CASE

SERVICE MANUAL

CRAWLER EXCAVATOR

CX700
TIER III

Bur • Issued 05-2006 (Revised 07-2006)
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CNH America LLC reserves the right to make improvements in design or changes in specifications at any time without incurring any obligation to install them on units previously sold.

All data given in this publication is subject to production variations. Dimensions and weights are only approximate. Illustrations do not necessarily show products in standard condition. For exact information about any particular product, please consult your Dealer.

REVISION HISTORY			
Issue	Issue Date	Applicable Machines	Remarks
First Edition	05-2006	CX700 TIER III Crawler Excavator	87551416 NA
Revision 1	07-2006	CX700 TIER III Crawler Excavator	87364111 NA

CX700 Crawler Excavator
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* *Consult the Engine Service Manual 9-36410NA*

[redacted] *Sections to be distributed at a later date*

NOTE: CNH Company reserves the right to make changes in the specification and design of the machine without prior notice and without incurring any obligation to modify units previously sold.

The description of the models shown in this manual has been made in accordance with the technical specifications known as of the date of design of this document.

Section

1001

SAFETY, GENERAL INFORMATION AND TORQUE SPECIFICATIONS

Issued February, 2006

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WARNING : *This symbol is used in this manual to indicate important safety messages. Whenever you see this symbol, carefully read the message that follows, as there is a risk of serious injury.*

GENERAL INFORMATION

Cleanning

Clean all metal parts except bearings, in a suitable cleaning solvent or by steam cleaning. Do not use caustic soda for steam cleaning. After cleaning, dry and put oil on all parts. Clean oil passages with compressed air. Clean bearings in a suitable cleaning solvent, dry the bearings completely and put oil on the bearings.

Inspection

Check all parts when the parts are disassembled. Replace all parts that have wear or damage. Small scoring or grooves can be removed with a hone or crocus cloth. Complete a visual inspection for indications of wear, pitting and the replacement of parts necessary to prevent early failures.

Bearings

Check bearings for easy action. If bearings have a loose fit or rough action replace the bearing. Wash bearings with a suitable cleaning solvent and permit to air dry. DO NOT DRY BEARINGS WITH COMPRESSED AIR.

Needle bearings

Before you press needle bearings in a bore always remove any metal protrusions in the bore or edge of the bore. Before you press bearings into position put petroleum jelly on the inside and outside diameter of the bearings.

Gears

Check all gears for wear and damage. Replace gears that have wear or damage.

Oil seals, O-rings and gaskets

Always install new oil seals, O-rings and gaskets. Put petroleum jelly on seals and O-rings.

Shafts

Check all shafts that have wear or damage. Check the bearing and oil seal surfaces of the shafts for damage.

Service parts

Always install genuine Case service parts. When ordering refer to the Parts Catalog for the correct part number of the genuine Case replacement items. Failures due to the use of other than genuine Case replacement parts are not covered by warranty.

Lubrication

Only use the oils and lubricants specified in the Operator's or Service Manuals. Failures due to the use of non-specified oils and lubricants are not covered by warranty.

SAFETY

This symbol means ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED. The message that follows the symbol contains important information about safety. Carefully read the message. Make sure you fully understand the causes of possible injury or death.

To prevent injury always follow the Warning, Caution and Danger notes in this section and throughout the manual.

Put the warning tag shown below on the key for the keyswitch when servicing or repairing the machine. One warning tag is supplied with each machine. Additional tags Part Number 331-4614 are available from your service parts supplier

.

WARNING: *Read the operator's manual to familiarize yourself with the correct control functions.*

WARNING: *Operate the machine and equipment controls from the seat position only. Any other method could result in serious injury.*

WARNING: *This is a one man machine, no riders allowed.*

WARNING: *Before starting engine, study Operator's Manual safety messages. Read all safety signs on machine. Clear the area of other persons. Learn and practice safe use of controls before operating.*
It is your responsibility to understand and follow manufacturers instructions on machine operation, service and to observe pertinent laws and regulations. Operator's and Service Manuals may be obtained from your Case dealer.

WARNING: *If you wear clothing that is too loose or do not use the correct safety equipment for your job, you can be injured. Always wear clothing that will not catch on objects. Extra safety equipment that can be required includes hard hat, safety shoes, ear protection, eye or face protection, heavy gloves and reflector clothing.*

WARNING: *When working in the area of the fan belt with the engine running, avoid loose clothing if possible, and use extreme caution.*

WARNING: *When doing checks and tests on the equipment hydraulics, follow the procedures as they are written. DO NOT change the procedure.*

WARNING: *When putting the hydraulic cylinders on this machine through the necessary cycles to check operation or to remove air from a circuit, make sure all people are out of the way.*

WARNING: *Use insulated gloves or mittens when working with hot parts.*

WARNING: *Lower all attachments to the ground or use stands to safely support the attachments before you do any maintenance or service.*

WARNING: *Pin sized and smaller streams of hydraulic oil under pressure can penetrate the skin and result in serious infection. If hydraulic oil under pressure does penetrate the skin, seek medical treatment immediately. Maintain all hoses and tubes in good condition. Make sure all connections are tight. Make a replacement of any tube or hose that is damaged or thought to be damaged. DO NOT use your hand to check for leaks, use a piece of cardboard or wood.*

WARNING: *When removing hardened pins such as a pivot pin, or a hardened shaft, use a soft head (brass or bronze) hammer or use a driver made from brass or bronze and a steel head hammer.*

WARNING: *When using a hammer to remove and install pivot pins or separate parts using compressed air or using a grinder, wear eye protection that completely encloses the eyes (approved goggles or other approved eye protectors).*

WARNING: *Use suitable floor (service) jacks or chain hoist to raise wheels or tracks off the floor. Always block machine in place with suitable safety stands.*

WARNING: *When servicing or repairing the machine, keep the shop floor and operator's compartment and steps free of oil, water, grease, tools, etc. Use an oil absorbing material and/or shop cloths as required. Use safe practices at all times.*

WARNING: *Some components of this machine are very heavy. Use suitable lifting equipment or additional help as instructed in this Service Manual.*

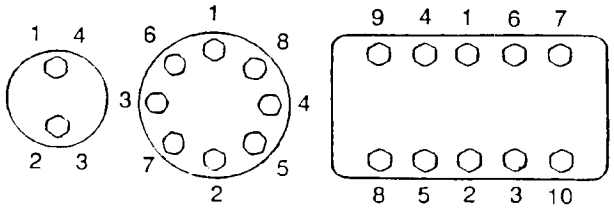
WARNING: *Engine exhaust fumes can cause death. If it is necessary to start the engine in a closed place, remove the exhaust fumes from the area with an exhaust pipe extension. Open the doors and get outside air into the area.*

WARNING: *When the battery electrolyte is frozen, the battery can explode if (1), you try to charge the battery, or (2), you try to jump start and run the engine. To prevent the battery electrolyte from freezing, try to keep the battery at full charge. If you do not follow these instructions, you or others in the area can be injured.*

STANDARD TORQUE DATA FOR CAP SCREWS AND NUTS

Tightening of cap screws, nuts

Tighten alternately so that tightening torque can be applied evenly. The numbers in the figure below indicate the order of tightening.



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Cap screws which have had Loctite used (white residue remains after removal) should be cleaned with loght oil or suitable cleaning solvent and dried. Apply 2-3 drops of Loctite to the thread portion of the cap screw and then tighten.

Torque table

Tighten cap screws and nuts according to the table below if there are no other special instructions.

Cap Screw Name Size (Size)			M6	M8	M10	M12	M14	M16	M18	M20
Hexagon Screw	Spanner	[mm]	10	13	17	19	22	24	27	30
		[in.]	0.39	0.51	0.67	0.75	0.87	0.95	1.06	1.18
	Tightening torque	[Nm]	6.9	19.6	39.2	58.8	98.1	156.9	196.1	294.2
		[lb-ft]	5.1	14.5	28.9	43.4	72.3	115.7	144.6	217
Hexagon Socket Head Cap Screw	Spanner	[mm]	5	6	8	10	12	14	14	17
		[in.]	0.20	0.24	0.32	0.39	0.47	0.55	0.55	0.67
	Tightening torque	[Nm]	8.8	21.6	42.1	78.5	117.7	176.5	245.2	343.2
		[lb-ft]	6.5	15.9	31.1	57.9	86.9	130.2	181	253.2

Section

1002

1002

SPECIFICATIONS
AND SPECIAL TORQUE SETTINGS

CNH

Lep 9-94060NA

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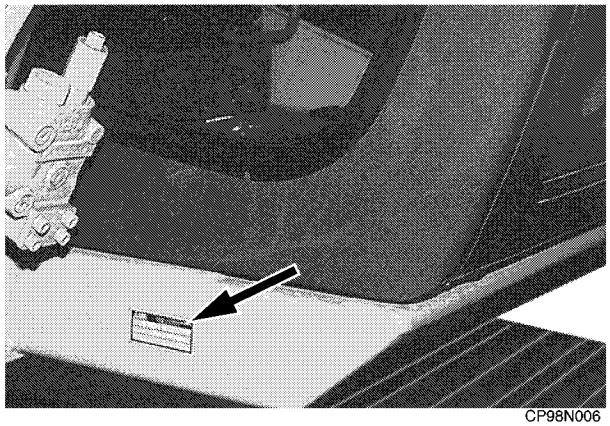
TYPE, SERIAL NUMBER AND YEAR OF MANUFACTURE OF THE MACHINE

For all part orders, request for information or assistance, always specify the type and the serial number of the machine to your Case dealer.

Fill in the following lines with the required information: Type, serial number, year of manufacture of the machine and the serial numbers of the hydraulic and mechanical components.

Machine



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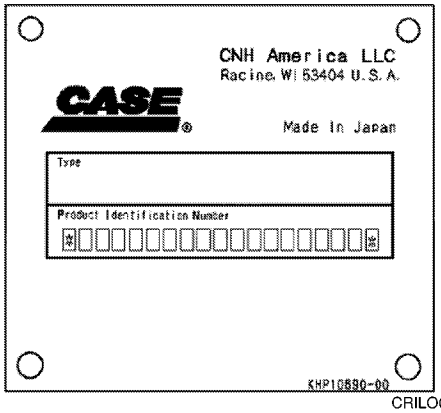

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Make and type .....

