PAULSTRA
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SPHERICAL ELASTOMERIC BEARING
AW 139 – MAIN ROTOR

579126 01

CLIENT/CUSTOMER	PROGRAMME/PROGRAM	CLASSIFICATION
AGUSTAWESTLAND	AW 139	CRITICAL PART
AG P/N	**SPECIFICATION**	**TTS**
3G6220V00154	139G6220E002	

TITRE/TITLE:

TECHNICAL NOTE
EXPERTISE

RESUME/SUMMARY:
The aim of this document is to present the conclusions of the expertise performed on five AW139 – M/R Elastomeric Bearings after a "hard landing".
S/N 0481 to 0485.
The expertise has been witnessed by the BEA.

Première édition/First issue: 01/07/2013

Rédigé par/ Written by *Service Technique* S. COMPIGNE	Vérifié par/Checked by	Approuvé par/Approved by *Qualité* G.RENAUD
Date 01/07/2013	Date	Date 01/07/2013
Visa [redacted]	Visa	Visa [redacted]

LISTE DE DIFFUSION/DIFFUSION LIST

PAULSTRA	Nb	EXTERNE/ EXTERNAL	Nb
SERVICE TECHNIQUE (Levallois)	1	BEA	1
U6	1	AGUSTAWESTLAND	1

Fichier File	Nombre de pages Number of pages	Nombre d'annexes Number of appendix	Nombre de figures Number of figures
TNe26d43a.doc	**33**	**4**	**-**

Indice Issue	Date	Pages	Modifications Changes
A	01/07/13	**All**	Première édition/ first issue

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1 – INTRODUCTION

The target of this document is to present the conclusions of the expertise performed by **PAULSTRA** on five AW139 – M/R Elastomeric Bearings.
In April 2013, PAULSTRA has been informed that five AW139 – M/R bearings have been removed from an aircraft after a "hard landing" occurred in October, 22sd 2012.
Those bearings have been sent back to **PAULSTRA** for expertise.

The expertise has been witnessed by the BEA (Marc LEVER & Stéphane OTIN) and AW (Luigi CANDIANI).

Concerned parts: **P/N 3G6220V00154** (PA P/N: 579126 01) **– S/N 0481** to **0485**

2 – APPLICABLE DOCUMENTS

2-1 – AGUSTA

139G6220E002	Rev. E	AB139 – Elastomeric Spherical Main Rotor Bearing Technical Specification
3G6220V00154	Rev. D	Drawing

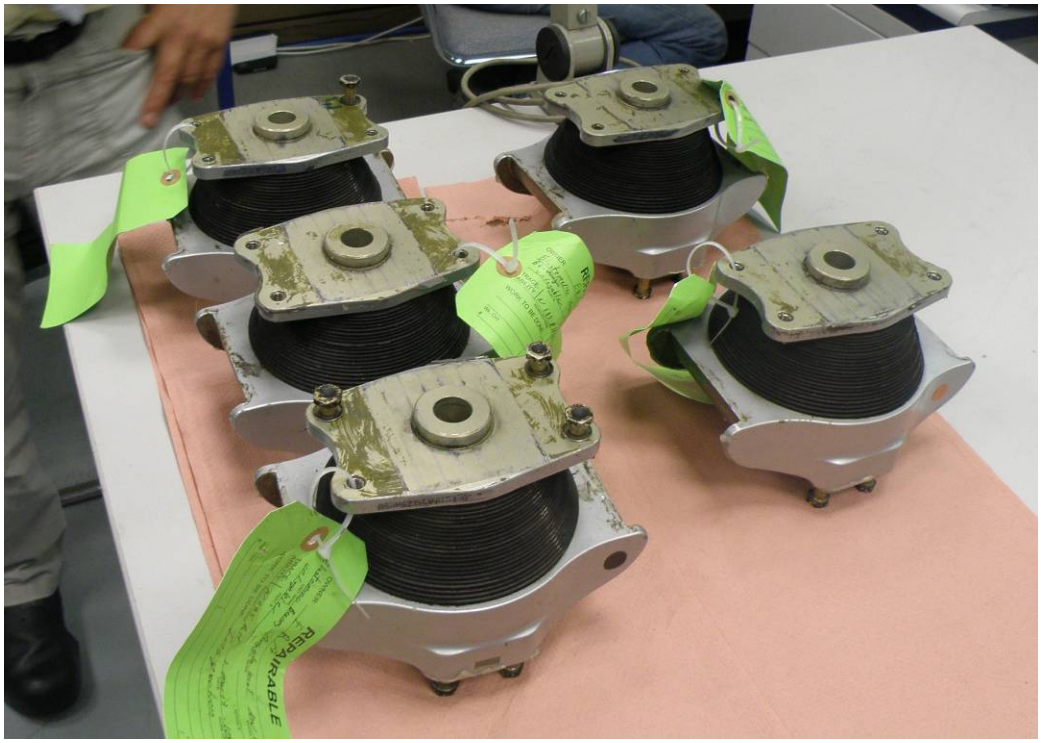
Delivery Documentation (Cf. *Appendix* **1**)

2-2 – PAULSTRA

579126 01	Iss. C	Drawing
PAQ E26 D7	Iss. F	Quality Plan
ATP E26 D9	Iss. G	Acceptance Tests Procedure
ATP E26 D9	Iss. K	Acceptance Tests Procedure (New Mould)
13-054		Quality Record

3 – EXPERTIZE

The expertise has been performed at PAULSTRA's facilities in Etrepagny (F-27150) on June, 3rd and 4th 2013.

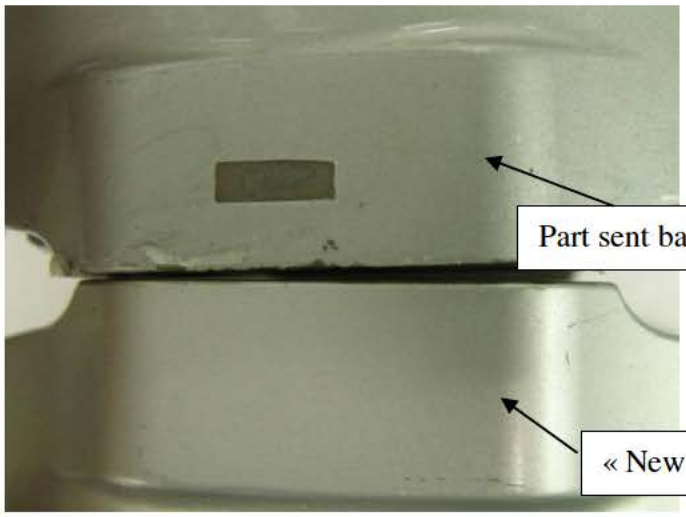


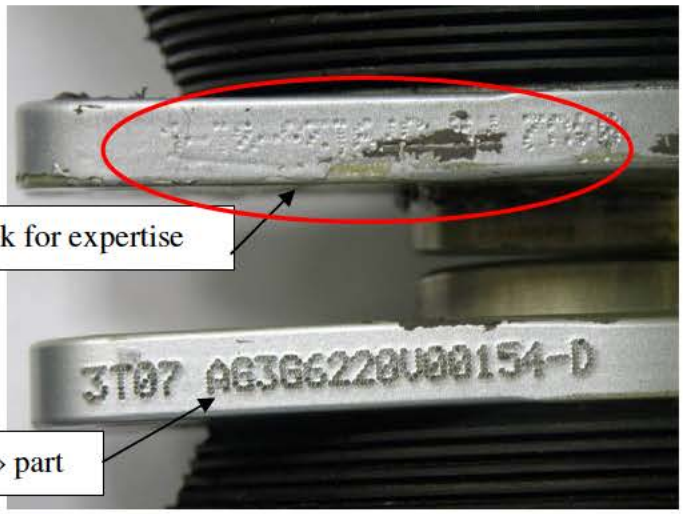
S/N	Manufacturing Date	Delivery Date	Service Life (Hours)	Returned	Blade Colour
0481	10/07/07				Black
0482					Orange
0483	11/07/07	19/07/07	2063.3	22/05/13	Blue
0484					Red
0485					White

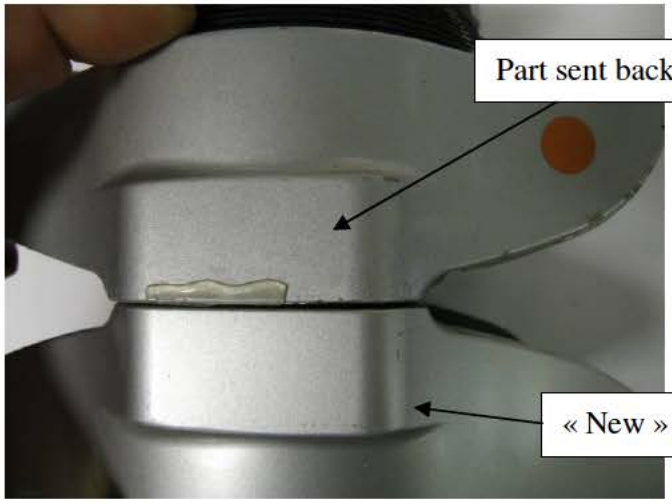
3.1 – Visual Inspection

A visual inspection has been first performed in order to identify potential cracks.

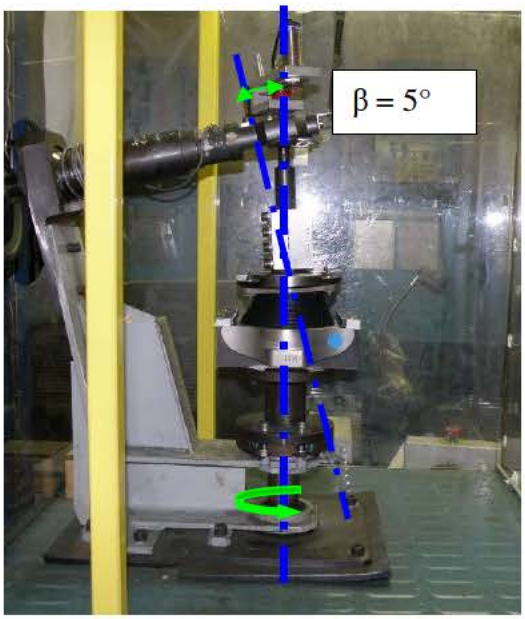
First of all, PAULSTRA mentioned that the marking is not more legible and that the final coating is not the original one.



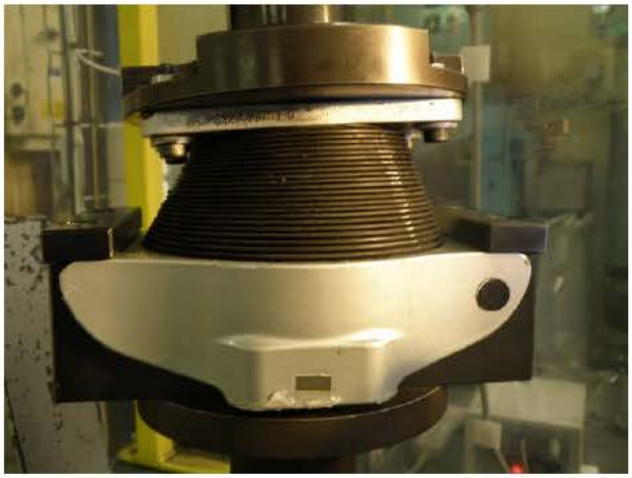




For the visual inspection, a specific test rig is used. It allows to apply a cocking angle in order to open the cracks, if there are any.

