SAFETY CHECKS	Start the Engine Check for LOOSE HARDWARE Check all OPERATOR CONTROLS Perform SAFETY INTERLOCK SYSTEM CHECK
Register Product	To register the product log onto www.ferrismowerparts.com, select the appropriate language, click "My Resources", select the "Product Registration and Rebate" icon and then the "New product registration / Update" tab. Fill out and submit the online product registration form.

Extended Pre Delivery Inspection

Pre delivery inspection (PDI)

- Extended pre delivery inspection
- Many occasions distributor does not setup machine for dealer
- Avoid important missed or poorly performed steps
- Extended check list with all recommended steps for least chance for field issues



Kawasaki fuel recommendation

Recommended fuel Kawasaki engines

- Octane rating of minimum 87
- Ethanol (Ethyl or Grain alcohol)
  - Up to 10% ethanol by volume
- MTBE (Methyl Tertiary Butyl Ether)
  - Up to 15% MTBE by volume
- Methanol (Methyl or Wood alcohol)
  - Up to 5% by volume, as long as it also contains cosolvents and corrosion inhibitors to protect the fuel system

Briggs & Stratton fuel recommendation

Recommended fuel Briggs & Stratton engines

- Clean, fresh, unleaded gasoline.
- Minimum of 87 octane/87 AKI (91 RON)
- Gasoline with up to 10% ethanol (gasohol) is acceptable

NOTICE: Do not use unapproved gasolines, such as E15 and E85. Do not mix oil in gasoline or modify the engine to run on alternate fuels. Use of unapproved fuels will cause damage to engine components, which will not be covered under warranty.

Yanmar fuel recommendation

Recommended fuel Yanmar engines

- Diesel fuel specification: EN590:96 or BS2868-A1 or BS2868-A2 or ISO8217DMX
- Fuel cetane number equal to or higher than 45
- Sulfur content must not exceed 0,5% (less than 0,05% preferred)
- Never mix with kerosene, used engine oil or residuel fuels
- Don’t use poor quality fuel
- Fuel additives are not recommended

Yanmar fuel recommendation

- Ash content not to exceed 0,01% by volume
- Carbon residue content not to exceed 0,35% by volume (less than 0,1% is preferred)
- Total aromatics content should not exceed 35% by volume (less than 30% is preferred)
- PAH (polycyclic aromatic hydrocarbons) content shoul be below 10% by volume
- Metal content of Na, Mg, Si and Al should be equal to or lower than 1 mass ppm

Yanmar fuel recommendation

- Lubricity: Wear mark of WS1,4 should be max. 0,018 in. (460µm) at HFRR test
- Bio-diesel:
  - Up to B7 concentrations can be used without special preparations (7% dilution of biodiesel by volume)
  - From B8 up to B20:
    - Service intervals should be halved
    - Parts need to be replaced before using B8-B20

Yanmar fuel recommendation

■ KIT parts list for B 20 (all TNV engines)

		KIT-V3700GS-BI 3TNM74F, 3TNV74F, 80F D19746-59250	KIT-V384BGS-BI 3TNV88F D29283-59280
Fuel oil tank - - Fuel oil tank	No.	(1)	(1)
	Length	2000	2000
	Part No.	129946-59050	129946-59060
	Part name	FO-T CMP	FO-T CMP
	Number	2	2
Fuel feed pump - Fuel oil filter	No.	(3)	(4)
	Length	450	1000
	Part No.	119546-59020	129946-59040
	Part name	FO-T CMP	FO-T CMP
	Number	1	1
Fuel oil filter - Fuel injection pump	No.	(6)	(5)
	Length	270	220
	Part No.	119546-59200	129236-59060
	Part name	FO-T CMP	FO-T CMP
	Number	1	1
Fuel injection pump - Fuel oil filter	No.	(11)	(7)
	Length	450	300
	Part No.	119546-59220	129236-59010
	Part name	FO-T CMP	FO-T CMP
	Number	1	1
Cap, fuel injection nozzle	Part No.	No need	119593-59581 124050-77680
	Part name		CAP CLIP
	Number		1 1
Fuel injection nozzle -Fuel injection nozzle	No.	No need	(13)
	Length		115
	Part No.		129486-59581
	Part name		FO-T CMP
	Number		2
Fuel injection nozzle - Fuel injection pump	No.	(16)	(17)
	Length	150	Formed pipe
	Part No.	119546-59030	129636-59561
	Part name	FO-T CMP	FO-T CMP
	Number	1	1
Fuel oil filter		Need to change only O-ring. P44: 24316-000440 --> A	No need (Because of cartridge type)
Water separator		Need to change only O-ring. P44: 24316-000440 --> B	Need to change only O-ring. G75: 24326-000750 --> C P16: 24316-000160 --> D P7 : 24316-000070 --> E G55: 24326-000650 --> C (Need only for TAIYO-GIKEN)

	KIT-M368GS-FP
	D19125-53100
Fuel feed pump	Electric feed pump: 119925-52102 Cover assy, feed pump: 129650-52000

Caterpillar fuel recommendation

Recommended fuel Caterpillar engines

- Caterpillar specification for distillate diesel fuels are recommended (No. 1-D or No. 2-D in “ASTM D975)
- General purpose diesel available at automotive gas station
- Bio-diesel:
  - Up to B20 (20% dilution of biodiesel with standard diesel)
  - B5-B20 blends should meet most current version of ASTM D6751 or EN14214

Importance of fuel quality

Fuel quality is of high importance

- Modern diesel engines developed from older generations to satisfy emission requirements
- Higher outputs paired with lower fuel consumption and lower air pollution changed combustion and injection systems
- Sulphur content of fuel has been lowered and number of orfices in injector tips increased. Smaller tip, higher pressure.
- Due to higher pressure, clearances between moving parts had to be reduced

Importance of fuel quality

Fuel quality is of high importance

- Due to smaller clearances and higher tolerances, this placed demand on the fuel: **CLEANLINESS**
- Engine failures occur on modern diesel engines which can directly be blamed to quality of fuel
- Poor lubricity and particle contamination lead to injector failure, poor combustion and subsequent damage to the engine
- Injector needle gets “stuck” and stays opened: HOSING
- Excessive heat built-up in cylinder wall and collapses

Engine oils

Recommended engine oils

- Kawasaki: SAE30 engine oil, SJ or higher
- Briggs & Stratton/Vanguard: SAE30 engine oil, SF, SG, SH, SJ or higher
- Vanguard **Oil Guard**: 15W50 full synthetic, SF, SG, SH, SJ or higher
- Yanmar 3TNM74F: SAE30, CD or higher
- Caterpillar: SAE 10W-30, CI4, CH4, CG4, CF4, CF, SL or higher

Critical torques

Part	Models	Torque (Nm)
Wheel hub castellated nut	Evolution, IS1500Z, IS2000Z, IS2500Z, IS4500Z, IS5100Z	163-190 Nm
Wheel hub castellated nut	ZT-3100, ZT-3400, ZT-4400	325-353 Nm
Wheel hub castellated nut	ZT-5400 transmission	373-406 Nm
PTO Clutch bolt	All models except IS5100Z	88 Nm
PTO Clutch bolt	IS5100Z	163 Nm
Wheel nuts	All Models	95 Nm
Blade bolts	All Models	95 Nm
Taper-Lock bolts	All Models	10 Nm

Warner CMS-200 PTO Clutch

Maintenance free

Most common problem when clutch won't work:

- Clutch coil resistance (1.74 - 1.93Ω)
  - Usually coil works or doesn't (short circuited of broken coil wire)
- Too low voltage to clutch
  - No clutch engagement or loss of clutch torque (bad battery)
- Noisy
  - Failed bearing

Warner GT300 PTO Clutch (IS5100Z)

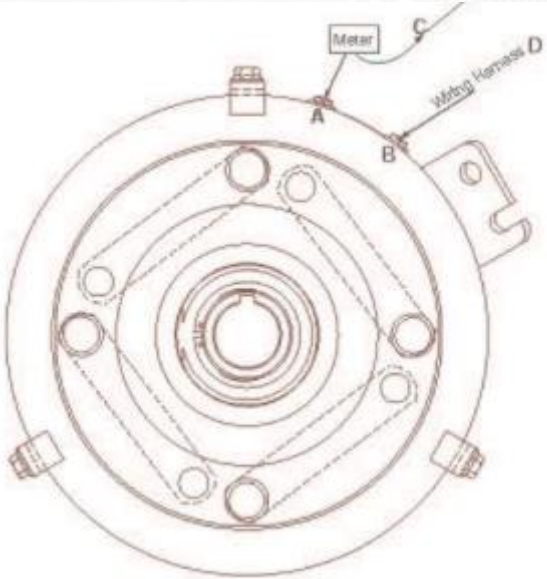
Air gap importance

- Clutch armature (contact surface) will inventionally wear during operation
- Causing clutch to engage “late”
- Loosing torque transfer (slipping armature)

Warner GT300 PTO Clutch (IS5100Z)

How to determine if clutch is still in good condition?

