MECAER | AVIATION | GROUP

RELAZIONE TECNICA D'INDAGINE
DEFECT INVESTIGATION REPORT

N°: DIR *02/12*

Data: *(Date):* 20 Dec 2012

Aeromobile tipo: *(Aircraft Type:)* *AW139*

1. ESTREMI SEGNALAZIONE O NOTA INCONVENIENTI *(REPORT DETAILS OR FAILURES NOTIFICATION)*	N° segnalazione inconvenienti *(Failure Report No.)*: N/A		Data segnalazione *(Report Date)*: N/A	Data inconveniente *(Failure Date)*: Not declared
2. ESTREMI RICHIESTA INDAGINE *(REQUEST FOR INVESTIGATION)*	Ente decisionale *(Requested by)*: AgustaWestland		N° Richiesta di indagine *(Request No.)*: COMO N. AW139AW/MAG-12-01	
3. ENTI PARTECIPANTI ALL'INDAGINE *(PARTICIPANTS TO THE INVESTIGATION)*	MAG, AW, ANSV (20 and 22 Nov 2012)			
4. ESTREMI PARTICOLARE DIFETTOSO *(DEFECTIVE PART ID DATA)*	Denominazione particolare *(Part Name)*: *Main Rotor Lag Damper*	NDR (P/N) *M006-01H001-007 (AW 3G6220V01351)* *M006-01H001-009 (AW 3G6220V01352)*	S.N. *1660B (Red) 1724B (White) 0557AB (Black)* *1602 (Blue) MCR5027 (Orange)*	
		NDC /		
5. ESTREMI COMPLESSIVO SUPERIORE *(NHA ID DATA)*	Denominazione *(Description)*: *AW139*	NDR (P/N) /	S.N. *41013 - N385RH*	
		NDC /		
6. ESTREMI CATALOGO NOMENCLATORE *(IPL DETAILS)*	N° Catalogo (CMM/IPL No.) *CMM 62-21-06 Iss-4, Rev.1*	N° fig. *1*	N° Part. *1*	
7. CLIENTE DI PROVENIENZA DEL PARTICOLARE *(PART OWNER)*	Denominazione e località *(Customer Name and Location)*: *ERA Helicopters a SEACOR Company – Houma (USA)*			
8. MOTIVO DELL'INVIO IN DITTA (da S.I., N.I. o cartellino di stato) *(REASON OF RETURN)*	Descrizione *(Description)*: *Investigation after helicopter incident*			
9. MOVIMENTI DEL MATERIALE *(PART RETURN)*	Data consegna a Ditta *(Return Date)*: *10 Nov 2012*			
10. DITTA COSTRUTTRICE *(MFR COMPANY)*	Denominazione *(Name)*: *MAG (Mecaer Aviation Group)- Borgomanero - Italy*			
11. DITTA CHE HA EFFETTUATO L'ULTIMA RIP/REV *(COMPANY WHICH PERFORMED THE LAST R&O)*	Denominazione *(Name)*: *Mecaer America Inc (Laval – Canada) for S/N's 1660B,1724B, 0557AB and 1602.*			

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12. DATA DI CONSEGNA CLIENTE. *(DELIVERY DATE TO CUSTOMER)*	Da nuovo *(New)*: *1660B- Sept 2008* *1724B- Oct 2008* *0557AB- Jul 2006* *1602- Jul 2008* *MCR5027 - Sept 2010*	Dopo ultima RG *(After last Overhaul)*: *N/A*	Dopo ultima RIP (solo se succes. ultima RG) *(After last Repair):* *1660B - Aug 2011* *1724B - Apr 2011* *0557AB - Nov 2011* *1602 - Sept 2012* *MCR5027 - N/A*

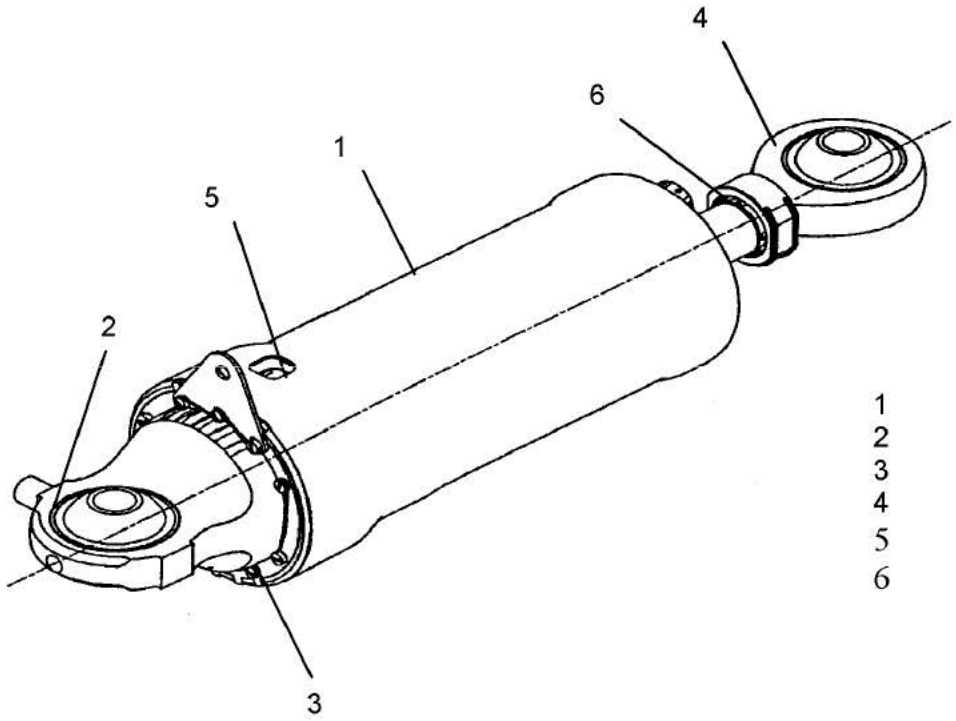
13. ORE FUNZIONAMENTO *(FLIGHT HOURS)*	N° ore totali *(Total hours)*: *1660B - FH 2013,4* *1724B- FH 796,3* *0557AB- FH 1636,2* *1602- FH 250,8* *MCR5027- FH 897,78*	DUR *(Since Overhaul)*: *New*	14. TERMINI DI GARANZIA *(Within Warranty Period)*: Unkn (To be defined)

15. PRECEDENTI INTERVENTI (RG comprese) *(PREVIOUS MAINTENANCE C/O OVERHAUL INCLUDED)*	Descrizione; data; ore relative *(Description; date; F.H.)*: S/N 1660B – *Repaired for leaks - Aug 2011 – FH 1509,9* *S/N 1724B – Repaired for leaks - Apr 2011– FH 439,3 (897,3 with Penalty application)* *S/N 0557AB – Repaired for leaks- Nov 2011– FH 1369,4* *S/N 1602 – Repaired for leaks and modified to 3G6220V01352 - Sept 2012- FH 68,5 (483,0 with Penalty application)* *S/N MCR5027 – N/A*
16. CONSTATAZIONI E RILIEVI SULLO STATO ALL'ARRIVO *(INCOMING CONDITION)*	Descrizione *(Description)*: a) packaging: *ok* b) parts: *ok* c) documentation: *no equipment Log card attached to parts*
17. INDAGINI ESPLETATE E DANNI RISCONTRATI *(INVESTIGATIONS C/O AND DISCOVERED FAILURES)*	Descrizione *(Description)*: *All the units have been subjected at a preliminary visual incoming inspection and a bearings check followed by a functional verification on the test bench. For parts nomenclature refer to Annex A scheme and for more detailed information to the Component Maintenance Manual reported at previous point 6. The two P/N equipments have to be considered functionally equivalent; the only difference between the two (AW 3G6220A01351/ MAG M006-01H001-007 and AW 3G6220A01352 / MAG M006-01H001-009) is a different coating on piston shaft (with an improved corrosion resistance on 3G6220A01352). The results of this activity are summarized in Annex B. Three dampers have been found with some characteristic out of limits: S/N 1660B and S/N 1724B with an ATP "Load- velocity characteristics curve" degradation in the "knee" area; S/N 1602 with Body End Bearing friction too high. ATP curves are reported in Annex C with original Manufacturing (or last maintenance, when applicable) delivery curves.* *Further investigation carried out on dampers S/N 1660B and S/N 1724B, with units disassembly, revealed a wear presence on the contact area of relief valve seat with relief valve poppet (ref. IPL Fig 1 items 460 and 480; items 520 and 540) of all 4 valves installed on piston (ref. Annex D). Regarding S/N 1602, during its last repair carried out at Mecaer America repair station (Laval Canada), it was subjected to a Body End bearing replacement. Working document records (Production Order n. 60300 – see extract in Annex E) give evidence that the reworking was performed correctly and that at the end the bearing friction values were within limits (Flex. 5 Nm, Tors. 15 Nm)*