Serial number .....

Year of Manufacture .....

Engine

Make and type .....

Serial number .....

Serial numbers of the components

Hydraulic pump .....

Swing reduction gear .....

Travel reduction gears .....

Control valve .....

FLUIDS AND LUBRICANTS

Lubricants must have the correct properties for each application.

WARNING: The conditions of use for individual fluids and lubricants must be respected.

Hydraulic fluid

CASE/AKCELA hydraulic fluid is specially designed for high pressure applications and for the CASE hydraulic system. The type of fluid to be used depends on the ambient temperature.

Temperate climates: -20°C to +40°C (-4° to 104° F)

CASE/AKCELA: HYDRAULIC EXCAVATOR FLUID (MS 1230. ISO VG 46. DIN 51524 PART 2 HV)

Hot climates: 0°C to +50°C (32° to 122° F)

CASE/AKCELA: AW HYDRAULIC FLUID 68 HV (MS 1216. ISO VG 68. DIN 51524 PART 3 CATEGORY HVLP)

Cold climates: -25°C to +20°C (-13° to 68° F)

CASE/AKCELA: AW HYDRAULIC FLUID 32 (MS 1216. ISO VG 32. DIN 51524 PART 2)

Biodegradable fluid: -30°C to +40°C (-22° to 104° F)

This yellow-colored fluid is miscible with standard fluid. If used to change standard fluid, it is advised to drain the circuit completely before refilling with this fluid.

CASE/AKCELA: HYDRAULIC EXCAVATOR FLUID BIO (MS 1230. ISO VG 46. DIN 51524 PART 2 HV)

Transmission component oil

Extreme pressure oil used for enclosed transmission components.

CASE/AKCELA: GEAR 135H EP (SAE 80W-90. API GL 5. MIL-L-2105 D. MS 1316. ZF TE-ML 05A)

Grease

CASE/AKCELA: MOLY GREASE 251H EP-M (251H EP-M. NLGI 2)

"Extreme Pressure" multipurpose grease with lithium soap and molybdenum disulphide.

CASE/AKCELA: MULTIPURPOSE GREASE 251H EP (251H EP. NLGI 2)

"Extreme Pressure" multipurpose grease with lithium soap and calcium.

CASE/AKCELA: PREMIUM GREASE EP2 (NLGI 2)

"Extreme Pressure" multipurpose grease with lithium soap.

Hydraulic breakers

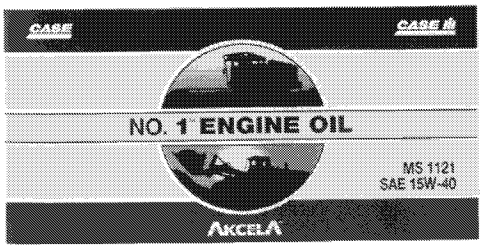
CASE/AKCELA: MULTIPURPOSE GREASE 251H EP (NLGI 2).

Engine Oil

THE CASE/AKCELA No. 1 engine oil is recommended for your engine. This oil ensures proper lubrication of your engine for all operating conditions.

If you are unable to procure the CASE No. 1 Multiperformance or Performance engine oil, use the corresponding oil from the API/CG/CF category.

NOTE: *Do not put any Performance Additives or any other additives in the engine housing. The oil changing intervals are indicated in the Operator's manual based on tests carried out on CASE lubricants.*



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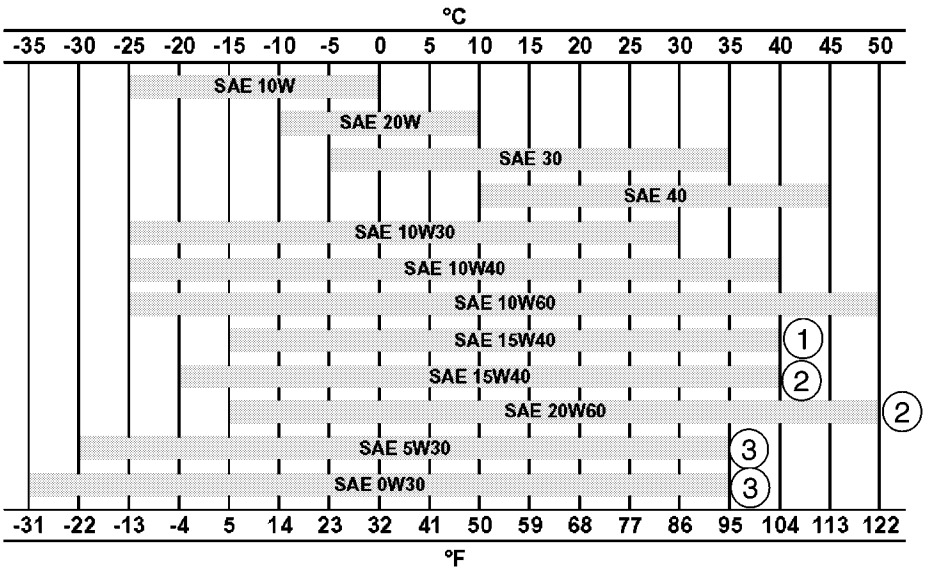
Oil viscosity / Oil range



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1) With mineral base

(2) With semi-synthetic base

(3) With synthetic base

Fuel

Use fuel which is to ASTM (American Society for Testing and Materials) D975 standard.

Use grade No. 2-D fuel. The use of other types of fuel can result in a loss of power of the engine and may cause high fuel consumption.

In cold weather (below -7°C), it is provisionally approved to use a mixture of fuels No. 1-D and No. 2-D.

If the temperature falls below the fuel cloud point (point at which wax begins to form) the wax crystals will cause power loss or will prevent the engine from starting.

Required conditions for diesel fuel

The following specific conditions are required for diesel fuel:

- Must be free from minute dust particles.
- Must have adequate viscosity.
- Must have high cetane value.
- Must have high fluidity at low temperature.
- Must have low sulphur content.
- Must have little residual carbon.

Diesel fuel recommendation

- JIS (Japanese Industrial Standard) : No. 2
- DIN (Deutsche Industrie Normen) : DIN 51601
- SAE (Society of Automotive Engineers) Based on SAE-J-313C: No. 2-D
- BS (British Standard) Based on BS/2869-1970: Class A-1

IMPORTANT : *If fuel other than the specified one is used, engine operation will be impaired.*

Using fuels other than those recommended can damage the fuel injection pump, the injector and other parts of the fuel supply system and the engine. **CASE disowns any responsibility concerning this kind of damage, which is not covered by the guarantee.** To avoid any damage to the engine fuel supply system, you are recommended to take the following safety messages into account:
Some fuel suppliers mix used engine oil with diesel fuel. Certain manufacturers of large engines allow them to do this. However, for your engine, do not use diesel fuel contaminated by engine oil. In addition to damaging the engine, this fuel can actually adversely affect the correct purification of exhaust gases. Before using any diesel fuel, ask the supplier if this fuel has been mixed with engine oil.

IMPORTANT : *For use of the correct fuel additives, consult your oil or lubrication supplier. Do not inject fuel oil or gasoline, both fuels can damage the engine.*

IMPORTANT : *In cold weather, fill the fuel tank at the end of the day's work, in order to prevent the formation of condensation.*

Fuel storage

Long storage can lead to the accumulation of impurities and condensation in the fuel. Engine trouble can often be traced to the presence of water in the fuel.

The storage tank must be placed outside and the temperature of the fuel should be kept as low as possible. Drain off water and impurities regularly.

Anti-freeze/Anti-corrosion

Use anti-freeze in all seasons to protect the cooling system from corrosion and all risk of freezing.

CASE/AKCELA: PREMIUM ANTI-FREEZE (MS 1710)

For areas where the temperature goes down to -38°C, mix 50/50 with water.

IMPORTANT : *Do not mix products of a different origin or brand. The same product must be used when topping up the system.*

Environment

Before carrying out any maintenance operation on this machine and before disposing of used fluids or lubricants, always think of the environment. Never throw oil or fluid on the ground and never place it in leaking receptacles.

Contact your local ecological recycling centre to obtain information on the correct method of disposing of these lubricants.

Plastic and resin parts

When cleaning plastic parts, the console, the instrument panel, the indicators etc... avoid using petrol, kerosene, paint solvents etc... Use only water, soap and a soft cloth.

The use of petrol, kerosene, paint solvents etc... causes discoloration, cracks or deformation of these parts.

SPECIFICATIONS

Main data

Model name ..... CX700 Hydraulic Excavator
Operating weight ..... 69 500 kg (153220 lbs)
Engine output ..... 345 kW / 1800 rpm

Performance

Standard weight ..... 38.8 kN (8723 lbf)
Swing speed ..... 6.5 Tr/min.
Travel speed ..... Low Speed 3.0 km/h (1.86 mph)
..... High Speed 4.1 km/h (2.54 mph)
Maximum drawbar pull ..... 469kN (105435 lbf)
Grade ability ..... 70% (35°)
Ground pressure ..... 74 kPa (900 mm (235.43 in) grouser shoe)

Complete machine dimensions

	Standard arm (3.55 m) (11 ft 7.7 in)	Short arm (3.00 m) (9 ft 10 in)	Long arm (4.11 m) (13 ft 1.4 in)	Super Long arm (5.00 m) (16 ft 4.8 in)	Mass Digging arm (3.00 m) (9 ft 10 in)
Length	13290 mm (523.22 in)	13250 mm (521.65 in)	13300 mm (523.62 in)	13170 mm (518.50 in)	12110 mm (476.77 in)
Width	4150 mm (163.38 in)	4150 mm (163.38 in)	4150 mm (163.38 in)	4150 mm (163.38 in)	4150 mm (163.38 in)
Height	4300 mm (169.29 in)	4370 mm (172.04 in)	4470 mm (175.98 in)	5160 mm (203.14 in)	4760 mm (187.40 in)