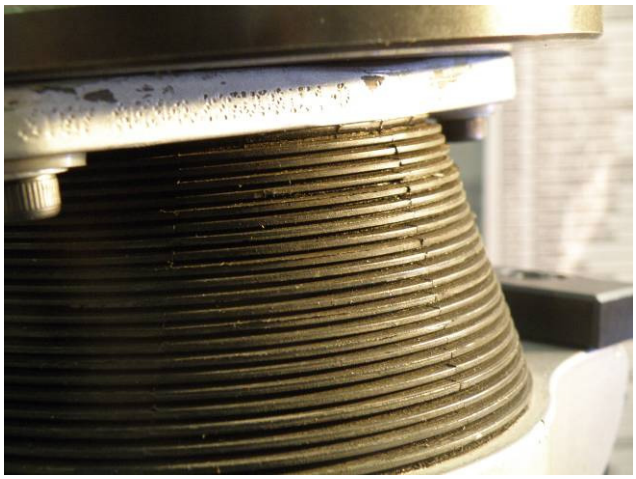


S/N 0481



There is a fold on the first layer. No depth detected

S/N 0482



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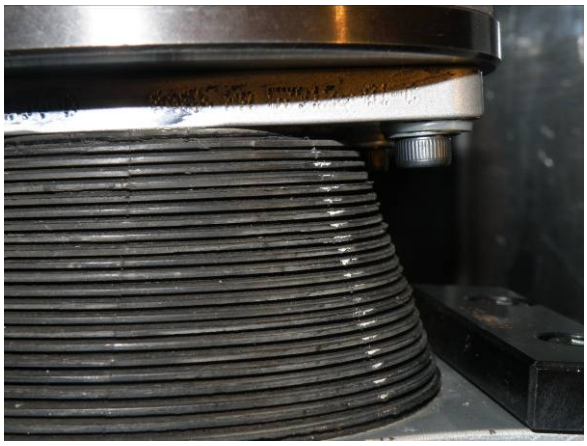


S/N 0484

S/N 0485

No crack detected on any bearing.
The five parts have the same aspect: a fold on the 1st layer in the lead-lag direction

3.2 – Acceptance Tests

Before the delivery, the bearings have been controlled according to **ATP E26 D9 iss.J**

S/N	Cocking Proof Test	Axial Stiffness (kN/mm)	Torsion Stiffness (mN/°)	Cocking Stiffness (mN/°)	Tensile Stiffness (kN/mm)	Height (mm)	Weight (g)
Specif.		276 ± 10%	7.2 ± 20%	24.5 ± 20%		105 ± 0.5	3845 ± 40
0481	OK	299.6	7.54	25.2	3142	104.85	3860
0482	OK	292.0	7.02	23.5	3147	104.86	3860
0483	OK	298.5	7.53	24.5	3328	104.88	3860
0484	OK	289.9	7.32	24.1	3138	104.88	3858
0485	OK	298.5	7.36	23.7	3080	104.90	3860

Before the delivery, the bearings have been controlled according to **ATP E26 D9 iss.K**

S/N	Cocking Proof Test	Axial Stiffness (kN/mm)	Torsion Stiffness (mN/°) (*)	Cocking Stiffness (mN/°) (**)	Height (mm) (***)
Specif.		290 ± 10%	7.2 ± 20%	24.5 ± 20%	105 ± 0.5
0481	OK	297.1	9.82	33.2	-
0482	OK	291.8	9.54	32.0	-
0483	OK	284.3	9.78	32.8	-
0484	OK	295.6	9.70	32.6	-
0485	OK	297.8	9.84	33.0	-

(*): Due to the ageing of the elastomer, the torsion stiffness increased and the required angle (± 20°) for the measure couldn't be respected because of the limitation of the test rig. The measure has been done between ± 14°. As the elastomer has a non linear behavior versus displacement, the impact of this deviation has been validated on a new part. (Cf. table 1).

(**): Due to the ageing of the elastomer, the cocking stiffness increased and the required angle (± 6°) for the measure couldn't be respected because of the limitation of the test rig. The measure has been done between ± 5.5°. As the elastomer has a non linear behavior versus the displacement, the impact of this deviation has been validated on a new part. (Cf. table 1).

Table 1:

	Torsion		**Cocking**	
	± 20°	± 14°	± 6°	± 5.5°
Stiffness (mN/°)	6.83	7.31	24.79	25.22
Variation		+7%		+1.75%

If we take into account this coefficient, we can extrapolate the stiffness according to the ATP requirements and then conclude on the angular stiffness' evolution.

S/N	Torsion Stiffness (mN/°) Measure	Torsion Stiffness (mN/°) Extrapolation	Δt_0	Cocking Stiffness (mN/°) Measure	Cocking Stiffness (mN/°) Extrapolation	
Specif.		7.2 ± 20%			24.5 ± 20%	
0481	9.82	9.13	+21.1 %	33.2	32.6	+29.4 %
0482	9.54	8.87	+26.3 %	32.0	31.4	+33.6 %
0483	9.78	9.09	+20.7 %	32.8	32.2	+31.4 %
0484	9.70	9.02	+23.2 %	32.6	32.0	+32.8 %
0485	9.84	9.15	+24.3 %	33.0	32.4	+36.7 %

The stiffening of the parts is induced by the ageing of the elastomer.
According to internal data base, the mean stiffening after 71 months of storage at ambient temperature is around +26%.
The data base is available upon request at PAULSTRA's facilities.

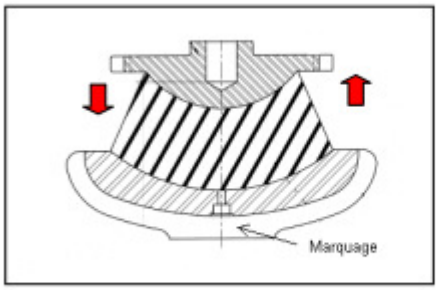
The elastomer has not the same ageing behavior in compression (axial stiffness) and in shear (torsion and cocking stiffness). The shear behavior is more affected by the ageing parameters (mainly time and temperature).

Curves and pictures of the ATP are given in *Appendix* **2, 3 & 4**.
(***): As each bearing has a permanent deformation, it is not more possible to measure the height. A specific dimensional inspection has been then performed (Cf. § 3.3)

3.3 – Dimensional Inspection

For each bearing, angular permanent deformations have been measured

S/N 0481



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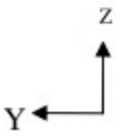

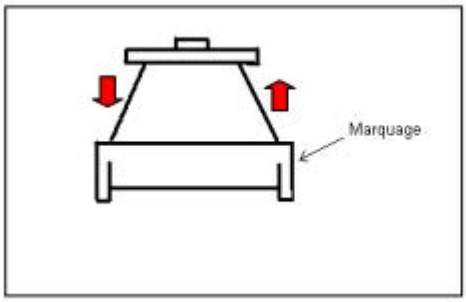

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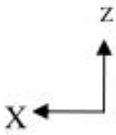

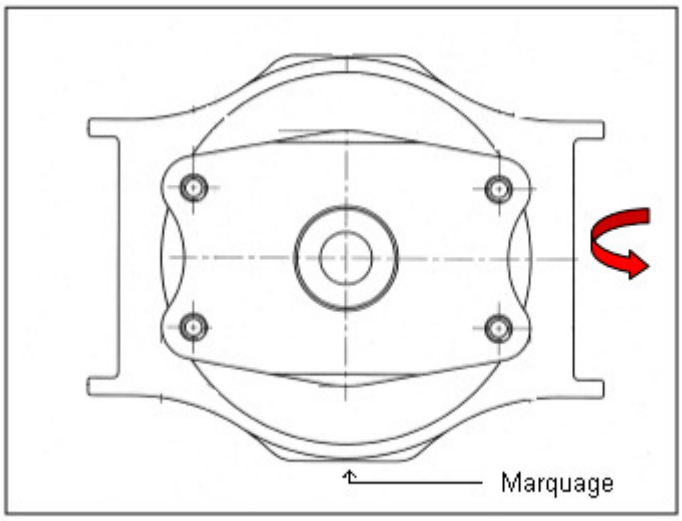

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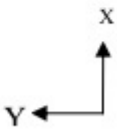

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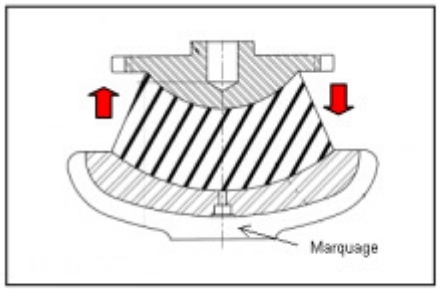

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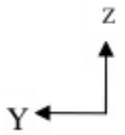

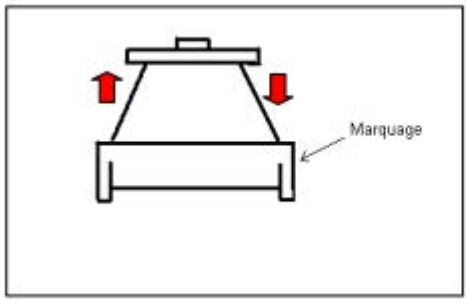

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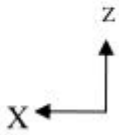

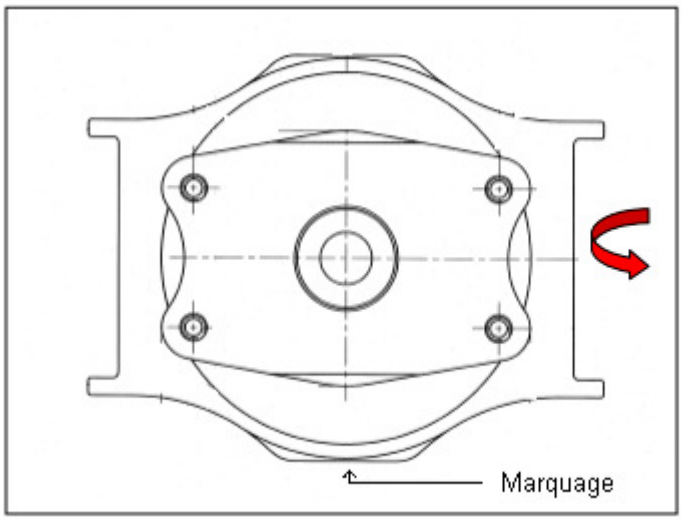

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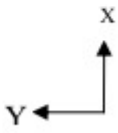

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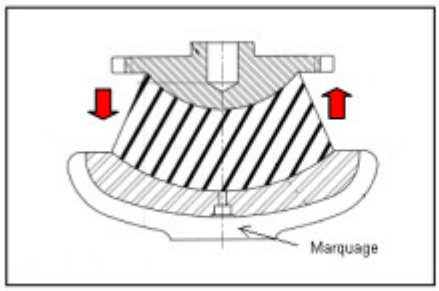

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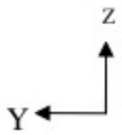

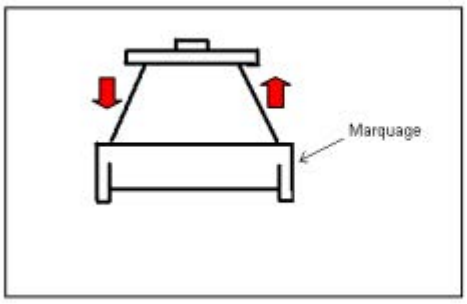

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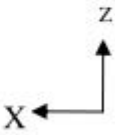

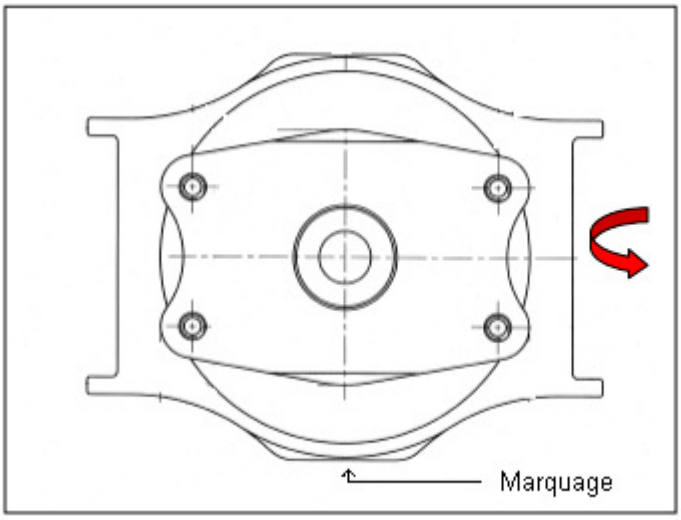

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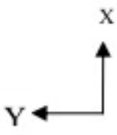

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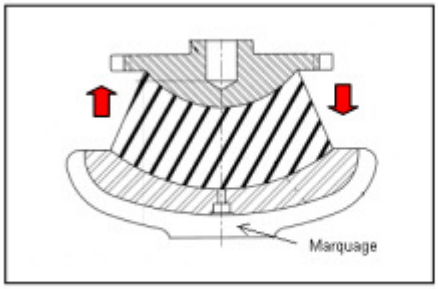

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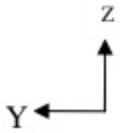

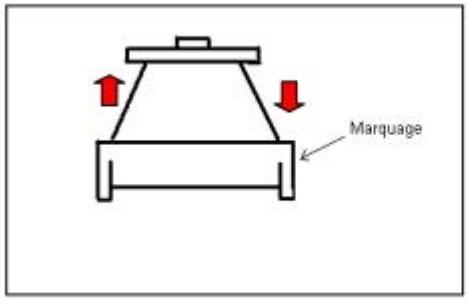

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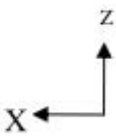