18. CAUSA INCONVENIENTE - OSSERVAZIONI *(DEFECT ROOT CAUSE-OBSERVATIONS)*	Descrizione *(Description)*: *ATP "Load- velocity characteristics curve" degradation in the "knee" area may be attributed to the observed valve seat wear problems.* *No evident cause for the body end bearing friction out of limit, the hypothesis is that operative environment (contamination and/or vibration) may cause in the first Flight Hours a bearing friction augmentation. However the ball bearing friction out of the maximum requirement should not affect the damper functionality but an increase of the local bending stress is expected.*
19. SITUAZIONE NUMERICA CASI ANALOGHI PRECEDENTI *(OTHER PREVIOUS SIMILAR INCONVENIENTS)*	N° inconvenienti precedenti *(No. Of previous inconvenients)*: *N/A*
20. LAVORI DA EFFETTUARE e/o PARTI DA SOSTITUIRE PER IL RIPRISTINO DELL'EFFICIENZA, OVE POSSIBILE *(ACTIVITIES TO BE C/O TO RETURN THE PARTS TO SERVICE)*	Descrizione *(Description)*: *The possibility of a return to service of components may be evautated only after a complete overhaul check.*
21. PROPOSTE RELATIVE A PROVVEDIMENTI CORRETTIVI e/o CONTROLLI DA EFFETTUARE PER ANALOGHI PARTICOLARI IN SERVIZIO *(CORRECTIVE ACTIONS AND/OR CHECKS TO BE C/O ON IN-SERVICE COMPONENTS)*	Descrizione:(citare anche gli estremi di eventuali PMT, Bollettini emessi) *(Description: report eventual Service Bullettins issued)* *None / Not applicable*

22. EVENTUALI PROVVEDIMENTI CORRETTIVI SU DATI PROGETTO *(EVENTUAL CORRECTIVE ACTIONS ON DESIGN DATA)*	Descrizione:(citare anche gli estremi di eventuali ECO emesse) *(Description: report eventual ECO issued)* *Under evaluation a design change to solve observed valve wear problem.*	
23. ALTRE EVENTUALI COMUNICAZIONI *(FURTHER ELEMENTS)*	Descrizione *(Description)*: *None*	
24. CARICO DELLE SPESE *(COSTS ATTRIBUITION)*	Spese per la rimessa in efficienza o per il reintegro dello specifico particolare in funzione dell'applicabilità o meno della garanzia. *(Repair or replacement charges, depending upon the validity of the warranty)* [ ] a carico Cliente *(Chargeable to the Customer)* - [ ] a carico MAG *(Charge to MAG)*	
25. ALLEGATI *(ATTACHMENTS)*	Titolo e numero *(Title and Number)* *Annex A – Damper scheme* *Annex B - Equipments inspection results* *Annex C - Equipments ATP Curves* *Annex D - Damper piston and valves inspection* *Annex E - Damper S/N 1602 Repair Order Extract*	
26. FIRME E DATA *(SIGNATURES AND DATE)*	Mecaer Aviation Group SpA [redacted] *M. Monti _ MAG MRO*	Per CLIENTE (se richiesto) *(Customer – If required)*

Damper general view and function (extract from CMM)



1	External body
2	Body end
3	Blocking ring
4	Eye end assy
5	Fluid reservoir
6	Broached ring nut

2. OPERATION

The damper is basically an actuator capable of reacting with a load when its rod is forced to move in both directions.

The damper has two equal section chambers as defined by the piston which also includes the four flow control relief valves (two for each flow direction). The hydraulic flow in the piston chambers is generated by the displacement of the piston during the operating stroke of the damper. The relief valves define the operating characteristic of damper. When the pressure difference, and subsequently the load, reaches a fixed value (cracking pressure, load), two relief valves open allowing the oil to flow across the piston and consequently a load limitation is obtained when the piston velocity increases.

The damper is provided with a pressurized reservoir, which is used as a fluid reserve and to avoid depressurization and cavitations of the inner piston chambers.

Adequate connection with the reservoir is provided to avoid high pressure in case of oil temperature increasing during operation.

The damper is also characterized by an end stroke damping (cushion) feature. This additional damping is obtained by the mating of two precision surfaces. The hydraulic fluid leakage across the clearance between piston and flanges causes an additional damping force.

The function of the "cushions", one at either end of the piston, is to slow the piston down when it nears its end stroke thereby avoiding the possibility of heavy impact between the piston and either the front or rear flange.

Adequate check valves installed in the piston avoid problems when the piston comes out from the cushion zone.

The damper operation is assured also in case of loss of reservoir pressurization.

During operation the piston is subjected to a helicoidal movement: axial displacement plus rotation. The possible rotation of the internal parts (internal cylinder, flanges) is prevented by adequate coupling surfaces between body, flanges and internal cylinder.

Equipments inspection results

Damper P/N M006-01H001-007 (AW 3G6220V01351) S/N **1660B**

General Conditions	
Visible Damages	*None*
Leaks	*None*
Oil Level	*OK*
Lockwirings (HYD ports)	*Not MFR original*
Weight (5,070 kg ± 50 g)	*5,060 Kg*

Bearings Conditions		Max allowed	Measured	Conformance
Eye End	Flex	10 Nm	*0,1 Nm*	*Yes*
	Torq.	20 Nm	*0,3 Nm*	*Yes*
	Axial play	0.25 mm	*0,01 mm*	*Yes*
Body End	Flex	10 Nm	*0,5 Nm*	*Yes*
	Torq.	20 Nm	*0,5 Nm*	*Yes*
	Axial play	0.25 mm	*0,01 mm*	*Yes*

Functional Check	
ATP Curve	***FAIL***

Damper P/N M006-01H001-007 (AW 3G6220V01351) S/N **1724B**

General Conditions	
Visible Damages	*None*
Leaks	*Slight oil presence on piston seal*
Oil Level	*OK*
Lockwirings (HYD ports)	*Not MFR original*
Weight (5,070 kg ± 50 g)	*5,060 Kg*

Bearings Conditions		Max allowed	Measured	Conformance
Eye End	Flex	10 Nm	*0,2 Nm*	*Yes*
	Torq.	20 Nm	*0,5 Nm*	*Yes*
	Axial play	0.25 mm	*0,03 mm*	*Yes*
Body End	Flex	10 Nm	*0,2 Nm*	*Yes*
	Torq.	20 Nm	*0,5 Nm*	*Yes*
	Axial play	0.25 mm	*0,06 mm*	*Yes*

Functional Check	
ATP Curve	***FAIL***

Damper P/N M006-01H001-007 (AW 3G6220V01351) S/N **0557AB**

General Conditions	
Visible Damages	*None*
Leaks	*None*
Oil Level	*OK*
Lockwirings (HYD ports)	*Not MFR original*
Weight (5,070 kg ± 50 g)	*5,080 Kg*

Bearings Conditions		Max allowed	Measured	Conformance
Eye End	Flex	10 Nm	*6,0 Nm*	*Yes*
	Torq.	20 Nm	*15,0 Nm*	*Yes*
	Axial play	0.25 mm	*None*	*Yes*
Body End	Flex	10 Nm	*3,0 Nm*	*Yes*
	Torq.	20 Nm	*8,0 Nm*	*Yes*
	Axial play	0.15 mm	*None*	*Yes*

Functional Check	
ATP Curve	*Ok*

Damper P/N M006-01H001-009 (AW 3G6220V01352) S/N **1602**

General Conditions	
Visible Damages	*None*
Leaks	*None*
Oil Level	*OK*
Lockwirings (HYD ports)	*Original MRO*
Weight (5,070 kg ± 50 g)	*5,080 Kg*

Bearings Conditions		Max allowed	Measured	Conformance
Eye End	Flex	10 Nm	*7,0 Nm*	*Yes*
	Torq.	20 Nm	*17,0 Nm*	*Yes*
	Axial play	0.25 mm	*None*	*Yes*
Body End	Flex	10 Nm	*15,0 Nm*	***FAIL***
	Torq.	20 Nm	*30,0 Nm*	***FAIL***
	Axial play	0.15 mm	*None*	*Yes*

