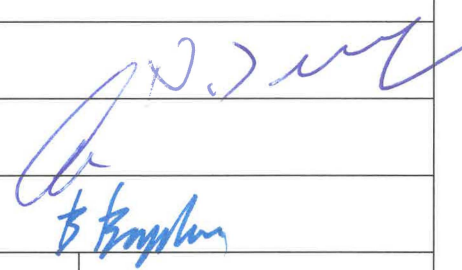





TÜRASAS ESKİŞEHİR REGIONAL DIRECTORATES	TECHNICAL SPECIFICATION	Document Nr.	050.115			
		Revision	B			
		Page	1/17			

T.Ş. 050.115
TECHNICAL SPECIFICATION OF PISTON
RINGS FOR TLMV185 AND MTU 8V396
TC13 TYPE DIESEL ENGINES

ENGINE FACTORY MNG	Nurten DEROĞLU		
TRACTİVE STOCK DIVİSİON MNG	Tuba N. EROĞLU		
İNCOMİNG CONTROL DIVİSİON MNG	Şükrü Baha BAYDIR		
Prepared by	İhsan BİLGİN	Hakan CANIDAR	Emre AYAZ
			
Date of Issue	08.01.2008		

TÜRASAS ESKİŞEHİR REGIONAL DIRECTORATES	TECHNICAL SPECIFICATION	Document Nr.	050.115			
		Revision	B			
		Page	3/17			

1. SUBJECT AND SCOPE

This technical specification covers the general requirements and technical features, inspection control, delivery, purchasing, packaging and guaranty conditions, as well as other related requirements of piston rings (compression, top, oil control rings) used in TLMV185 and MTU 8V396 TC13 type diesel engines overhauled in TURASAS (Turkish Railway Vehicles Industry Inc.).

2. GENERAL REQUIREMENTS

- 2.1. All items of this technical specification shall be explicitly, definitely and fully responded by the Tenderers in their offer one by one in the same order as in the specification. Any offer not complying with the specifications or stating “All conditions of the technical specification are accepted” will be considered as invalid and will not be evaluated at all.
- 2.2. Should the bidders hesitate on the whole, on any article or on the annexed drawings of this technical specification, they can apply to TURASAS for more detailed information at least 7 days before the bid opening date. In case the demand for more information will be found acceptable, TURASAS will give relevant information to all Tenderers at least 3 days before due date for the submission of offers. Any application related to the specification after the offers are submitted will not be accepted.
- 2.3. Since the piston rings to be procured according to this technical specification will be used in TLMV185 and MTU 8V396 TC13 type diesel engines of DE 24000 – DE 11000 type diesel-electrical main line and shunting locomotives, they shall operate physically and functionally in coherence.
- 2.4. The manufacturer shall have ISO/TS 16949 quality management system certificate. The proofing documents shall be enclosed to the offer.
- 2.5. TURASAS reserves the property right of the drawing and documents obtained by the Tenderers from TURASAS and they shall not be used for other purpose and given to third parties.
- 2.6. All issues related to the shipment and loading-unloading of the piston rings subject to the tender will be under the responsibility of the contractor.
- 2.7. The contractor will be responsible for the piston ring subject to the tender up to date the acceptance document is prepared. The contractor will also be held responsible for any kind

TÜRASAS ESKİŞEHİR REGIONAL DIRECTORATES	TECHNICAL SPECIFICATION	Document Nr.	050.115			
		Revision	B			
		Page	4/17			

of damage and detriment that may occur up to this date. In this case, the damaged piston rings shall be replaced by the contractor with new ones within the specified delivery period.

2.8. The administrative specification will be valid for items not mentioned in this specification.

3. TECHNICAL CHARACTERISTICS AND REQUIREMENTS

3.1. DIMENSION , TOLERANCE, MATERIAL AND MANUFACTURING PROPERTIES

The piston rings subject to the tender will be subjected to dimension, tolerance, material and manufacturing inspection in accordance to the procedures given in the technical drawings enclosed to this specification.

3.1.1. Dimension, Tolerance and Material:

The production of the piston rings shall comply with the dimensions, tolerances, material and special notes specified in the technical drawings of piston rings for TLMV185 type diesel engine given in Annex 1 and piston ring drawings for MTU 8V396 TC13 type diesel engines given in Annex 2.

