PROCEDURE FOR INSPECTION OF PISTONS & LINERS

PARTS I, II & III
Version 1.0 – November 2010

MAN | PrimeServ

PISTON CROWN

PISTON DEPOSITS

RING BREAKAGE

RING MOVEMENT

SURFACE CONDITION

LUBRICATION CONDITION

SCAVENGE COMPARTMENTS

SCOPE OF SCAVENGE PORT INSPECTIONS:

The following shall be carried out during a scavenge port inspection:

- Visual examination in accordance with requirements of MAN *Inspection Through Scavenge Ports* form.
- Measurement of the remaining depth of the pressure relief grooves (CL grooves), ring groove clearance and piston burn-away in accordance with *MAN Condition Monitoring Report (Port Inspection)* form.
- Inspection of the cylinder liner running surface through the scavenge ports.
- Photos taken of piston crown, top land, piston rings, piston skirt, piston rod, cylinder liner and scavenge receiver. Photos are required for any surfaces that are wiped down or cleaned, see taking photos section for details in Part II.
- Inspection of non-return flaps.
- Inspection of water mist catcher.

PRACTICES FOR SCAVENGE PORT INSPECTIONS

1. Always use MAN Diesel & Turbo sheets *Inspection through Scavenge Ports and Cylinder Condition Report* when submitting scavenge port inspection results. Blank inspection forms are available in APPENDIX.
2. Conduct scavenge inspections on a monthly or as soon thereafter basis.
3. Always pre-view the last scavenging port inspection prior to accomplishing a new port inspection.
4. Photos and comments in this booklet are an overview of the MAN Diesel & Turbo Instruction Manual Vol. 1, Operation Manual, Chapter 707. Refer to Chapter 707 for complete descriptions of procedures for scavenge port inspections, cylinder conditions, piston conditions, ring conditions, factors influencing cylinder wear, and cylinder lubrication.
5. The scavenge port inspection should be carried out at the first stop after a long voyage, e.g. by anchoring if possible, to obtain the most reliable result with regard to the effectiveness and sufficiency of the cylinder lubrication and the combustion cycle (complete or incomplete). A misleading result may be obtained if the scavenge port inspection is carried out after arrival at harbour, since manoeuvring and low speed running requires increased oil dosage.

***one star at a photo indicate a perfect condition.**
****two stars at a photo indicate machining marks still invisible.**

PART I

Supplement to the MAN Diesel & Turbo form titled
Inspection Through Scavenge Port

Version 1.0
November 2010

PISTON CROWN

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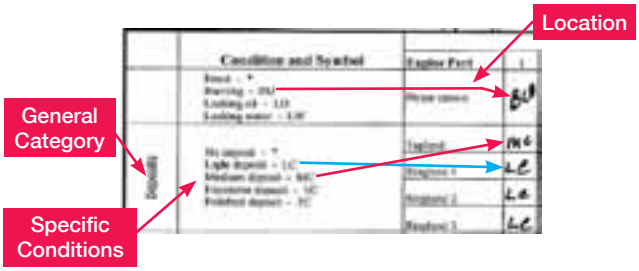
HOW TO USE THE MAN Diesel & Turbo FORM *Inspection through Scavenge Port*

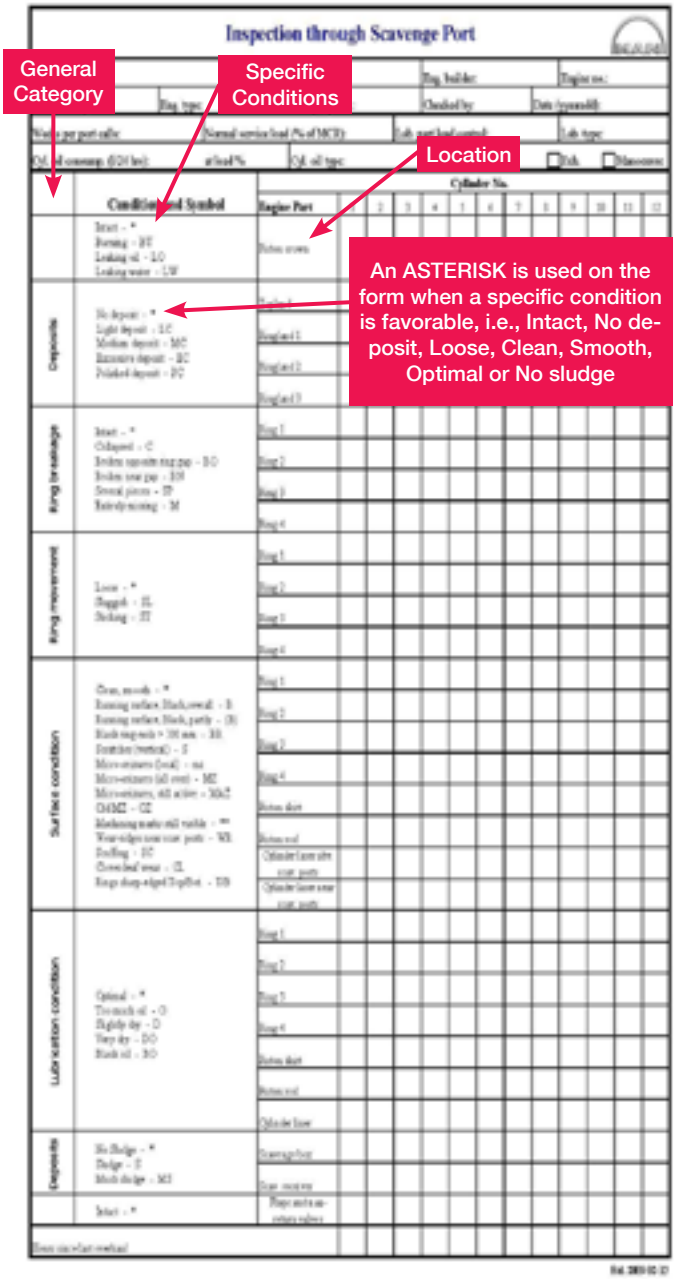
The form on the next page is the MAN Diesel & Turbo form titled *Inspection through Scavenge Port*, a blank form is provided in the APPENDIX.

The left column on the MAN Diesel & Turbo form lists GENERAL CATEGORIES, the next column lists SPECIFIC CONDITIONS within each GENERAL CATEGORY. The scavenge port inspection involves the identification of SPECIFIC CONDITIONS within each of the GENERAL CATEGORIES.

Partial view of MAN form, full page view on opposite page



When conducting a scavenge port inspection on a unit, start by asking what is the status of each GENERAL CATEGORY in relationship to the SPECIFIC CONDITION. Once that determination has been made, write the symbol for that condition in the box that corresponds to the location, i.e. topland, ring land number or ring number.



PISTON CROWN
PISTON DEPOSITS
RING BREAKAGE
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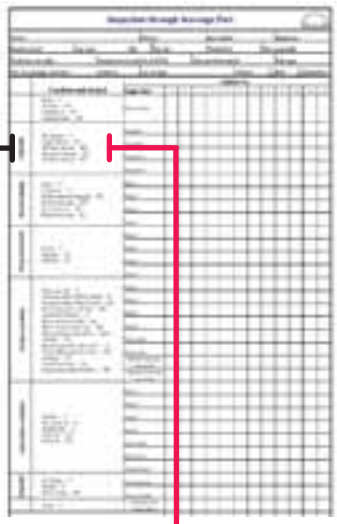
PART I

PART I of this booklet was developed to provide a photographic representation of each piston and liner condition listed on the MAN Diesel & Turbo *Inspection through Scavenge Port* form.