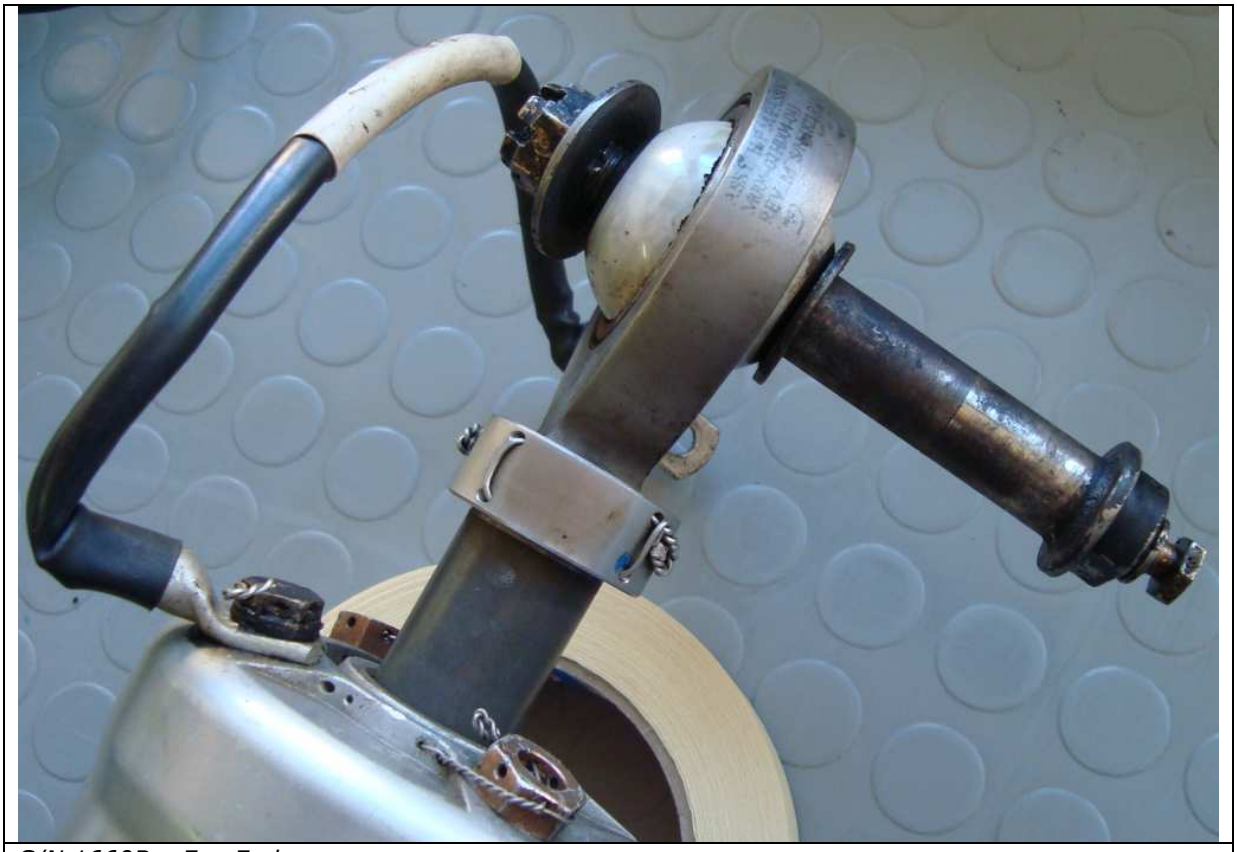
Functional Check	
ATP Curve	*Ok*

Damper P/N M006-01H001-009 (AW 3G6220V01352) S/N **MCR5027**

General Conditions	
Visible Damages	*None*
Leaks	*None*
Oil Level	*OK*
Lockwirings (HYD ports)	*Original MFR*
Weight (5,070 kg ± 50 g)	*5,060 Kg*

Bearings Conditions		Max allowed	Measured	Conformance
Eye End	Flex	10 Nm	*0,2 Nm*	*Yes*
	Torq.	20 Nm	*0,4 Nm*	*Yes*
	Axial play	0.25 mm	*0,015 mm*	*Yes*
Body End	Flex	10 Nm	*2,0 Nm*	*Yes*
	Torq.	20 Nm	*3,0 Nm*	*Yes*
	Axial play	0.25 mm	*None*	*Yes*