ANNEX-1 Technical drawings of piston rings for TLMV185 type diesel engines:

- Drawing no 690 117 Compression Ring (2 rings in 1 piston)
- Drawing no 690 118 Top Ring (1 ring in 1 piston)
- Drawing no 690 119 Oil Ring (2 rings in 1 piston)

ANNEX-2 Technical drawings of piston rings for MTU 8V396 TC13 type diesel engines:

- Drawing no LM 03517 Compression Ring (1 ring in 1 piston)
- Drawing no LM 03518 Top Ring (1 ring in 1 piston)
- Drawing no LM 03519 Oil Ring (1 ring in 1 piston)

3.1.2. Manufacture:

The contractor will be free to use the desired method for material preparation, moulding, casting and machining. However, the contractor will be responsible to supply a casting that will comply with the specified chemical alloy, internal structure, hardness and machining values as per order contract. The mechanical properties of the casting (elastic module, tensile strength and static bending) shall be provided to TURASAS. Casting non-conforming to the

TÜRASAS ESKİŞEHİR REGIONAL DIRECTORATES	TECHNICAL SPECIFICATION	Document Nr.	050.115			
		Revision	B			
		Page	5/17			

provisions and inspections specified above will cause to the rejection of the delivery and to the interruption of the payment to the contractor.

3.2. MECHANICAL CHARACTERISTICS

3.2.1. Hardness:

Hardness values (Brinell or Rockwell) shall be measured from either top or bottom surface of the ring. These measurements shall be obtained from three points of the ring surface (the first measurement at the ring gap, the second one 90° from the gap and the third at the opposite side of the gap) and the average value of these three values shall comply with the values given in the drawings. In case of any dispute this measurement shall be performed according to the stipulations of the relevant TS EN standard. However, the contractor shall obtain in any case the values provided by TURASAS.

3.2.2. Tensile Test (to be applied on top rings):

The tensile test shall be performed according to the latest edition of the relevant TS EN standard. Three test pieces shall be prepared from each charge with the same heat treatment performed as the casting for the rings shall be submitted in machined condition by the contractor to TURASAS. This test will be performed to check the compliance to the technical drawings.

3.2.3. Tangential Stress:

Tangential stress shall be measured according to the enclosed technical drawings or if not applicable, this measurement shall be performed in kilogram-weight with reference to the equivalents given in the latest edition of the relevant TS EN standards and as described below:

The piston ring is wound with a rather elastic metal strip (strip width equal to the ring height, thickness between 0,10 – 0,30 mm) and one of the ring ends is secured and the other end is pressed by using a suspended weight. This weight is called “Tangential Stress”. Meanwhile the metal strip shall press (close) the ring ends so as to obtain the required gap specified on the technical drawings. The meeting ends of the metal strip and the ring clamps shall face each other.

TÜRASAS ESKİŞEHİR REGIONAL DIRECTORATES	TECHNICAL SPECIFICATION	Document Nr.	050.115			
		Revision	B			
		Page	6/17			

3.2.4. Gap Enlargement Test:

The free gap of the piston ring shall be enlarged with special pliers or similar tool without deforming its shape (this shall be agreed with TURASAS). During the test, the end of the piston ring shall be enlarged so that a mandrel with an outer diameter that is 1,01 times greater than the nominal outer diameter can fit into the ring. The following controls shall be performed after the ring is taken out from the mandrel.

- Control of free opening after enlargement test,
- Control of ring outer contact area as specified in Item 3.4.1,
- Control of ring gap as specified in Item 3.4.2,
- Control of ring free opening closing of ring after outer contact check,

The way of how to check the outer contact and ring opening is described in detail in the following sections.

3.3. GEOMETRIC CHARACTERISTICS

Shape, dimension and finish tolerances of piston rings are given in detail in the technical drawings enclosed to this specification.

3.3.1. Control of Outer Contact:

The completely finished ring is inserted after cleaning into a ring gage having a surface quality of ≤ 10 micron CLA and inner diameter in the nominal diameter of the ring with $\pm 0,01$ mm tolerance (10 micron "CLA:0,25 micron Ra). The ring is half turned within the gage to remove any scale in between them.