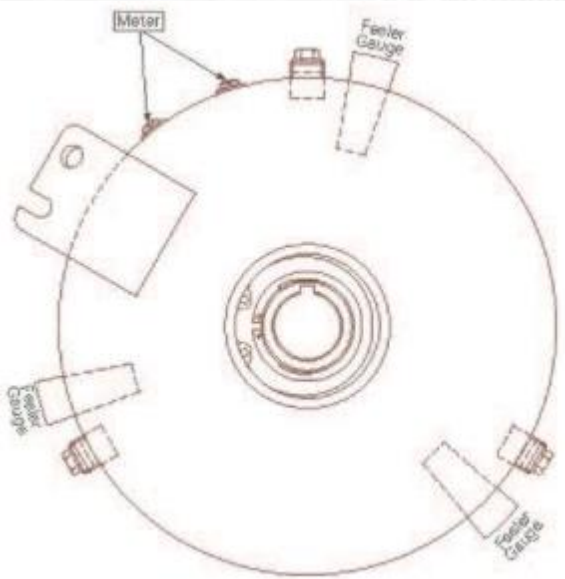
- Magnetic coil fields
  - Disconnect clutch wires
  - Select Ohms (Ω) on meter
  - Meter should read between 1.82Ω and 2.03Ω
- Clutch draw at 12 Volts
  - Select Amps (A) on meter (clamp type)
  - Engage clutch
  - Measure clutch draw (6.21 A)
  - Below 6 A, problem would be in the electrical system



Warner GT300 PTO Clutch (IS5100Z)

Air gap adjustment procedure

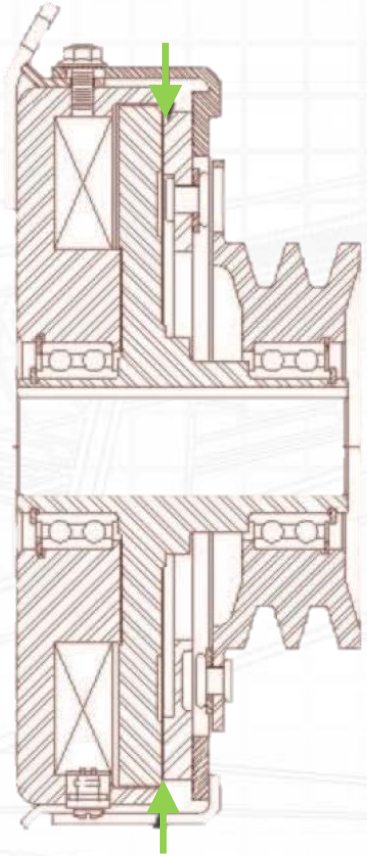
- Loosen three (3) brake mounting screws (don't remove)
- Apply 0.4 mm feeler gauges at each brake screw location (between rotor and armature)
- Apply 12 Volts to engage the clutch
- Tighten the three (3) brake mounting screws and apply torque 8,5 Nm
- Remove 12 Volts and feeler gauges
- Check for drag by turning rotor by hand



PTO Clutch burnishinig procedure

Why important?

- New clutch will not transfer maximum torque
- Rotor and armature surfaces are machined (radial grooves)
- Two surfaces require wearing-in
- Maximize contact surface



IS2100Z

IS2100Z

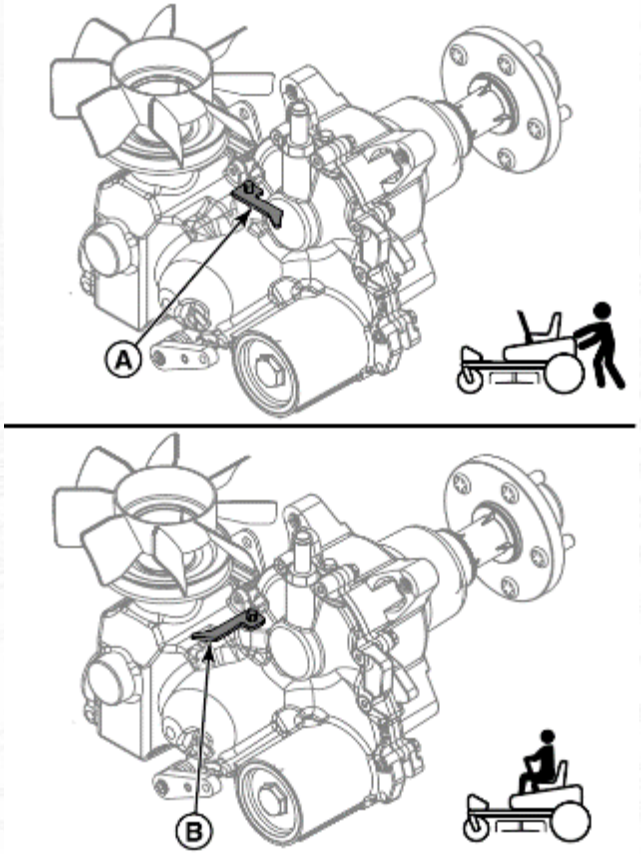
TECHNICAL SPECIFICATIONS	
Engine	Vanguard 810 EFI
Spark Plugs	Champion RC12YC
Spark plug Gap	0,76 mm
Low Idle Speed	1750 rpm
High Idle speed	3600 rpm
Valve Clearance	In 0,10-0,15 mm
	Ex 0,10-0,15 mm
Engine oil type	SAE30
Engine oil API Class	SF, SG, SH, SJ or higher
Engine Oil Capacity	1,9 L oil filter not removed
	2,0 L oil filter is removed
PTO Clutch air gap	0,3 mm
Mower blade stopping time	5 seconds
Transmission	HydroGear ZT-4400
Transmission oil type	20W-50 engine oil
Transmission oil API Class	SL
Transmission Oil Capacity	3,55 Liter
Tire pressure front wheels	1,72 bar
Tire pressure drive wheels	1,03 bar

PERIODIC MAINTENANCE			
Engine	Daily		Check and add engine oil
Engine	Daily		Check for loose or lost nust and screws
Engine	Daily		Check for fuel and oil leakage
Engine	Daily		Check or clean air inlet screen
Engine	Daily		Clean area around muffler and controls
Mower	Daily		Check battery electrolyte level
Mower	Daily		Check unit brakes
Mower	Daily		Check transmission oil level
Mower	Daily		Check safety interlock system
Mower	Daily		Check for loose hardware
Mower	Daily		Clean debris from mower deck
Engine	First	5	Change engine oil **Skip with with OilGuard**
Mower	First	25	Check / Adjust PTO Clutch air gap
Mower	Every	25	Check tire pressure
Mower	Every	25	Lubricate machine and mower
Mower	Every	25	Clean machine and mower
Mower	Every	25	Check / sharpen / replace mower blades
Engine	Every	50	Check muffler and spark arrester
Mower	First	100	Change transmission oil and filter
Engine	Every	100	Clean air filter
Engine	Every	100	Change engine oil **500 hours with OilGuard**
Engine	Every	100	Change engine oil filter
Engine	Every	100	Check fuel filter
Mower	Every	100	Check / Adjust PTO Clutch air gap
Mower	Every	100	Check mower blade stopping time
Mower	Every	400	Change transmission oil and filter
Engine	Every	400	Change air filter
Engine	Yearly		Replace spark plugs
Engine	Yearly		Check and adjust valve clearance
Engine	Yearly		Replace fuel filter
Engine	Yearly		Clean air cooling system
Engine	Yearly		Change pre-cleaner
Engine	Yearly		Clean oil cooler fins

IS2100Z

Transmission disengagement

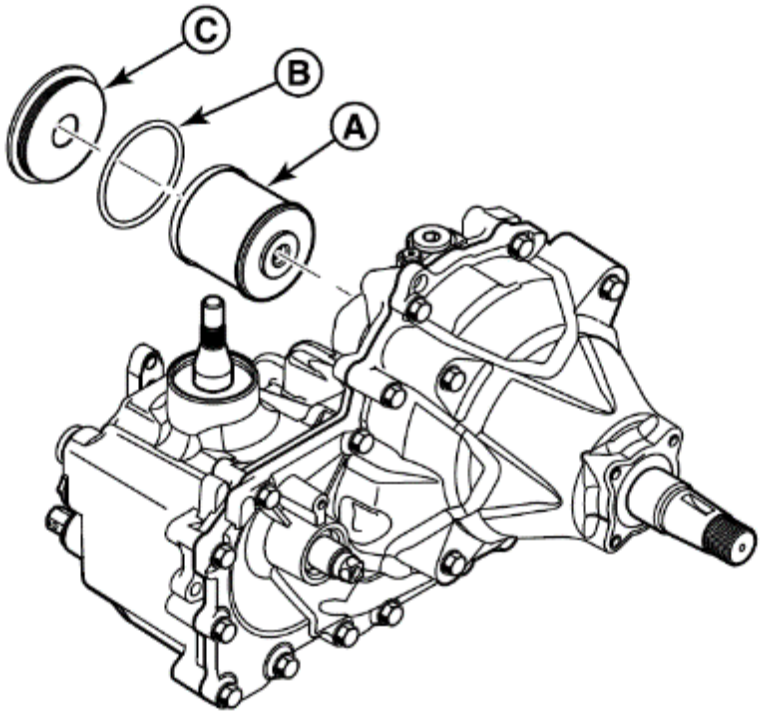
- Individual release levers placed on top of transmission units (A)
- Position A: “bypass” position. Unit can be pushed
- Position B: “driving” position. Unit can be operated
- Only push by hand
- Towing will damage transmissions