Functional Check	
ATP Curve	*Ok*

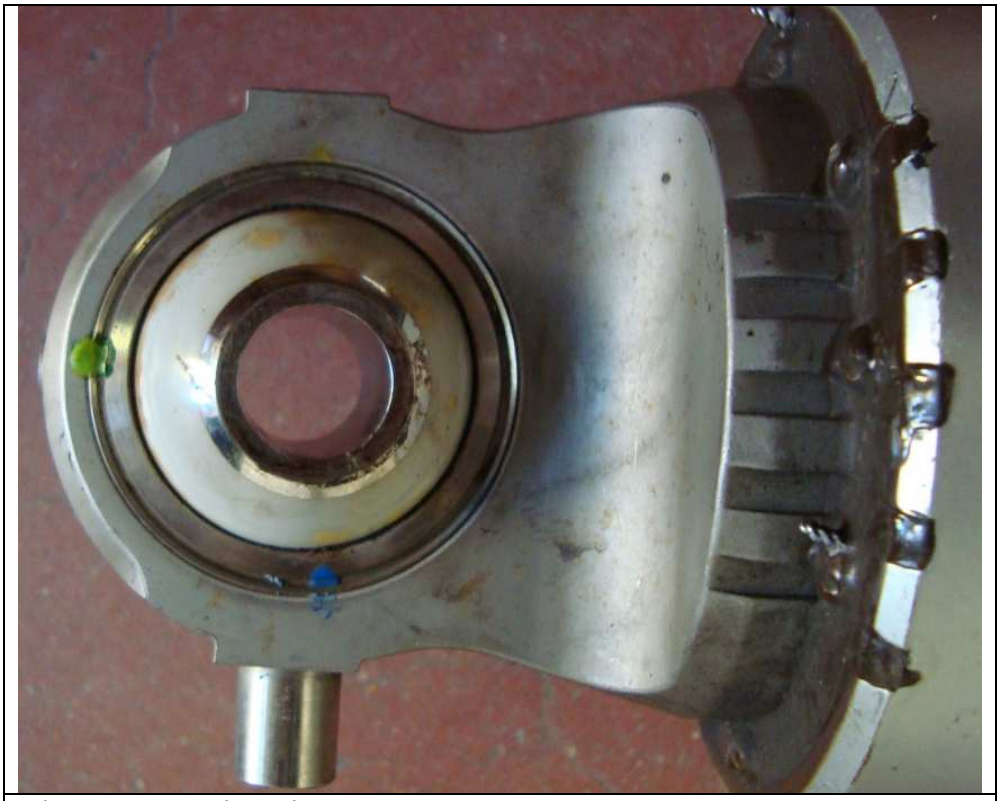


S/N 1660B – Eye End

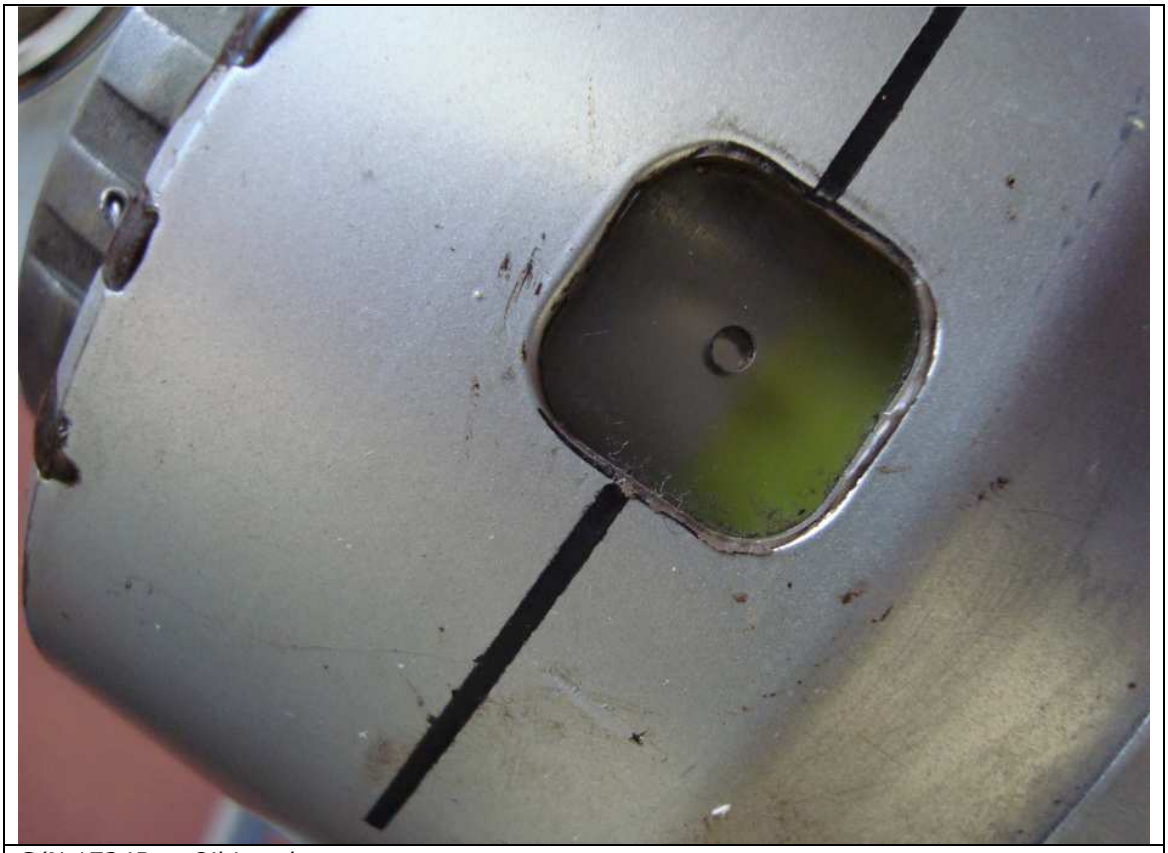
S/N 1660B – Body End

S/N 1660B – Oil Level

S/N 1724B – Eye End



S/N 1724B – Body End



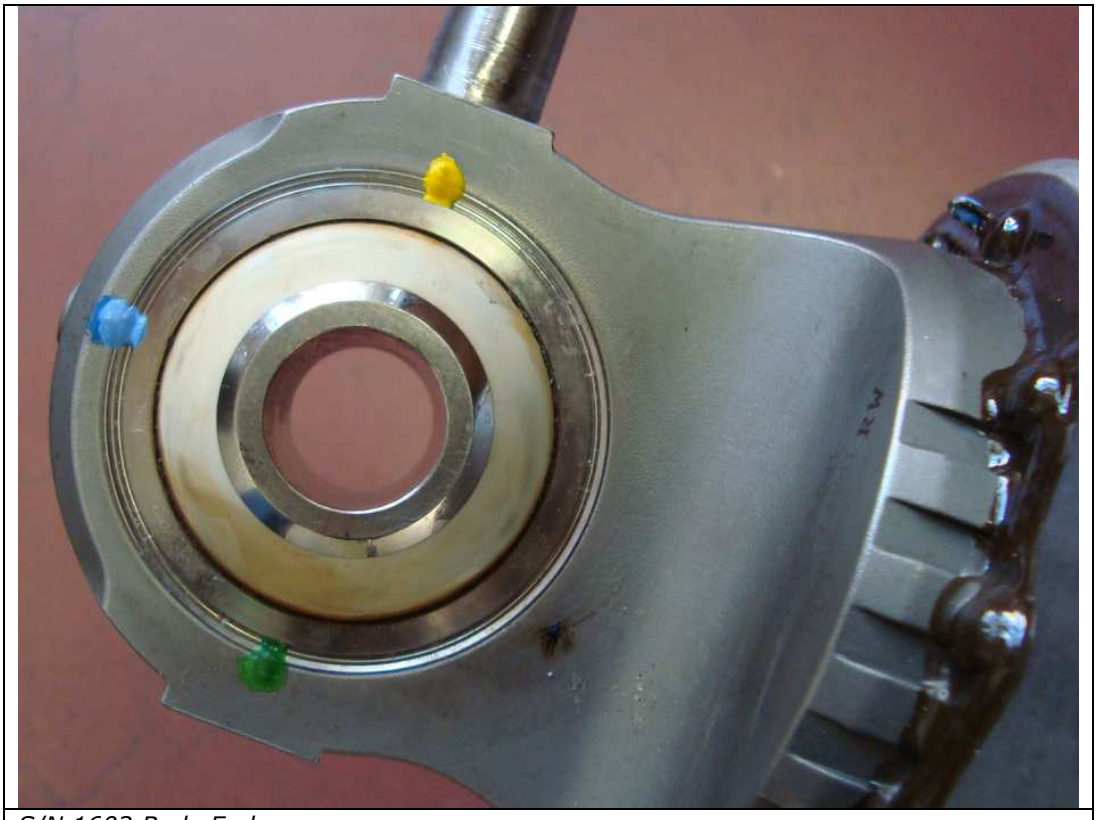
S/N 1724B – Oil Level

S/N 0557AB – Eye End

S/N 0557AB – Body End

S/N 0557AB – Oil Level

S/N 1602– Eye End