The ring gage together with the piston ring is placed on a light box (this is lighting arrangement, the effect of which diminished with frosted glass that only permits the light beams going through between the ring gage and piston ring). The contact of the piston ring outer surface is checked by this way. The illumination level of the bulb put into this arrangement shall be appr. 170 lux at the free penetration zone mentioned above (for example, a bulb with 15W – 24V can be placed at 15 mm distance). No light beam shall be seen on the circular area on both sides of the piston ring ends at a length not more than 7% of the ring circumference. Continuous or interrupted surface contacts can be seen on an area equal to 86% of the circumference.

TÜRASAS ESKİŞEHİR REGIONAL DIRECTORATES	TECHNICAL SPECIFICATION	Document Nr.	050.115			
		Revision	B			
		Page	7/17			

- Surface contact of 50% can be observed on oil scraping rings, two-piece scraping rings and tapered rings (this rate is acceptable is scraping rings. During the surface contact check of tapered piston ring, hold the small pocket side to the area of the light arrangement).

- A surface contact of 80% shall be seen on hard chromium plated piston rings and semi-tapered piston rings.

- A surface contact of 85% is required on all other conditions. A slight transition of light between ring gage and piston rings will be regarded as acceptable.

The piston ring will be rejected if a feeler gauge with 0,02 mm thickness can be inserted without any force between ring gauge and piston ring where the light gets through directly.

3.3.2. Control of Ring Gap:

The ring cap control is performed with a feeler gauge after the piston ring is placed into the ring gage mentioned above. Grind the ends if necessary to provide the clearance specified in the drawings.

3.3.3. Surface Roughness Check of Upper and Lower Surfaces:

Surface roughness is checked by using the blueing method. The cleaned piston ring is placed into a ring with an inner diameter in the nominal diameter of the piston and with a thickness less than the height of the piston ring. They will then be placed in between two plates that have received a thin layer of blue control paint. The bottom plate consists of a single block and the top plate shall have the following features:

- The weight of the top plate shall be three times more than the nominal diameter in decimeter of the piston ring.
- Four inserts located in equal distances less than the inner diameter of the piston ring shall be provided on the control surface in a circle with nearly 30 mm diameter.

The top plate is first set in motion so that the inserts will touch the inner surface of the piston ring on different points and then moved together with the piston ring on the lower plate.

The piston ring is then taken out and checked on both surfaces. A continuous or an interrupted surface contact shall be found on min. 90% of the piston ring side surface. This contact may show a difference in appearance on the outer and inner circumference of the piston ring.

TÜRASAS ESKİŞEHİR REGIONAL DIRECTORATES	TECHNICAL SPECIFICATION	Document Nr.	050.115			
		Revision	B			
		Page	8/17			

3.3.4. Warping Check on Piston Rings:

Bridge method is used for this check. Two liners with a thickness that is 0,20 mm greater than the max. allowable height for this piston ring is placed in between two plates to form the bridge. The bridge is then brought to a vertical position and the piston ring shall freely pass in between the two plates with its own weight.

3.3.5. Control of Other Dimensions:

Other dimensions (radial thickness, height) are checked with a micrometer. The difference between max. and min. radial thickness values in a piston ring shall not exceed half value of the tolerance given in the drawing for this thickness.

3.4. PHYSICAL CHARACTERISTICS:

3.4.1. Visual Inspection:

The piston rings shall be free of any material defects such as cracks or blisters and the side surfaces touching the piston channel shall be free of any machining defects such as grooves or slots.

3.4.2. Surface Roughness Quality:

The surface roughness quality of the piston rings shall comply with the values given in the technical drawings.

Outer circumference of chromium plated piston rings: The thickness of the coating shall be measured with a control device.

3.4.3. Internal Structure:

The inspection shall be performed according to the requirements of TURASAS on sections taken from the following areas:

- Sections taken from a plane directly across the ring opening, 1 mm behind the circumference and the plane that is tangential to the friction surface.
- Sections taken from the longitudinal and 90° plane to the ring opening.