IS2100Z

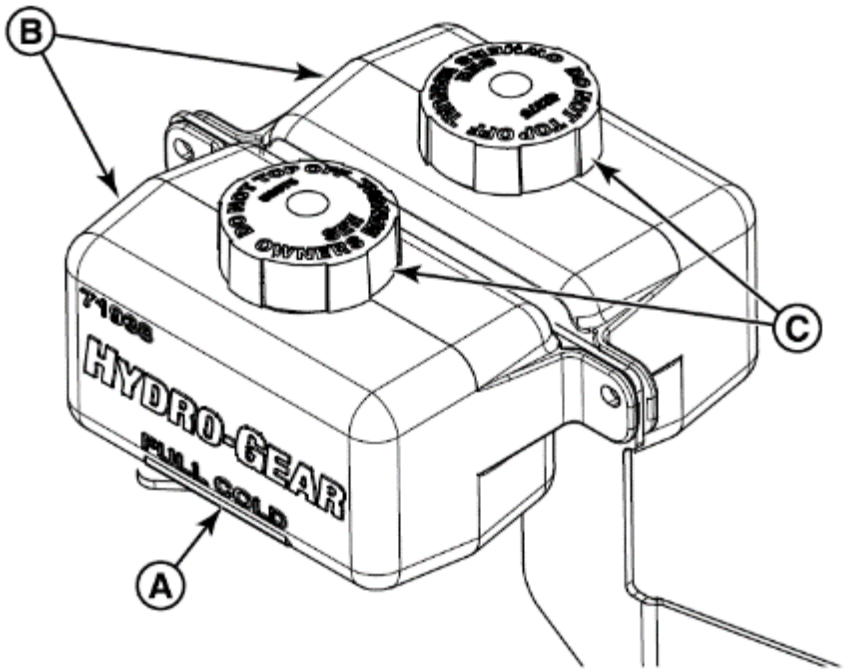
Replacing transmission oil

- 20W-50 Conventional detergent motor oil (synthetic preferred)
- Approximately 3,55 liter
- Remove filter to drain the oil (A)
- Reinstall filter and cover and tighten to 54-61 Nm



IS2100Z

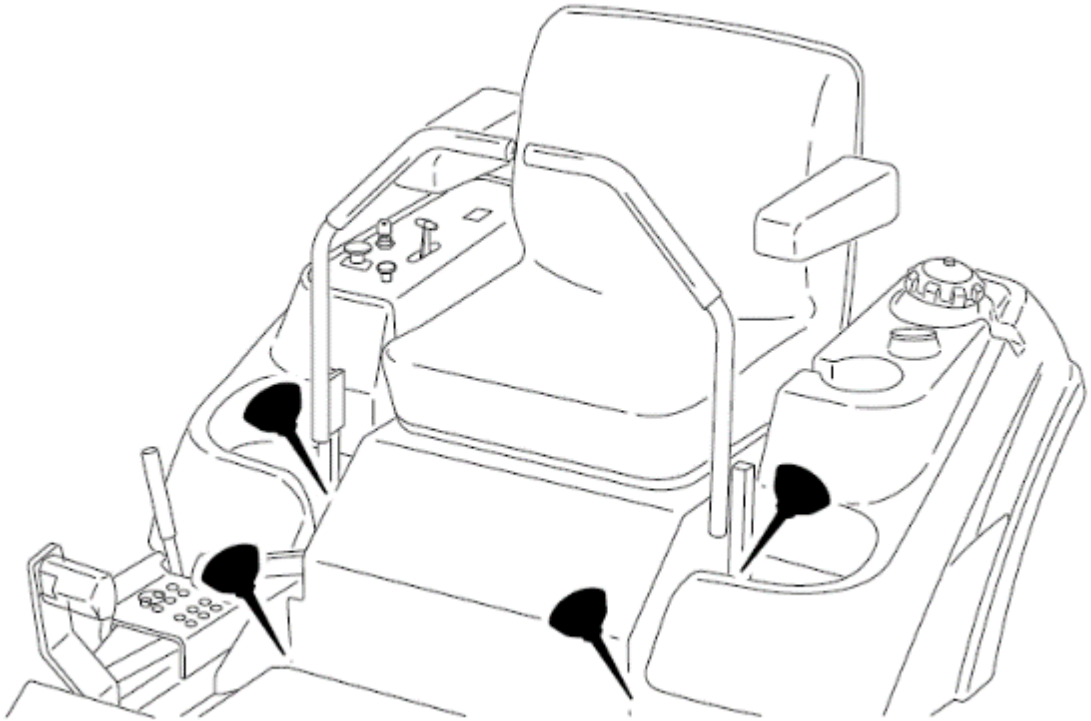
- Remove transmission vent
- Add fresh oil through expansion reservoirs (B)
- Continue to add oil till “COLD” mark (A)
- Check oil level when unit is cold



IS2100Z

Grease	
front caster wheel axles & yokes	
deck lift pivot blocks	
mower deck spindles	
mower deck idler arm	
transmission cradle pivot points	

Oil	
control handle pivots	
seat plate pivots	
deck lift pivots	
discharge chute hinge	



Not all greases are compatible. Red grease (p/n 5022285) is recommended, automotive-type, high-temperature, lithium grease may be used when this is not available.

IS2100Z

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mower deck idler arm
transmission cradle pivot points

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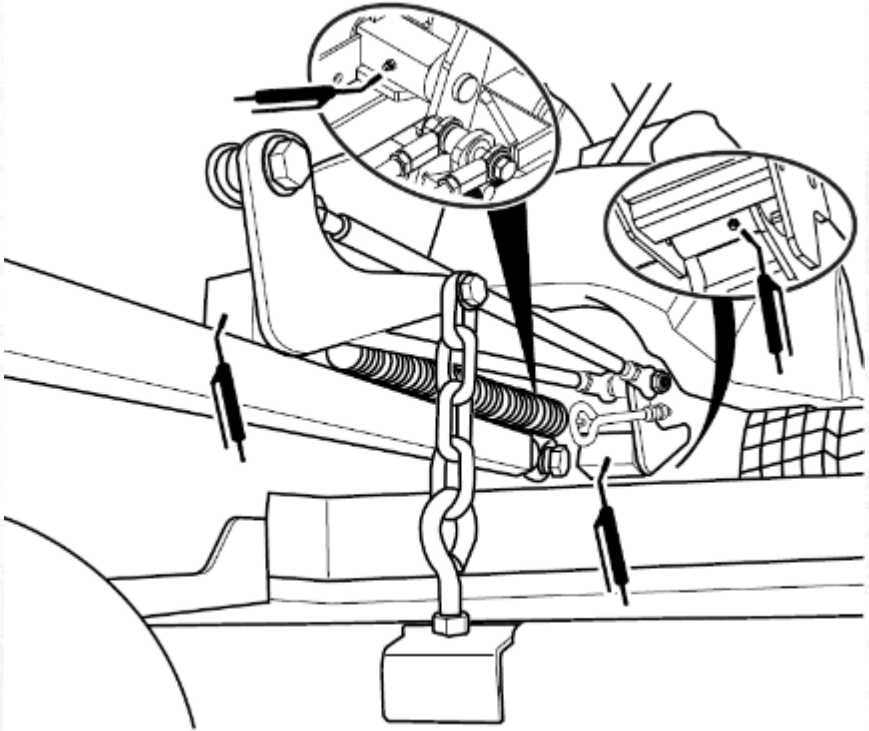
discharge chute hinge



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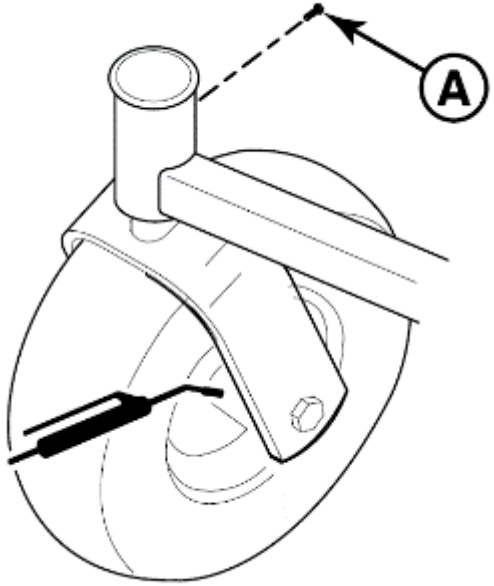