Main body dimensions

Main body length ..... 6910 mm (272.04 in)
Main body width ..... 4140 mm (162.99 in) (Grouser shoe retracted width: 3990 mm (157.08 in))
Upper swing body width ..... 3990 mm (157.08 in)
Cab width ..... 1000 mm (39.36 in)
Main body height ..... 3460 mm (136.22 in)
Tail swing radius ..... 4000 mm (157.47 in)
Distance of rear swing body ..... 3970 mm (156.29 in)
Ground clearance for upperstructure ..... 1510 mm (59.44 in)
Center-to-center of wheels ..... 4700 mm (185.03 in)
Overall track length ..... 5880 mm (231.49 in)
Maximum track width ..... 4150 mm (163.4 in) (Retracted width in transporting style: 3640 mm (143.3 in)
Center-to-center for track ..... 3250 mm (127.95 in) (Retracted width in transporting style: 2740 mm) (107.87 in)
Width of track shoe ..... 900 mm) (35.43 in) (Optional: 650 mm (25.59 in), 750 mm (29.52 in)
Minimum ground clearance ..... 825 mm (32.48 in) (To bottom of lower frame)

Engine

Name ..... ISUZU, 6WG1X
Type: 4-cycle, water-cooled, overhead camshaft, common rail injection (electric control), with air-cooling type inter-cooler turbo with air-cooling.
No. of cylinders - bore x stroke ..... 6-dia. 147 mm x 154 mm (5.78 x 6.06 in)
Displacement ..... 15.7 L (4.15 gal)
Compression ratio 16
Rated output ..... 345 ± 7.0 kW / 1850 min^{-1}
Maximum torque ..... 1980N•m (1460.37 lb-ft) / 1500 min^{-1}
Engine dimensions (LxWxH) ..... 1462x1017x1422 mm (57.55 x40.03x55.98 in)
Oil pan ..... All direction 35°, inclinable
Oil pan capacity ..... Maximum: 52 L (13.73 gal) Minimum: 37 L (9.77 gal) (excluding oil filter)
Direction of rotation ..... Right (viewed from fan side); compliant with
Starter, reduction type ..... 24 V, 7 kW
Alternator, AC type ..... 24 V, 50 A
Battery ..... 2x 12V/24V,140 Ah/5 Hr

Cooling system

Fan drive system ..... hydraulic drive
Fan type ..... diameter 1016 mm (40 in), suction type - 6 blades resin & steel
Radiator capacity 187.7kW
  Fin type ..... wavy
  Fin space ..... 2.0 mm (0.07 in)
Oil cooler capacity ..... 145.9 kW
  Fin type ..... plate
  Fin space ..... 3.0 mm (0.11 in)
Inter-cooler capacity ..... 61.1 kW
  Fin type ..... triangular straight
  Fin space ..... 2.0 mm (0.07 in)
Fuel cooler capacity ..... 3.58 kW
  Fin type ..... wavy
  Fin space ..... 2.0 mm (0.07 in)
Coolant capacity ..... 36 L (9.51 gal) (engine only)

Capacity of coolant and lubricants

Coolant ..... 112 L (29.58 gal)
Fuel ..... 900 L (237.75 gal)
Lubricant for engine ..... 52 L (13.73 gal)
Lubricant for travel reduction gear (per side) ..... 15 L (3.96 gal)
Lubricant for swing reduction gear (per side) ..... 13.5 L (3.56 gal)
Hydraulic oil ..... 650 L (171.71 gal)
Capacity of hydraulic oil tank ..... 310 L (81.89 gal)

Hydraulic oil filter

Suction filter (inside tank) ..... 150 mesh
Return filter (inside tank) ..... 10 μm
Nephron filter (inside housing) ..... 1 μm
Pilot line filter (inside housing) ..... 10 μm

Operating devices

Operator's seat
- Location; left side
- Structure; low frequency air suspension with helical springs and double acting hydraulic damper.

Cab
- Smooth and round shape design cab, fabricated by press work Safety glass for front window, high impact plastics for other all windows.

Levers and pedals
- For travel use; levers and pedals (hydraulic pilot type) (2)
- For operating machine use; levers (hydraulic pilot type) (2)

Instruments and switches
- Work mode switchover; 4 modes (heavy digging, standard, finishing and auto)
- Travel speed switchover; Low Speed / High Speed panel switch
- One-touch idle; Knob switch type

Monitor device
- Machine status display (full-dot liquid crystal)
- Travel speed selection status; Low Speed / High Speed
- Work mode selection status; H/S/L/A
- Auto idle selection status; ON/OFF

Instruments (full-dot liquid crystal, except for hour meter)
- Fuel gauge; bar graph indicator
- Engine coolant temperature gauge; bar graph indicator
- Hydraulic oil temperature gauge; bar graph indicator
- Hour meter; digital type
- Machine Status and Warning Alarms (full-dot liquid crystal and warning tone) *Items have a warning alarm

Over heat*	Battery charge*	Faulty electrical system*
Refill fuel*	Engine oil pressure*	Refill coolant*
Engine preheat	Auto warm-up	Air cleaner*
Idling	Service interval	Digging power up

Lighting

Working light	Tank:	24V, 70W (1)
	Boom:	24V, 70W (1)
	Cab:	24V, 70W (2)
Interior light		24V, 10W (1)

- Horn; electric horn (2)
- Other
  - Wiper with intermittent function (1)
  - Window washer fluid (1)
  - Air conditioner (1)
  - Rear view mirror (right-hand side) (1)
  - High dump

Hydraulic system

Hydraulic pump drive system, directly coupled to the engine (no transmission)

Main pump

- Manufacturer ..... Kawasaki
- Pump type ..... double variable displacement piston pump
- Displacement ..... 242 cm^3 (14.76 cu in) X 2 /rev
- Rated operating pressure ..... 31.4 MPa (4555 psi)
- Maximum operating pressure ..... 34.3 MPa (4975 psi)
- Input revolution speed 1850 min-1
- Maximum flow ..... 448 L/min (118.34 gpm) X 2 at 1850 min^{-1}
- Input horsepower ..... 282.2 kW
- Shaft input horsepower ..... 285 kW at 1850 min^{-1}
- Shaft input torque ..... 1471 N•m (1085 lb-ft) at 1850 min^{-1}

Pilot pump

- Pump type ..... Gear pump
- Displacement ..... 15 cm^3 (0.91 cu in)/rev
- Operating pressure ..... 4.4 MPa (638.16 psi) to 4.6 MPa (667.17 psi)
- Maximum flow ..... 27.8 L/min (7.34 gpm) (at 1850 min^{-1}) (1850 rpm^{-1})
- Input horsepower ..... 2.8 kW

Control characteristics; simultaneous output control of overall, negative control, electric horse power control

Control Valve

Model; 4-spool section: integrated (1) or 5-spool section: integrated (1)
Operation method; hydraulic pilot method: travel, swing and operating machine
Maximum flow ..... 448 L / min (118.34 gpm)
Set pressure of main relief valve ..... standard; 31.4 MPa (4554 psi), power boost 34.3 MPa (4975 psi)
Set pressure of overload relief valve ..... when boom down; 27.5 MPa (3988 psi) at 20 L / min
..... other: 36.3 MPa (5265 psi) at 20 L / min

Functions

- Straight travel circuit
- Boom UP / 2-speed internal confluence for Arm
- Boom/arm load holding circuit
- Boom down regenerative circuit
- Arm IN forced regenerative circuit
- Boom up priority (speed restriction of bucket)
- Boom up priority (Speed restriction of swing)
- Bucket 2-speed internal confluence
- Resevbe 2-speed internal confluence

Hydraulic Cylinders

Boom cylinder (2)
- Inner diameter of tube x rod diameter x stroke ..... 190x130x1805 mm (7.48x5.12x72.83 in)

Arm (dipper) cylinder
- Inner diameter of tube x rod diameter x stroke ..... 200x140x2025 mm (7.87x5.51x79.72 in)

Bucket cylinder (Standard boom specifications)
- Inner diameter of tube x rod diameter x stroke ..... 180x125x1465 mm (7.09x4.92x57.68 in)

Bucket cylinder (Mass boom specifications)
- Inner diameter of tube x rod diameter x stroke ..... 200x145x1450 mm (7.87x5.71x57.09 in)

Rotating Joint
- Operating pressure
  - High pressure passage (ABCD) ..... 34.4 MPa (4989 psi)
  - Drain port (E) ..... 1.0 MPa (145 psi)
  - Pilot port (F) ..... 3.9 MPa (566 psi)
- Hydrostatic test pressure
  - High pressure passage (ABCD) ..... 51.5 MPa (7470 psi)
  - Drain port (E) ..... 2.0 MPa (290 psi)
  - Pilot port (F) ..... 5.9 MPa (856 psi)
- Flow
  - High pressure passage (ABCD) ..... 500 L/min (132 gpm)
  - Drain port (E) ..... 50 L/min (13.2 gpm)
  - Pilot port (F) ..... 27.8 L/min (7.34 gpm)
- Number of revolutions ..... 15 min^{-1}
- Torque, when pressurizing 2 ports ..... 196 N m (145 lb-ft)
- Port A; forward right ..... SAE 6000 psi $1^1/_4$
- Port B; forward left ..... SAE 6000 psi $1^1/_4$
- Port C; backward right ..... SAE 6000 psi $1^1/_4$
- Port D; backward left ..... SAE 6000 psi $1^1/_4$
- Port E; drain port ..... G3/4-A Class
- Port F; pilot port ..... G1/4-A Class

Solenoid Valve
- Maximum flow ..... P -> B: 30 L / min (7.92 gpm) Other: 5 L / min (1.32 gpm)
- Rated pressure ..... 4.41 MPa (640 psi)
- Operating voltage ..... DC 20 to 32 V
- Current ..... 13.0 W (at 24 V, 20° C)