To take a section from the planes above, the piston ring shall be broken after a slight trace made with a saw pretending any heating of material on both sides. If necessary, the piston ring shall be degreased before breaking. The section obtained shall then be polished and inspected under microscope magnified in the rates given below:

TÜRASAS ESKİŞEHİR REGIONAL DIRECTORATES	TECHNICAL SPECIFICATION	Document Nr.	050.115			
		Revision	B			
		Page	9/17			

1 x 50 times (on deep etched sample): to be performed on compression and oil piston rings of TLMV185 type diesel engines. Homogenous and closed phosphide eutecticity shall be provided on the deep etched sample.

2 x 100 times (without etching): The distribution of the graphite laminates on the compression and oil piston rings of TLMV185 type diesel engines shall be homogenous complying with ASTM standard type A Nr 4. They shall not be above Nr 4. The size of graphites shall also be homogenous and there shall not be any area without graphite. The distribution and size of graphite in top piston rings shall be homogenous and the shape of graphite shall be spherical. And there shall not be any area without graphite.

The graphite distribution for the internal structure of piston rings to be used in MTU 8V396 TC13 type diesel engines shall be in A5-7 type according to ASTM-247 standard. A rosette pattern distribution of $\leq 10\%$ is acceptable. However, D and E type (ASTM standard) dendritic distribution will cause to the rejection of the part. The conjunction area of cast iron and chromium in chromium plated piston rings is also inspection in this magnification range. In this inspection it is checked if the porosity of chromium has affected the thickness of plating.

2 x 200 magnification (etching with 1% Nital): The compression and oil scraping piston rings in TLMV185 type diesel engines shall have a perlitic matrix, no cementite shall be observed and the rate of ferrite shall be max. 5%. The matrix of top piston rings shall be of annealed martensite structure.

3 x 250 magnification (etching with 4% Nital): The piston rings for MTU 8V396 TC13 type diesel engines shall show a small amount of well distributed and homogeneously dispersed phosphor eutectic.

4 x 270 magnification (etching with 4% Nital): During the inspection the piston rings for MTU 8V396 TC13 type diesel engines shall have a homogenous dispersed structure.

- No free cementite shall be observed.
- Free ferrite in the amount of nearly 2% on the microscope surface that shows a well dispersed structure and that cannot be detected with x 100 magnification is acceptable.

TÜRASAS ESKİŞEHİR REGIONAL DIRECTORATES	TECHNICAL SPECIFICATION	Document Nr.	050.115			
		Revision	B			
		Page	10/17			

3.4.4. Inspection of Chromium Plating:

This inspection will be performed according to TURASAS's request. The plating is inspected by grinding and etching a section of 3 mm length and 0,5 mm depth across piston ring opening without preheating.

3.5. CHEMICAL PROPERTIES

Chemical analysis are performed in the manufacturer's laboratories. However, in case of any disagreement, TURASAS reserves the right to perform the analysis in its own premises and the chemical composition of the material used shall be in compliance with the document supplied by the manufacturer to TURASAS as per delivery conditions.

3.6. PROTOTYPE

Before starting with manufacture the contractor shall provide to TURASAS piston rings in sufficient number to test on each type of engine. These piston rings will be mounted to the engines after performing necessary measurements and checks and will be tested during the engine tests. If found necessary, TURASAS may test the engine with the prototype piston rings fitted for 30 days on the locomotive. The performance values of the engine will be checked during these tests. The result of the inspections and the tests to be performed by TURASAS will be provided to the company in a short time. The company will be able to continue the production above the approval of the prototypes. However, approval of the prototypes does not mean that the whole production will be approved. The requirements and conditions of the technical specification shall be fulfilled and the acceptance tests shall be performed to meet these requirements.

3.6.1. In case all or part of the prototypes delivered are found unsuitable, the company will be given a second chance to produce other prototypes. TURASAS reserves the right to annul the contract in case the prototype samples are rejected for the second time. The contractor will not have a right for any claim related with this issue.