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IS2100Z

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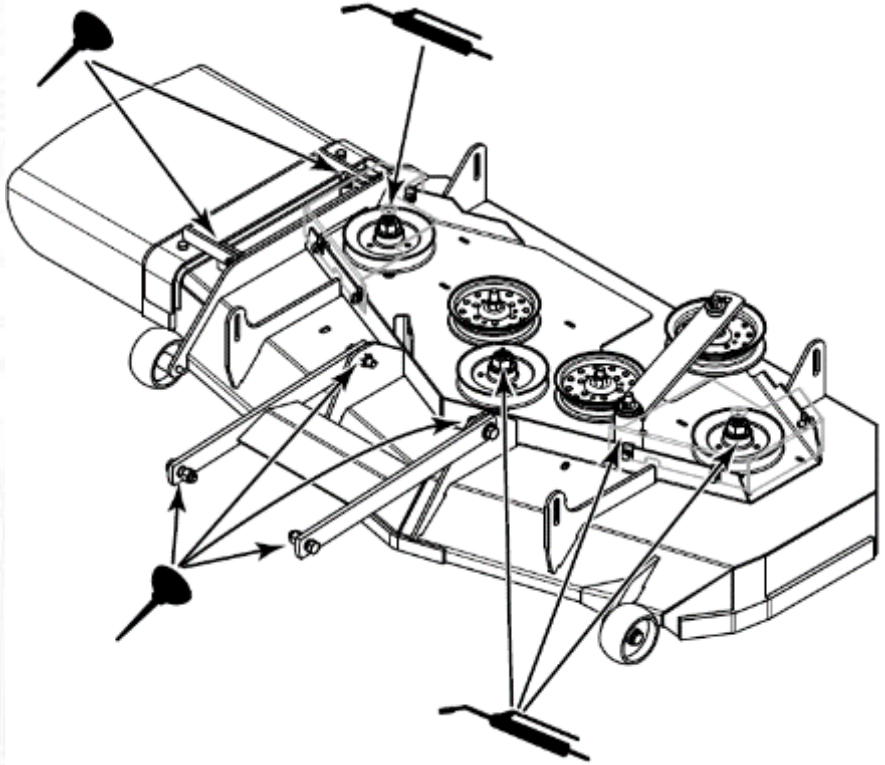
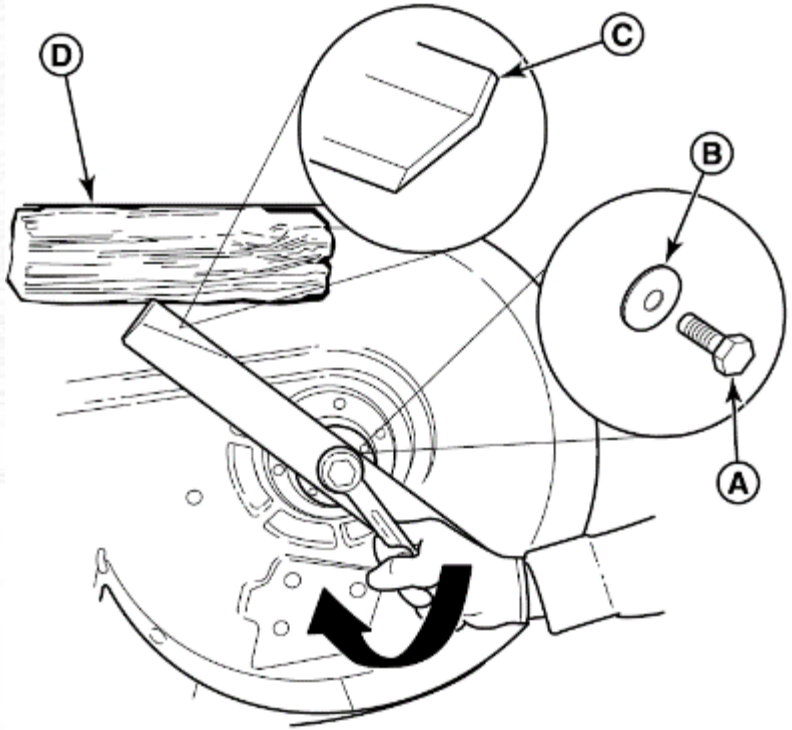


Not all greases are compatible. Red grease (p/n 5022285) is recommended, automotive-type, high-temperature, lithium grease may be used when this is not available.

IS2100Z

Replacing mower blades

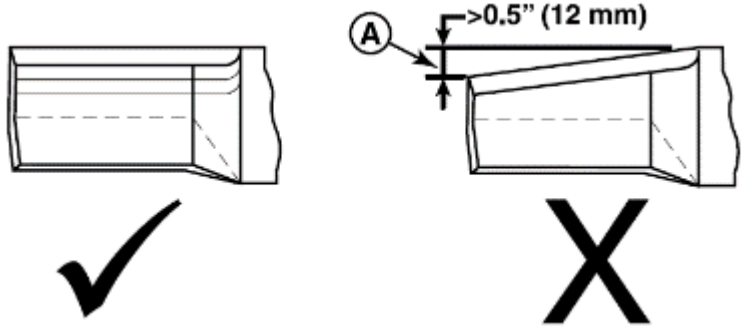
- Block mower blade (D)
- Remove securing bolt (A) and washer (B)
- Discard old blade
- Replace blade with air lift pointing upwards
- Torque to 94 Nm

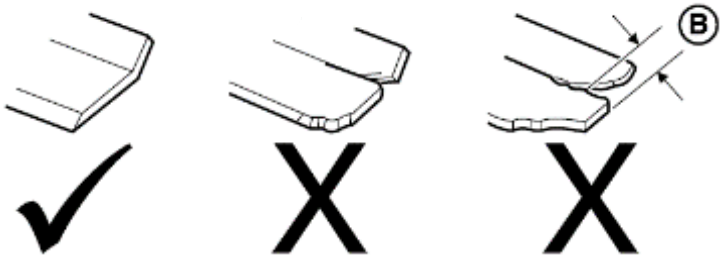


IS2100Z

Inspecting mower blades

- Blade is worn when:
- 12,7 mm of metal has been removed from previous sharpening (A)
- Air lifts are excessively eroded and notch (B) is 6,35 mm deep or greater

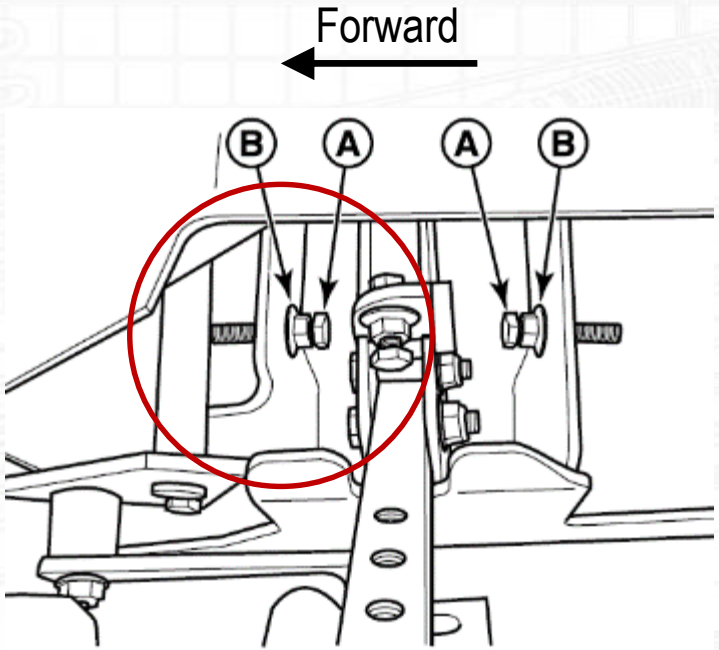




IS2100Z

Forward speed balancing adjustment

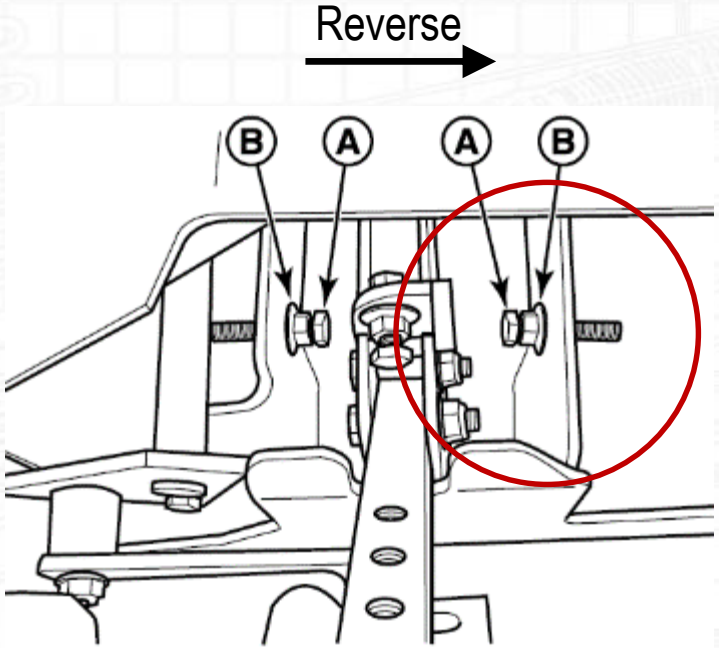
- Loosen jam nut (B)
- Drive LH and RH adjustment screw (A) completely in
- Test drive on flat and level surface
- Determine desired max drive speed
- Unit veers left: reduce RH speed
- Unit veers right: reduce LH speed
- Re-tighten jam nuts (B)



IS2100Z

Reverse speed balancing adjustment

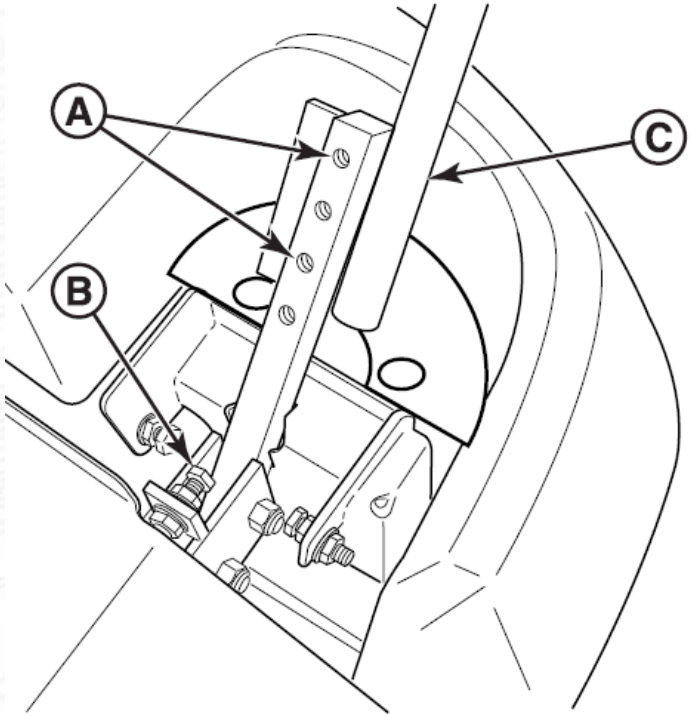
- Loosen jam nut (B)
- Test drive on flat and level surface
- Determine desired reverse speed
- Unit veers left: reduce RH speed
- Unit veers right: reduce LH speed
- Re-tighten jam nuts (B)