Hand control valve
- Manufacturer ..... Kawasaki
- Operating pressure ..... 3.92 MPa (569 psi)
- Secondary pressure, primary short type ..... 0.64 ± 0.1 to 2.45 ± 0.15 MPa
- Operating angle
  - Ports 1, 3 ..... 19 ± 1.9°
  - Ports 2, 4 ..... 25 ± 2.5°
- Operating torque
  - Port 1 ..... 0.58 to 2.03 N m (0.42 to 1.49 lb-ft)
  - Port 3 ..... 0.47 to 1.92 N m (0.34 to 1.41 lb-ft)
  - Ports 2, 4 ..... 0.71 to 2.30 N m (0.52 to 1.69 lb-ft)

Foot control valve
- Manufacturer ..... Nishina
- Operating pressure ..... 3.92 MPa (569 psi)
- Secondary pressure; primary short type ..... 0.64 ± 0.1 to 2.45: 0.14 MPa
- Operating angle ..... 12.4 ± 0.3°
- Operating torque
- Valve ..... 4.16 to 10.6 N m (3.06 to 7.81 lb-ft)
- Damper ..... 4.90 ± 0.98 Nm (3.61 ±0.72 lb-ft) at 0.0275 m/s

Digging force (New JIS)

Bucket digging force (Standard boom specifications)
- Standard pressure ..... 290 kN (65195 lbf)
- Power boost pressure ..... 317 kN (71264 lbf)

Bucket digging force (Mass boom specifications)
- Standard pressure ..... 334 kN (75086 lbf)
- Power boost pressure ..... 365 kN (82055 lbf)

Arm (dipper) digging force (Standard boom specifications)
- Standard pressure
  - 3.00 m arm ..... 244 kN (54853 lbf)
  - 3.55 m arm ..... 224 kN (50357 lbf)
  - 4.11 m arm ..... 202 kN (45412 lbf)
  - 5.00 m arm ..... 175 kN (39342 lbf)
- Power boost pressure
  - 3.00 m arm ..... 267 kN (60024 lbf)
  - 3.55 m arm ..... 245 kN (55078 lbf)
  - 4.11 m arm ..... 221 kN (49683 lbf)
  - 5.00 m arm ..... 192 kN (43163 lbf)

Arm (dipper) digging force (Mass boom specifications)
- Standard pressure
  - 3.00 m arm ..... 237 kN (53280 lbf)
- Power boost pressure
  - 3.00 m arm ..... 259 kN (58226 lbf)

Swing unit

Swing circle; swing bearing type (with internal gears)

Swing hydraulic motor (2); fixed displacement piston motor with parking brake and reversal prevention valve
- Displacement ..... 210.1 cm^3 (12.82 cu in)/rev
- Operating pressure ..... 27.9 MPa (4046.55 psi)
- Operating flow ..... 224 L/min (59.17 gpm)
- Brake torque ..... 1161 to 1504 N m (856 to 1109 lb-ft)
- Brake off pressure ..... 2.6 MPa (377.09 psi) less than
- Relief set pressure ..... 26.9 to 27.9 MPa (3902 to 4047 psi) at 215 L/min (56.79 gpm)

Reduction gears, planetary gear 2-stage reduction system
- Reduction ratio 23.247

Swing parking brake; mechanical lock (operational lever linkage type)

Swing lock; mechanical lock (swing lock switch linkage type

Travel lower body

Travel hydraulic motor (2); variable displacement piston motor, automatic 2-speed switch-over with parking brake
- Displacement ..... 337.2 / 228.6 cm^3 (20.57/13.95 cu in)/rev
- Operating pressure ..... 34.3 MPa (4975 psi)
- Operating flow ..... 448 L/min (118.34 gpm)
- Brake torque ..... 1120 N•m (826.06 lb-ft) or over (excluding reduction gear)
- Relief set pressure ..... 35.3 MPa (5120 psi) at 40 L/min (10.56 gpm)
- 2-speed control pressure ..... 25.5 ± 1 MPa (3698 psi)

Reduction gears; planetary gear 3-stage reduction system
- Reduction ratio 74.853

Travel brake; hydraulic lock

Parking brake; mechanical lock (travel lever linkage type)

Track shoe
- Model; assembly-type double grouser shoe
- Number of shoes (per side) 47
- Shoe width
  - standard ..... 900 mm (35.43 in)
  - optional ..... 650 mm (25.59 in), 750 mm (29.52 in)
- Grouser height ..... 50 mm (1.96 in)

Link pitch .....260.35 mm (10.24 in)
Roller
Number of upper rollers (per side) 3
Number of lower rollers (per side) 8
Track belt tension adjuster; grease cylinder type (with cushion spring)
mounting length of spring.....1080 mm (42.52 in)

Work Unit

Model; backhoe attachment
Capacity / dimensions / working dimensions
Boom length (Standard boom spec.) .....7700 mm (303.14 in)
Boom length (Mass boom spec.) .....6580 mm (259.05 in)

	Standard boom				Mass boom
	Standard arm 3.55 m (11 ft 7.7 in)	Short arm 3.00 m (9 ft 10 in)	Long arm 4.11 m (13 ft 1.4 in)	Super Long arm 5.00 m (16 ft 4.8 in)	Digging arm 3.00 m (9 ft 10 in)
Arm length	3550 mm (1398 in)	3020 mm (1189 in)	4110 mm (1618 in)	5000 mm (1968.5 in)	3020 mm (1189 in)
Bucket radius	2100 mm (827 in)	2100 mm (827 in)	2100 mm (827 in)	2100 mm (827 in)	2200 mm (866 in)
Bucket wrist angle	175°	175°	175°	175°	170°
Maximum digging radius	13160 mm (5181 in)	12870 mm (5067 in)	13650 mm (5374 in)	14600 mm (5748 in)	11750 mm (4626 in)
Maximum digging radius at ground line	12900 mm (5079 in)	12600 mm (4961 in)	13400 mm (5276 in)	14300 mm (5620 in)	11460 mm (4512 in)
Maximum digging depth	8400 mm (3307 in)	7870 mm (3098 in)	8970 mm (3532 in)	9850 mm (3878 in)	7180 mm (2827 in)
Maximum vertical straight wall digging depth	6870 mm (2705 in)	6850 mm (2697 in)	7360 mm (2898 in)	8630 mm (3398 in)	5100 mm (2008 in)
Maximum reach height	11920 mm (4693 in)	12400 mm (4882 in)	12040 mm (4740 in)	12700 mm (5000 in)	11130 mm (4382 in)
Maximum dump height	8020 mm (3157 in)	8330 mm (3280 in)	8160 mm (3213 in)	8710 mm (3429 in)	7040 mm (2772 in)
Minimum swing radius at front	5810 mm (2287 in)	5860 mm (2307 in)	5680 mm (2236 in)	5700 mm (2244 in)	5210 mm (2051 in)
Overall height with minimum swing radius at front	10040 mm (3953 in)	9990 mm (3933in)	10030 mm (3949 in)	10030 mm (3949 in)	9070 mm (3571 in)

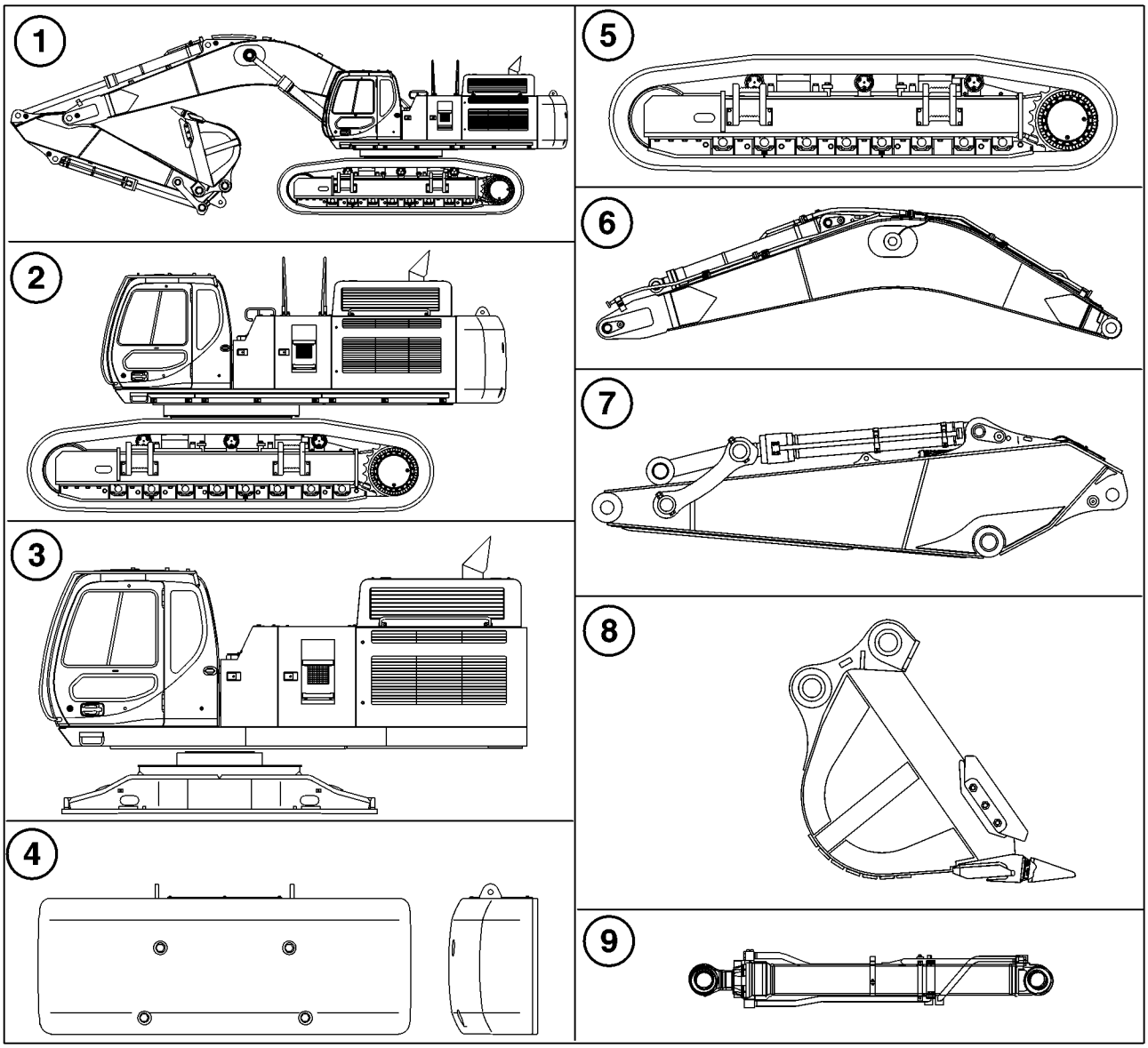
Reference Values

Numerical values for performance may change without notice due to product improvement.