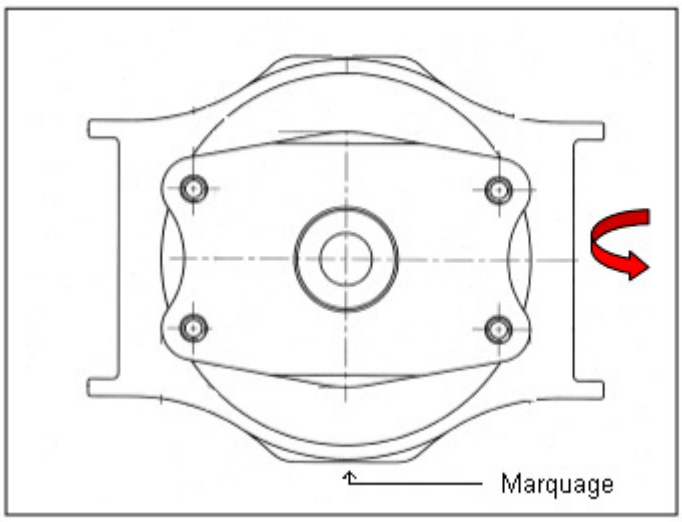

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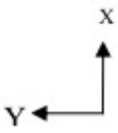

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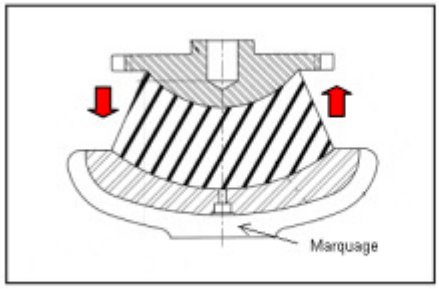

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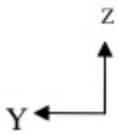

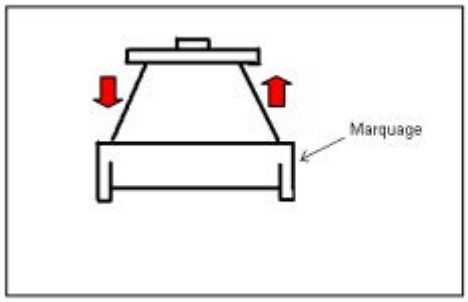

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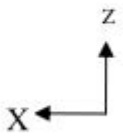

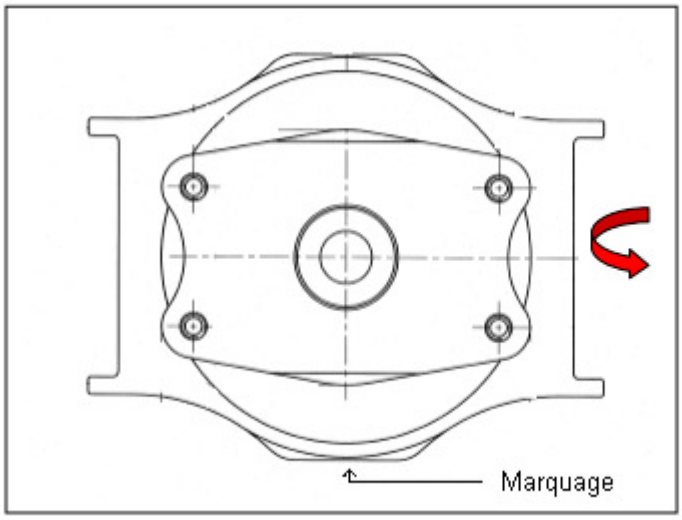

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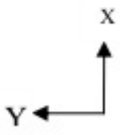


4– CONCLUSION

The expertise has been successfully performed.
The five bearings do not present any anomaly after 2063.3 flight hours and a hard landing.

- None crack has been detected on any bearing
- The measured stiffnesses are compliant with the expected values, taking into account the ageing of the elastomer.
- There are angular permanent deformations, mainly in cocking and pitch directions, compatible with 2063.3 flight hours in hot environment. These deformations are more important on the bearings installed on the black, blue and white blades.

Notes:

- The marking is not more legible.
- The final coating is not more conform to the delivered configuration

The parts will be sent back to HELI WORKS as requested by Shin Chihoon in his mail dated June, 10th 2013.

APPENDIX 1:

HELIWORKS, LLC.
4475 JERRY L. MAYGARDEN RD.
PENSACOLA, FL 32504
(850) 438-6056 PH
(850) 438-1469 FX

Date: 04/03/2013

SHIP TO:
AUGUSTAWESTLAND PHILADELPHIA CORP
ATTN:CHRIS LEMIEUX
3050 RED LION RD.
PHILADELPHIA, PA 19114
[redacted]

WORK ORDER:W/O 1000
REF. NO: AUGUSTA
N385RH

PART NUMBER	SERIAL NUMBER	DESCRIPTION	QTY	UNIT
		M/R ELASTOMERIC BEARINGS	5	EA.

IF YOU HAVE ANY CONCERNS, PLEASE CALL....
GENNI BILLINGSLEY
Heliworks, LLC.
4475 Jerry L. Maygarden Rd.
Pensacola, Fl 32504
[redacted]

Agusta Westland
3050 Red Lion Road
Philadelphia, Pa. 19114
215.281.1400 Fax: 215.281.0440
BILLTO:
PAULSTRA
2 RUE TURGOT
27150 ETREPAGNY
FRANCE
ATTN: S. COMPIGNE [redacted]

SHIP TO:
PAULSTRA
2 RUE TURGOT
27150 ETREPAGNY
FRANCE
ATTN: S. COMPIGNE [redacted]

AGUSTA
REF: CL0429/13

	BILL OF LADING	INVOICE DATE	ACNTRL NO	SHIP VIA	RECEIVING REPORT NO (S)	TERMS
	302 784 3885	4/29/13		UPS SCS		

ITEM NO.	QTY. ORD.	QTY. SHP.	U/M	QTY. B/O	PART NUMBER / DESCRIPTION	PRICE	U/M	AMOUNT
1		5	EA		3G6220V00154 ELASTOMERIC DAMPER These commodities, technology or software were exported from the United States in accordance with the Export Administration Regulations. Diversion contrary to U.S. law is prohibited.	[redacted]	USD	[redacted]

CARTONS	PACKAGES	WEIGHT
	1	85

INVOICE TOTAL [redacted]

ID:4124489885 User:pxfrufieaux1 TIF SN:3027843885 Print GMT:5/2/2013 4:56:10 AM pg:1

PAR/HPH ECD

CRN No. | HAWB NO. 3027843885

Shipper's Name and Address | Shipper's Account Number [redacted]

AGUSTA WESTLAND PHILADELPHIA CORP
3076 RED LION RD
PHILADELPHIA PA 19114 US

Not Negotiable
Air Waybill **Air Freight Services**
AIR CONSIGNMENT NOTE
ISSUED BY UPS SUPPLY CHAIN SOLUTIONS

Copies 1,2 and 3 of this Air Waybill are originals and have the same validity.

Consignee's Name and Address | Consignee's Account Number [redacted]

PAULSTRA
2 RUE TURGOT
ETREPAGNY 27150 FR

It is mutually agreed that the goods described were received in good condition (except as noted) for transportation as specified in the Shipper's Letter of Instruction.

RECEIVED BY UPS SUPPLY CHAIN SOLUTIONS AT: SHIPPERS DOOR
Place PHL Time 16:00 Date 29-APR-2013 No of Shipments 1

Issuing Carrier's Agent Name and City
UPS SUPPLY CHAIN SOLUTIONS, INC.
1 HOG ISLAND ROAD, AIR CARGO BUILDING
PHILADELPHIA PA 19153 US

Also Notify

Agent's IATA Code [redacted] | Account No.

Third Party Billing

Airport of Departure(Addr. of First Carrier) and Requested Routing
PHILADELPHIA/406PHL11531774

To	By First Carrier / Routing and Distribution	to	by	to	by	Currency	Chgs Code	WT/VAL PPD	WT/VAL COLL	Other PPD	Other COLL	Declared Value for Carriage	Declared Value for Customs
CDG	5X219/CDG/30					USD		X		X		NVD	[redacted]

Airport of Destination	Flight/Date For Carrier Use Only	Flight/Date	Amount of Insurance	INSURANCE- If shipper requests insurance in accordance with conditions on reverse hereof, indicate amount to be insured in figures in box marked amount of insurance.	TC
PARIS	30-APR-2013		NIL		

Handling Information (Special Instructions)
*** DUTY PREPAID ***

SR-CL429/13/CUST
SC-JEFF MORRIS/[redacted] CC-S COMPIGNE/[redacted]

No. of Pieces RCP	Gross Weight	kg lb	Rate Class / Commodity Item No.	Chargeable Weight		Rate / Charge		Total	Nature and Quantity of Goods (Include Dimensions or Volume)
1	39.00	K	N 9Z14	39.00	K	1.41	K	55.00	PROPS & RTRS & PRTS FOR CVL
AES X20130429060642									Qty 1 Length 76.2 Width 58.4 Height 35.5 UoM CM
406-11531774 DD 120 5X 219 *** CUST ***									
1	39.00							55.00	Volume = 0.157978 M3

Prepaid: Weight Charge 55.00 | Collect

Valuation Charge

Tax

Total Other Charges Due Agent

Total Other Charges Due Carrier [redacted]

Currency

Other Charges
E01 REGUL 10.00 P PU PICK 15.00 P TC TERMI 27.50 P
33 FUEL- 58.61 P 41 DDP/D 39.00 P 44 BILL 27.80 P
83 US EX 15.00 P 84 SECUR 7.99 P

All shipments are subject to the terms and conditions of contract as set forth in the UPS Air Freight Terms and Conditions of Contract at www.ups.com. If this shipment contains Dangerous Goods, this air waybill must describe the Shipment and the Shipment must be in condition for carriage, in accordance with the current International Air Transport Association's Dangerous Goods Regulations.

Total Prepaid [redacted] | Total Collect

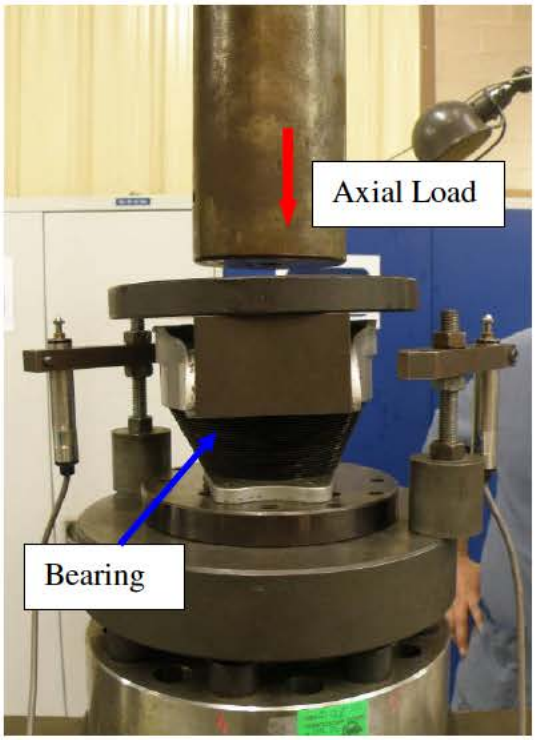
Currency Conversion | cc Charges in Dest. Currency

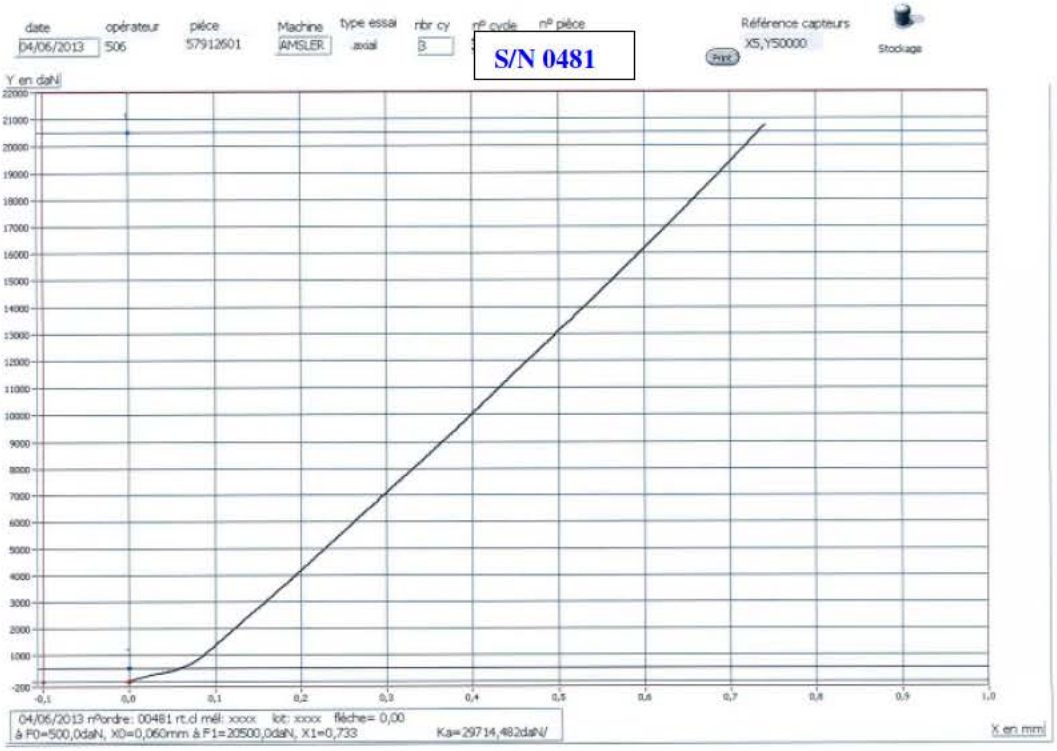
Executed on
29-APR-2013 (Date) 16:00 (Time) PAR at (Place) 3027843885 Signature of Issuing Carrier or its Agent pxfrutie