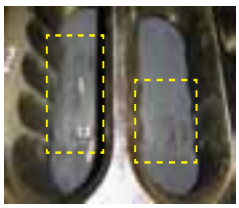
GENERAL CATEGORIES on the MAN form match the name on the tab at the bottom of each booklet page (black arrow).

SPECIFIC CONDITIONS on the form are represented by photographs (red arrow) in this booklet.



EXCESSIVE DEPOSIT - EC

EXCESSIVE DEPOSIT - EC (Close Up of Top Photo)



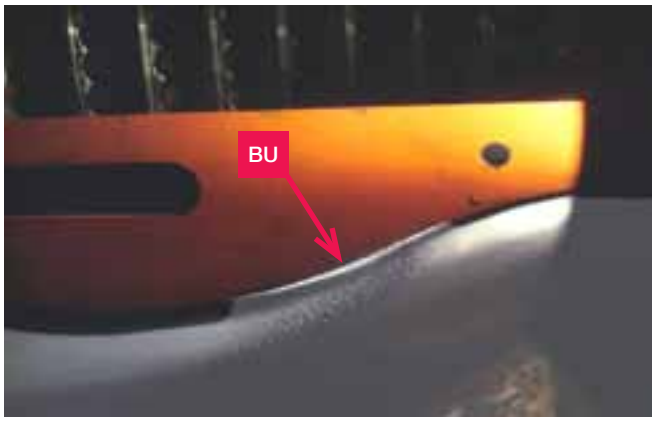
POLISHED DEPOSIT - PC

PISTON DEPOSITS

PHOTOGRAPHIC REPRESENTATIONS OF **SPECIFIC CONDITIONS** LISTED ON MAN DIESEL & TURBO FORM **INSPECTION THROUGH SCAVENGE PORT**

INTACT PISTON CROWN – *

An intact piston crown has a minor layer of carbon, no burn-away (elephant skin).



PISTON CROWN BURNING – BU

Further information concerning piston crown burning can be found in PART III.

LEAKING OIL – LO

If oil is found on the piston, determine if it is fuel oil or lube oil. Fuel oil will be black and sticky, indicating a fuel valve is leaking. Lube oil will be brown and non-sticky, indicating it could be from an exhaust valve.

LEAKING WATER – LW

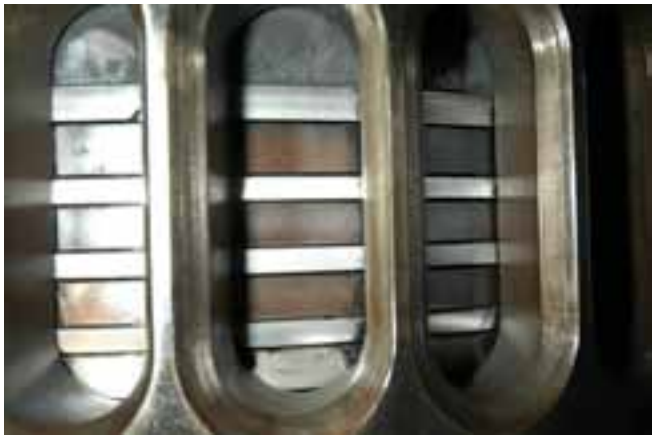
Water on a piston indicates a cooling system leak. If water is found, it is important to determine what the cause is.

Viewed by either a mirror or photo, does it appear the leak is from the cylinder head, exhaust valve, injectors or another source?

Keep cooling water and cooling oil circulating during inspection so possible leakages can be detected.

CARBON DEPOSITS

Often some deposits will accumulate on the side of the top land. Carbon deposits on the ring lands indicate lack of gas sealing at the respective rings. If the deposits are thick, the surface may be smooth and shiny from rubbing on the cylinder wall. This contact may locally wipe away the oil film, resulting in micro-seizure and increased wear of liner and rings.



NO DEPOSIT – *

Running surfaces of piston rings will be worn bright. In addition, the rings will move freely in their grooves, be well oiled evenly around the circumference of the piston, and intact.

PISTON DEPOSITS
RING BREAKAGE
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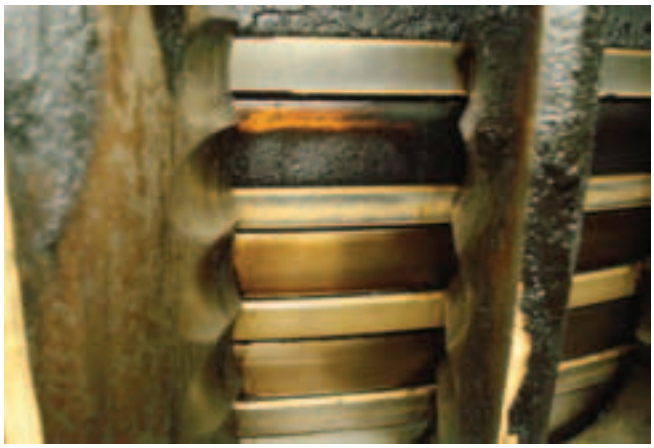
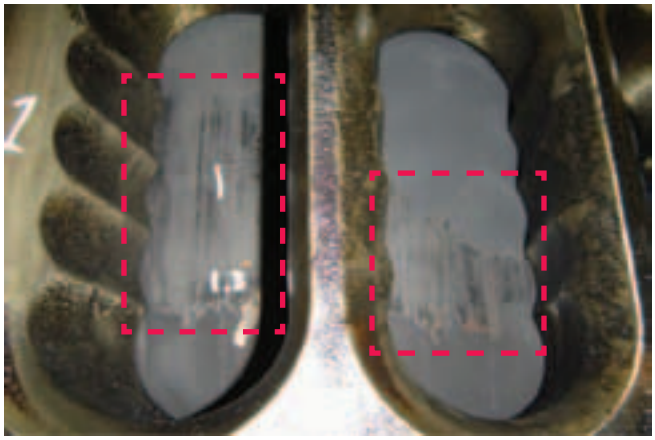


LIGHT DEPOSIT – LC

EXCESSIVE DEPOSIT – EC

Excessive carbon deposits are the result of over lubrication or improper combustion.

MEDIUM DEPOSIT- MC



POLISHED DEPOSIT – PC

If the deposits are abnormally thick, the carbon deposits may be smooth and shiny from rubbing against the cylinder wall. This can result in locally wiping away the oil film, causing micro-seizures and increased wear of liner and rings.

In some instances, mechanical clover leafing (Surface Condition section, CL) can occur, visible as vertical grooves of slightly higher wear in between the lubricating quills.

RING BREAKAGE/COLLAPSE

IF PART OF A RING IS MISSING (Condition "M"), ATTEMPT TO FIND THE MISSING PART(S). IF THE MISSING BROKEN RING PART(S) CANNOT BE LOCATED, INSPECT THE EXHAUST GAS RECEIVER, THE SCAVENGE AIR RECEIVER AND THE SCAVENGE AIR BOX, IF STILL NOT FOUND, INSPECT THE TURBOCHARGER FOR MISSING PART(S) AND/OR DAMAGE.

During a scavenge port inspection, broken rings are identified by:

- Collapsed ring (C).
- Lack of "elastic tension" (*SL and ST, Ring Movement section*).
- Blackish appearance (*B or (B), Surface Condition section*).
- Fractured ring(s) (*BO, BN or SP*).
- Missing ring (*M*).

INTACT RING – *

Running surfaces of the rings are worn bright, smooth, clean, without scratches, move freely in the grooves and are well oiled.