IS2100Z

Control lever positioning

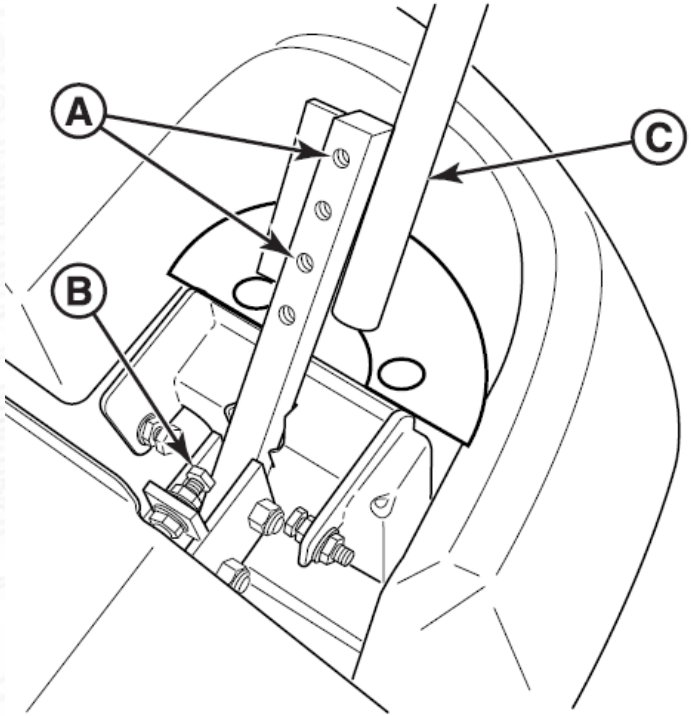
- Two set of holes for height adjustment
- Loosen retaining bolts (A)
- Move control lever (C) to other set of holes
- Reinstall retaining bolts (A)



IS2100Z

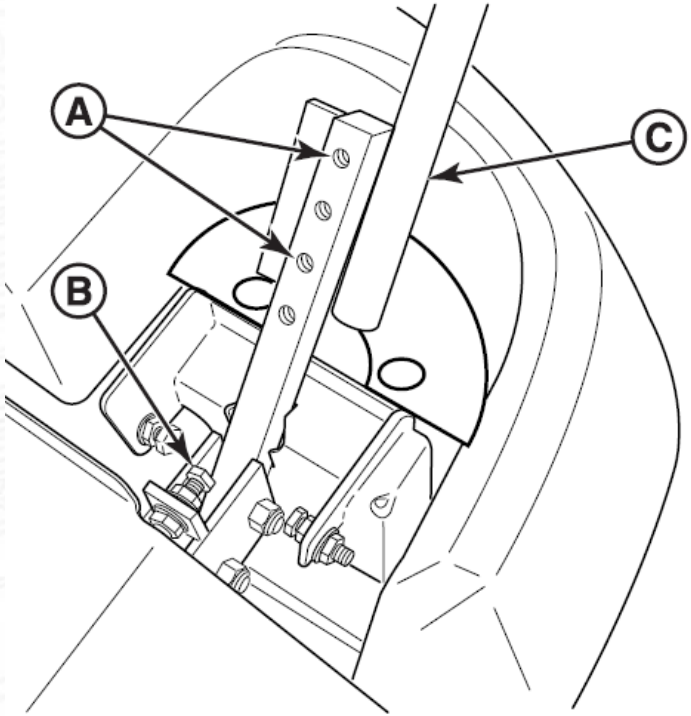
Control lever alignment

- Takes place after speed balancing and lever positioning
- Loosen bolts (A) slightly and make hand tight
- Fix square control rods in full forward position with eg. a bungy cord



IS2100Z

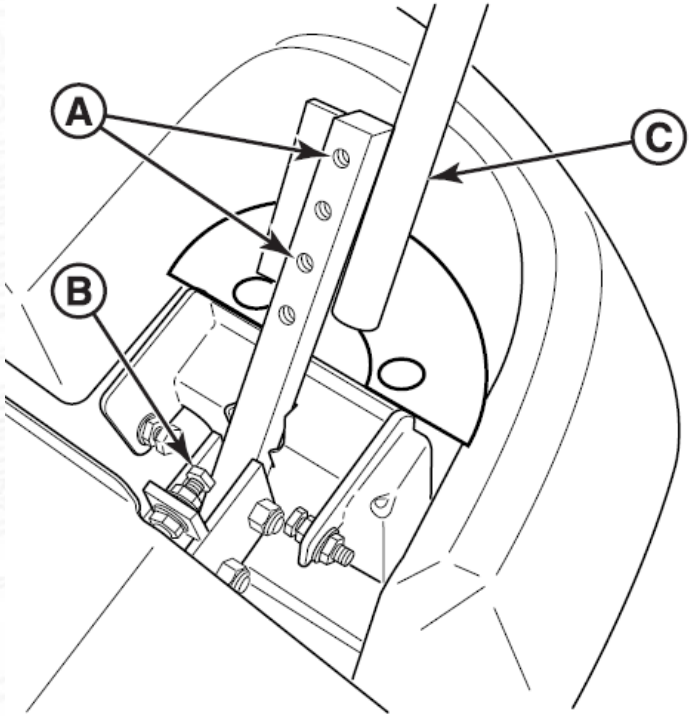
- Sit on the unit, adjust the seat correctly in fore and aft position
- Bring the control levers (C) to a comfortable maximum forward position
- Tighten retaining bolts (A) of the RH control lever (C)
- Align and retain LH control lever according to position of RH lever



IS2100Z

Control lever angle adjustment

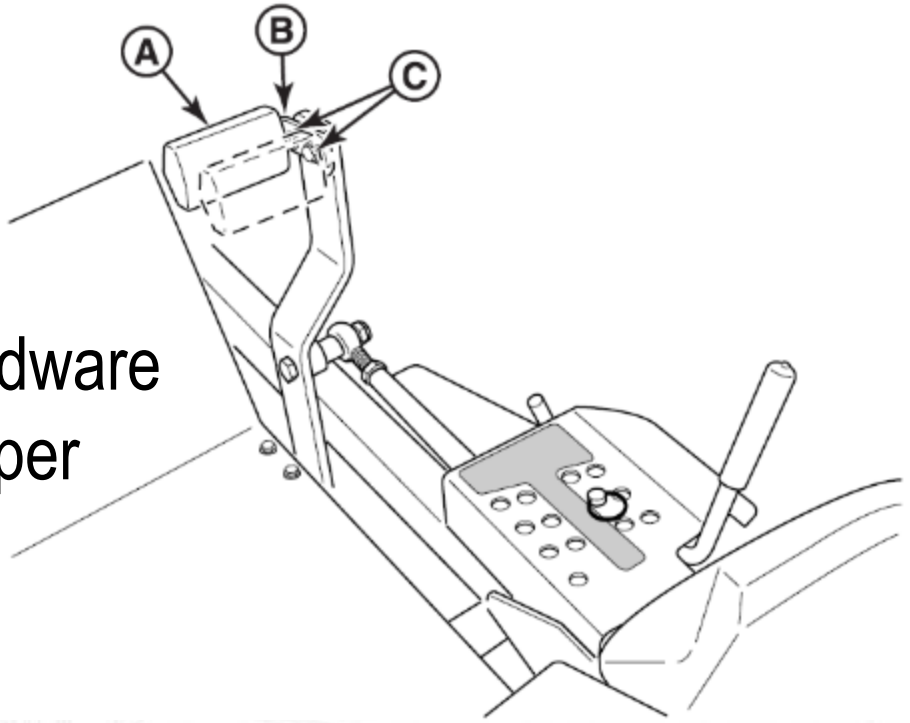
- Loosen jam nuts of LH and RH adjustment bolts (B)
- Align RH and LH contol levers and balance out to equal position
- Keep approximately 15-25 mm space between both lever ends
- Operators like one handed steering ability



IS2100Z

Foot pedal adjustment

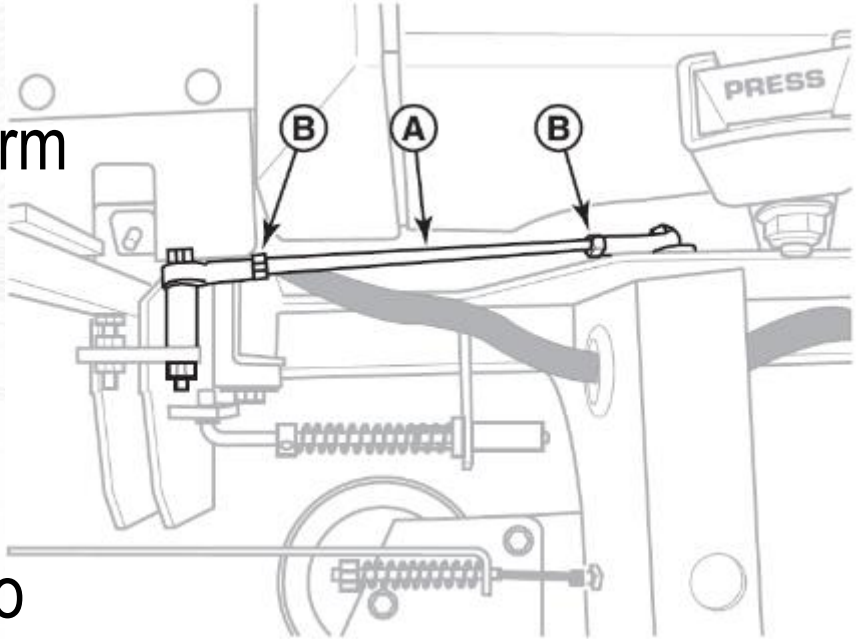
- Two length positions
- Remove retaining bolts (C)
- Rotate pedal tab 180 degrees
- Reinstall and tighten pedal hardware
- Install rubber pedal liner in proper orientation