For Carrier's Use Only at Destination | Charges at Destination | Total Collect

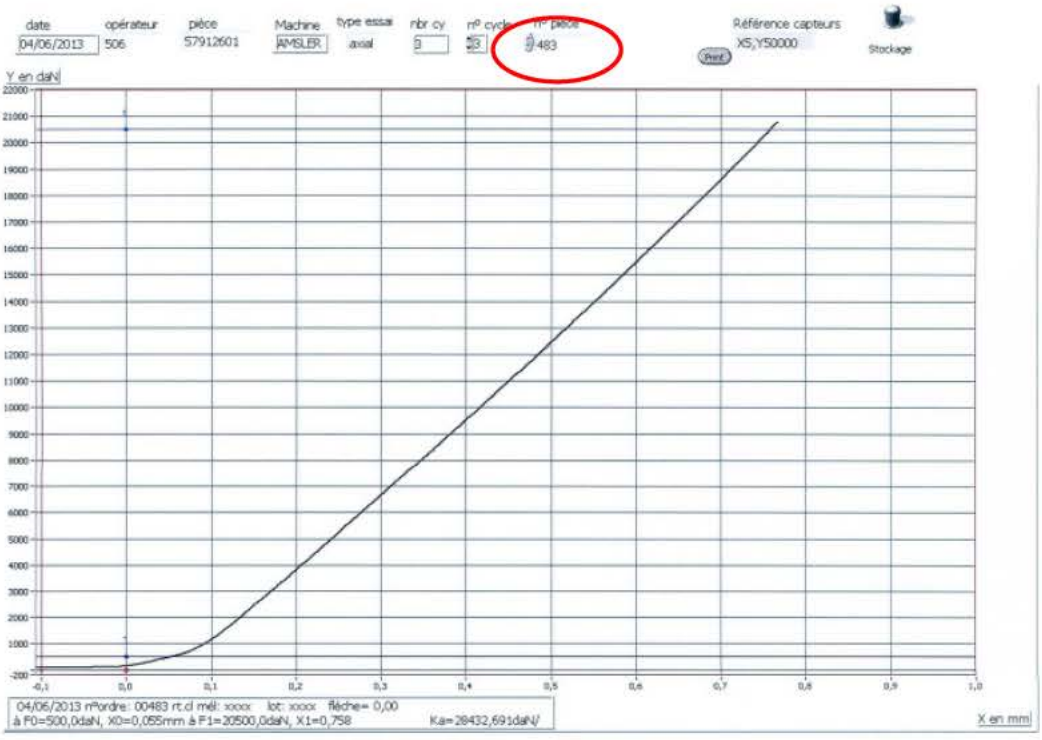
Shipper certifies that these commodities, technology or software were exported from the United States in accordance with the Export Administration Regulations. Diversion contrary to U.S. law prohibited

APPENDIX 2: AXIAL STIFFNESS





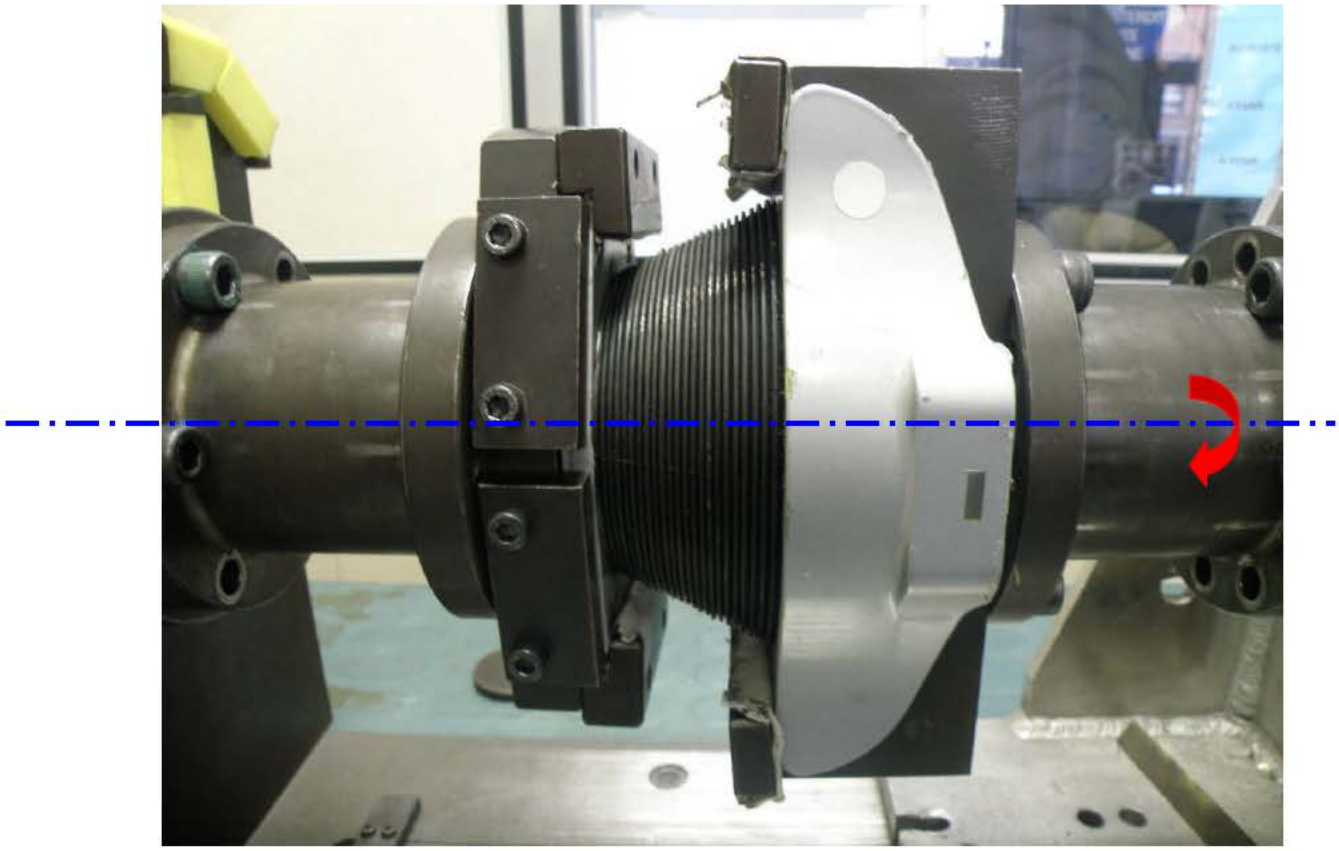

date
opérateur
pièce
Machine
type essai
nbr cy
nº cycle
nº pièce
04/06/2013
506
57912601
AMSLER
axial
3
3
482
Référence capteurs
X5,Y50000
Print
Stockage
Y en daN
X en mm
04/06/2013 nºordre: 00482 rt.cl mél: xxxx lot: xxxx flèche= 0,00
à F0=500,0daN, X0=0,077mm à F1=20500,0daN, X1=0,762
Ka=29175,275daN/


date
opérateur
pièce
Machine
type essai
nbr cy
nº cycle
nº pièce
04/06/2013
506
57912601
AMSLER
axial
3
3
483
Référence capteurs
X5,Y50000
Print
Stockage
Y en daN
X en mm
04/06/2013 nºordre: 00483 rt.cl mél: xxxx lot: xxxx flèche= 0,00
à F0=500,0daN, X0=0,055mm à F1=20500,0daN, X1=0,758
Ka=28432,691daN/

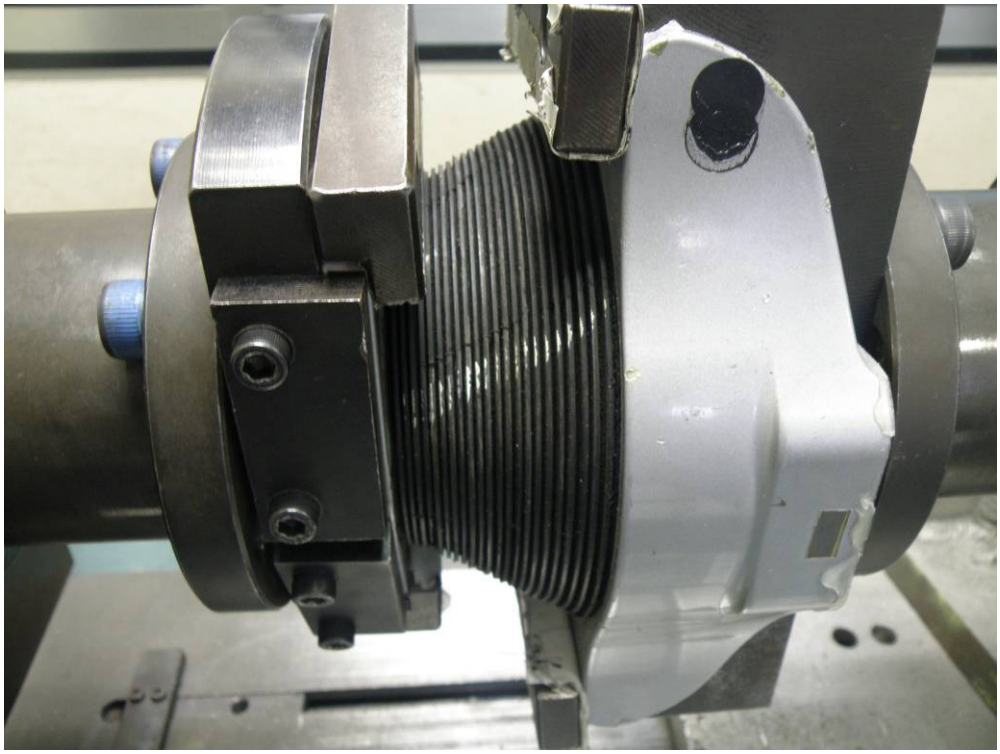

date
04/06/2013
opérateur
506
pièce
57912601
Machine
AMSLER
type essai
axial
nbr cy
3
nº cycle
3
nº pièce
484
Référence capteurs
X5,Y50000
Print
Stockage
Y en daN
X en mm
04/06/2013 nºordre: 00484 rt.cl mél: xxxx lot: xxxx flèche= 0,00
à F0=500,0daN, X0=0,061mm à F1=20500,0daN, X1=0,737
Ka=29558,762daN/

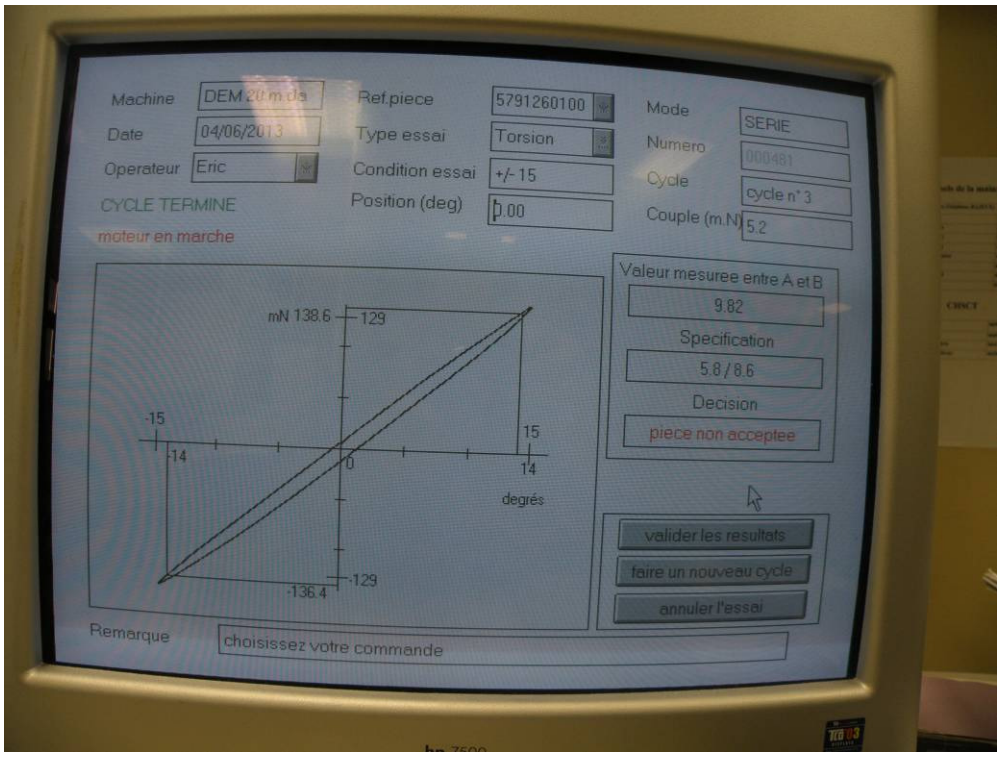

date
04/06/2013
opérateur
506
pièce
57912601
Machine
AMSLER
type essai
axial
nbr cy
3
nº cycle
3
nº pièce
485
Référence capteurs
X5,Y50000
Print
Stockage
Y en daN
X en mm
04/06/2013 nºordre: 00485 rt.cl mél: xxxx lot: xxxx flèche= 0,00
à F0=500,0daN, X0=0,055mm à F1=20500,0daN, X1=0,726
Ka=29778,781daN/