RING BREAKAGE
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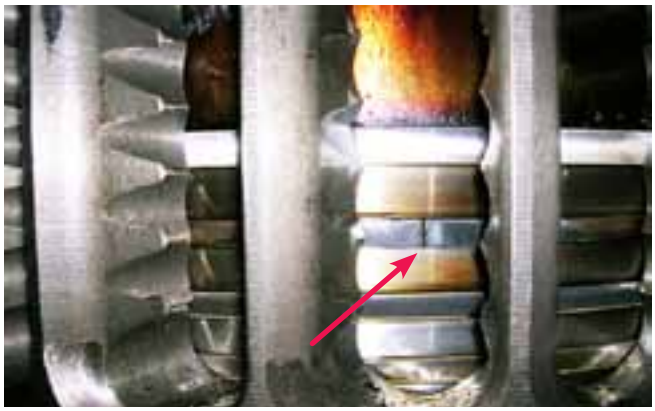
COLLAPSED RING – C

Collapse occurs if the gas pressure behind the ring is built up too slowly. With inadequate outward pressure behind the ring, combustion gas can penetrate between the liner and the ring, violently forcing the ring inwards, into the ring groove. The sudden shock loading will eventually lead to fracture, particularly if the ring ends slam against each other.

The slow pressure build-up behind the rings can be due to:

- Carbon deposits in the ring groove *(MC and EC, Deposits section)*.
- Insufficient vertical ring clearance *(PART III, Ring Groove Measurement).*
- Partial sticking *(ST, Ring Movement section)*
- Poor sealing between the ring and the ring groove floor.
- Clover-leafing *(CL, Surface Condition section)*.
- Ring end chamfers.
- Too large ring-edge radii.
- Continual striking against wear ridges *(WR, Surface Condition section)*, or other irregularities in the cylinder wall.



BROKEN OPPOSITE RING GAP – BO

Ring breakage opposite the ring gap is evidence of localized overstressing of the ring material during installation resulting in permanent deformation, causing blow-by and broken rings

BROKEN NEAR GAP – BN

If seen on topring female partbreakage often caused by turning edges in the liner top

SEVERAL PIECES – SP

ENTIRELY MISSING – M

If part of a ring is missing, attempt to find the missing part(s). If the missing broken ring part(s) cannot be located, inspect the exhaust gas receiver and the bottom of the scavenge air box, if still not found, inspect the turbocharger for missing part(s) and/or damage.

RING BREAKAGE

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RING MOVEMENT

Piston rings provide a gas tight seal between the piston and cylinder liner wall. The seal occurs by gas pressure above and behind the piston ring forcing the ring down and out towards the cylinder wall. To create this seal, free ring movement is essential.

Ring movement is described as:

- Loose
- Sluggish
- Sticking

CHECKING RING MOVEMENT

Ring movement is checked by pressing on each ring with a wooden stick through a scavenge port. Turn the piston up and down. For large bore engines it can be necessary to use a wooden block and a hammer.

RING MOVEMENT
SURFACE CONDITION
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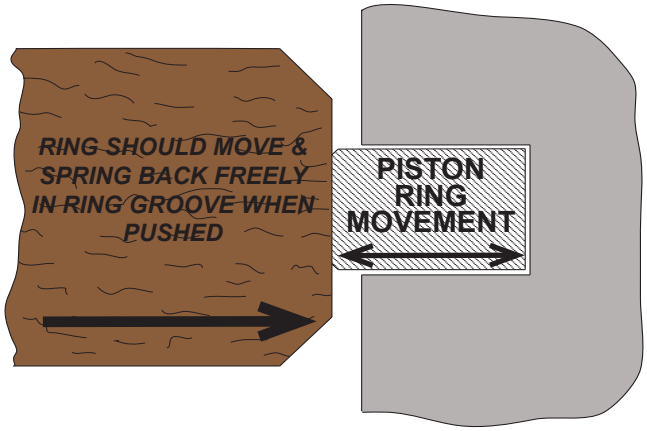
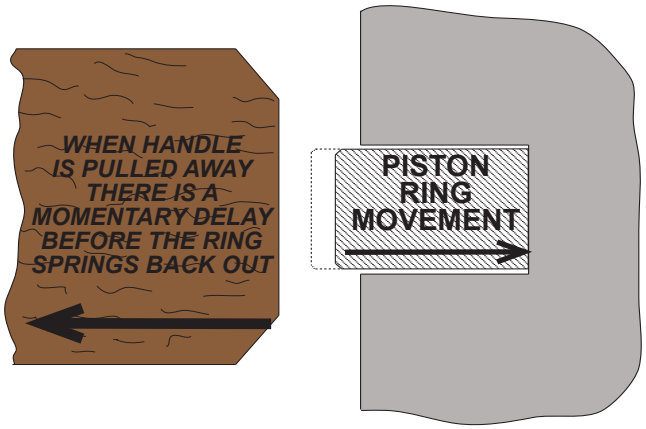
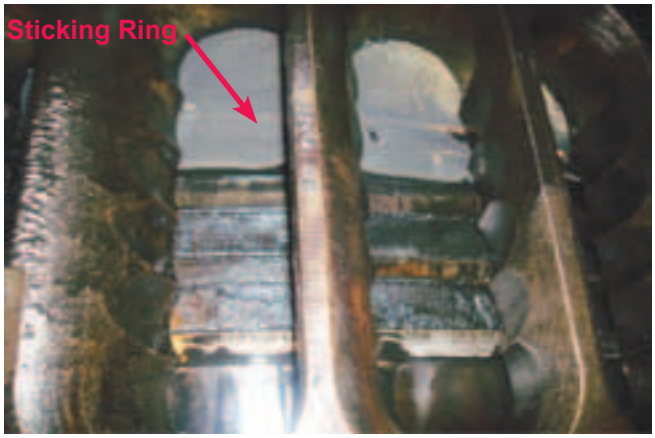
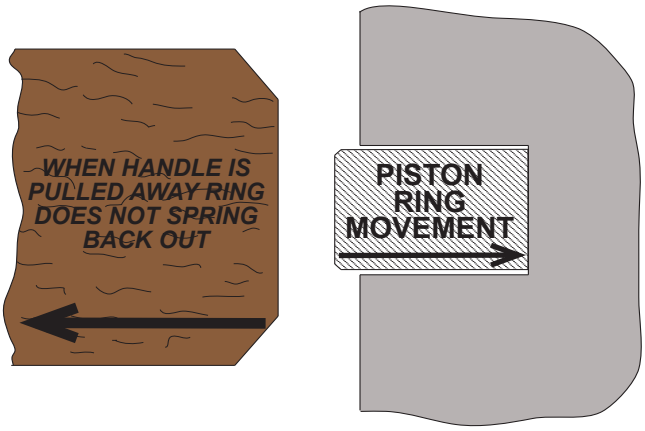


LOOSE – *



SLUGGISH – SL





STICKING – ST

RING MOVEMENT

RING MOVEMENT
SURFACE CONDITION
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SCAVENGE COMPARTMENTS

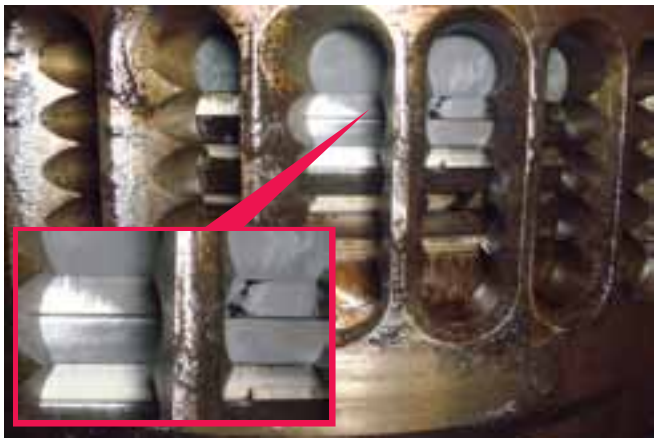
CLEAN, SMOOTH – *

Running surfaces of the piston rings and cylinder liner are worn bright, rings move freely in the grooves, are well oiled, and intact.