3.6.2. Delivery time of prototypes shall be definitely stated in the offer.

TÜRASAS ESKİŞEHİR REGIONAL DIRECTORATES	TECHNICAL SPECIFICATION	Document Nr.	050.115			
		Revision	B			
		Page	11/17			

4. MARKING

The manufacturer shall mark each piston ring subject to the tender without causing any damage to them to facilitate their assembly and identification. The piston rings shall receive a permanent marking (either by engraving, sanding or by other means) near to the claws at min. 5 mm distance to the ends indicating manufacturer's name and part reference number. These markings shall be provided on the upper surface according to the position of the ring in the piston. If required, the inscription "üst" as shown on the technical drawings may be stamped to indicate the upper surface of the rings. (The inscriptions shall be clearly visible when looked to the piston with the rings fitted from the top.)

5. PACKAGING

- 5.1. The piston rings subject to the tender shall first receive a thin layer of protective grease and then wrapped in the form of rolls in proper quantities with suitable oiled paper to prevent any contact between them and any damage to the surface. These rolls shall then be packed in wooden cases. The piston rings in each package shall be suitably protected against undesirable environmental conditions
- 5.2. The contractor may work together with TURASAS Engine Factory in regard to the packaging of the piston rings subject to the tender.
- 5.3. TURASAS reserves the right to reject the materials with improper packaging.
- 5.4. In case the piston rings to be procured are stepped piston rings, the contractor shall clearly and properly indicate this on the packages of the piston rings.
- 5.5. After packaging the piston rings subject to tender, the materials shall not be affected from corrosion, climatic conditions and other environmental effects. The piston rings subject to the tender shall be suitably packed so as not to be scratched, worn up, damaged and effected from climatic conditions during shipment and storing.

6. DELIVERY

- 6.1. The place of delivery for the piston rings subject to the tender is TÜRASAS Eskişehir Regional Directorates Acceptance and Transfer Division Management.

TÜRASAS ESKİŞEHİR REGIONAL DIRECTORATES	TECHNICAL SPECIFICATION	Document Nr.	050.115			
		Revision	B			
		Page	12/17			

6.2. In conclusion of the inspections, tests, controls and checks to be performed on the piston rings subject to the tender, an “Acceptance Document” will be prepared upon the approval of TURASAS respective staff that the piston rings are complete, undamaged and approximately packed.

6.3. The delivery period and order amounts of the pistons rings subject to the tender are given in the order request lists.

6.4. Submission to the delivery: Tests on internal structure and coating, chemical analysis and other inspections are carried out in the manufacturer’s works on the samples to be submitted to delivery. If TURASAS will not be able to perform dimensional and material checks, all costs relates to these checks shall be borne by the contractor.

6.5. The content of the batch submitted to delivery: The piston rings of the same type that are manufactured by using the same production method and subjected to the same delivery tests will be submitted in a batch to the delivery inspections.

6.6. Quantity and property of samples to be taken from each batch: The number of samples necessary for inspections and tests are given below.

6.6.1. Inspections of Group A:

- Hardness test (article 3.2.1)
- Gap enlargement test (article 3.2.4)
- Tensile test (article 3.2.2)
- Tangential stress test (article 3.2.3)
- Outer contact test (article 3.3.1)
- Control of ring gap (article 3.3.2)
- Surface roughness test (article 3.3.3)
- Warping test (article 3.3.4)
- Control of other dimensions (article 3.3.5)
- Visual inspection (article 3.4.1)
- Surface finish quality (article 3.4.2)

6.6.2. Inspections of Group B:

- Microscopic inspection of internal structure (article 3.4.3)
- Chemical analysis (article 3.5)

TÜRASAS ESKİŞEHİR REGIONAL DIRECTORATES	TECHNICAL SPECIFICATION	Document Nr.	050.115			
		Revision	B			
		Page	13/17			

- Inspection of chromium plating (article 3.4.4)

The inspections and tests shall be approximately in the manufacturer's works and the test reports shall be submitted to TURASAS. The required number of samples for these test are given below.

6.6.3. For inspections and test of group A:

- For 0-11 parts in a batch: 11
- For 11-14 parts in a batch: 11
- For 14-20 parts in a batch: 14
- For 20-40 parts in a batch: 17
- For 40-100 parts in a batch: 20
- For 100-300 parts in a batch: 22
- For over 300 parts in a batch: 25

6.6.4. For inspections and tests of group B: (These inspections are performed upon TURASAS's request) These inspections are performed on the date the samples are submitted to delivery on all samples selected at random according to the number of batches. The inspections on samples are either performed by TURASAS Quality Control staff or assigned control firms or by the manufacturer upon TURASAS's request.