APPENDIX 3: TORSION STIFFNESS

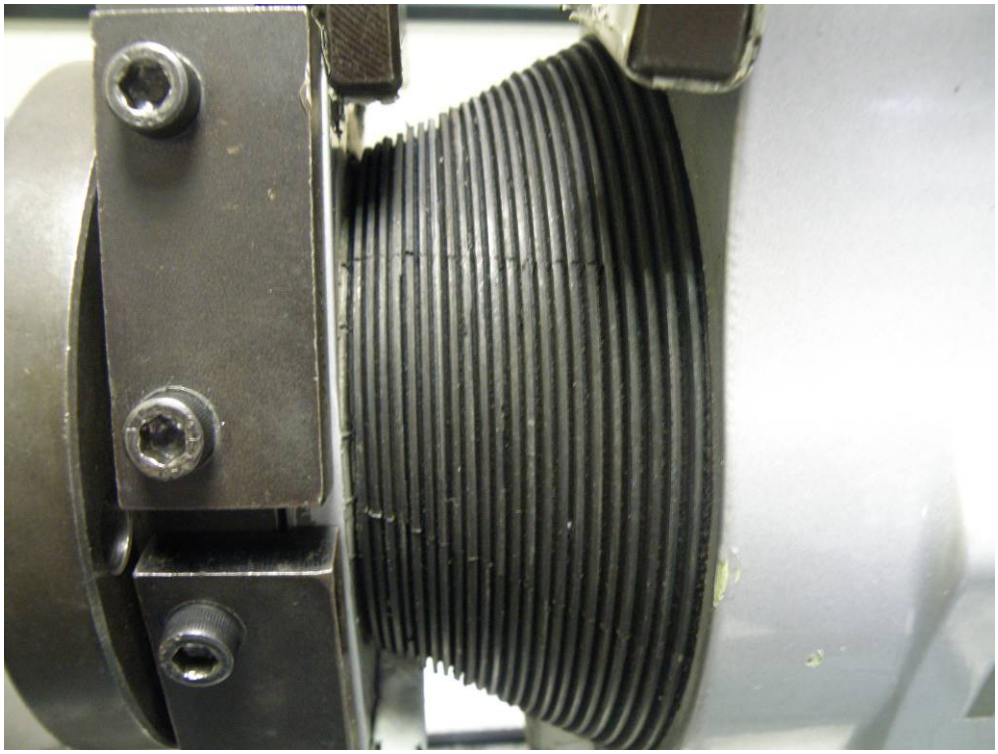


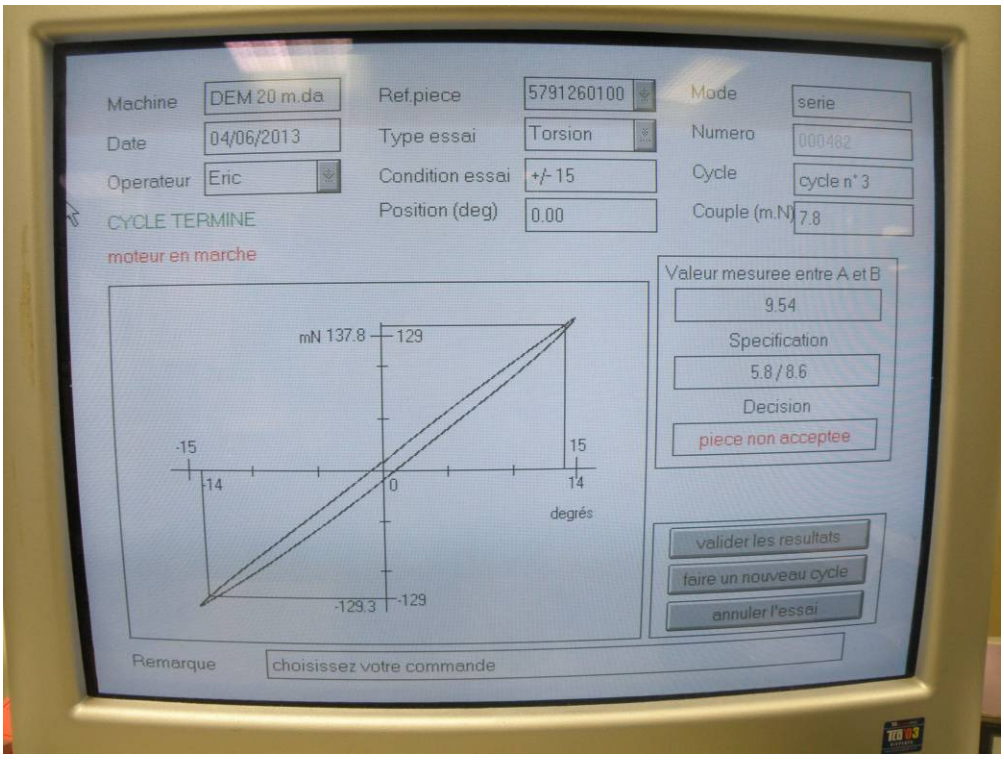
S/N 0481



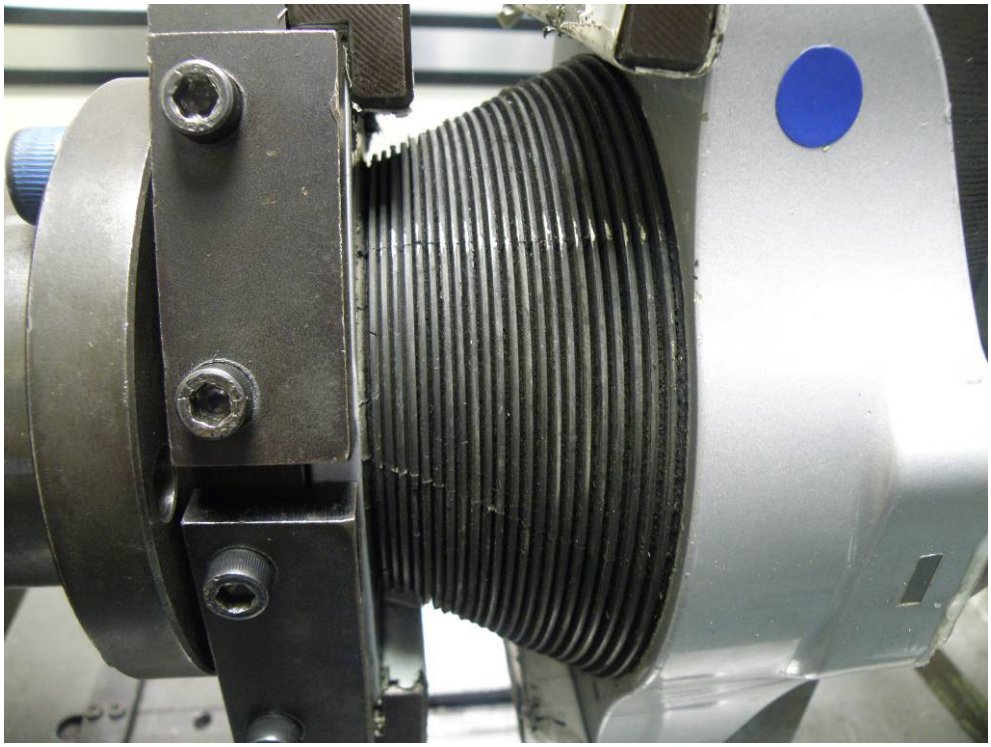

Machine
DEM 2
Date
04/06/2013
Operateur
Eric
CYCLE TERMINE
moteur en marche
Ref.piece
5791260100
Type essai
Torsion
Condition essai
+/- 15
Position (deg)
0.00
Mode
SERIE
Numero
000481
Cycle
cycle n° 3
Couple (m.N)
5.2
Valeur mesuree entre A et B
9.82
Specification
5.8 / 8.6
Decision
piece non acceptee
mN 138.6
129
-15
-14
0
14
15
degrés
-129
-136.4
valider les resultats
faire un nouveau cycle
annuler l'essai
Remarque
choisissez votre commande