BLOW-BY:

Blow-by, the leakage of combustion gas past the piston rings, is the result of ring sticking, collapse or breakage. It is indicated by black, dry areas on the rings and by larger black dry zones on the upper part of the liner wall which can only be seen when overhauling the piston or when exchanging the exhaust valve. In this booklet, blow-by is indicated by the following conditions: BLACK OVERALL, BLACK PARTIALLY and BLACK RING ENDS.

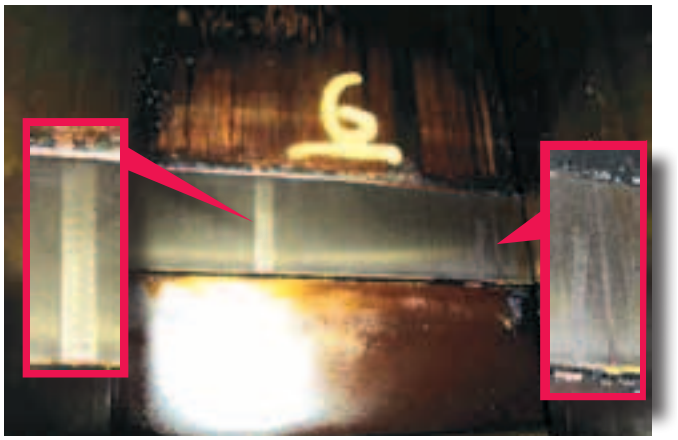
RUNNING SURFACE, BLACK OVERALL – B



RUNNING SURFACE, BLACK PARTLY – (B)

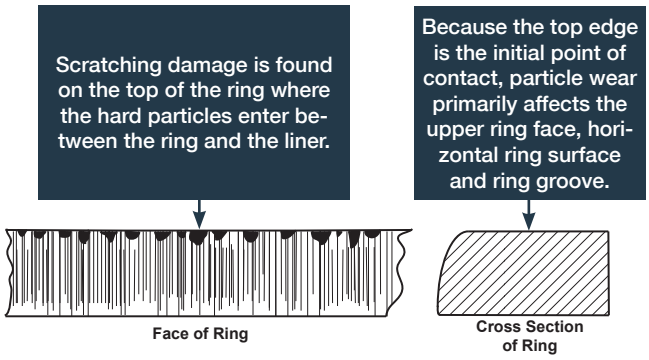
BLACK RING ENDS >100MM – BR

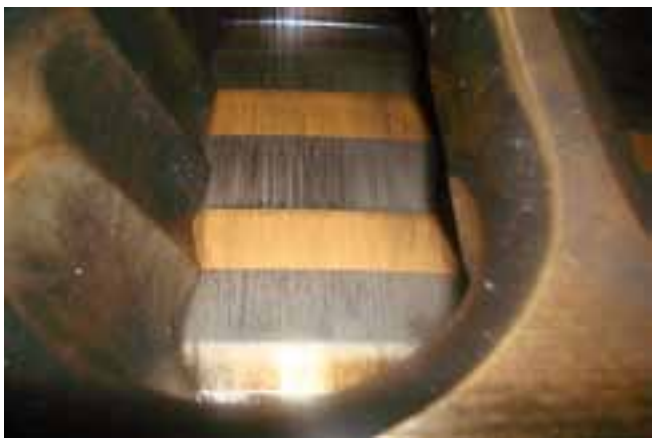
VERTICAL SCRATCHES



SCRATCHES (VERTICAL) – S

Scratching is caused by hard abrasive particles from the fuel oil, from a broken ring or from turbocharger intake. Scratches on the piston ring running surface is one of the first signs of abrasive particles, and can be observed during scavenge port inspections. Usually, micro-seizures do not occur from scratching, i.e., the ring surface remains soft. Hardness can be checked with a file, *see RECOGNIZING MICRO SEIZURES in this section and MAN Diesel & Turbo Plate 70704*.





SCRATCHES (VERTICAL) – S
Piston Skirt

MICRO-SEIZURES:

Micro-seizures are the result of break down of the lube oil film, causing metal to metal contact. The contact will cause a high friction and high temperature that will change the appearance of the ring surface. The cylinder oil film break down is in most cases caused by borepolish. May be due to overlubrication causing built up of deposits polishing the liner running surface.

LOCAL micro-seizures are limited to part of a ring circumference. However, because rings turn in their grooves, LOCAL micro-seizures on a ring can produce micro-seizures all the way around the cylinder liner as the ring rotates in the ring groove, creating a condition known as ALL OVER micro-seizures.

To identify LOCAL micro-seizures before they develop into ALL OVER micro-seizures, when conducting an inspection it is important to check the exhaust and cam (manoeuvring) sides as well as the forward and aft piston ring conditions using a mirror.

RECOGNIZING MICRO-SEIZURES

Micro-seizures on a running surface will have a vertically-striped appearance, and be relatively "**hard**", which refers to the result of a FILE TEST.

To conduct a file test, use a new, finely cut file to file across the hardened surface. If the file leaves almost no scratch, it indicates the surface is covered by a hard glaze, the result of micro-seizure hardening. See *MAN Diesel & Turbo Plate 70704* for additional information concerning the FILE TEST. The file test can of course only take place on a dismantled piston ring.

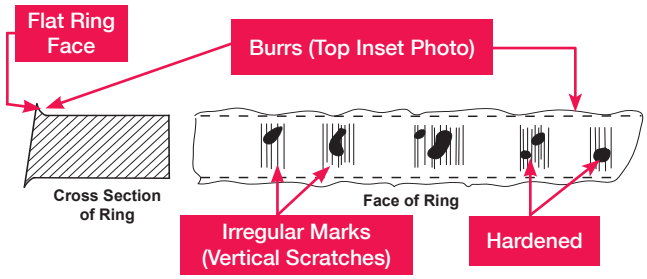
LOCAL & ALL OVER MICRO-SEIZURES

LOCAL MICRO-SEIZURES – mz

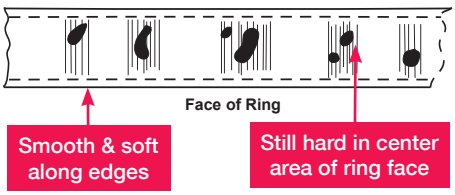
ALL OVER MICRO-SEIZURES – MZ

Notice in the top photo the micro-seizures are limited to the center scavenge port. In the bottom photo micro-seizures can be seen in all 3 scavenge ports. This is the distinction between LOCAL and ALL OVER micro-seizures.

ACTIVE & INACTIVE MICRO-SEIZURES



STILL ACTIVE MICRO-SEIZURES – MAZ



OLD MICRO-SEIZURES – OZ

FACTORS INFLUENCING CYLINDER WEAR

It is vital that the system be free of condensation and water. Condensation produces sulphuric acid corrosion, water breaks down cylinder lubrication.

To minimize **condensation** observe the following best practices:

- Optimize the temperature of the liner wall by maintaining cooling water outlet temperatures within the specified limits.
- Keep cooling water temperature differences across the cylinder units between 12°-18°C at MCR.

To minimize **water** observe the following best practices:

- Check that the drain for the water mist catcher functions properly to prevent water droplets from entering the cylinders.
- Check water mist catcher for correct fitting according to Service Letter
- Check for free standing water in the mist catcher.