Items				Reference values	Conditions
1	Engine speed (RPM)	Idling		900 ± 10	Mode: H
		Maximum without load		1870 ± 10	
2	Pressure of each part	Main Relief	Standard	31.4 ± 1.0 MPa 4554 ± 145 PSI	Mode: S
			Boosting	34.3 ± 1.0 MPa 4974 ± 145 PSI	
		Swing relief	Vertical	27.9 ± 1.0 MPa 4046 ± 145 PSI	
		Pilot relief		4.4 ± 0.2 MPa 638 ± 30 PSI	
3	Natural lowering level of each cylinder	Boom cylinder		10 mm (25/64 in) or below	No load for 10 minutes
		Arm cylinder		15 mm (19/32 in) or below	
		Bucket cylinder (when open)		20 mm (25/32 in) or below	
		Overall		225 mm (9 in) or below	No load for 10 minutes
4	Operational speed of each cylinder (sec)	Boom	Up	5.6 ± 0.6	Mode: S
			Down	4.1 ± 0.4	
		Arm	Open	3.8 ± 0.4	
			Close	4.4 ± 0.4	
		Bucket	Open	3.4 ± 0.3	
			Close	3.4 ± 0.3	
5	Swing speed (sec/1 revolution)			6.3 ± 0.3	Mode: S
6	Swing angle 180°, neutral brake flow angle (degrees)			50° or below	Mode: S
7	Travel speed (sec/20 ft)		High	6.5 ± 0.3	Mode: S
8	Number of drive sprocket revolutions (sec/10 revolutions)		High	23.5 ± 1.8	Mode: S
			Low	16.3 ± 1.8	
9	Amount of turntable bearing shift		Horizontal	13.5mm (17/32in) or below	Mode: S
			Vertical	2.1mm (5/64in) or below	
10	Amount of shoe tension ranging from the side frame bottom to shoe surface			410 to 430 mm (16 to 17 in)	

COMPONENT WEIGHT

Major component weight



700-3-01-00-45A

Weight information is approximate

1) Overhall machine	69500 kg (153220 lbs)
2) Machine without attachment	54800 kg (120810 lbs)
3) Upperstructure assembly	22500 kg (49600 lbs)
4)Counterweight	10500 kg (23150 lbs)
5) Side Frame 900 mm (35.43 in) (47 shoe)	10900 kg (24030 lbs)
6) Boom assembly	6600 kg (14550 lbs)
7) Dipper assembly	3430 kg (7580 lbs)
8) Bucket	3000 kg (6600 lbs)
9) Boom cylinder assembly	700 kg (1545 lbs)

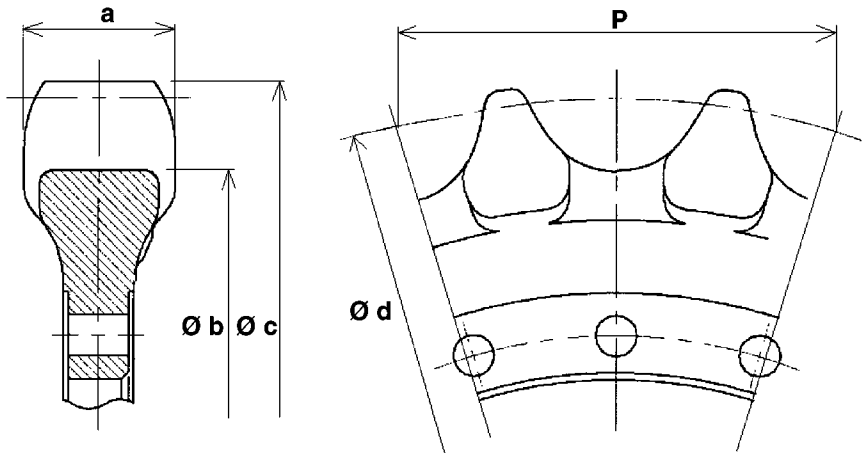
Other component weight

Engine	Approximately 1185 kg (2612 lbs)
Air cleaner	40.3 kg (89 lbs)
Hydraulic pump	300 kg (661lbs)
Attachment control valve	430 kg (948 lbs)
Swing motor and reduction gear assembly (2)	410.8 kg (906 lbs)
Travel motor and reduction gear assembly	761.6 kg (1679 lbs)
Rotary joint	106.7 kg (235 lbs)
8 solenoid valve bank	10.5 kg (23lbs)
Hand control valve	1.8 kg (4 lbs)
Foot control valve	10.5 kg (23 lbs)
Boom cylinder	598 kg (1318 lbs)
Arm (dipper) cylinder	753 kg (1660 lbs)
Bucket cylinder (Standard boom)	479 kg (1056 lbs)
Bucket cylinder (Mass boom)	605 kg (1334 lbs)
Cab	255 kg (560 lbs)
Muffler	21.0 kg (46 lbs)
Radiator total weight	601 kg (1325 lbs
Oil cooler	215 kg (474 lbs)
Radiator	23.6 kg (52 lbs) x 3
Air cooler	35 kg (77 lbs)
Fuel cooler	6 kg (13.22 lbs)
Idler wheel	454 kg (1000 lbs)
Upper roller	63.4 kg (140 lbs)
Lower roller	136.9 kg (302 lbs)
Tension damper assembly	709.2 kg (1563 lbs)
Recoil spring assembly	552.1 kg (1217 lbs)
Grease cylinder assembly	153.4 kg (338 lbs)
Track chains	
650 mm (25.6 in) (47 shoe)	3873 kg (8538 lbs)
750 mm (29.5 in) (47 shoe)	4178.6 kg (9212 lbs)
900 mm (35.4 in) (47 shoe)	4578.1 kg (10093 lbs)

DIMENSIONS AND WEAR LIMIT OF THE TRACK ASSEMBLY

Sprocket

Dimensions

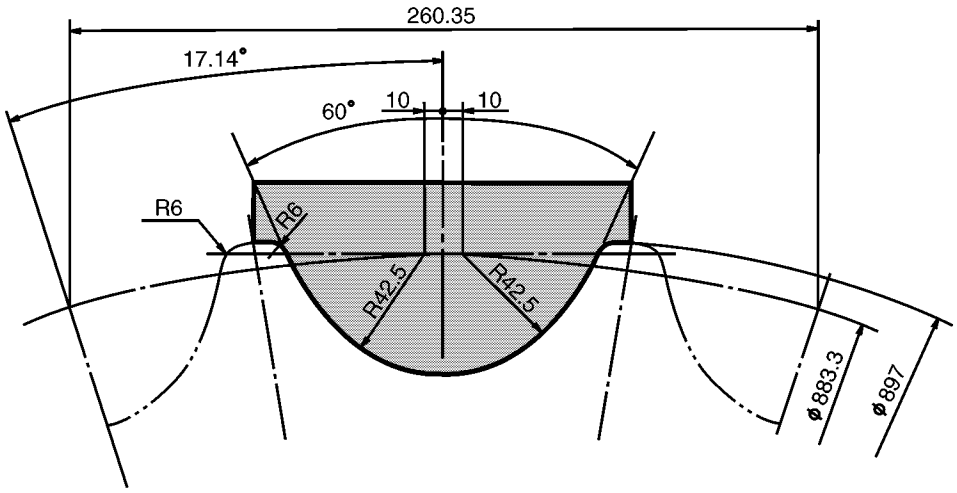


CS01B512

Mark		Dimension	
		mm	in
a	Standard	106.5	4.19
	Limit	92	3.62
Ø b	Standard	797.2	31.39
	Limit	787.2	30.99
Ø c	Standard	897.1	35.32
	Limit	883.6	34.79
Ø d	Standard	883.28	34.77
	Limit	---	---
P	Standard	230.35	9.07
	Limit	---	

Gauge

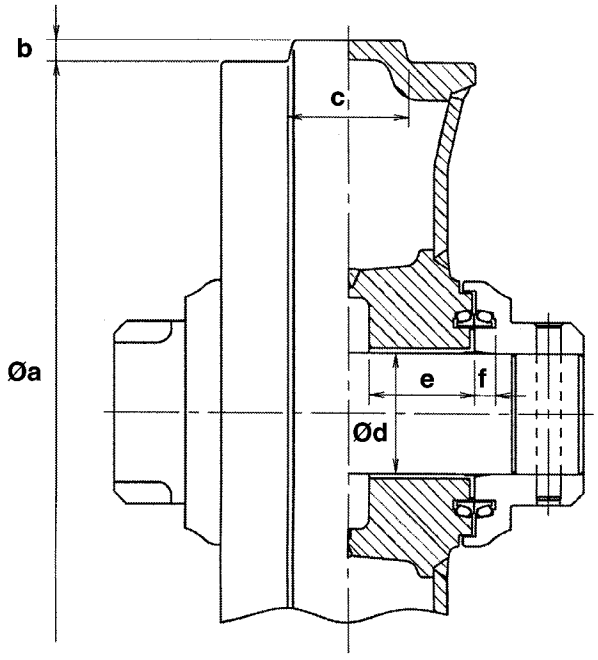
unit in mm



700-6-10-03-13A

Idler wheel

Dimensions

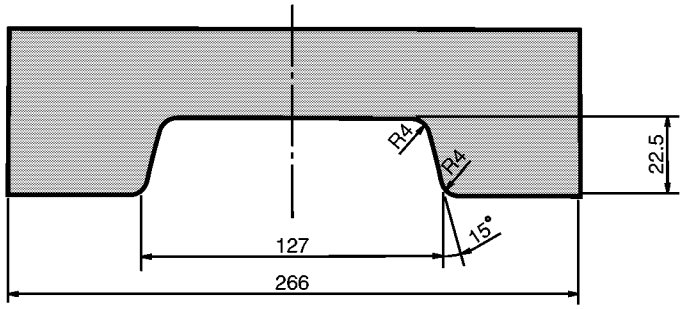


700-6-10-00-10B

Mark		Dimension	
		mm	in
Ø a	Standard	730	28.74
	Limit	724	28.5
b	Standard	22.5	0.89
	Limit	---	---
c	Standard	127	5
	Limit	125	4.92
Ø d (shaft)	Standard	125	4.92
	Limit	124	4.88
Ø d (bushing)	Standard	125	4.92
	Limit	126	4.96
e (bushing)	Standard	110	4.331
	Limit	109.9	4.327
f	Standard	21.6	0.85
	Limit		