- For 0-40 parts in a batch: 1
- For 40-500 parts in a batch:2
- For over 500 parts in a batch:3

All samples are taken from batches in which less than 300 parts are provided shall be found suitable for the acceptance of a batch in group A.

6.7. Parts damaged during destructive tests shall be replaced with new ones free of charge by the contractor.

6.8. Tenderers shall specify the delivery period in their offer

TÜRASAS ESKİŞEHİR REGIONAL DIRECTORATES	TECHNICAL SPECIFICATION	Document Nr.	050.115			
		Revision	B			
		Page	14/17			

7. GUARANTY

- 7.1. The contractor shall guarantee the piston rings subject to the tender for a period of 2 years starting from the date of final delivery against any defects attributable to production, workmanship, material, packaging, etc.
- 7.2. TURASAS will notify the contractor with a guaranty sheet prepared by TURASAS in case of failures due to fault of production, workmanship, material, etc. except those attributable to fault of use. In this case, the contractor shall replace the parts under consideration with new ones free of charge within 30 work days with all costs to be borne by the contractor. TURASAS reserves the right to encash the guaranty bond if the materials are not replaced within the above specified time.
- 7.3. Failures of the same type detected during use on more than 5% on piston rings delivered and subject to the tender will be regarded as EPIDEMIC FAILURES. The contractor shall take the necessary measures such as correction, modification, change, etc. free of charge to remove the failure and to the repetition of the failure within 60 calendar days upon notification. All costs arising thereto, including shipment of replacement parts and the delivery of new ones to shall be borne by the contractor.
- 7.4. The contractor shall replace the piston rings with failures that have not been revealed during inspections, tests and delivery, but detected later during the guaranty period within 30 work days free of charge.

8. SUBMISSION OF OFFER

Tenderers shall submit together with the offer their price offer for each type of piston ring, including their quantity (price / unit).

9. MISCELLANEOUS

- 9.1. TURASAS reserves the right to see and inspect the facilities of the companies participating to the tender.
- 9.2. Tenderers are able to see and inspect the piston rings subject to the tender in TURASAS.
- 9.3. A protocol will be signed between TURASAS authorities and the contractor following the inspection against any failure that may occur after the contract. The related standards and

TÜRASAS ESKİŞEHİR REGIONAL DIRECTORATES	TECHNICAL SPECIFICATION	Document Nr.	050.115			
		Revision	B			
		Page	15/17			

norms will be taken as reference in case of any point that is not mentioned in this specification.

ANNEXES

ANNEX – 1 Technical drawings of piston rings for TLMV185 type diesel engines

ANNEX – 2 Technical drawings of piston rings for MTU 8V396 TC13 type diesel engines

TÜRASAS ESKİŞEHİR REGIONAL DIRECTORATES	TECHNICAL SPECIFICATION	Document Nr.	050.115			
		Revision	B			
		Page	16/17			

ANNEX – 1

Technical Drawings of Piston Rings for TLMV185 Type Diesel Engines

Annex – 1.1 Drawing no 690 117 Compression Ring (2 rings in 1 piston)

Annex – 1.2 Drawing no 690 118 Top Ring (1 ring in 1 piston)

Annex – 1.3 Drawing no 690 119 Oil Ring (2 rings in 1 piston)

Annex – 1.4 Figures 1-2-3

Annex – 1.5 Photographs of Piston Ring Internal Structure

Annex – 1.6 Wald diagram

TÜRASAS ESKİŞEHİR REGIONAL DIRECTORATES	TECHNICAL SPECIFICATION	Document Nr.	050.115			
		Revision	B			
		Page	17/17			

ANNEX – 2

Technical Drawings of Piston Rings for MTU 8V396 TC13 Type Diesel Engines

Annex – 2.1 Drawing no LM 03517 Top Ring (1 ring in 1 piston)

Annex – 2.2 Drawing no LM 03518 Compression Ring (1 ring in 1 piston)

Annex – 2.3 Drawing no LM 03519 Oil Ring (1 ring in 1 piston)