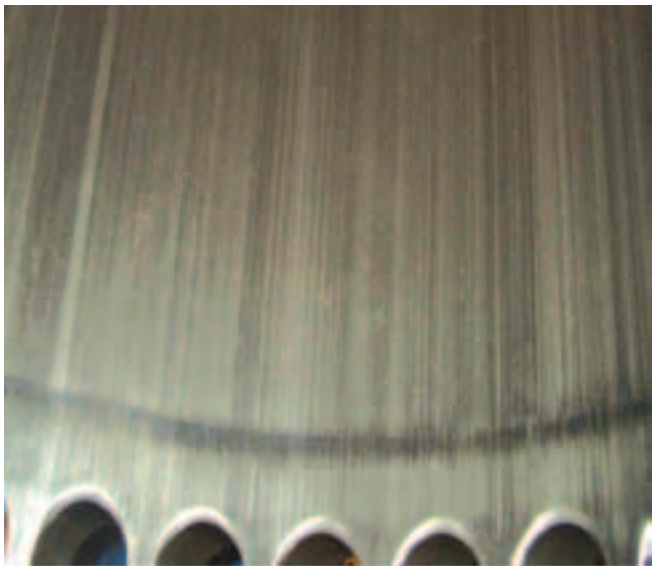
Whenever inspecting a cylinder liner, use a mirror and a bright light or a flash photo to inspect the condition of injectors, exhaust valve and cylinder head.

SCUFFING:

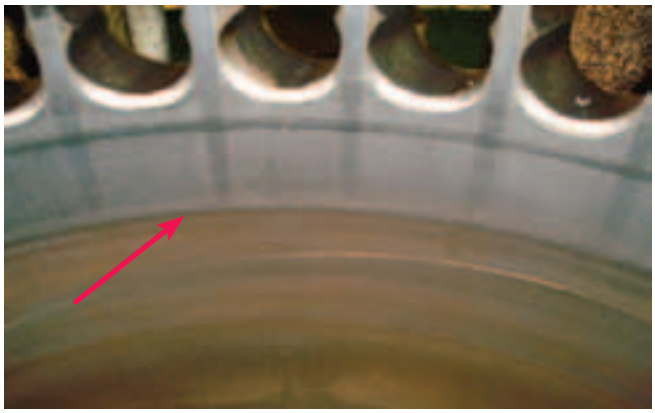
Scuffing is the result of oil film breakdown. With the cylinder walls no longer able to retain an oil film, frictional interaction between the cylinder wall and ring surfaces occurs. Due to the heat, ring and cylinder surfaces friction weld, harden, and seizures develop on both surfaces.

MACHINING MARKS STILL VISIBLE – **

A cylinder liner in good condition will have “wave-cut” machining marks visible on the complete running surface. The wave-cut surface is a single spiraled 0.01-0.02mm deep groove. The groove acts as a pocket for the cylinder lubricating oil to maintain a proper oil film so as the piston rings move across the groove, oil is deposited on the rings. If the wave cut pattern is worn away or the cylinder wall microstructure changes the cylinder liner will not properly distribute cylinder oil and scuffing can occur.



LINER SCUFFED – SC



WEAR RIDGES NEAR SCAVENGER PORTS – WR

Ring breakage can occur by rings repeatedly moving across a wear ridge.

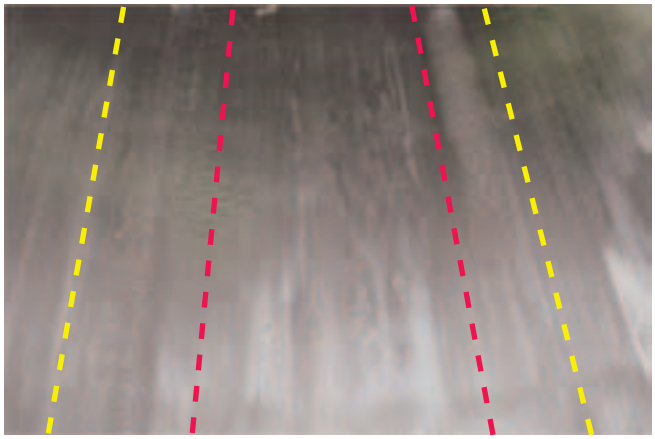
RINGS SCUFFING – SC

RINGS SCUFFING – SC (CLOSE-UP)

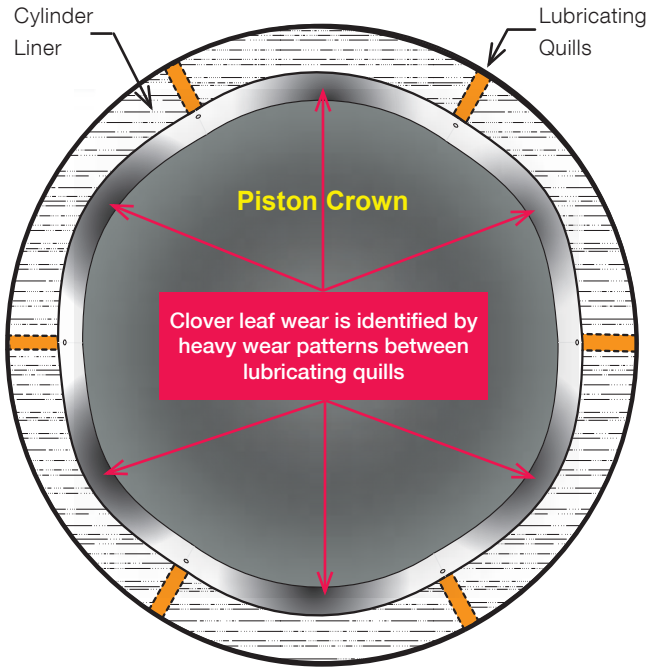
CLOVER LEAFING:

The clover-leaf formation in a liner is described by heavy wear patterns in the cylinder liner between the lubricating quills (between red lines), with less wear outside of the heavy wear areas (between red & yellow lines).

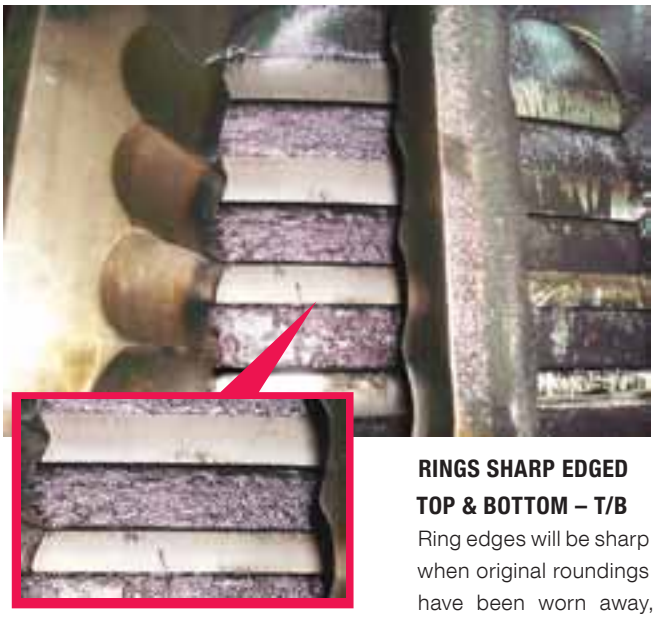
In extreme cases the liner bore may resemble a clover leaf, thus the name. Clover-leafing can be the result of micro-seizures, misalignment, polished deposits, improper lubrication or water disrupting the oil film on the cylinder wall.



Cross section view looking down at a clover leafed cylinder liner



CLOVER LEAF WEAR – CL



Rings with sharp edges.

RINGS SHARP EDGED TOP & BOTTOM – T/B

Ring edges will be sharp when original roundings have been worn away, but without burrs.

RINGS WITH SOFT EDGES:

Ring roundings from start.