Gauge

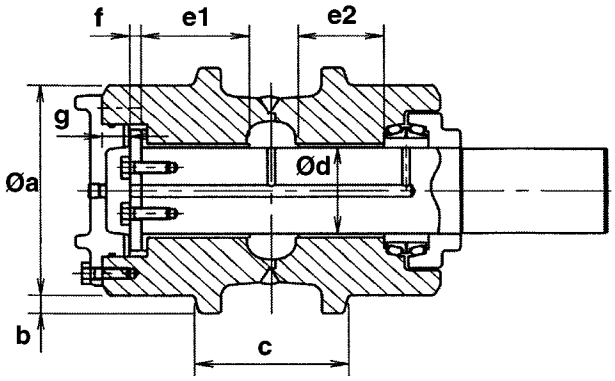
Unit in mm



700-6-10-03-13B

Upper roller

Dimensions

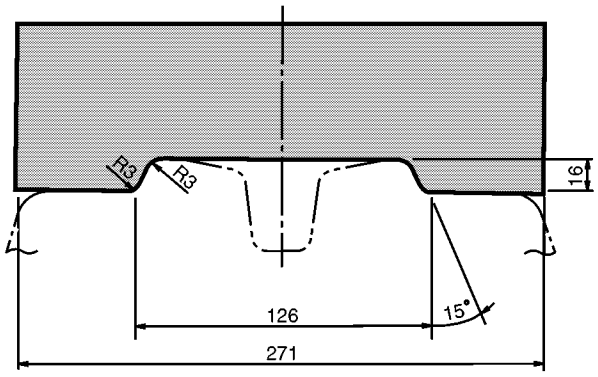


700-6-10-00-10C

Mark		Dimension	
		mm	in
Ø a	Standard	190	7.48
	Limit	178	7.01
b	Standard	16	0.63
	Limit	---	---
c	Standard	126	4.96
	Limit	118	4.65
Ø d (shaft	Standard	78	3.07
	Limit	77.6	3.06
Ø d (bushing)	Standard	78	3.07
	Limit	78.4	3.09
e1/e2 (bushing)	Standard	88/70	3.46/2.76
	Limit	87.6/---	3.46/---
f	Standard	9	0.35
	Limit	8	0.31
g	Standard	21.7	0.85
	Limit	---	---

Gauge

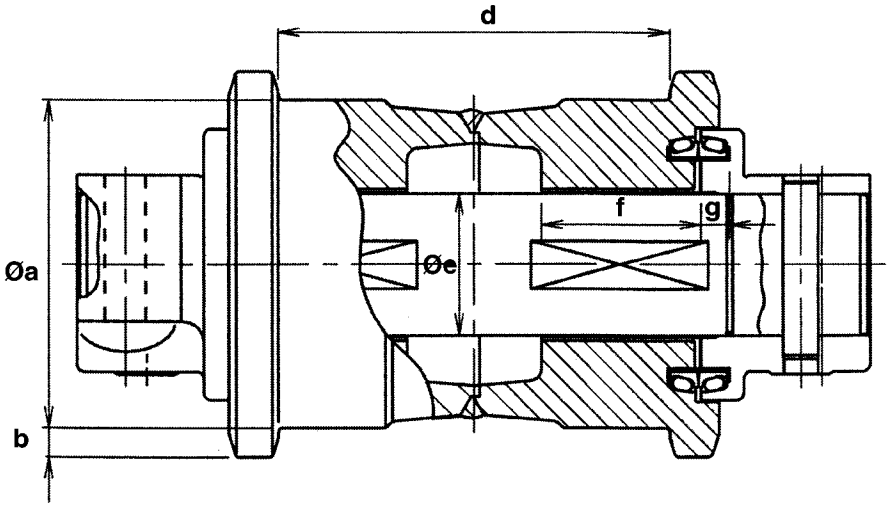
Unit in mm



700-6-10-03-13C

Lower roller

Dimensions

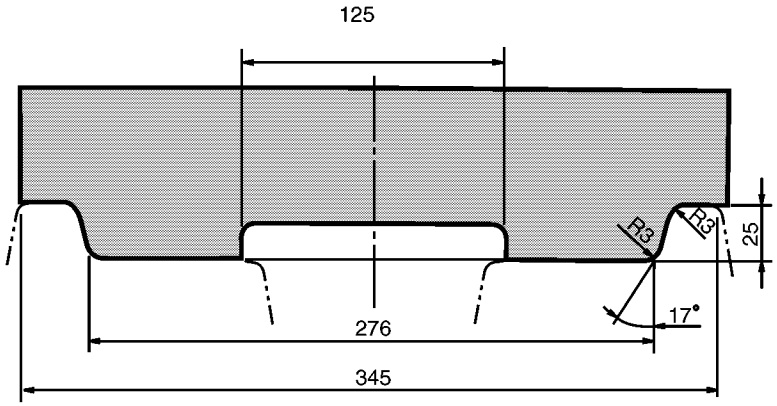


700-6-10-00-10D

Mark		Dimension		Mark		Dimension	
		mm	in			mm	in
Ø a	Standard	230	9.06	Ø e (bushing)	Standard	100	3.94
	Limit	212	8.35		Limit	101	3.98
b	Standard	25	0.98	f	Standard	113	4.45
	Limit	---	---		Limit	112.5	4.43
d	Standard	276	10.87	g	Standard	20	0.79
	Limit	288	11.34		Limit	19.5	0.77
Ø e (Pin)	Standard	100	3.94				
	Limit	99	3.90				