IS2100Z

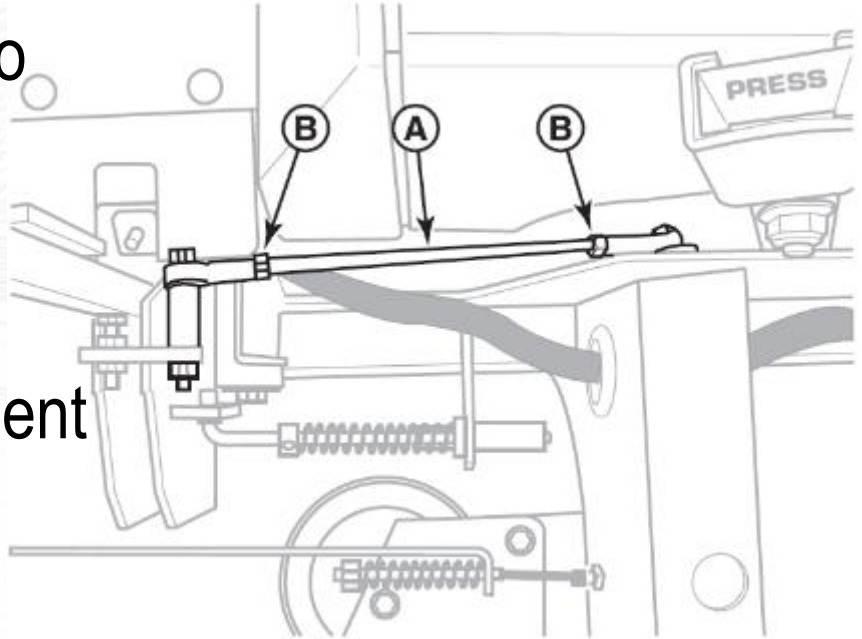
Neutral adjustment

- Put the unit on jack stands
- Start the engine and run until warm
- Loosen jam nuts (B)
- Disengage parking brake
- Run engine at high idle
- Slowly turn linkage rod (A) clockwise until drive tires begin to rotate backwards



IS2100Z

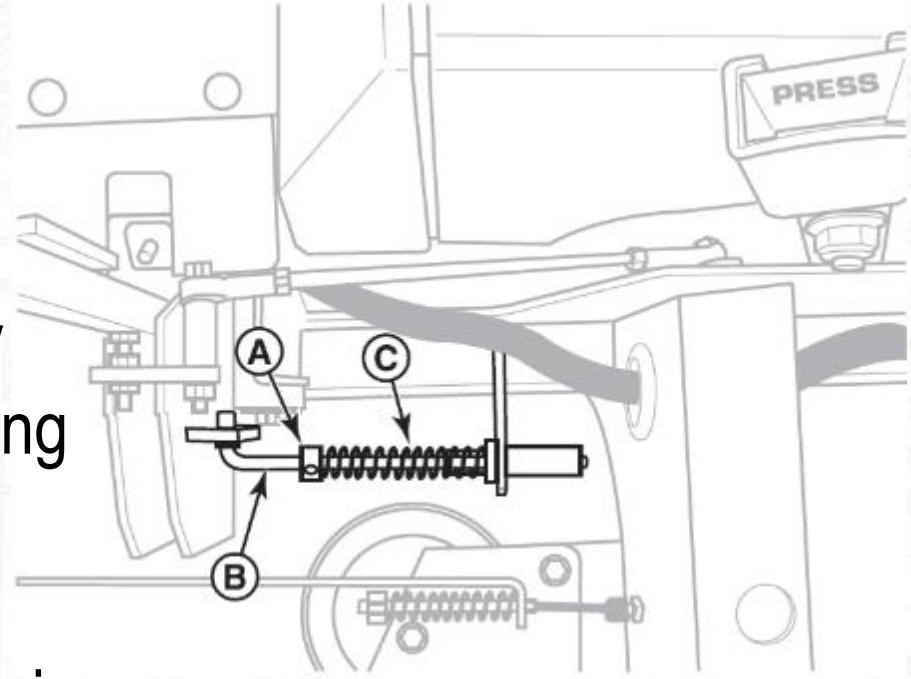
- Slowly turn linkage rod (A) counter clockwise until drive tires begin to move forward
- Count revolutions and set adjustment halfway between forwards and bachwards movement
- Re-tighten jam nuts (B)



IS2100Z

Return to neutral adjustment

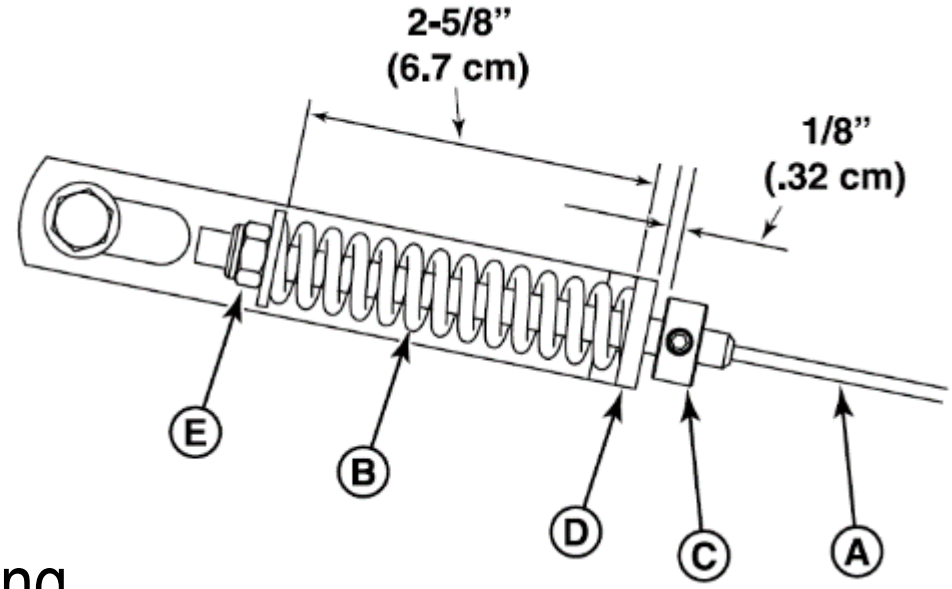
- Lock control levers in neutral
- Loosen set collar (A)
- Position set collar until it lightly compresses neutral return spring
- Bring control levers in reverse position and release them
- Check if levers align with notch in neutral lock plate



IS2100Z

Parking brake adjustment

- Engage parking brake
- Raise seat plate
- Compressed spring length should measure 6,7 cm
- Adjust spring length with adjustment nut (B)
- Adjust in uncompressed spring postition



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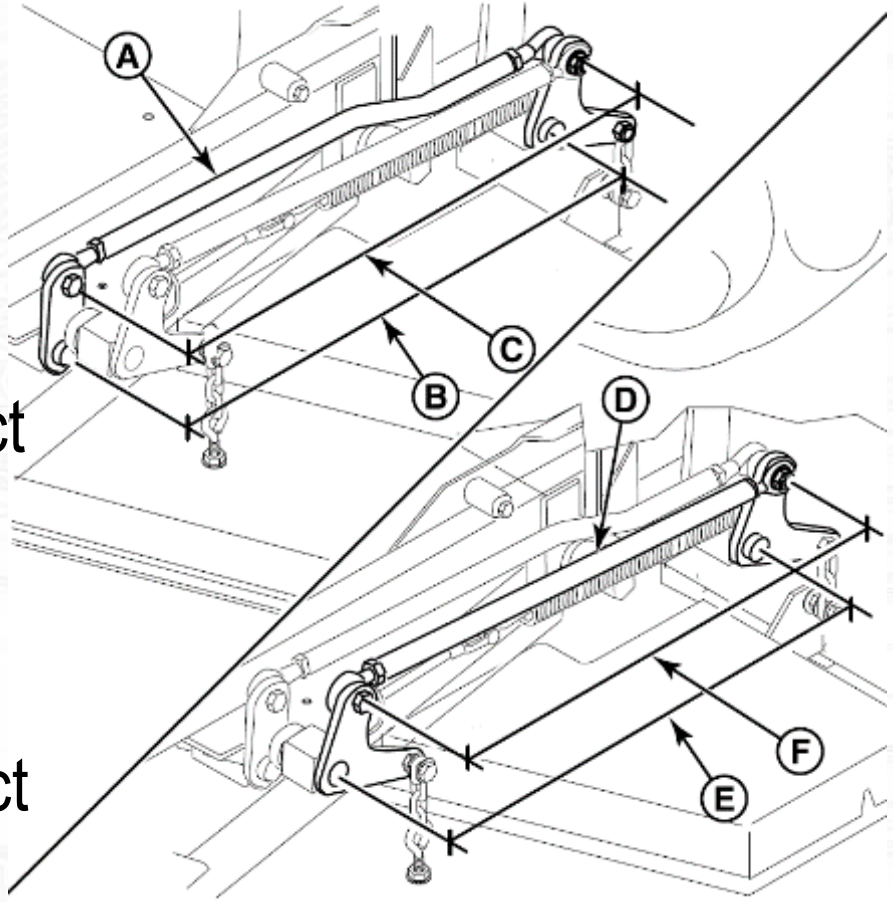
Deck lift rod timing measurement