S/N 1602 Body End

S/N 1602– Oil Level

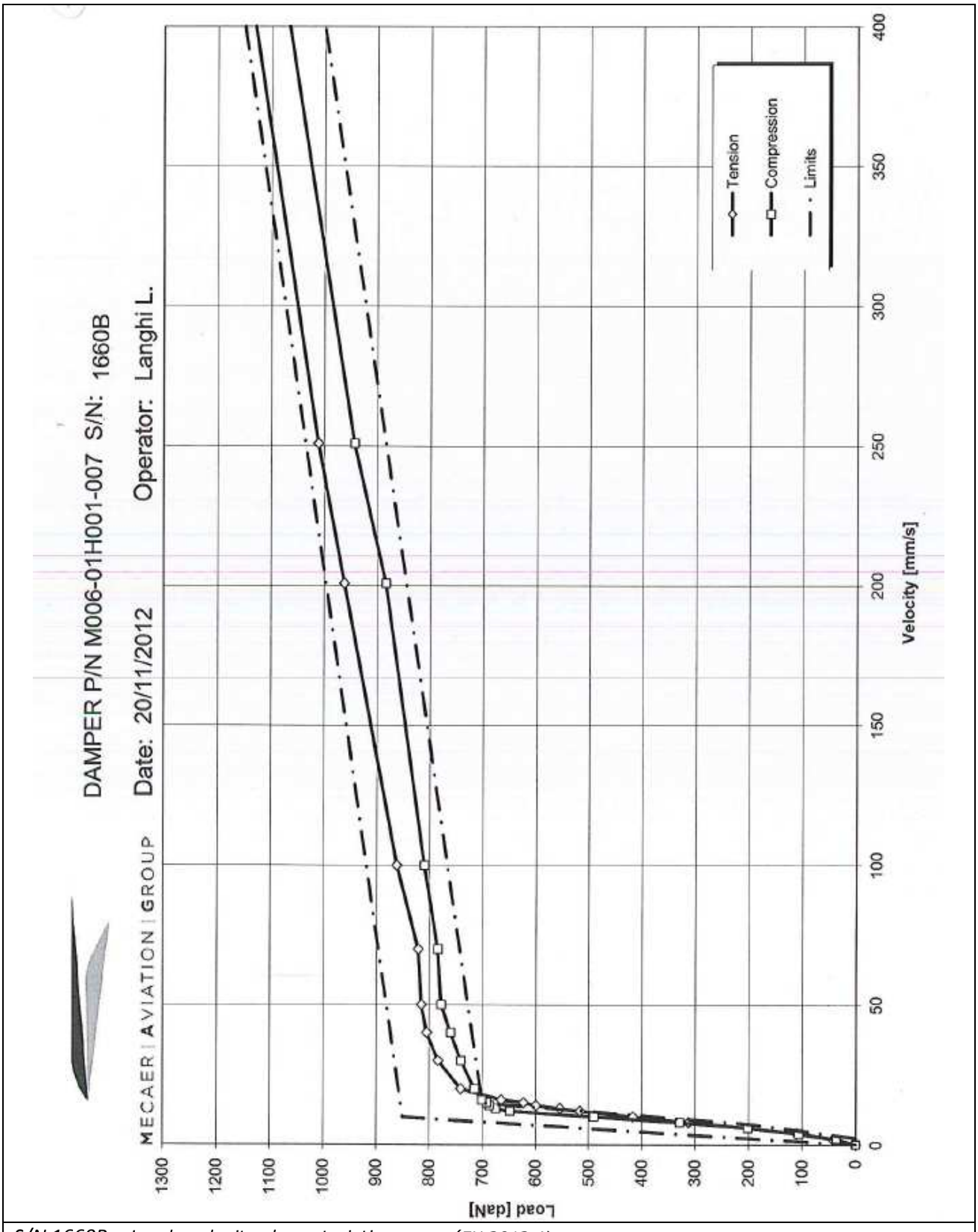
S/N MCR5027 Eye End

S/N MCR5027– Body End

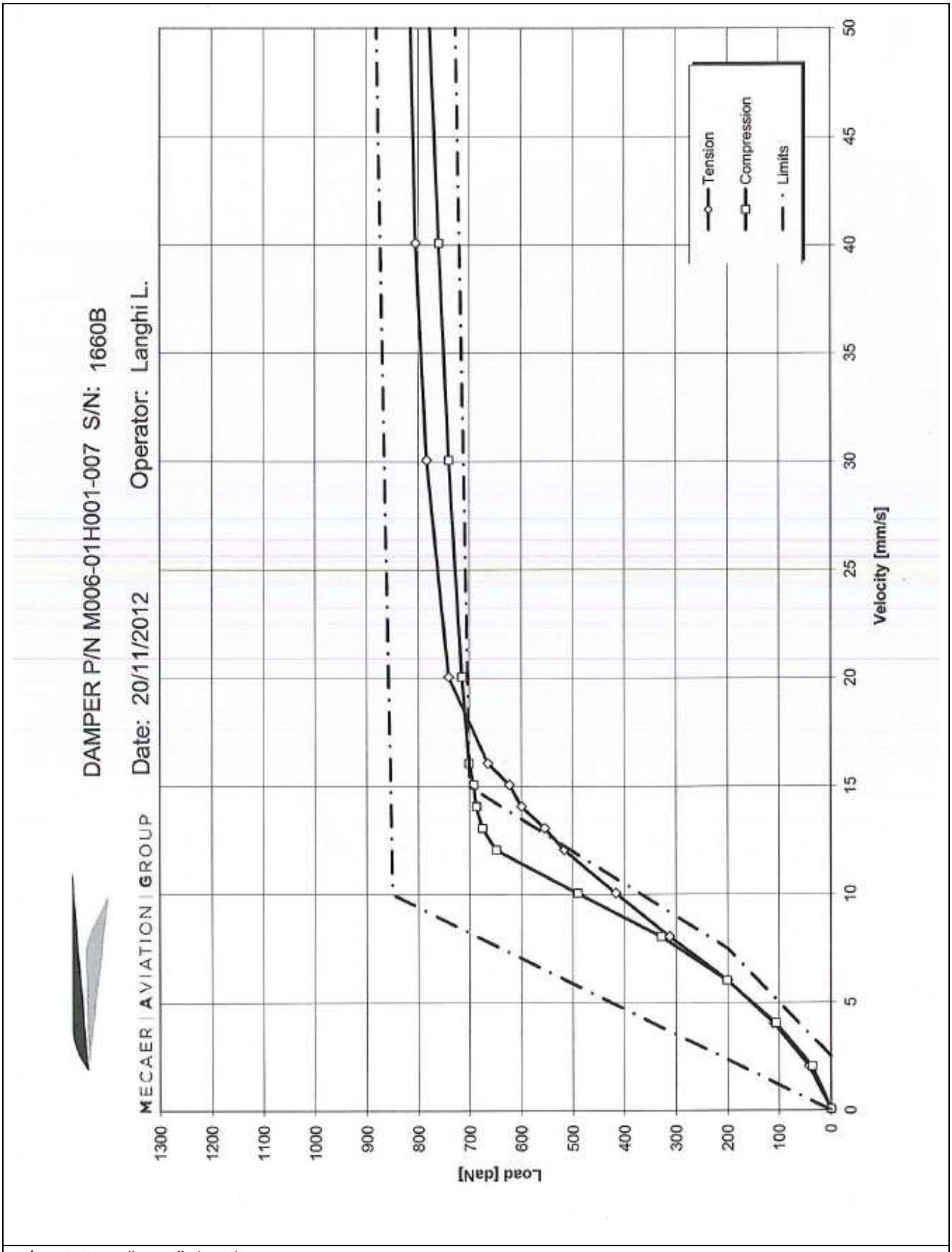
S/N MCR5027– Oil Level

Equipments ATP Curves

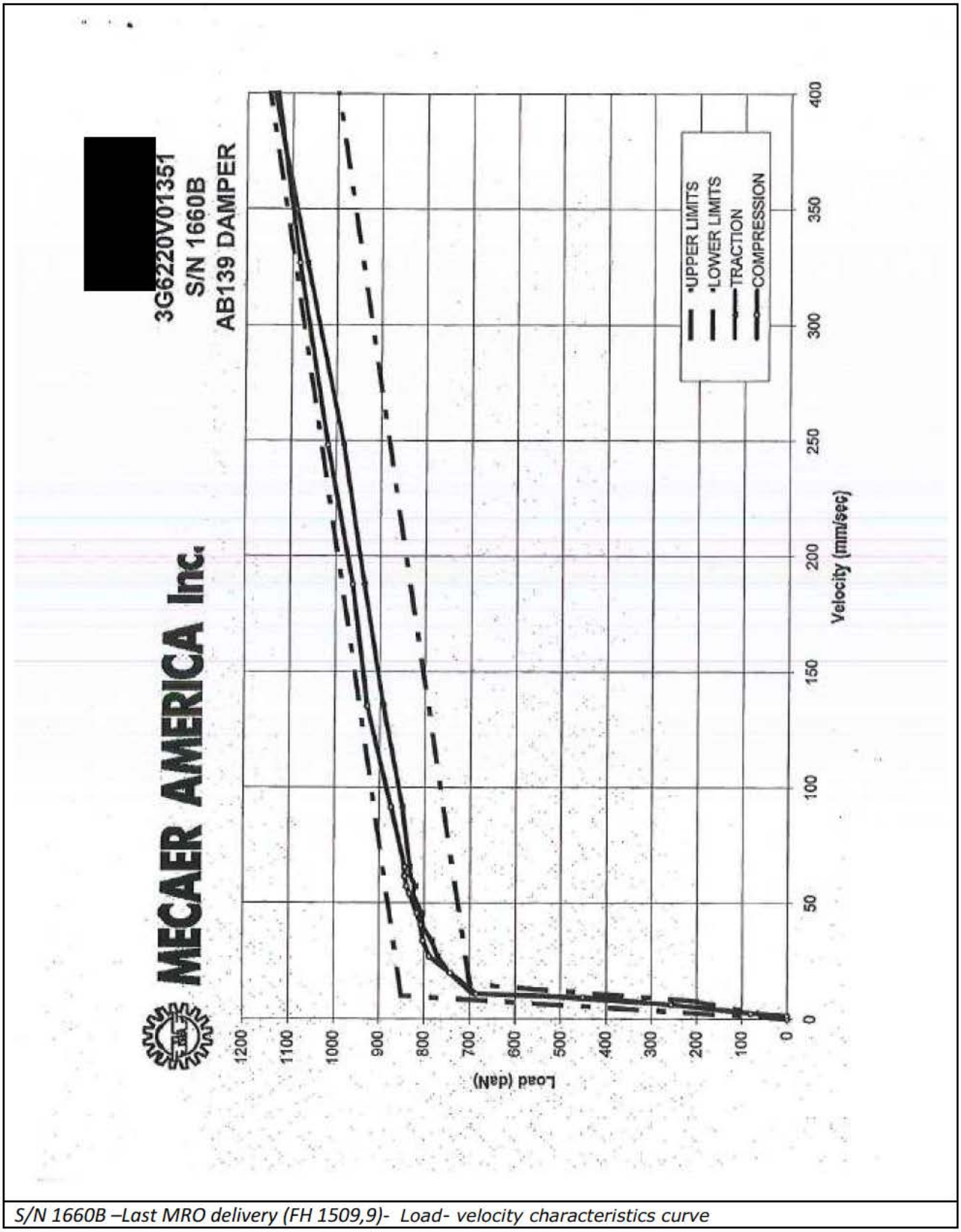
Damper P/N M006-01H001-007 (AW 3G6220V01351) S/N **1660B**



S/N 1660B – Load- velocity characteristics curve (FH 2013,4)