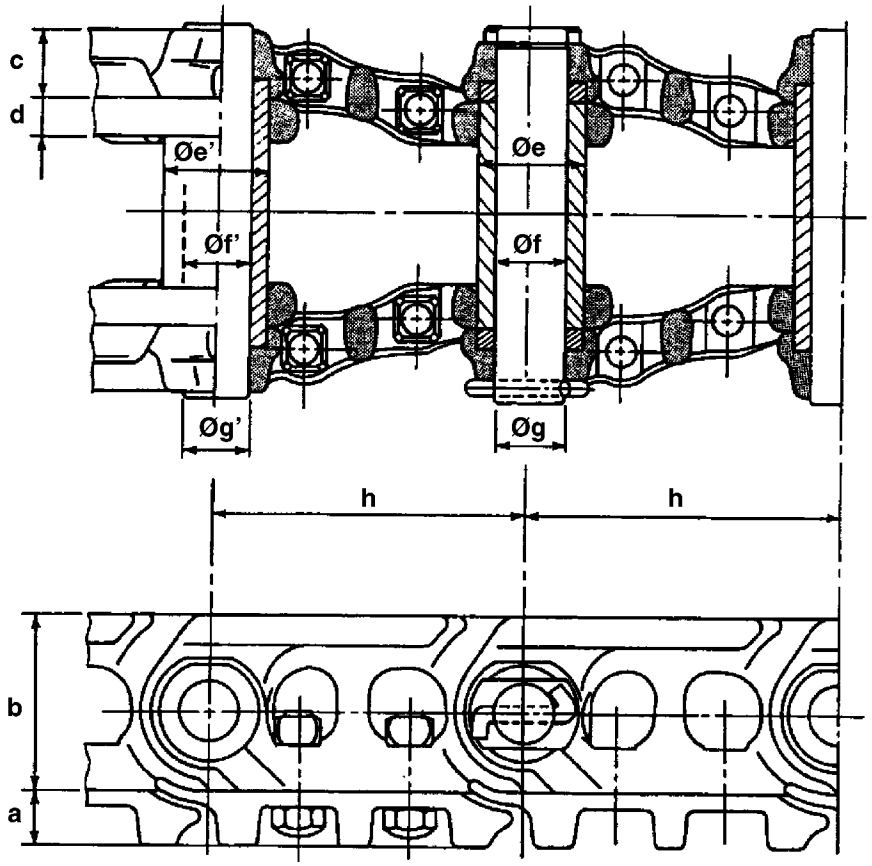
Gauge

Unit in mm



700-6-10-03-13D

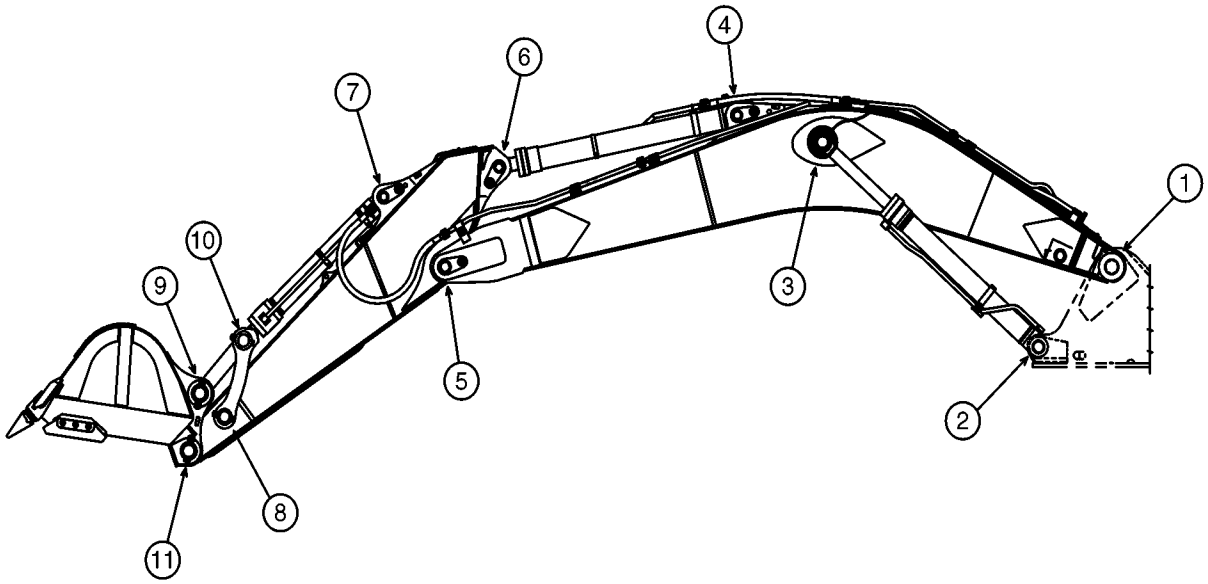
Track



CS01B520

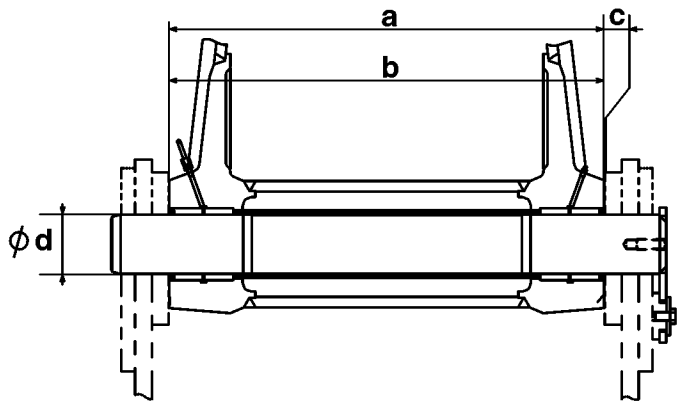
Mark		Dimension		Mark		Dimension	
		mm	in			mm	in
a	Standard	69	2.72	h	Standard	260.35	10.25
	Limit	43	1.69		Limit	265.8	10.46
b	Standard	152	5.98	Ø e' (bushing)	Standard	85.4	3.36
	Limit	146	5.75		Limit	80.7	3.18
c	Standard	106	4.17	Ø f' (bushing)	Standard	58.15	2.29
	Limit	104	4.09		Limit	---	---
d	Standard	36	1.42	Ø g' (Pin)	Standard	57	2.24
	Limit	34	1.34		Limit	---	---
Ø e (bushing)	Standard	85.4	3.36				
	Limit	80.7	3.18				
Ø f (bushing)	Standard	57.65	2.27				
	Limit	---	---				
Ø g (Pin)	Standard	56.8	2.24				
	Limit	---	---				

DIMENSIONS AND WEAR LIMITS OF ATTACHEMENT MOBILE JOINTS



700-1-06-05JJ

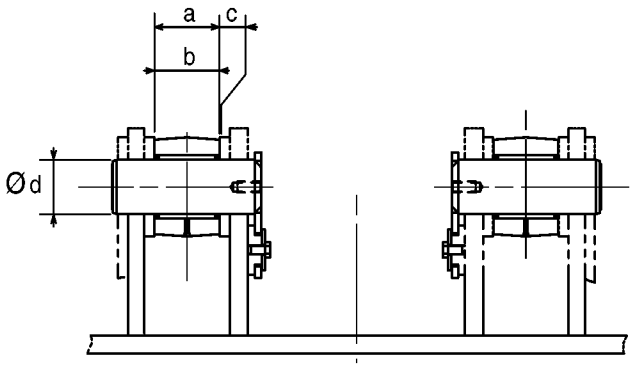
1. Boom foot/Frame



700-1-06-02-05JA

Mark		Dimension mm	
		mm	in
a (frame)	Standard	1030	40.55
	Limit	1038	40.87
b (boom)	Standard	1027	40.43
	Limit	1024	40.31
c (clearance)	Standard	3	0.12
	Limit	Shim adjustment	
Ø d (pin)	Standard	140	5.51
	Limit	139	5.47
Ød (bushing)	Standard	140	5.51
	Limit	141.5	5.57

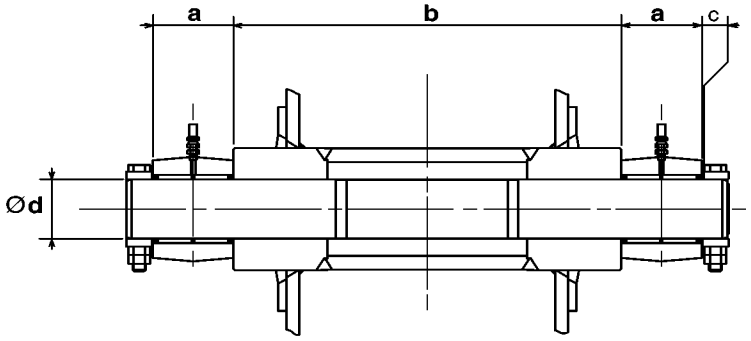
2. Boom cylinder foot/Frame



700-1-06-02-05JB

Mark		Dimension	
		mm	in
a (boom)	Standard	162	6.38
	Limit	168	6.61
b (cylinder)	Standard	161	6.34
	Limit	159	6.26
c (clearance)	Standard	1	0.04
	Limit	Shim adjustment	
Ø d (pin)	Standard	120	4.72
	Limit	119	4.69
Ød (bushing)	Standard	120	4.72
	Limit	121.5	4.78

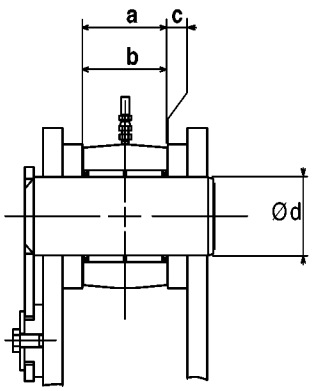
3. Boom cylinder head/Boom



700-1-06-02-05JC

Mark		Dimension	
		mm	in
a	Standard	155	6.1
	Limit	152	5.98
b	Standard	743	29.25
	Limit	739	29.09
c (clearance)	Standard	2	0.08
	Limit	Shim adjustment	
Ø d (pin)	Standard	130	5.12
	Limit	129	5.08
Ød (bushing)	Standard	130	5.12
	Limit	131.5	5.18

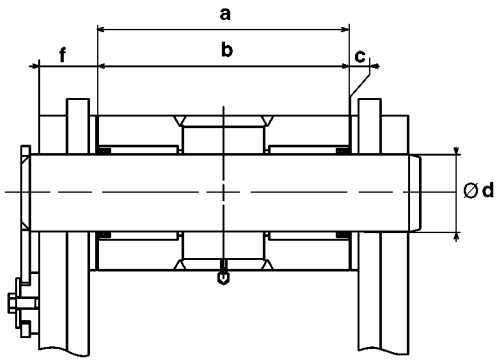
4. Arm cylinder foot/Boom



700-1-06-02-05JD

Mark		Dimension	
		mm	in
a (boom)	Standard	156	6.14
	Limit	162	6.38
b (cylinder)	Standard	155	6.1
	Limit	153	6.02
c (clearance)	Standard	1	0.04
	Limit	Shim adjustment	
Ø d (pin)	Standard	120	4.72
	Limit	119	4.69
Ød (bushing)	Standard	120	4.72
	Limit	121.5	4.78

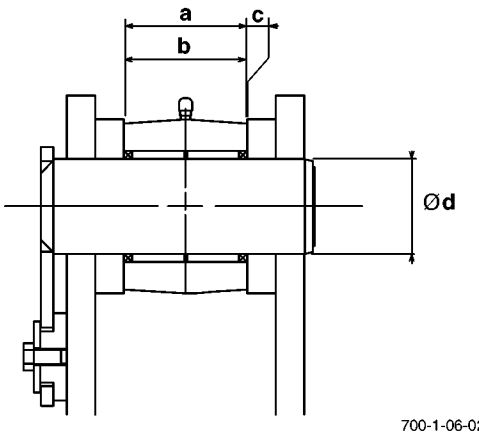
5. Boom/Arm



700-1-06-02-05JE

Mark		Dimension	
		mm	in
a (boom)	Standard	462	18.19
	Limit	465	18.31
b (arm)	Standard	457.7	18.02
	Limit	454.7	17.9
c (clearance)	Standard	1	0.04
	Limit	Shim adjustment	
Ø d (pin)	Standard	140	5.51
	Limit	139	5.47
Ød (bushing)	Standard	140	5.51
	Limit	141.5	5.57
f	Standard	104	4.09
	Limit	---	

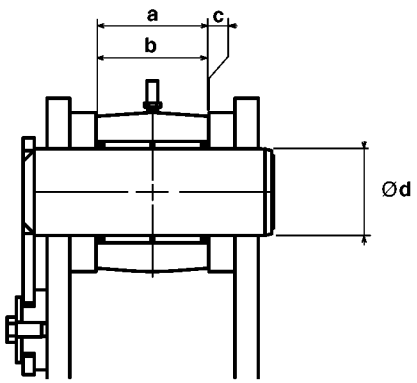
6. Arm cylinder head/Arm



700-1-06-02-05JH

Mark		Dimension	
		mm	in
a (arm)	Standard	156	6.14
	Limit	161	6.34
b (cylinder)	Standard	155	6.1
	Limit	153	6.02
c (clearance)	Standard	1	0.04
	Limit	Shim adjustment	
Ø d (pin)	Standard	120	4.72
	Limit	119	4.69
Ød (bushing)	Standard	120	4.72
	Limit	121.5	4.78