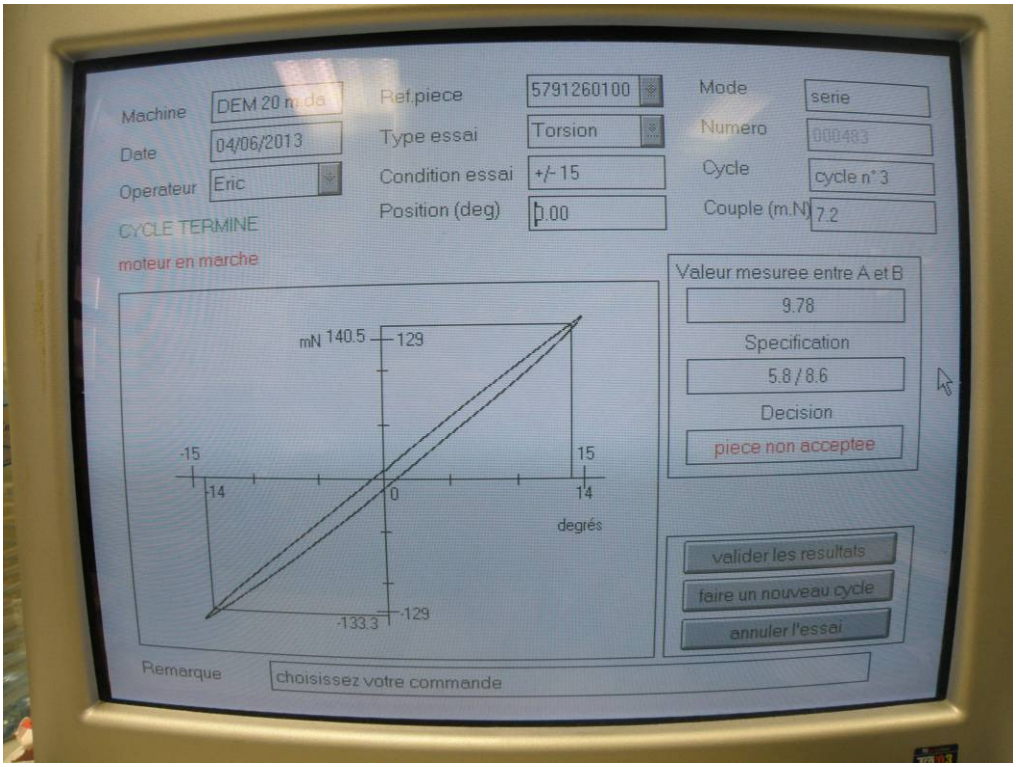
S/N 0482



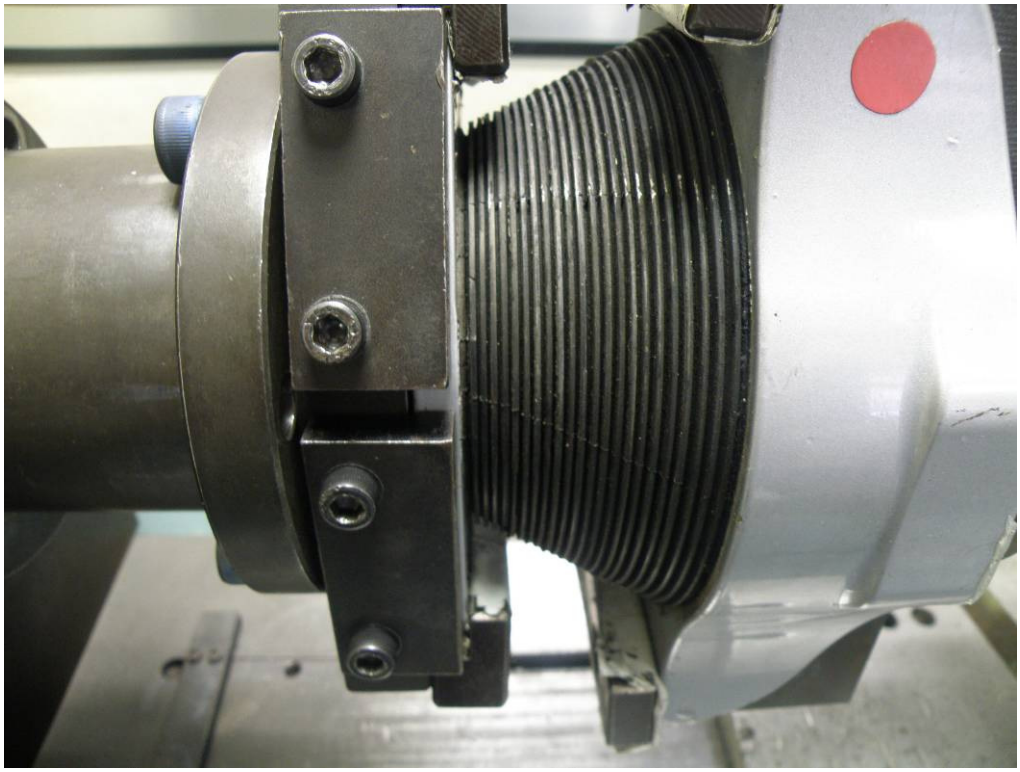

Machine
DEM 20 m.da
Date
04/06/2013
Operateur
Eric
CYCLE TERMINE
moteur en marche
Ref.piece
5791260100
Type essai
Torsion
Condition essai
+/- 15
Position (deg)
0.00
Mode
serie
Numero
000482
Cycle
cycle n°3
Couple (m.N)
7.8
Valeur mesuree entre A et B
9.54
Specification
5.8 / 8.6
Decision
piece non acceptee
mN 137.8
129
-15
15
-14
0
14
degrés
-129.3
-129
valider les resultats
faire un nouveau cycle
annuler l'essai
Remarque
choisissez votre commande

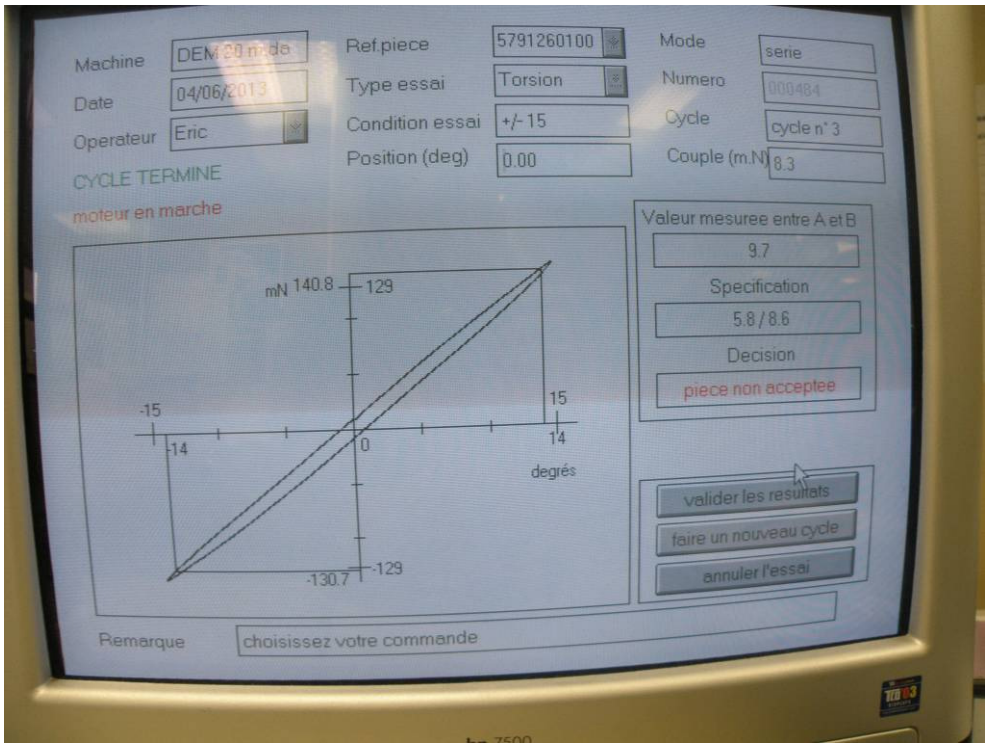
S/N 0483



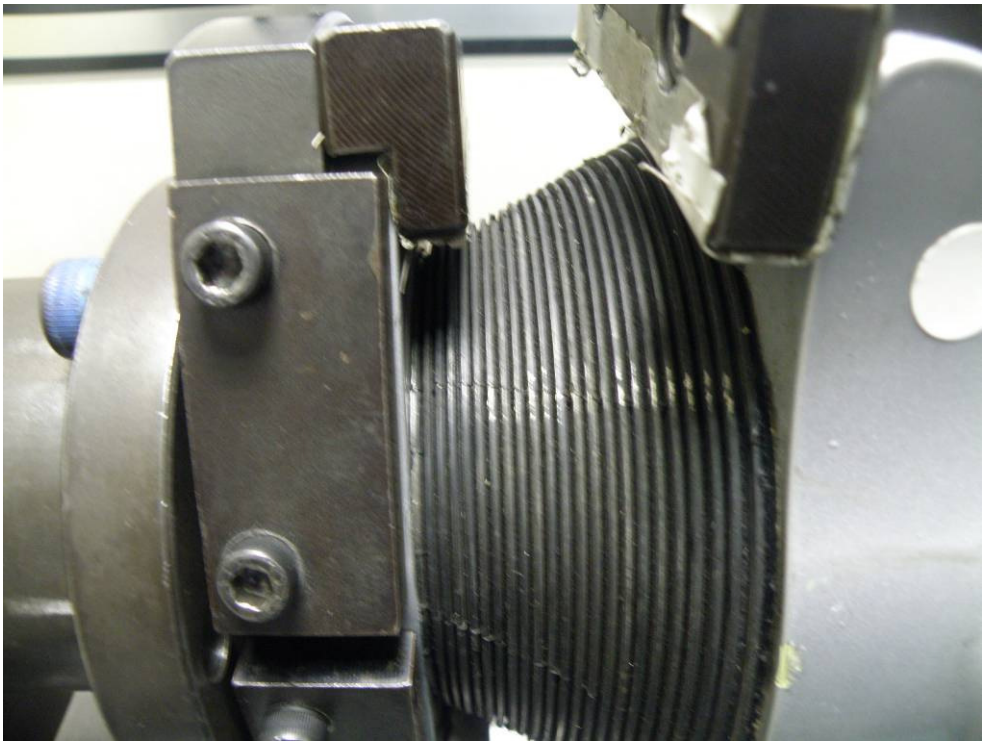

Machine
DEM 20 mda
Date
04/06/2013
Operateur
Eric
CYCLE TERMINE
moteur en marche
Ref.piece
5791260100
Type essai
Torsion
Condition essai
+/- 15
Position (deg)
0.00
Mode
serie
Numero
000483
Cycle
cycle n°3
Couple (m.N)
7.2
Valeur mesuree entre A et B
9.78
Specification
5.8 / 8.6
Decision
piece non acceptee
mN 140.5
129
-15
15
-14
0
14
degrés
-133.3
-129
valider les resultats
faire un nouveau cycle
annuler l'essai
Remarque
choisissez votre commande

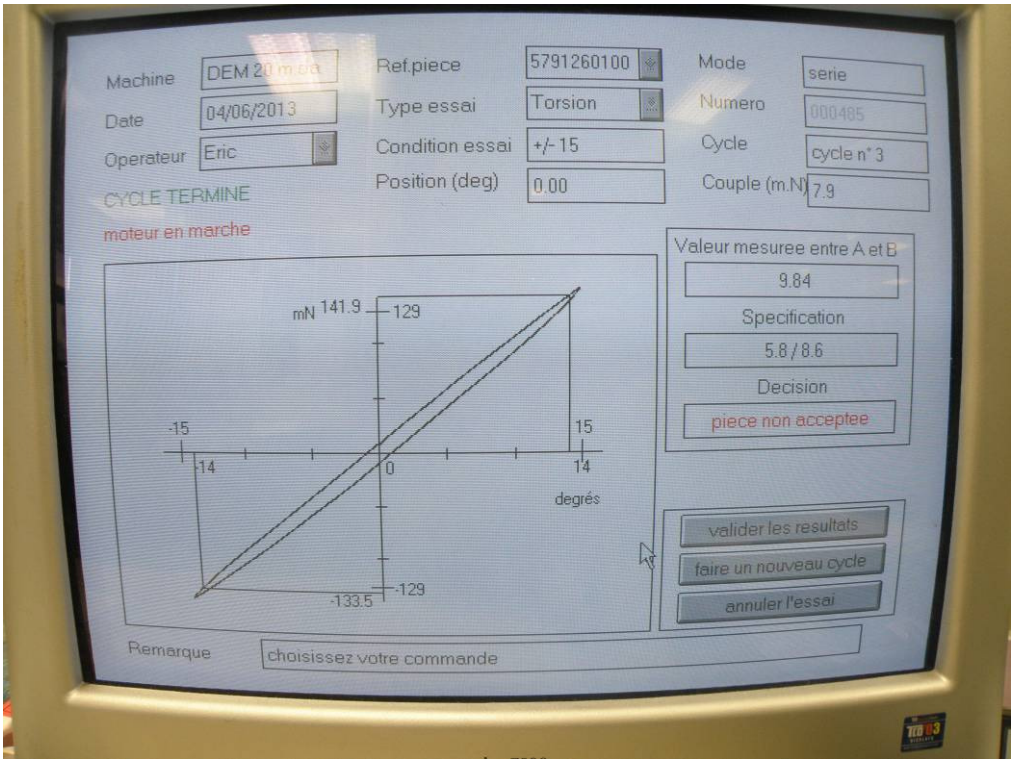
S/N 0484



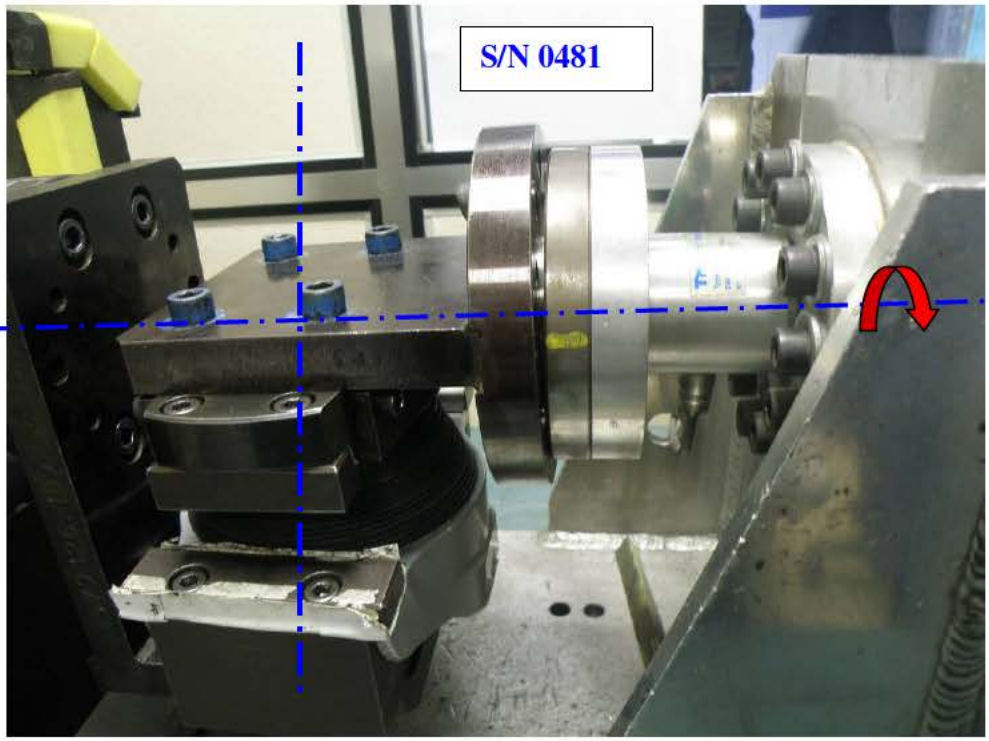

Machine
Date
04/06/2013
Operateur
Eric
CYCLE TERMINE
moteur en marche
Ref.piece
5791260100
Type essai
Torsion
Condition essai
+/- 15
Position (deg)
0.00
Mode
serie
Numero
Cycle
cycle n° 3
Couple (m.N)
8.3
Valeur mesuree entre A et B
9.7
Specification
5.8 / 8.6
Decision
piece non acceptee
mN
140.8
129
-15
15
-14
14
0
degrés
-130.7
-129
valider les resultats
faire un nouveau cycle
annuler l'essai
Remarque
choisissez votre commande