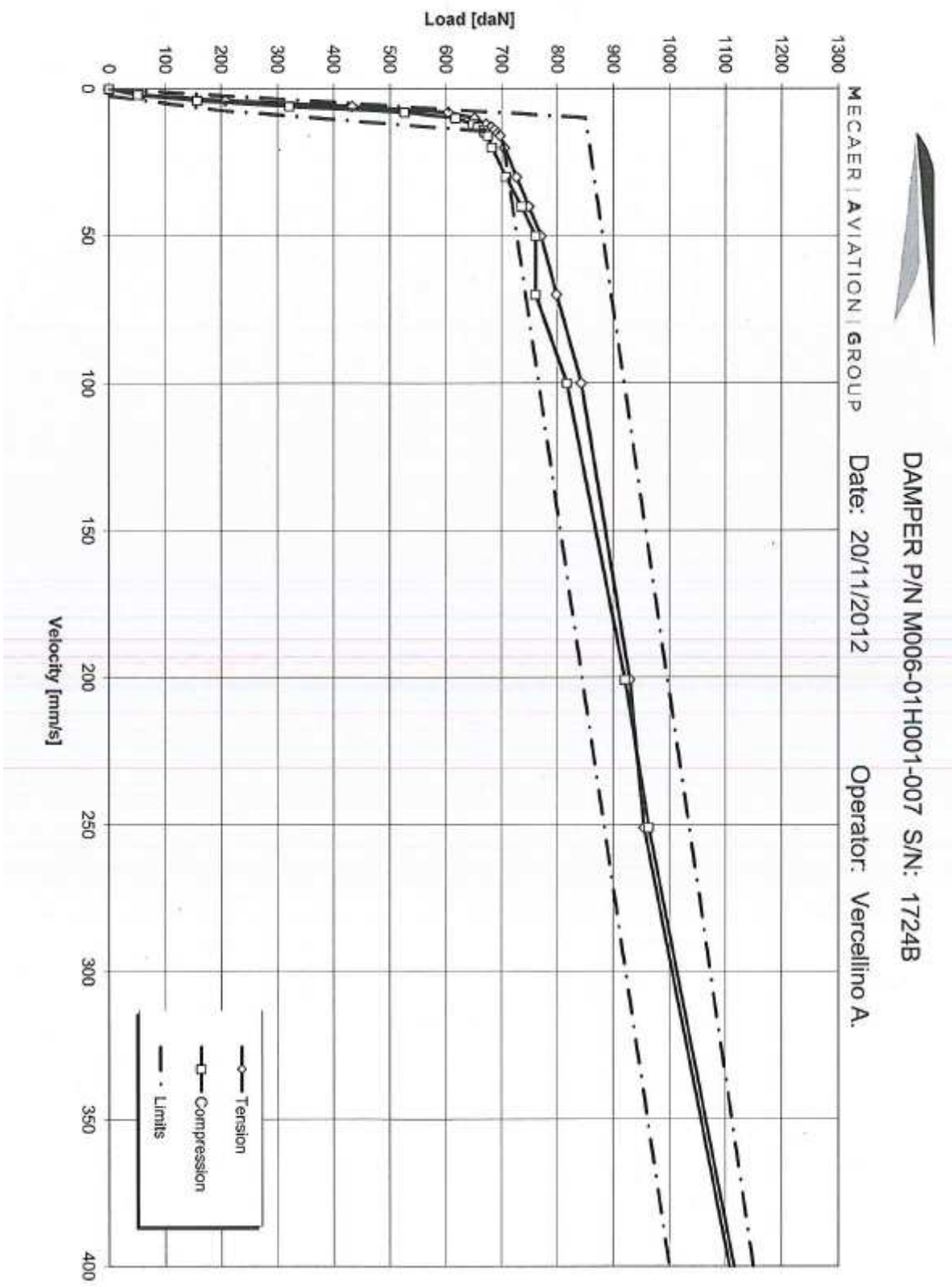


S/N 1660B – "Knee" detail

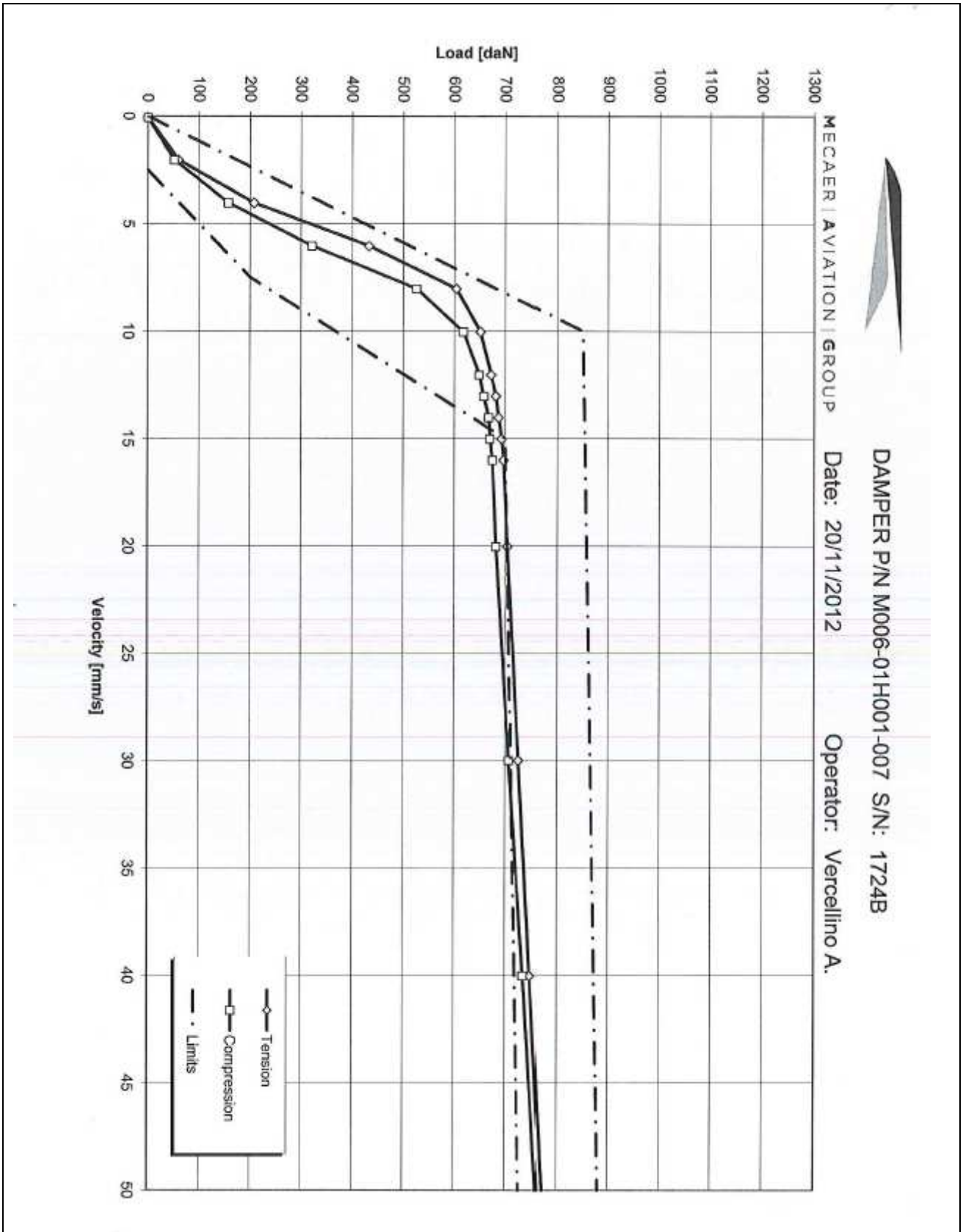


S/N 1660B –Last MRO delivery (FH 1509,9)- Load- velocity characteristics curve

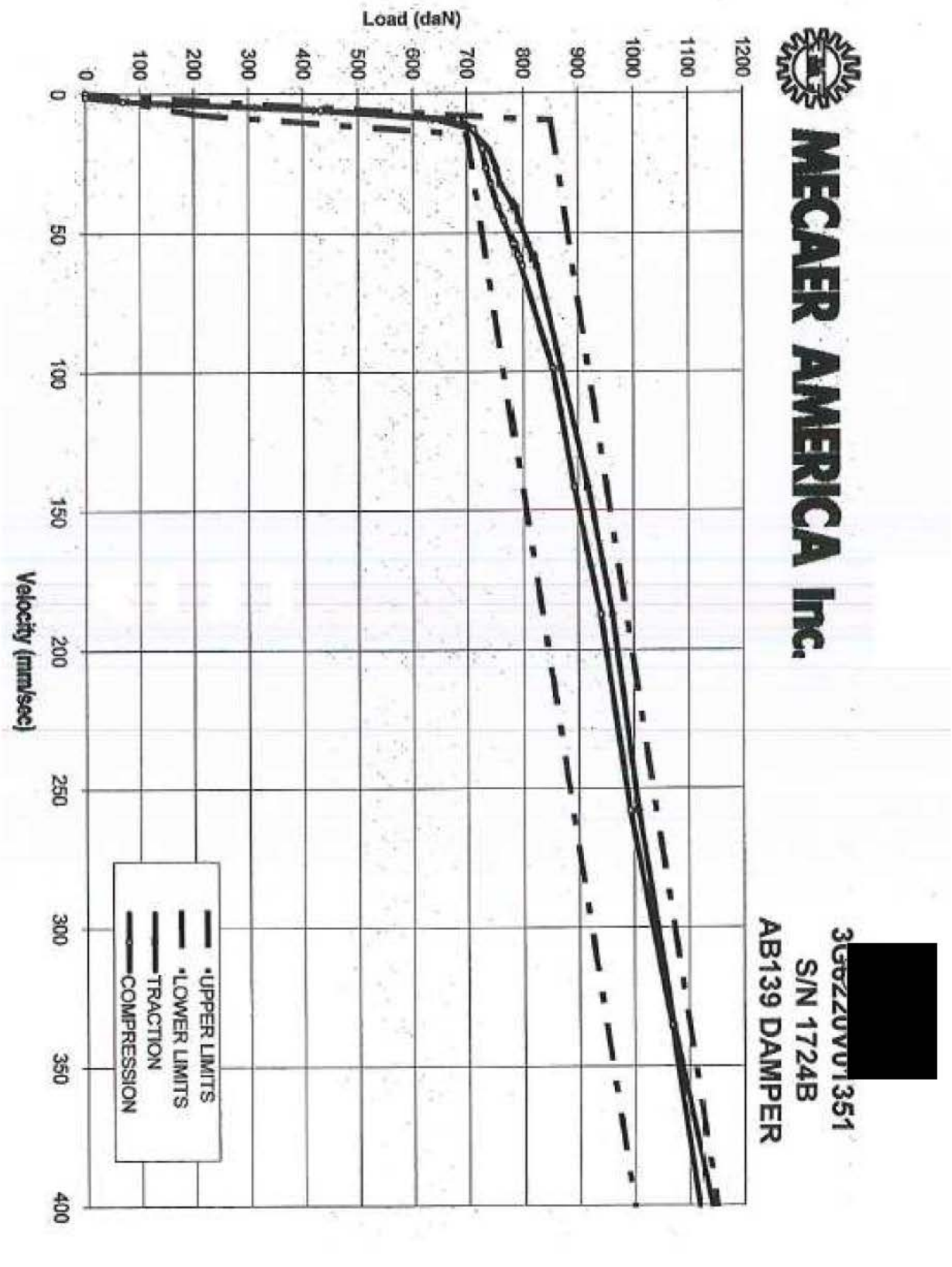
Damper P/N M006-01H001-007 (AW 3G6220V01351) S/N **1724B**