- Measure center distance between lift rod pivots (B)
- Lift rod (A) needs to match exact length of rod pivots (B)
- Measure center distance between lift rod pivots (E)
- Lift rod (D) needs to match exact length of rod pivots (E)



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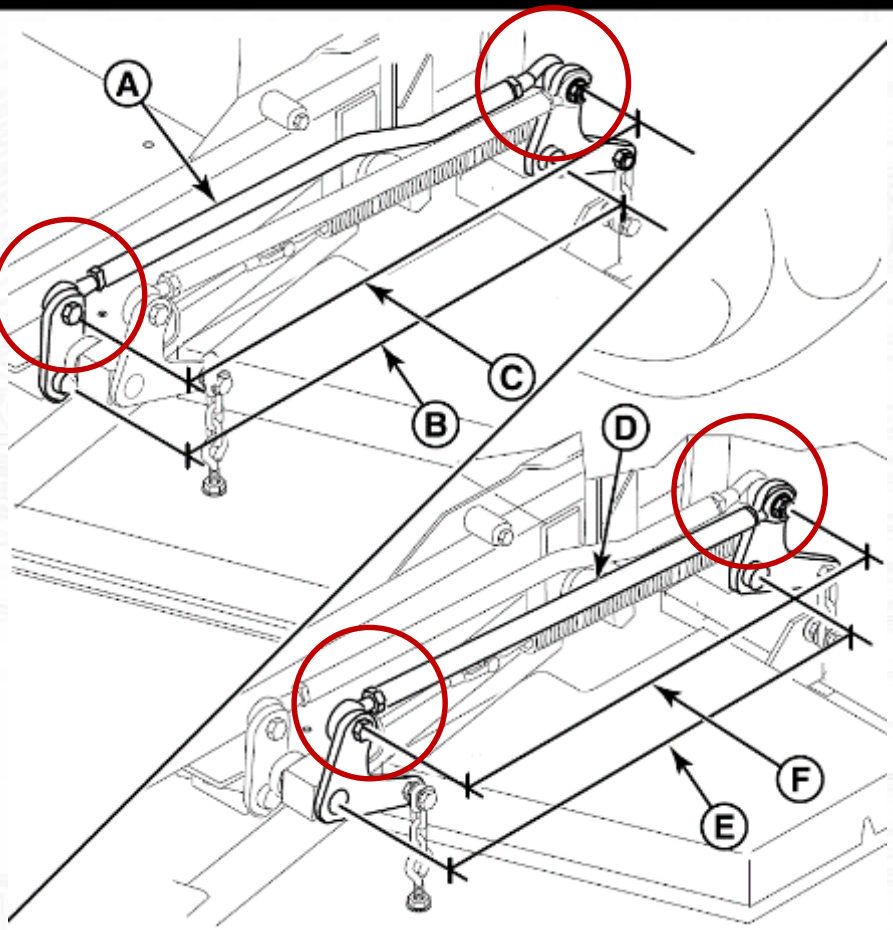
Deck lift rod timing adjustment

- Block up the mower deck until hanger chains are slack
- Push lift pedal forward and lock with height adjustment pin
- Loosen jam nuts on ball joints
- Remove ball joint bolts
- Lengthen or shorten rod length by rotating ball joints



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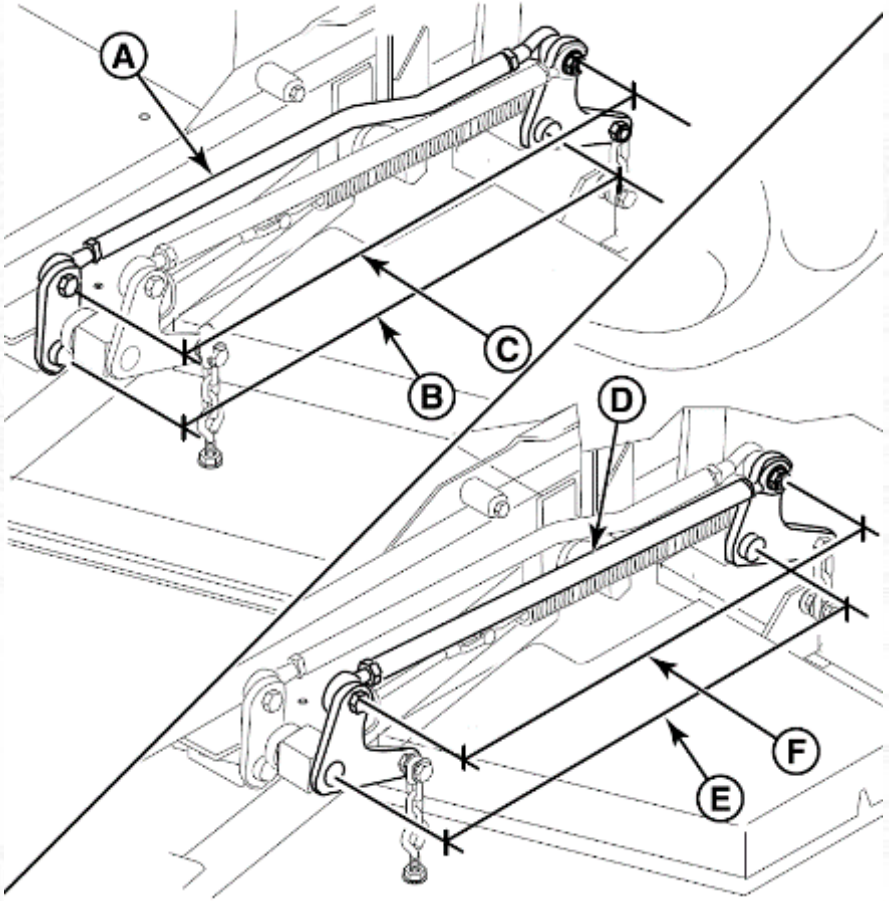
- Match timing rod length to rod pivot distance
- Re-fasten ball joints to lift arm pivots
- Tighten ball joint jam nuts



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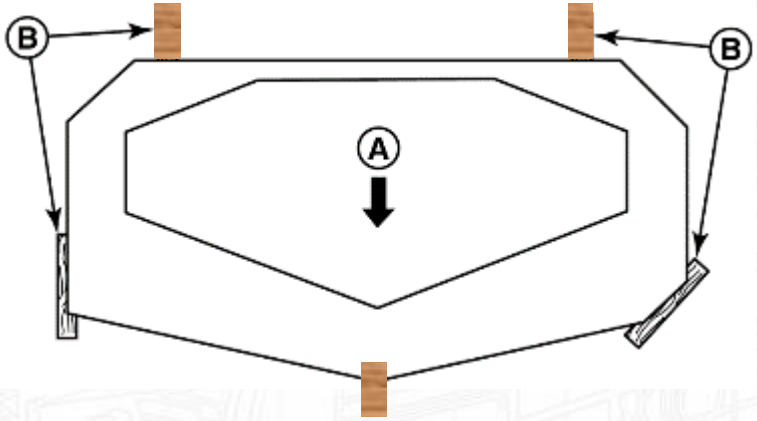
Deck levelling procedure

- Place equal height blocks under rear deck corners and front
- Lower mower deck and measure blade tip distance to floor
- Place deck height adjustment pin at measured position
- Lock foot pedal forward with eg. a bungy strap (assist springs)



Adjustment block height

- **HOC setting 3”**
- **Required blocks 2 ½”**
- **Blade positioned ½” up**

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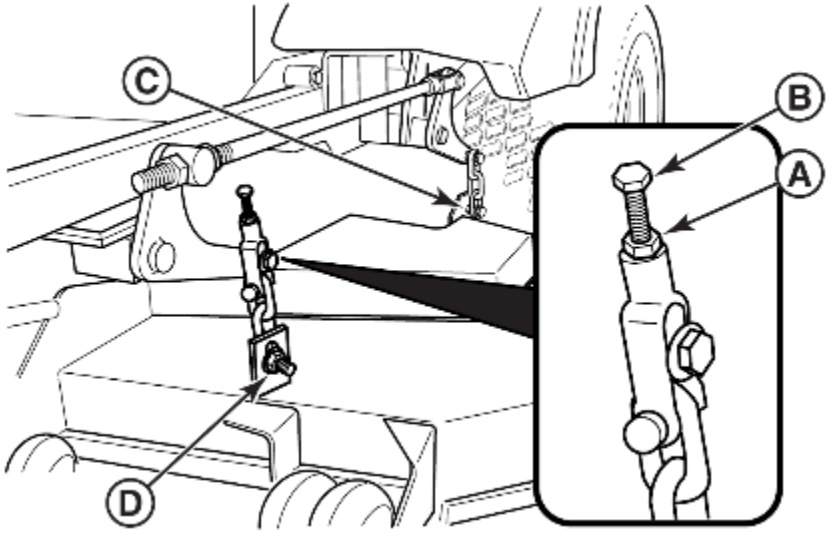
- Loosen jam nuts (A)
- Drive out adjustment bolt (B) till top arc of adjustment fork
- Loosen retaining nut (D) and slide down till chain is tense
- Tighten retaining nut (D)
- Dial in adjustment bolt (B) until all four chains are equally tensioned
- Tighten jam nuts (A)