26-35 . . . . . 0,8 mm
42-50 . . . . . 1,2 mm
60-70 . . . . . 1,6 mm
80-98 . . . . . 2,0 mm

When the piston is positioned at approximately TDS, inspect the piston rod through the scavenge ports.

PISTON ROD, SMOOTH – *

PISTON ROD, CORROSION – CO

PISTON ROD (Close-Up), CORROSION – CO

OPTIMAL – *

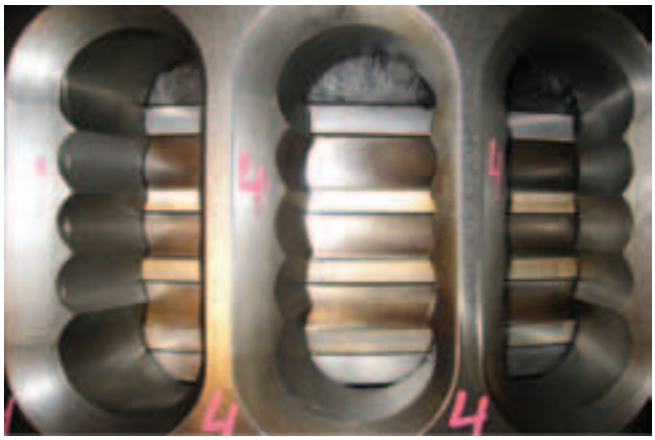
All piston rings have oil at the edges and the oil film is evenly dispersed around the circumference of the piston.

TOO MUCH OIL – O

Too much cylinder lubricating oil can create calcium deposits on the pistons, *see photo below*. Calcium deposits rubbing against the liner can lead to mechanical "bore polish" and destroy the oil film, leading to scuffing (*SC, Surface Condition section*). Over lubrication also suppresses corrosion completely. Controlled corrosion is necessary to continuously refresh the liner surface to counteract bore polish.

CALCIUM DEPOSITS

(Provided as a reference only, not a listed condition)



SLIGHTLY DRY – D

Running surface of piston rings dry but oil is still visible on ring lands.

VERY DRY – DO

Too little cylinder lubricating oil can result in break down of the oil film between the piston rings and the cylinder liner leading to adhesive contact and possible scuffing of rings and liner.

BLACK OIL – BO

Surfaces covered with black oil indicates poor combustion combined with excessive cylinder oil. Surfaces covered with black oil can also be the result of manoeuvring.

If cleaning scavenge boxes or air receiver, take photos both before and after cleaning.

Scavenge Box, NO SLUDGE – *

Scavenge Box, SLUDGE – S

Scavenge Box, MUCH SLUDGE – MS

Too much sludge can contaminate system oil. Remove any oil sludge and carbon deposits in the scavenge air boxes.

Scavenge Receiver, NO SLUDGE – *

Alert:water washing from defect water mist catcher could cause a very clean scavenge air receiver.

Scavenge Receiver, SLUDGE – S *

Normal picture. Indicate good cylindercondition.

Scavenge Receiver, MUCH SLUDGE – MS

Remove any oil sludge and carbon deposits in scavenge receiver.

FLAPS (NON-RETURN VALVES), INTACT – *

Check the non-return valves (flap valves) for easy movement and damage.

FLAPS BENT

(Provided as a reference only, not a listed condition)

FLAPS, Move Freely

WATER MIST CATCHER, OUTLET SIDE

Check for gaps and missing bolts that cause gaps between the mist catcher and the casing. In the top photo the arrows indicate where to check for loose or missing bolts, the circle indicates where to check for gaps. In the lower photo a gap exists.

WATER MIST CATCHER

Depending on the temperature and humidity of the ambient air and the temperature of the cooling water, water may condensate on the coldest air cooler tubes of the air cooler. Water mist catchers are installed directly after the air coolers to prevent water droplets from entering the cylinders. If water enters the cylinders, the oil film on the cylinder liner can be ruptured, resulting in scuffing and clover-leafing on the liner surfaces.

Inspect the water mist catcher for cracks in the frame and correct mounting during scavenge port inspections. A broken or loose mounting may cause an upstream gap at the bottom of the water mist catcher elements. Air on the upstream side will short-circuit the element and cause water running down through the element to be sprayed downstream out through the water mist catcher. The water spray from the broken water mist catcher may enter the cylinder units.

It is very important that the water mist catcher drains function properly and that the water mist catcher is fitted correct in the frame. if any doubt remove the casing covers to check.

INTACT – *

Inspect the condition of the locking wire for the piston skirt bolts. A loose locking wire can indicate one of the screws is loose or the wire is broken.

PART II

SCAVENGE PORT INSPECTION TOOLS & TAKING PHOTOS

Version 1.0
November 2010

PART III

SCAVENGE PORT INSPECTION TOOLS

From left, MAN Diesel & Turbo Piston Crown Template, Vernier Gauge, Soft Metal Drift, Camera, Feeler Gauge, Pencil, Marker, Mirror, Flashlight, Large Screw Driver, Mallet, Coating Layer Measuring Tool.

Also include clean rags for wiping down surfaces and two 20 liter (5 gl.) pails (1 to carry tools, the other for rags).

A bright light is not only used for general lighting, but also for talking close up photos of pistons and rings, see Taking Photos.

INSPECTION TOOLS

TAKING PHOTOS

PART III

PRESSURE RELIEF GROOVE (CL GROOVE) DEPTH MEASUREMENT

RING GROOVE CLEARANCE

PISTON CROWN BURNING

A mirror, with tiltable telescopic handle is used to inspect:

- Forward and aft scavenge port running surfaces.
- Cylinder wall above and below scavenge ports.
- Cylinder covers
- Injectors
- Exhaust valve
- Cylinder wall wear ridges

REQUIRED PHOTOS: Take photos of the following:

- Piston crown
- Top land
- Piston rings
- Piston skirt
- Piston rod
- Cylinder liner
- Scavenge box
- Scavenge receiver
- Damage

Before and after photos are required for items that are wiped down during the inspection.

When taking close-up photos, use the camera's **MACRO** function and turn the camera's flash **OFF.** Use the work light as the camera's light source. This will eliminate reflection and glare from the camera's flash, see top photo on the next page.

The photo above was taken with the camera's flash switched **OFF** and using the work light as the camera's light source. The work light provides soft light for the photo, without the flash glare concealing details.

INSPECTION TOOLS

TAKING PHOTOS

PART III

PRESSURE RELIEF GROOVE (CL GROOVE) DEPTH MEASUREMENT

RING GROOVE CLEARANCE

PISTON CROWN BURNING

Photo taken with camera's flash switched **ON**. Since this photo includes a broken ring, carbon deposits and sharp edges on rings, details in the photo are important, but concealed by the glare from the camera's flash.

Photos are a good method for detecting and documenting conditions such as machine marks (**), wear ridges (WR), clover leafing (CL), scuffing (SC), micro-seizures (MZ) and polishing.

If oil or water is found on top of a piston, use photos to document the condition of the exhaust valve, cylinder head and injectors.

Photo taken in figure above

PART III

Supplement to the MAN Diesel & Turbo form titled
PISTON CONDITION MONITORING (Port Inspection)

Version 1.0
November 2010

PART III

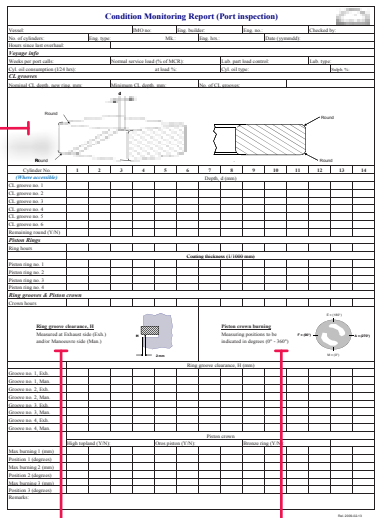
PRESSURE RELIEF GROOVE (CL GROOVE) DEPTH MEASUREMENT

RING GROOVE CLEARANCE

PISTON CROWN BURNING

PART III

In accordance with MAN Diesel & Turbo form, *Condition Monitoring Report (Port inspection)*, PART III of this booklet provides a pictorial description of measurement procedures pertaining to Pressure Relief Groove (CL groove) depth, ring groove clearance and piston crown burn-away.