S/N 1724B – Load- velocity characteristics curve (FH 796,3)

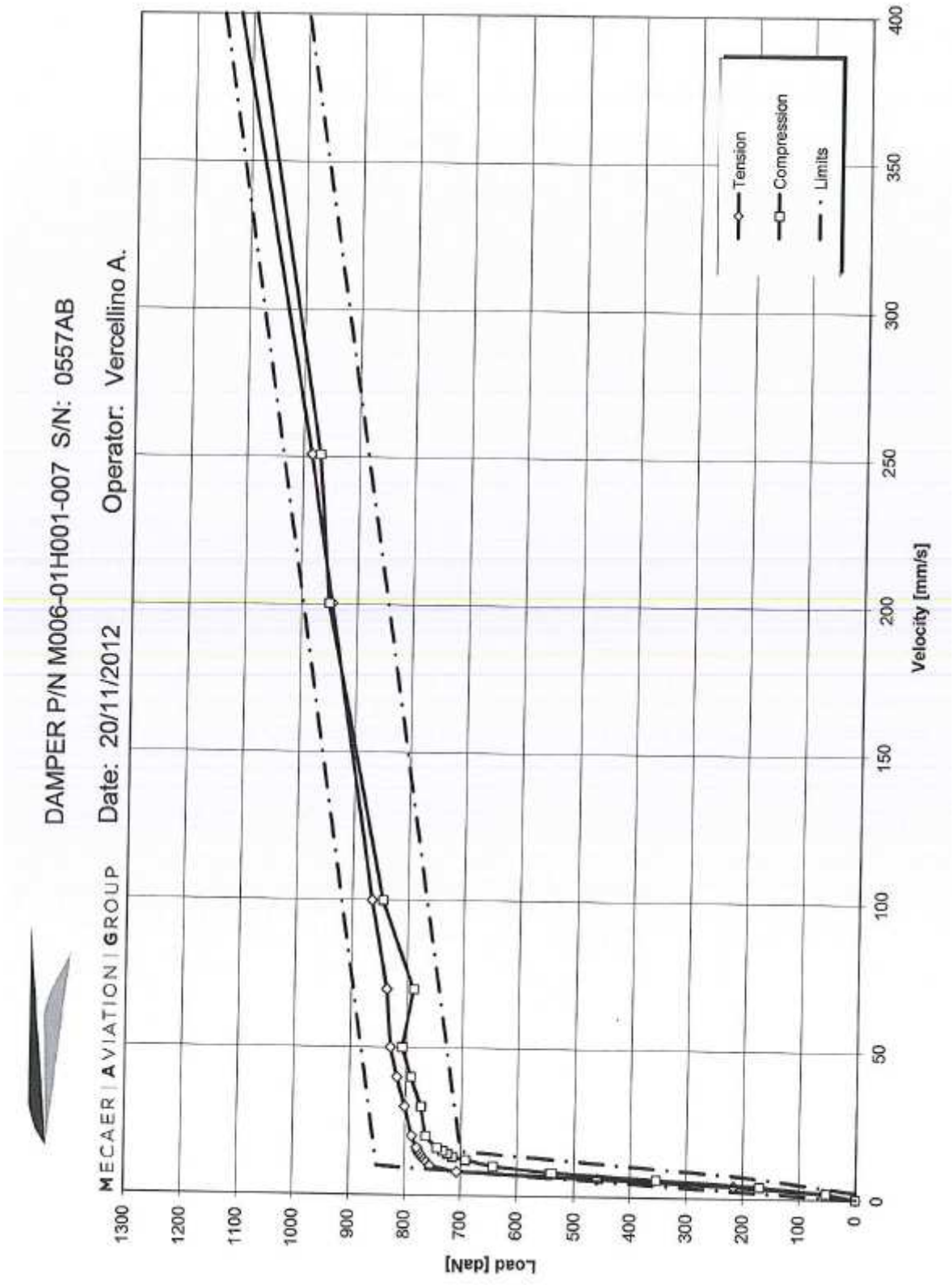


S/N 1724B – "Knee" detail

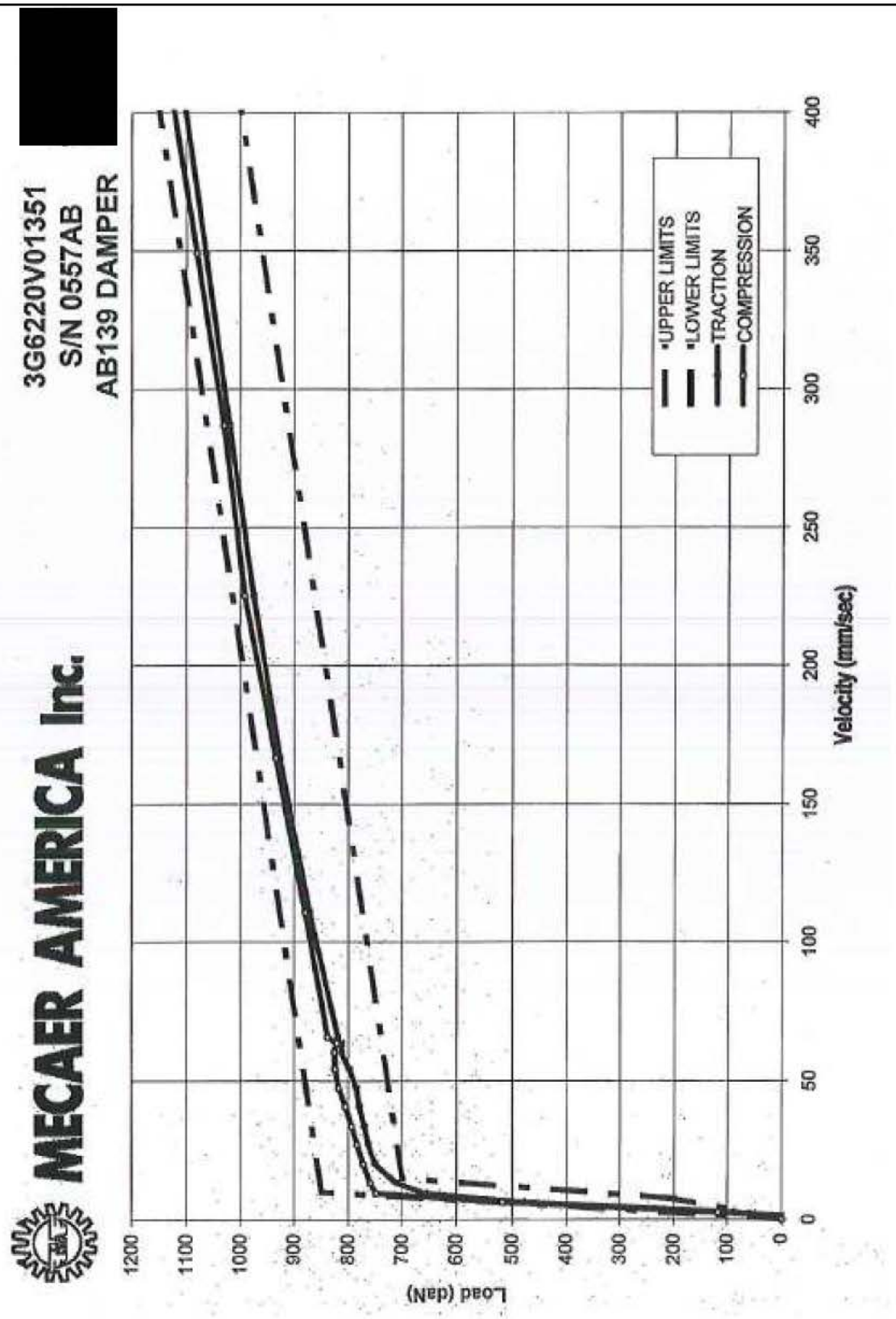


S/N 1724B –Last MRO delivery (FH 439,3)- Load- velocity characteristics curve

Damper P/N M006-01H001-007 (AW 3G6220V01351) S/N **0557AB**