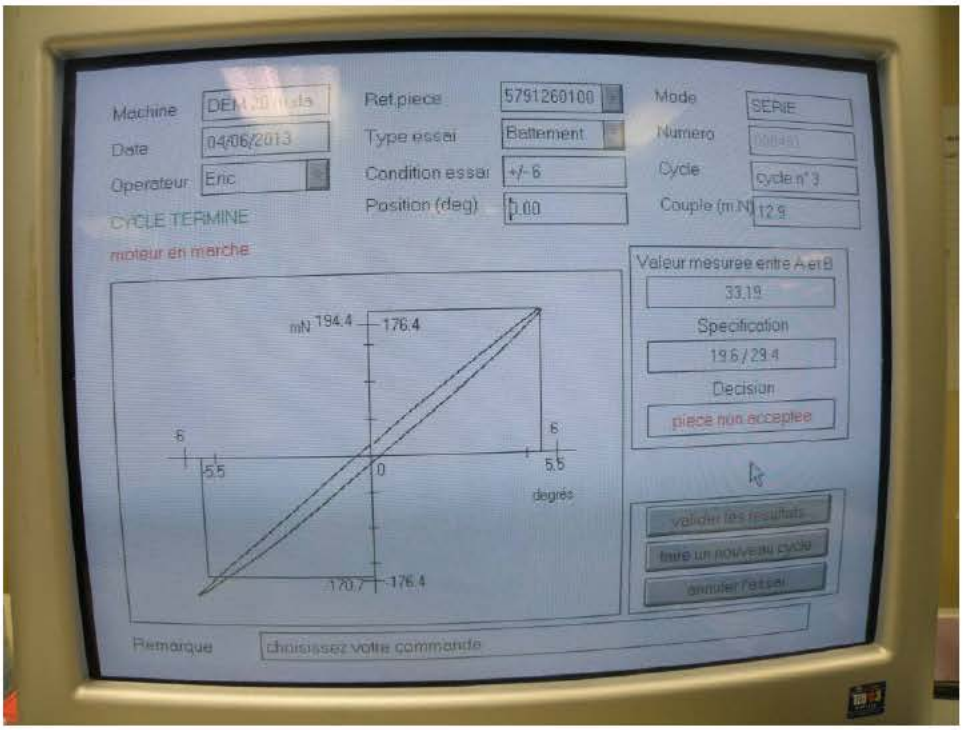
S/N 0485



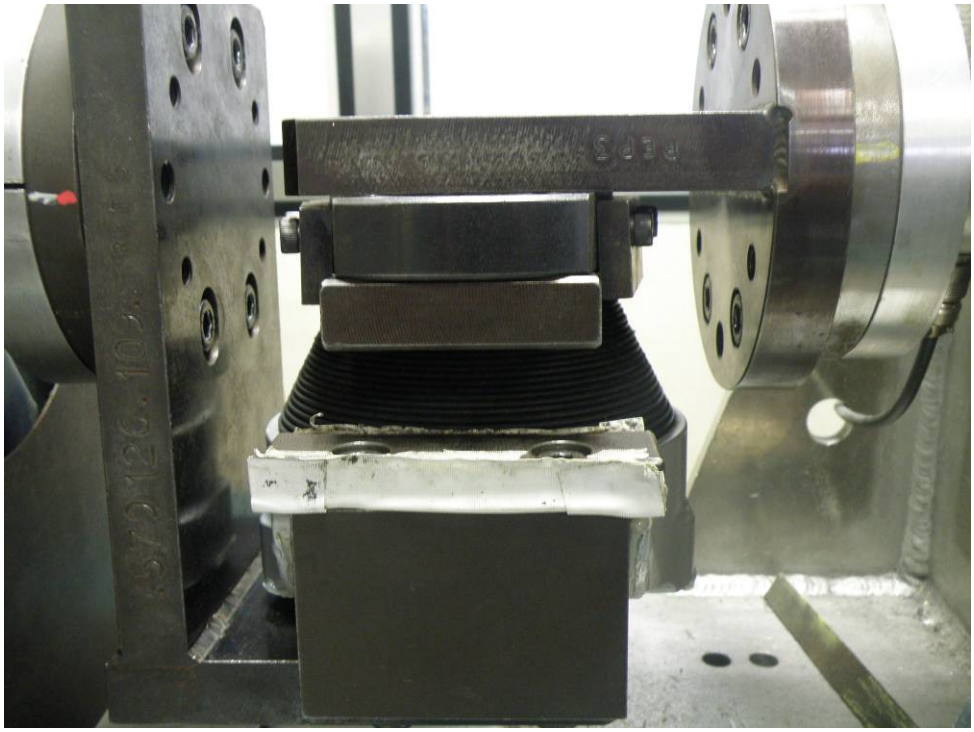

Machine
DEM 20 m.ea
Date
04/06/2013
Operateur
Eric
CYCLE TERMINE
moteur en marche
Ref.piece
5791260100
Type essai
Torsion
Condition essai
+/- 15
Position (deg)
0.00
Mode
serie
Numero
000485
Cycle
cycle n° 3
Couple (m.N)
7.9
Valeur mesuree entre A et B
9.84
Specification
5.8 / 8.6
Decision
piece non acceptee
mN
141.9
129
-129
-133.5
-15
15
-14
14
0
degrés
valider les resultats
faire un nouveau cycle
annuler l'essai
Remarque
choisissez votre commande