Condition Monitoring Report (Port inspection)

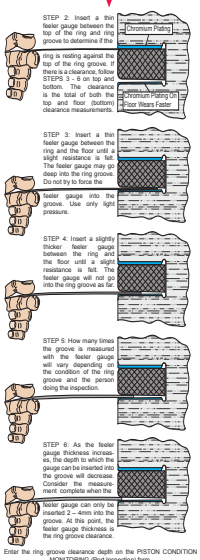
MEASURING PRESSURE RELIEF GROOVE (CL GROOVE) DEPTH


Fig. 4
Measure the Pressure Relief Groove (CL Groove) depth


Fig. 5
When taking the measurement, verify that the stem of the vernier gauge is sitting on the bottom of the Pressure Relief Groove (CL Groove)


Fig. 6
The pressure relief groove depth shall not be less than 1mm, notify CSC immediately if the depth is less than 1mm. Enter all measurements on the MAN Diesel PISTON CONDITION MONITORING (Port Inspection) form.

PRESSURE RELIEF GROOVE (CL GROOVE) DEPTH MEASUREMENT



STEP 2: Insert a thin feeler gauge between the top of the ring and ring groove to determine if the ring is resting against the top of the ring groove. If there is a clearance, follow STEPS 3 – 6 on top and bottom. The clearance is the total of both the top and floor (bottom) clearance measurements.

STEP 3: Insert a thin feeler gauge between the ring and the floor until a slight resistance is felt. The feeler gauge may go deep into the ring groove. Do not try to force the feeler gauge into the groove. Use only light pressure.

STEP 4: Insert a slightly thicker feeler gauge between the ring and the floor until a slight resistance is felt. The feeler gauge will not go into the ring groove as far.

STEP 5: How many times the groove is measured with the feeler gauge will vary depending on the condition of the ring groove and the person doing the inspection.

STEP 6: As the feeler gauge thickness increases, the depth to which the gauge can be inserted into the groove will decrease. Consider the measurement complete when the feeler gauge can only be inserted 2 – 4mm into the groove. At this point, the feeler gauge thickness is the ring groove clearance.

Enter the ring groove clearance depth on the PISTON CONDITION MONITORING (Port Inspection) form.

RING GROOVE CLEARANCE

Prior to inspecting the piston crowns, review the maximum permissible burn-away values on the Piston Data Plate in the MAN DIESEL MAINTENANCE MANUAL.


Insert the piston template through a scavenge port and place evenly across piston crown.


Check for burn-away and cracks (elephant skin) around the entire circumference of the piston crown. If elephant skin is found, look at the area from several positions to get a sense of the depth of the cracks in the elephant skin area.


Enter piston crown burn-away values and locations on the MAN Diesel PISTON CONDITION MONITORING (Port Inspection) form. Record the length and depth of cracks.

PISTON CROWN BURNING

PROPER SELECTION OF VERNIER GAUGE

Before measuring the depth of a Pressure Relief Groove (CL Groove), consider the width and shape of the vernier gauge's stem end (Fig. 1). If the stem is too wide (Fig. 2) the measurement will indicate the groove depth is less than the actual depth. For an accurate measurement, use a vernier gauge with a stem that will sit on the bottom of the groove (Figs. 3 & 5).

Fig. 1

When selecting a vernier gauge, verify that the stem end is not too wide for the Pressure Relief Groove (CL groove).

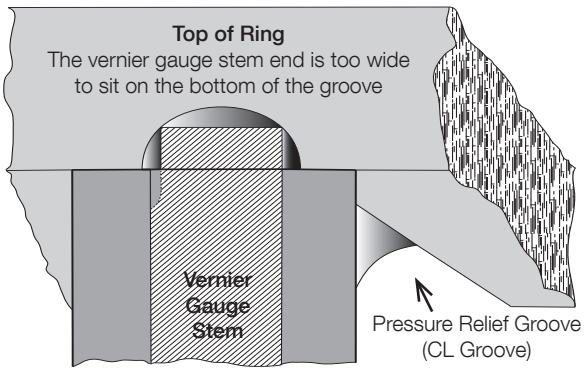


Fig. 2 – WRONG

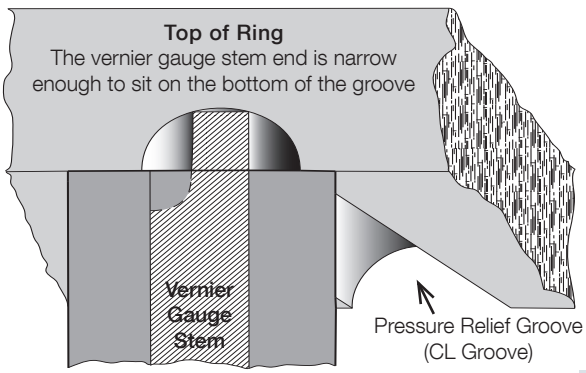


Fig. 3 – CORRECT

PRESSURE RELIEF GROOVE (CL GROOVE) DEPTH MEASUREMENT
RING GROOVE CLEARANCE
PISTON CROWN BURNING

MEASURING PRESSURE RELIEF GROOVE (CL GROOVE) DEPTH

Fig. 4 Measure the depth of the pressure relief groove. The depth is an indicator of piston ring wear.

Fig. 5 When taking the measurement, verify that the stem of the vernier gauge is sitting on the bottom of the Pressure Relief Groove (CL Groove).

Fig. 6 The pressure relief groove depth shall not be less than stated on the Piston Data Plate. Enter all measurements on the MAN Diesel Turbo PISTON CONDITION MONITORING (Port Inspection) form.

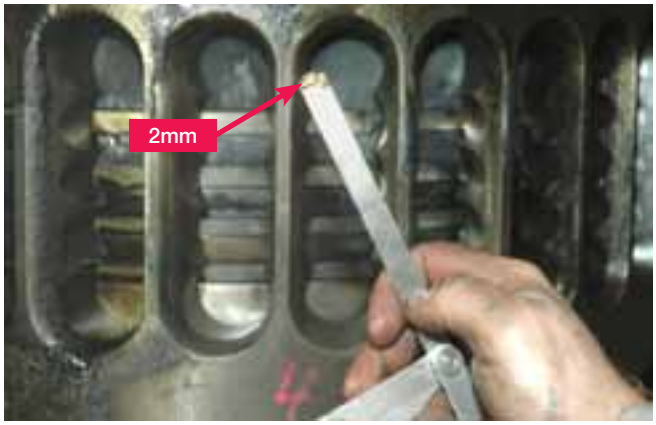
PRESSURE RELIEF GROOVE (CL GROOVE) DEPTH MEASUREMENT

METHOD A, MEASURING RING GROOVE CLEARANCE

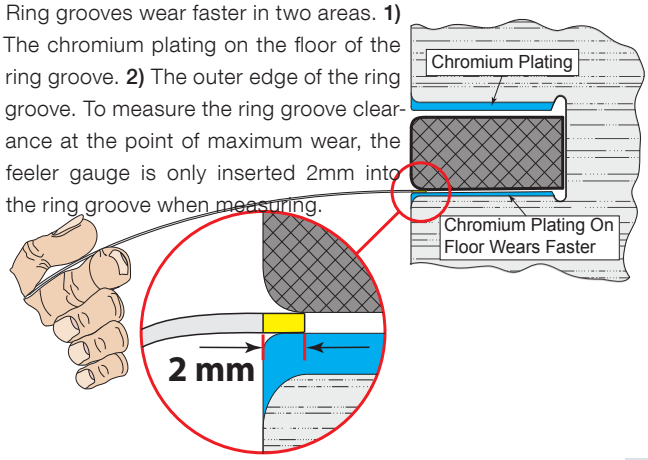
Prior to inspecting the ring groove clearance, review the vertical clearance specified on the Piston Data Plate.