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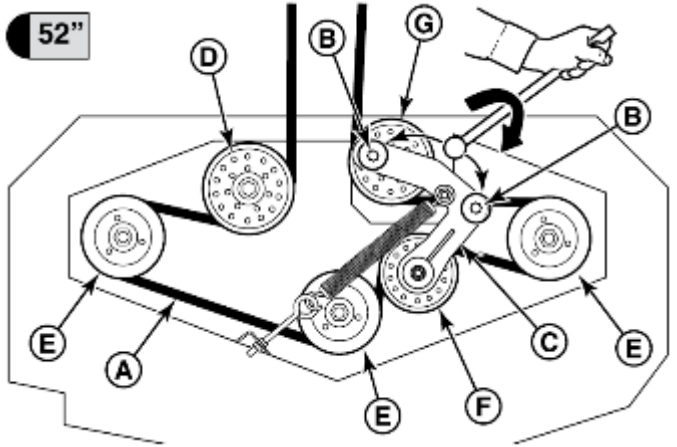
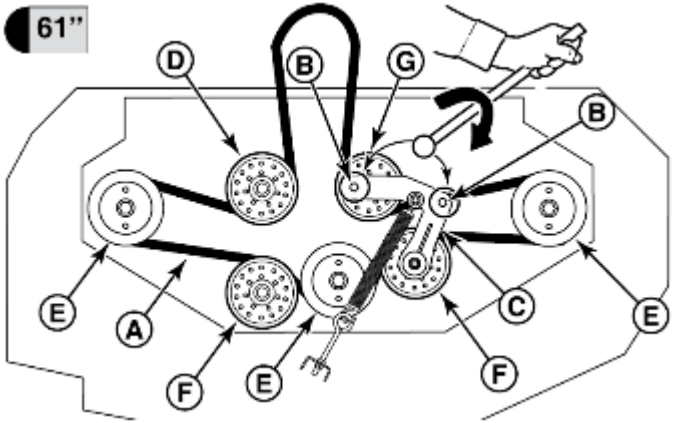
Deck drive belt replacement

- Lower mower deck to lowest position
- Use ½” breaker bar and relieve belt tension (B)
- Slide belt over stationary idler pulley (D) and remove completely
- Replace belt
- Carefully retension deck drive system
- Run system for 5 minutes at no load





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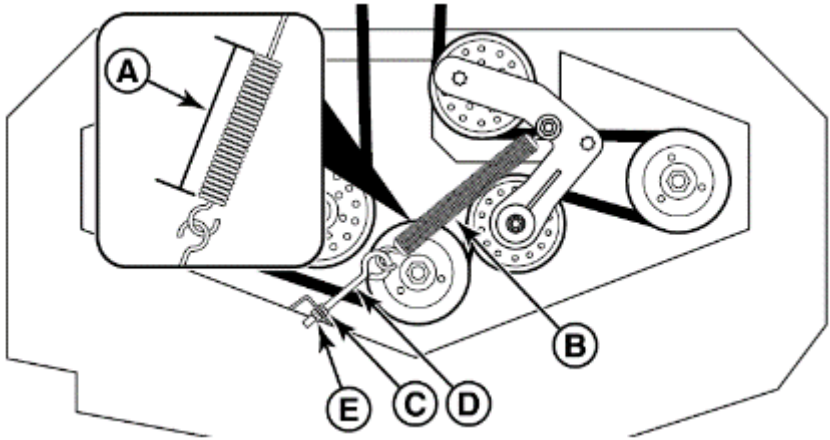
Deck idler tensioner adjustment

- Correct Spring body length (A) should measure:
- 29,2 cm for 52” (132 cm) deck
- 30,5 cm for 61” (155 cm) deck
- Loosen jam nut (C)
- Turn adjustment nut (E) till spring body reaches correct length
- Re-tighten jam nut (C)



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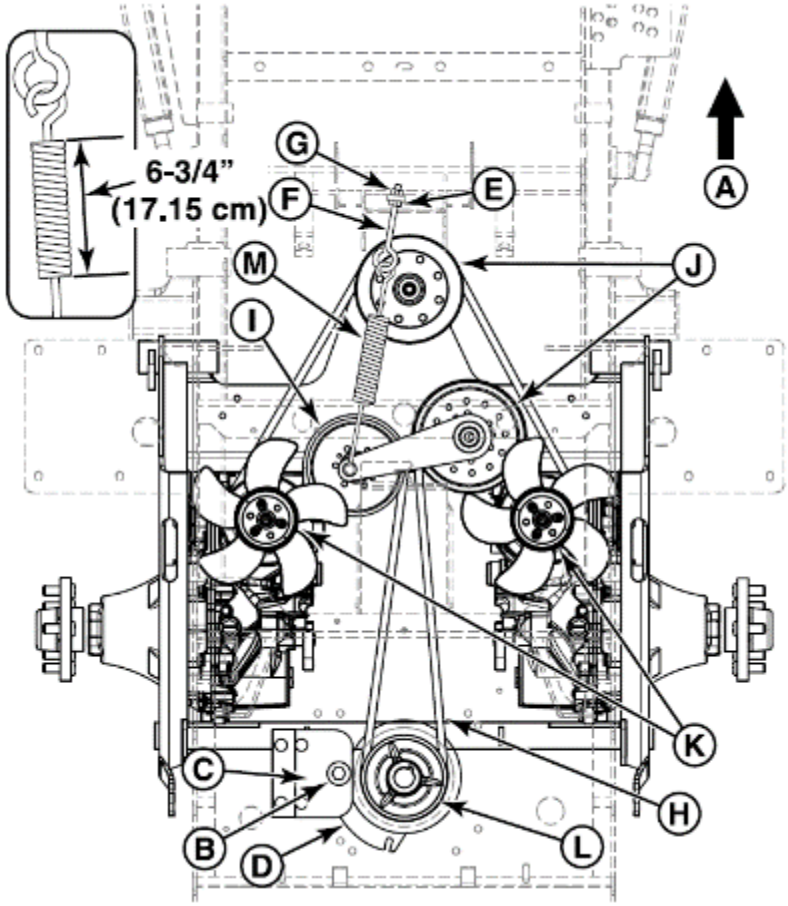
Transmission belt replacement

- Remove deck drive belt
- Remove clutch anchor bolt (B)
- Disconnect PTO clutch connector
- Loosen jam nut (E)
- Loosen adjustment nut (G) to release belt tension
- Remove eyebolt
- Remove old belt en replace



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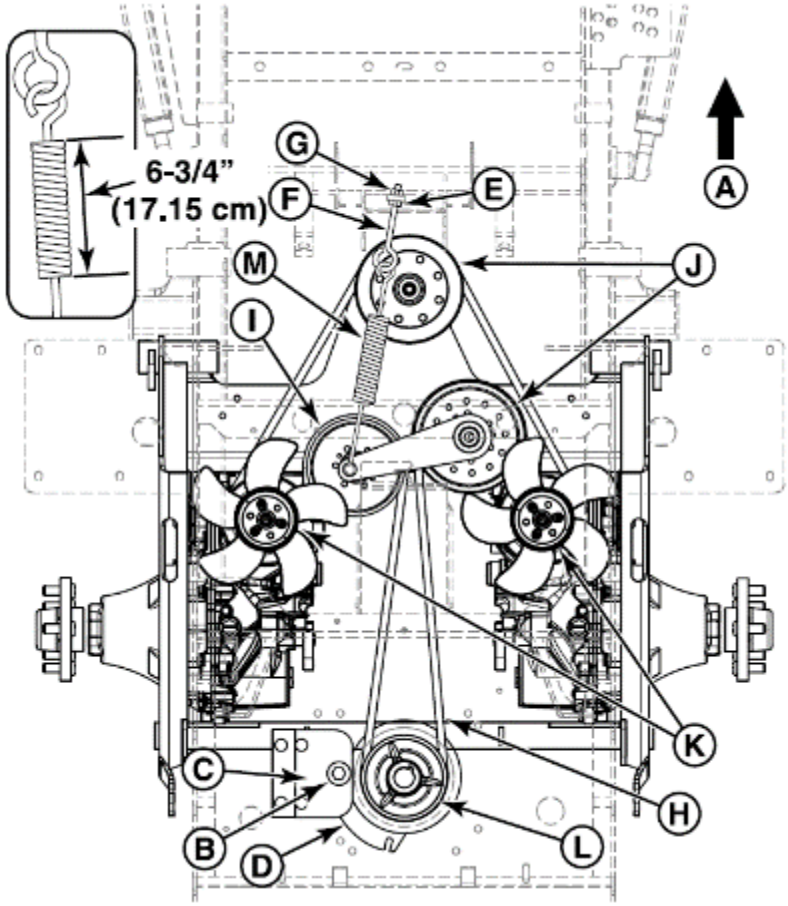
- Reinstall eyebolt and install adjustment nut (G)
- Tighten nut (G) untill spring achieves body length of 17,15 cm
- Tighten jam nut (E)
- Reinstall clutch anchor bolt and reconnect PTO connector
- Reinstall deck drive belt



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Suspension adjustment

- Operator weight/operating conditions

1. Coil-over-shock adjustment
2. Coil-over-shock position

- Always take weight off suspension when making adjustments