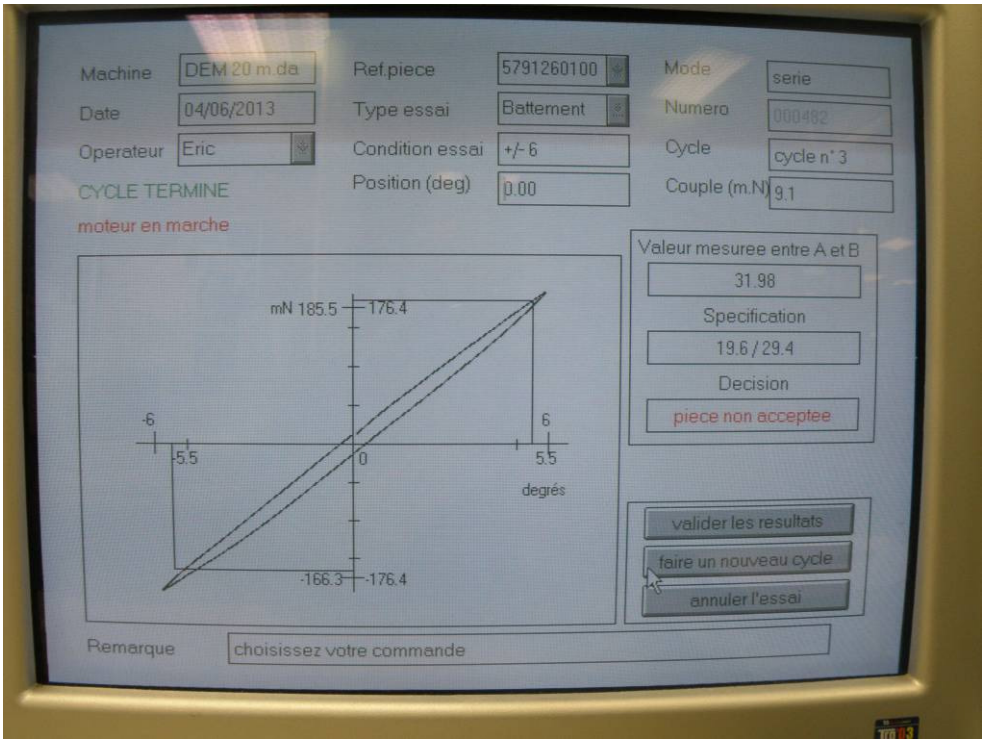
APPENDIX 4: COCKING STIFFNESS



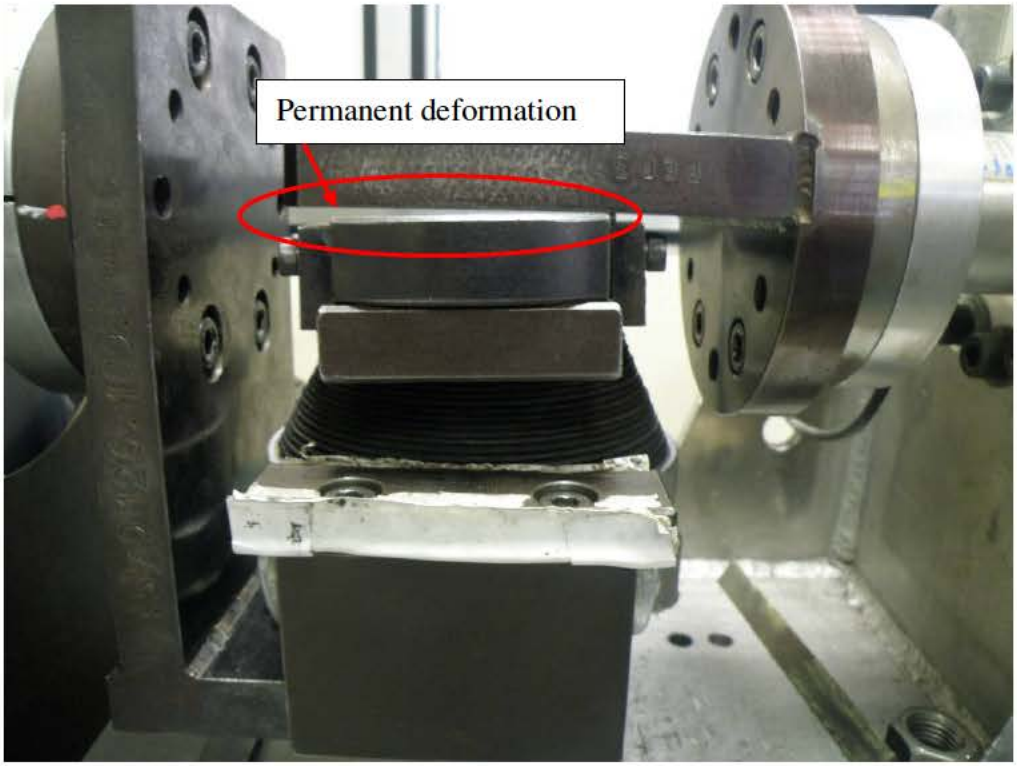


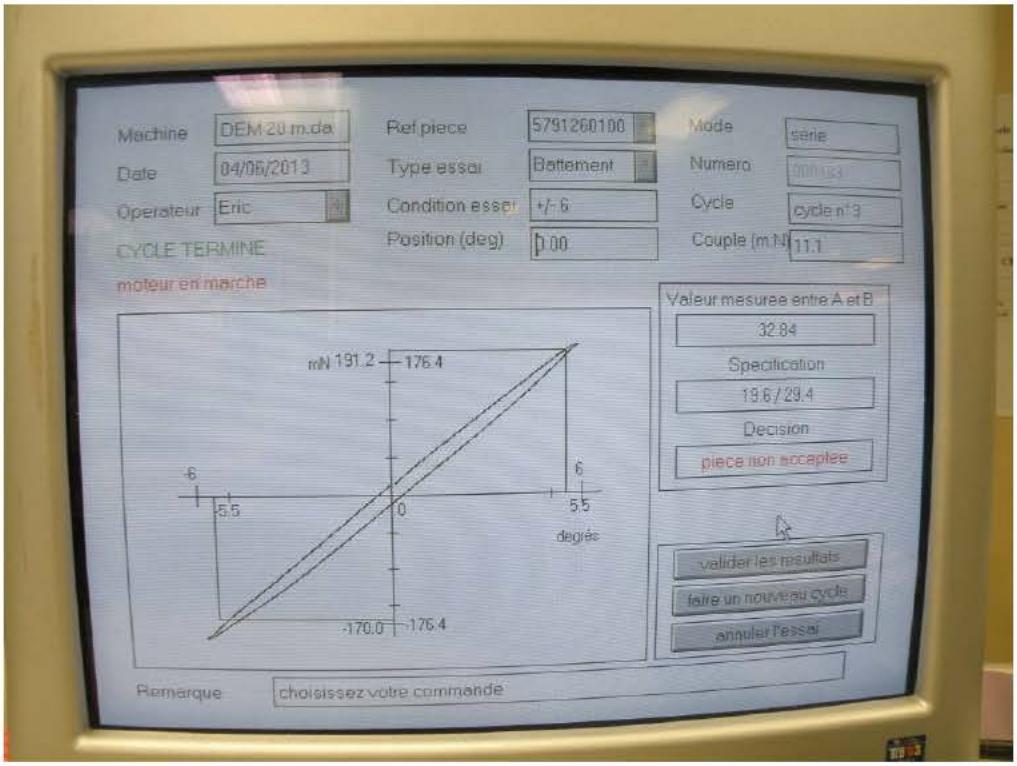
S/N 0482



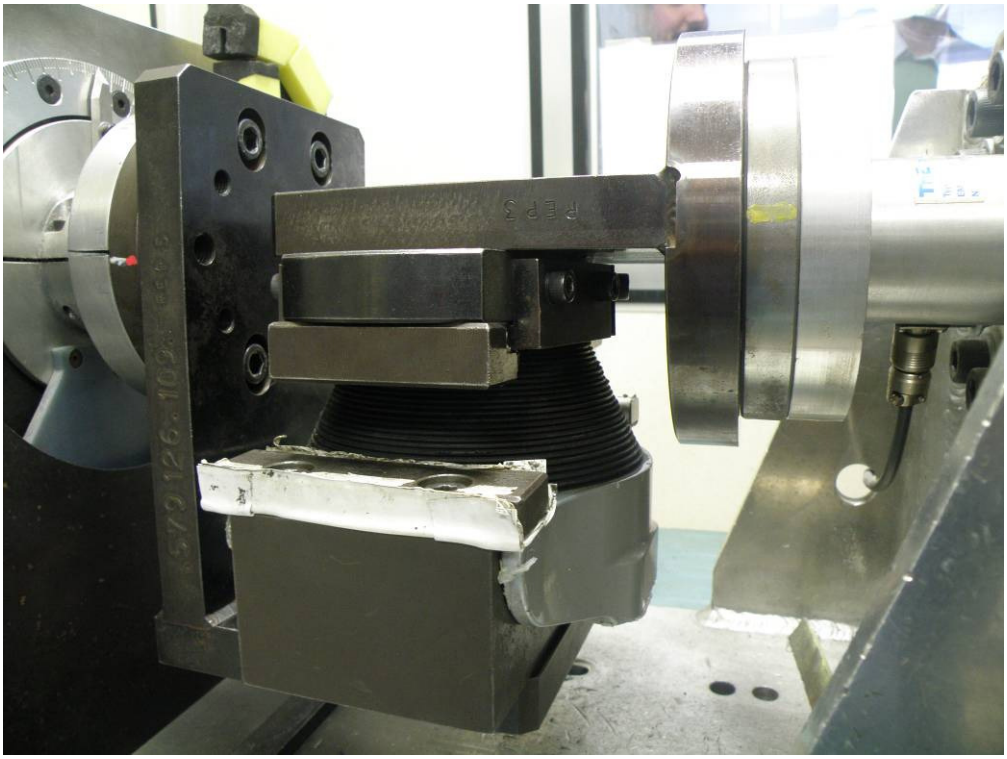

Machine
DEM 20 m.da
Date
04/06/2013
Operateur
Eric
CYCLE TERMINE
moteur en marche
Ref.piece
5791260100
Type essai
Battement
Condition essai
+/- 6
Position (deg)
0.00
Mode
serie
Numero
000482
Cycle
cycle n° 3
Couple (m.N)
9.1
Valeur mesuree entre A et B
31.98
Specification
19.6 / 29.4
Decision
piece non acceptee
mN 185.5
176.4
-6
6
-5.5
0
5.5
degrés
-166.3
-176.4
valider les resultats
faire un nouveau cycle
annuler l'essai
Remarque
choisissez votre commande

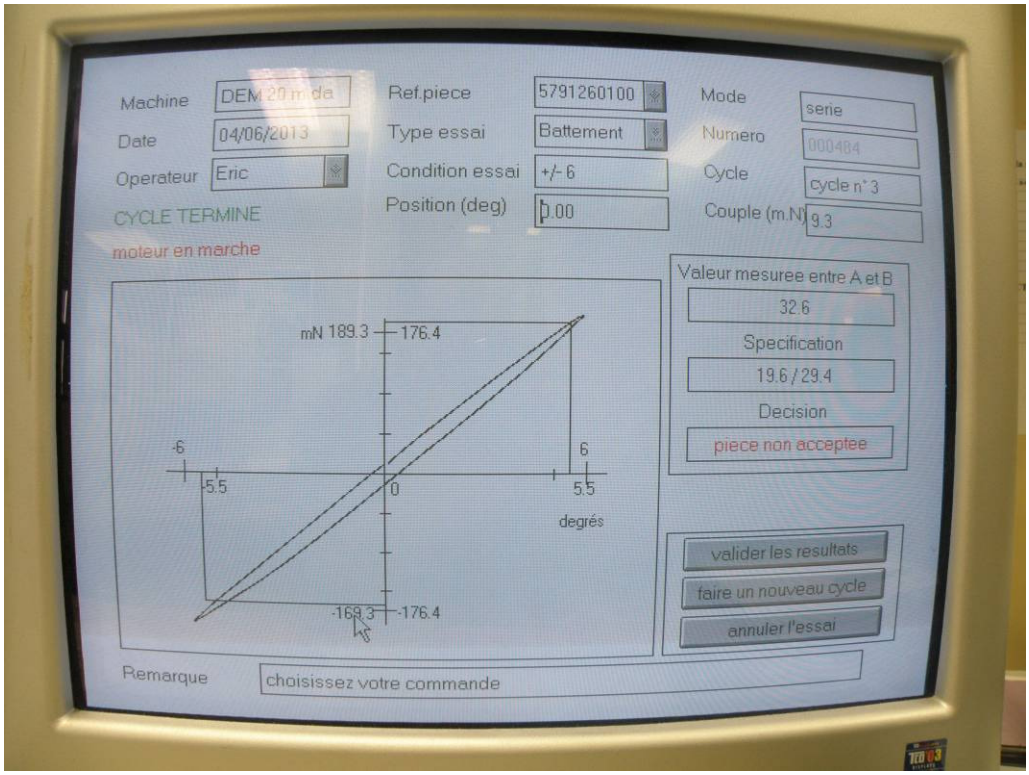
S/N 0483


Permanent deformation

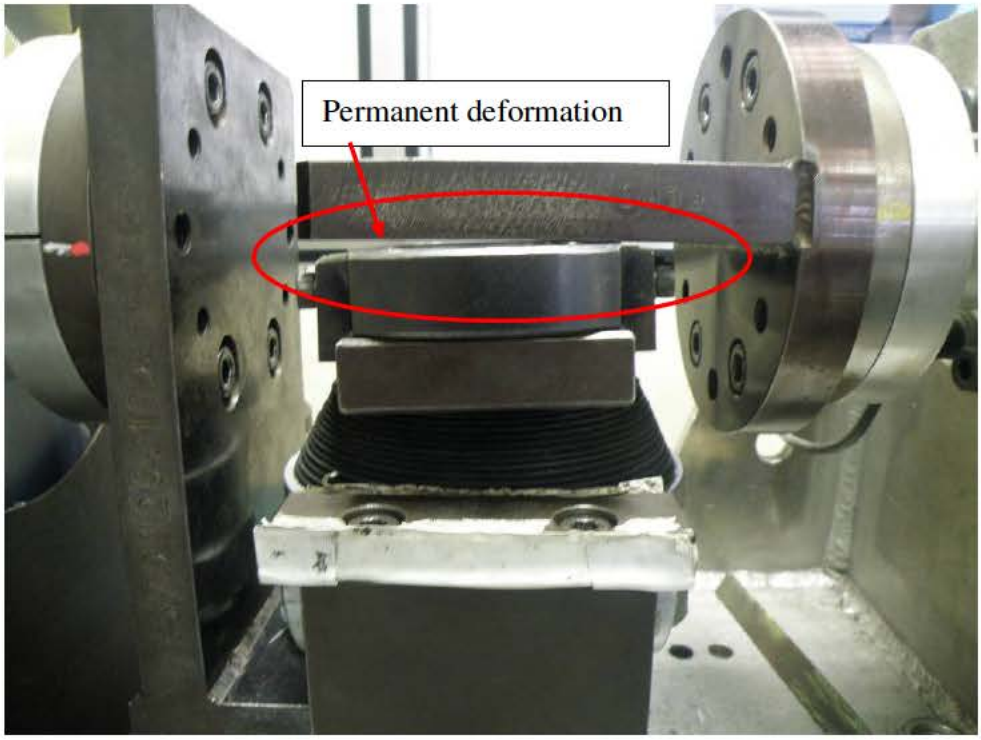

Machine
DEM 20 m.da
Date
04/06/2013
Operateur
Eric
CYCLE TERMINE
moteur en marche
Ref piece
5791260100
Type essai
Battement
Condition essai
+/- 6
Position (deg)
0.00
Mode
série
Numero
Cycle
cycle n°3
Couple (m N)
11.1
Valeur mesuree entre A et B
32.84
Specification
19.6 / 29.4
Decision
piece non acceptee
mN 191.2
176.4
-170.0
-176.4
-6
-5.5
0
5.5
6
degrés
valider les resultats
faire un nouveau cycle
annuler l'essai
Remarque
choisissez votre commande

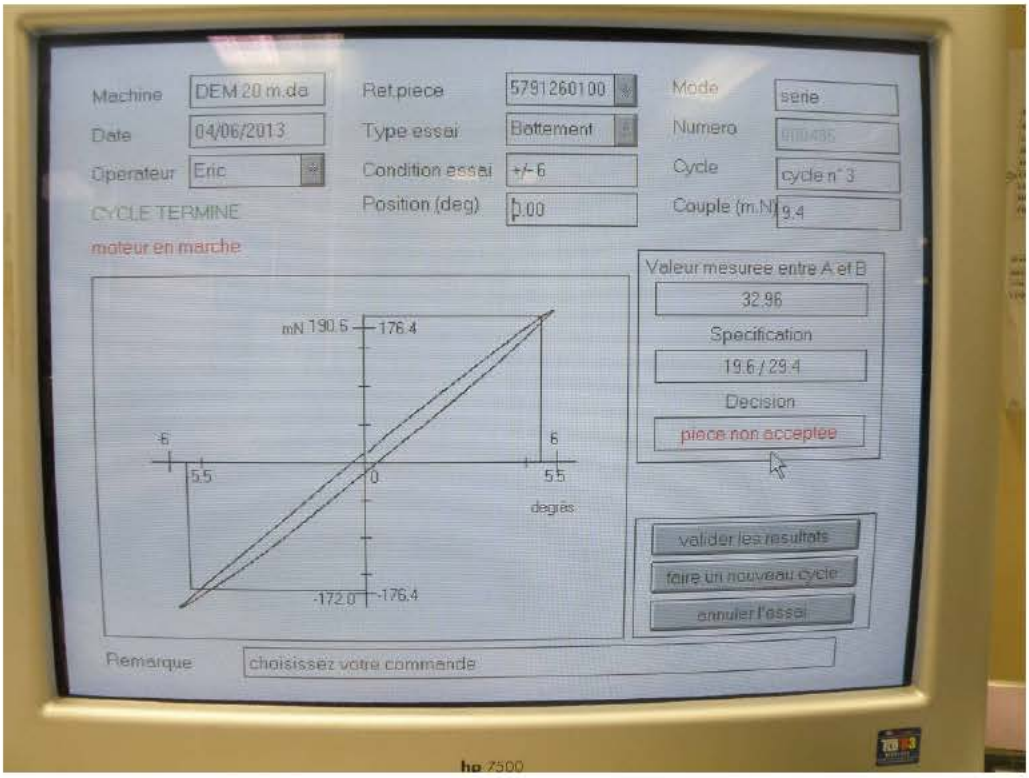
S/N 0484




Machine
DEM 20 mda
Ref.piece
5791260100
Mode
serie
Date
04/06/2013
Type essai
Battement
Numero
000484
Operateur
Eric
Condition essai
+/- 6
Cycle
cycle n° 3
CYCLE TERMINE
Position (deg)
0.00
Couple (m.N)
9.3
moteur en marche
Valeur mesuree entre A et B
32.6
Specification
19.6 / 29.4
Decision
piece non acceptee
mN 189.3
176.4
-6
6
-5.5
0
5.5
degrés
-189.3
-176.4
valider les resultats
faire un nouveau cycle
annuler l'essai
Remarque
choisissez votre commande

S/N 0485


Permanent deformation


Machine
DEM 20 m.da
Date
04/06/2013
Operateur
Eric
CYCLE TERMINE
moteur en marche
Ref.piece
5791260100
Type essai
Battement
Condition essai
+/- 6
Position (deg)
0.00
Mode
serie
Numero
Cycle
cycle n°3
Couple (m.N)
9.4
Valeur mesuree entre A et B
32.96
Specification
19.6 / 29.4
Decision
piece non acceptee
mN 190.5
176.4
-6
6
5.5
0
5.5
degrés
-172.0
-176.4
valider les resultats
faire un nouveau cycle
annuler l'essai
Remarque
choisissez votre commande
hp 7500