The ring groove clearance measurement is an indicator of the wear taking place on the chromium plating in the ring groove. If the ring groove wear rate suddenly increases it could be due to a malfunction of the air cooler system causing water to enter the cylinder, a malfunction of the cylinder lube system or abrasive particles from fuel oil or scavenge air.

Using a feeler gauge, measure top and bottom clearances between the ring and the ring groove. The total of the top and bottom clearances must not exceed the value specified on the Piston Data Plate.



Ring grooves wear faster in two areas. **1)** The chromium plating on the floor of the ring groove. **2)** The outer edge of the ring groove. To measure the ring groove clearance at the point of maximum wear, the feeler gauge is only inserted 2mm into the ring groove when measuring.



Enter the ring groove clearance depth on the PISTON CONDITION MONITORING (Port Inspection) form.

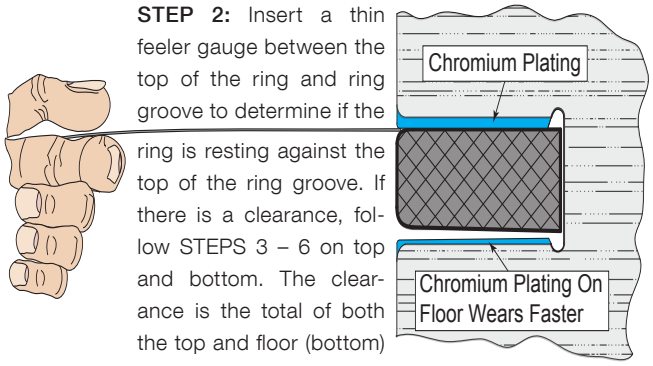
RING GROOVE CLEARANCE

PISTON CROWN BURNING

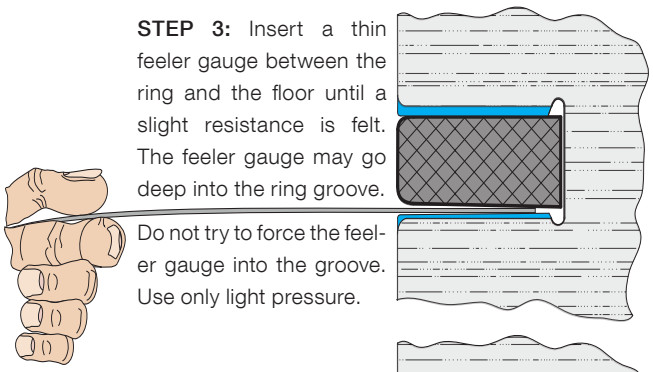
METHOD B, MEASURING RING GROOVE CLEARANCE

STEP 1: Run the turning gear so the piston is in the downstroke. If the rings have good movement, the rings will move to the top of the ring groove.

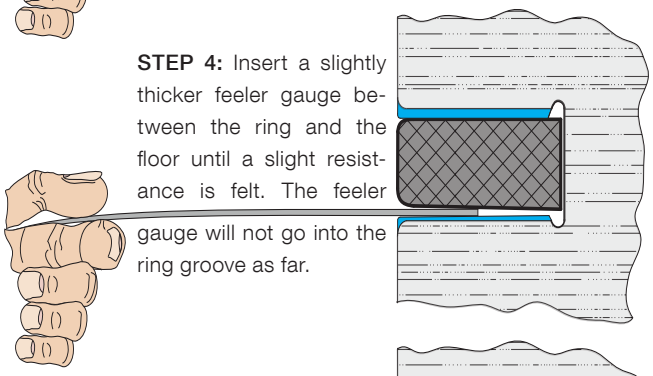
If the ring rests on the top of the groove, taking ring groove measurements are simplified by checking the top of the ring as seen in Step 2. Then, if the ring is actually resting against the top, feeler gauge measurements can be performed on the floor of the ring groove as illustrated in Steps 3 – 6. If not, feeler gauge measurements must be made at the top and the floor. The clearance will be the total of the two measurements.



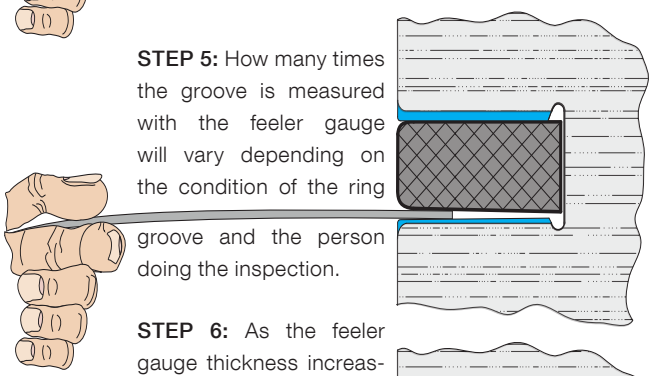
STEP 2: Insert a thin feeler gauge between the top of the ring and ring groove to determine if the ring is resting against the top of the ring groove. If there is a clearance, follow STEPS 3 – 6 on top and bottom. The clearance is the total of both the top and floor (bottom) clearance measurements.



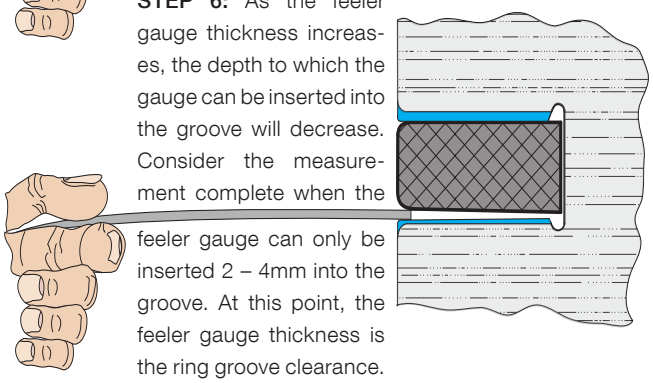
STEP 3: Insert a thin feeler gauge between the ring and the floor until a slight resistance is felt. The feeler gauge may go deep into the ring groove. Do not try to force the feeler gauge into the groove. Use only light pressure.



STEP 4: Insert a slightly thicker feeler gauge between the ring and the floor until a slight resistance is felt. The feeler gauge will not go into the ring groove as far.



STEP 5: How many times the groove is measured with the feeler gauge will vary depending on the condition of the ring groove and the person doing the inspection.



STEP 6: As the feeler gauge thickness increases, the depth to which the gauge can be inserted into the groove will decrease. Consider the measurement complete when the feeler gauge can only be inserted 2 – 4mm into the groove. At this point, the feeler gauge thickness is the ring groove clearance.

Enter the ring groove clearance depth on the PISTON CONDITION MONITORING (Port Inspection) form.

Prior to inspecting the piston crowns, review the maximum permissible burn-away values on the Piston Data Plate.

Check for burn-away and cracks (elephant skin) around the entire circumference of the piston crown. If elephant skin is found, look at it from several angles and estimate the depth of cracks.

Enter piston crown burn-away values and locations on the PISTON CONDITION MONITORING (Port Inspection) form.

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