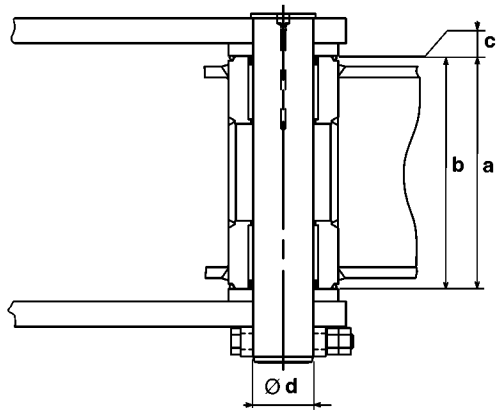
7. Bucket cylinder foot/Arm



700-1-06-02-05JI

Mark		Dimension	
		mm	in
a (arm)	Standard	156	6.14
	Limit	161	6.34
b (cylinder)	Standard	155	6.1
	Limit	153	6.02
c (clearance)	Standard	1	0.04
	Limit	Shim adjustment	
Ø d (pin)	Standard	120	4.72
	Limit	119	4.69
Ød (bushing)	Standard	120	4.72
	Limit	121.5	4.78

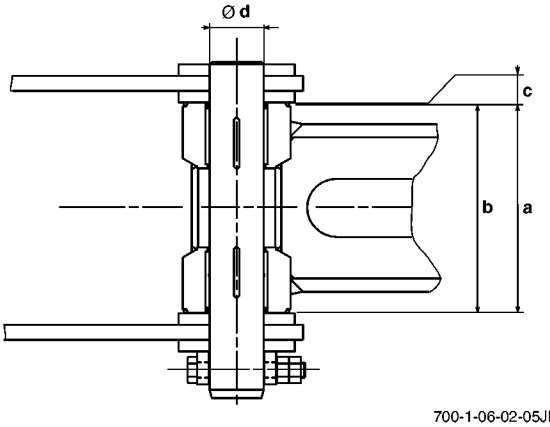
8. Connecting rod/Arm



700-1-06-02-05JK

Mark		Dimension	
		mm	in
a (link)	Standard	467	18.39
	Limit	472	18.58
b (arm)	Standard	466	18.35
	Limit	462	18.19
c (clearance)	Standard	1	0.04
	Limit	Shim adjustment	
Ø d (pin)	Standard	120	4.72
	Limit	119	4.69
Ød (bushing)	Standard	120	4.72
	Limit	121.5	4.78

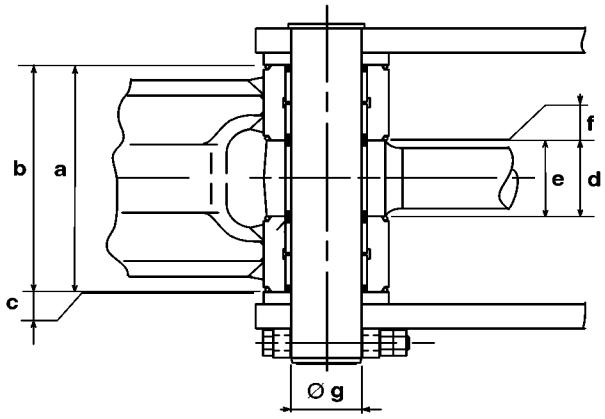
9. Compensator/Bucket



700-1-06-02-05JL

Mark		Dimension	
		mm	in
a (bucket)	Standard	508	20
	Limit	513	20.2
b (link)	Standard	507	19.96
	Limit	504	19.84
c (clearance)	Standard	1	0.04
	Limit	Shim adjustment	
Ø d (pin)	Standard	130	5.12
	Limit	129	5.08
Ød (bushing)	Standard	130	5.12
	Limit	131.5	5.18

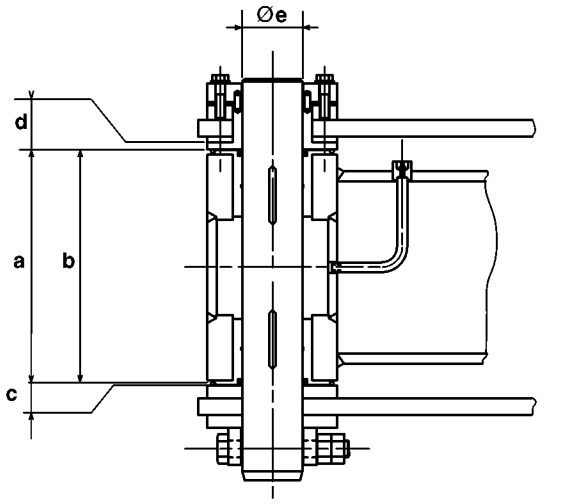
10. Connecting rod/Compensator/Bucket cylinder head



700-1-06-02-05JF

Mark		Dimension	
		mm	in
a (link)	Standard	467	18.39
	Limit	472	18.58
b (bucket)	Standard	466	18.35
	Limit	461	18.15
c (clearance)	Standard	1	0.04
	Limit	Shim adjustment	
d (link)	Standard	156	6.14
	Limit	158	6.22
e (cylinder)	Standard	155	6.1
	Limit	153	6.02
f (d - e)	Standard	1	0.04
	Limit	Shim adjustment	
Ø g (pin)	Standard	130	5.12
	Limit	129	5.08
Ø g (link)	Standard	130	5.12
	Limit	131.5	5.18
Ø g (cylinder)	Standard	130	5.12
	Limit	131.5	5.18

11. Arm/Bucket

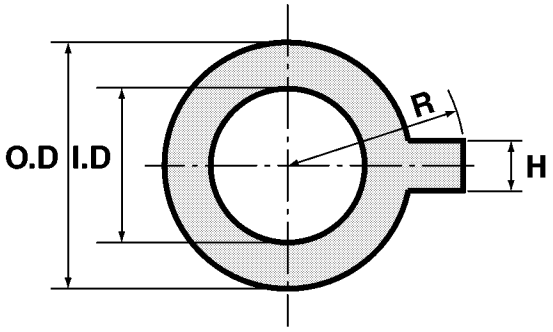


700-1-06-02-05JG

Mark		Dimension	
		mm	in
a (bucket)	Standard	508	20
	Limit	---	---
b (arm)	Standard	506	19.92
	Limit	510	20.08
c (clearance)	Standard	1	0.04
	Limit	Shim adjustment	
d	Standard	16	0.63
	Limit	10	0.39
Ø e (pin)	Standard	130	5.12
	Limit	129	5.08
Ø e (arm)	Standard	130	5.12
	Limit	131.5	5.18
Ø e (bucket)	Standard	130	5.12
	Limit	131.5	5.18

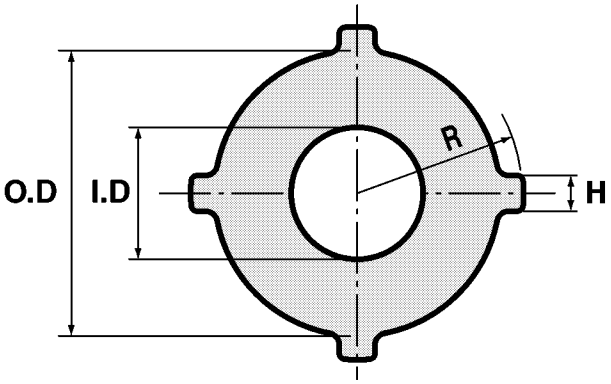
SHIMS FOR ADJUSTING ATTACHMENT GAPS

For boom foot



000-6-10-02-02A

Part No.	I.D.	O.D.	R	H	Shim Thickness	Material
KNV1132	76	160	100	30	1.2	SPHC
KRV2390	91	190	115	30	1.2	SPHC
KBV1441	101	220	130	30	1.2	SPHC
KBV1748	101	230	135	30	1.2	SPHC
KSV1805	111	240	140	30	1.2	SPHC



000-6-10-02-02B

Part No.	I.D.	O.D.	R	H	Shim Thickness	Material
KSV1930	111	240	140	30	1.0	Urethone
KSV11380	111	240	140	30	2.0	Urethone
KSV1931	116	240	140	30	1.0	Urethone
KSV11390	116	240	140	30	2.0	Urethone

NOTES

SPECIAL TORQUE SETTINGS

No.	Component	Screw	Wrench (mm)	Torque setting
1 *	Travel motor and reduction gear assembly	M24	41	901-1052 Nm (664 - 776 lb-ft)
2 *	Sprocket	M24	41	901-1052 Nm (664 - 776 lb-ft)
3	Idler wheel			
4 *	Upper roller	M30	46	1781-2078 Nm (1314-1533 lb-ft)
5 *	Lower roller	M30	46	1781-2078 Nm (1314-1533 lb-ft)
6 *	Chain guide	M30	46	1668-1962 Nm (1230-1447 lb-ft)
7	Track pad	M27	30	1765-2157 Nm (1302-1591 lf-ft)
8	Counterweight	M42	65	2256-2550 Nm (1664-1880 lb-ft)
9*	Turntable (frame)	M30	46	1460-1700 Nm (1077-1254 lb-ft)
10*	Turntable (upperstructure)	M30	46	1460-1700 Nm (1077-1254 lb-ft)
11 *	Swing motor and reduction gear assembly	M24	36	900-1050 Nm (664-775 lb-ft)
12 *	Engine	M24	36	902-1049 Nm (665-774 lb-ft)
13 *	Engine bracket	M14	22	173-202 Nm (128-149 lb-ft)
14	Radiator	M20	30	392-490 Nm (289-361 lb-ft)
15 *	Hydraulic pump	M12	19	109-127 Nm (80-94 lb-ft)
16 *	Hydraulic reservoir	M20	30	471-258 Nm (347-419 lb-ft)
17 *	Fuel reservoir	M20	30	471-258 Nm (347-419 lb-ft)
18 *	Control valve	M20	30	343-392 Nm (253-289 lb-ft)
19 *	Hydraulic swivel	M12	19	109-127 Nm (80-94 lb-ft)
		M16	24	267-312 Nm (197-230 lb-ft)
20	Cab	M16	24	78-80 Nm (58-59 lb-ft)
21	Battery	M10	17	20-29 Nm (15-21 lb-ft)
22	Frame	M36	55	2550-2942 Nm (1880-2170 lb-ft)
23	Frame	M30	46	1781-2078 Nm (1314-1533 lb-ft)
24	Air cleaner			

NOTE: *Use Loctite 262 or an equivalent on retaining screws of those components marked with an asterisk (*).*