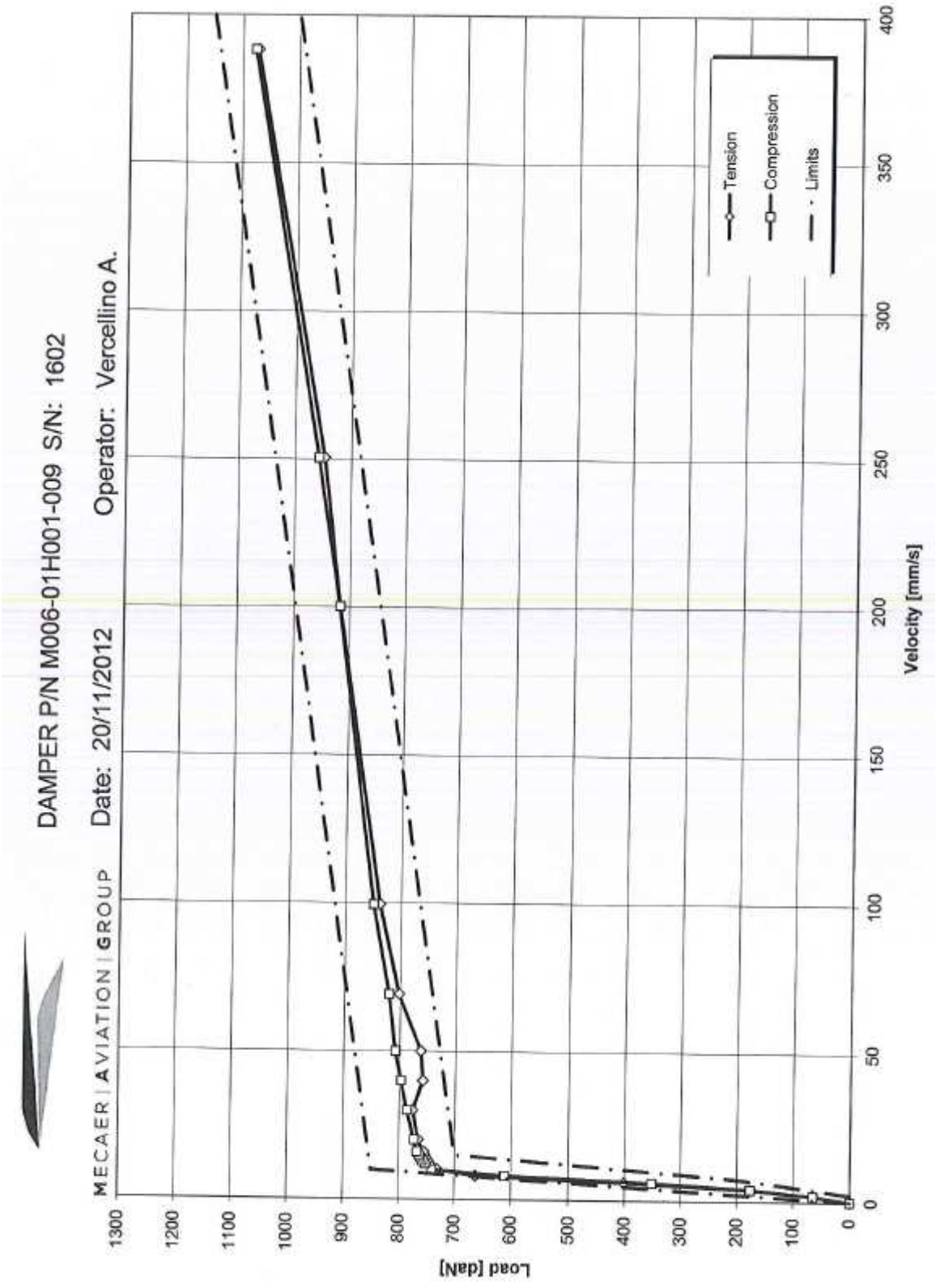


S/N 0557AB – Load- velocity characteristics curve (FH 1636,2)

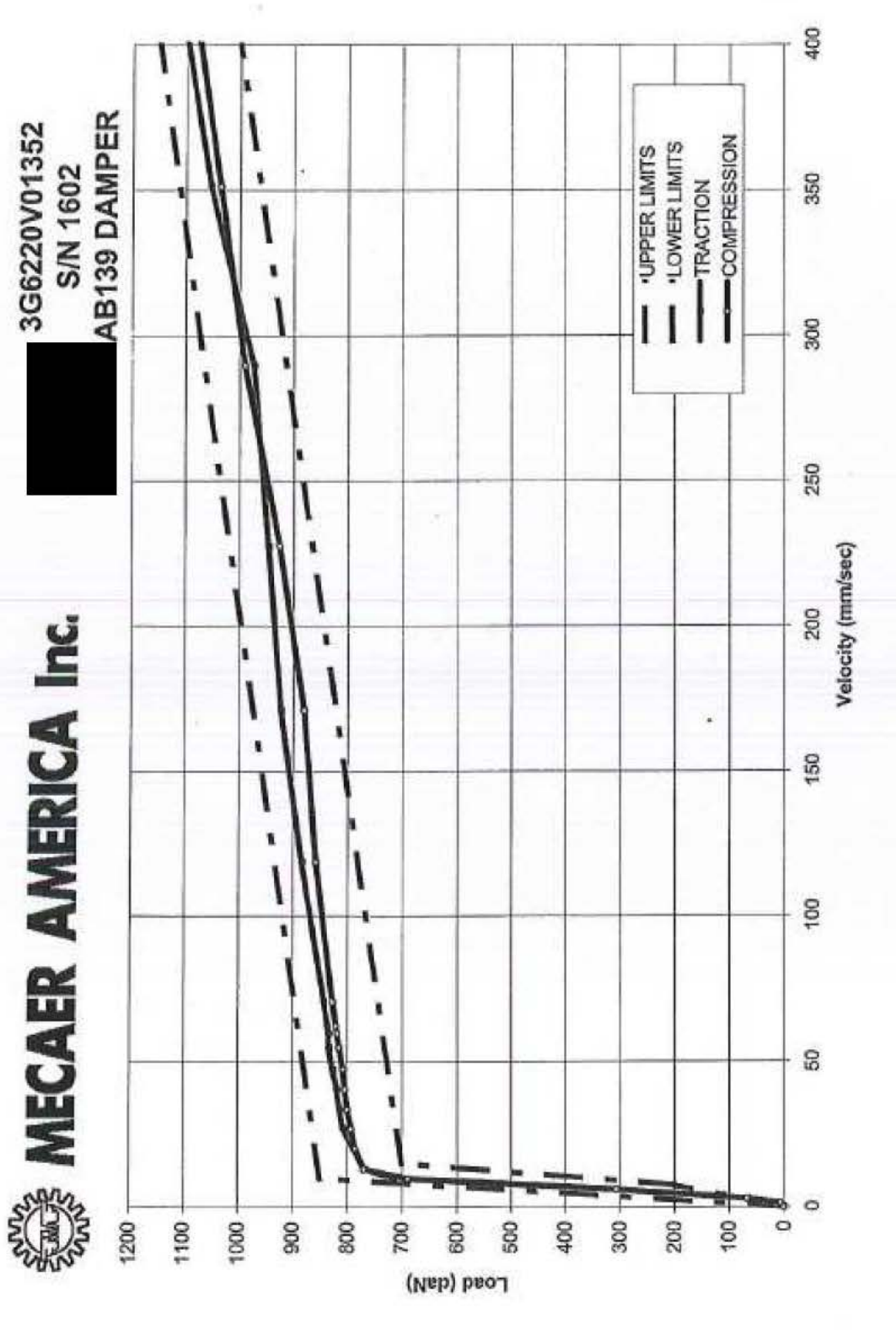


S/N 0557AB –Last MRO delivery (FH 1369,4)- Load- velocity characteristics curve

Damper P/N M006-01H001-009 (AW 3G6220V01352) S/N **1602**

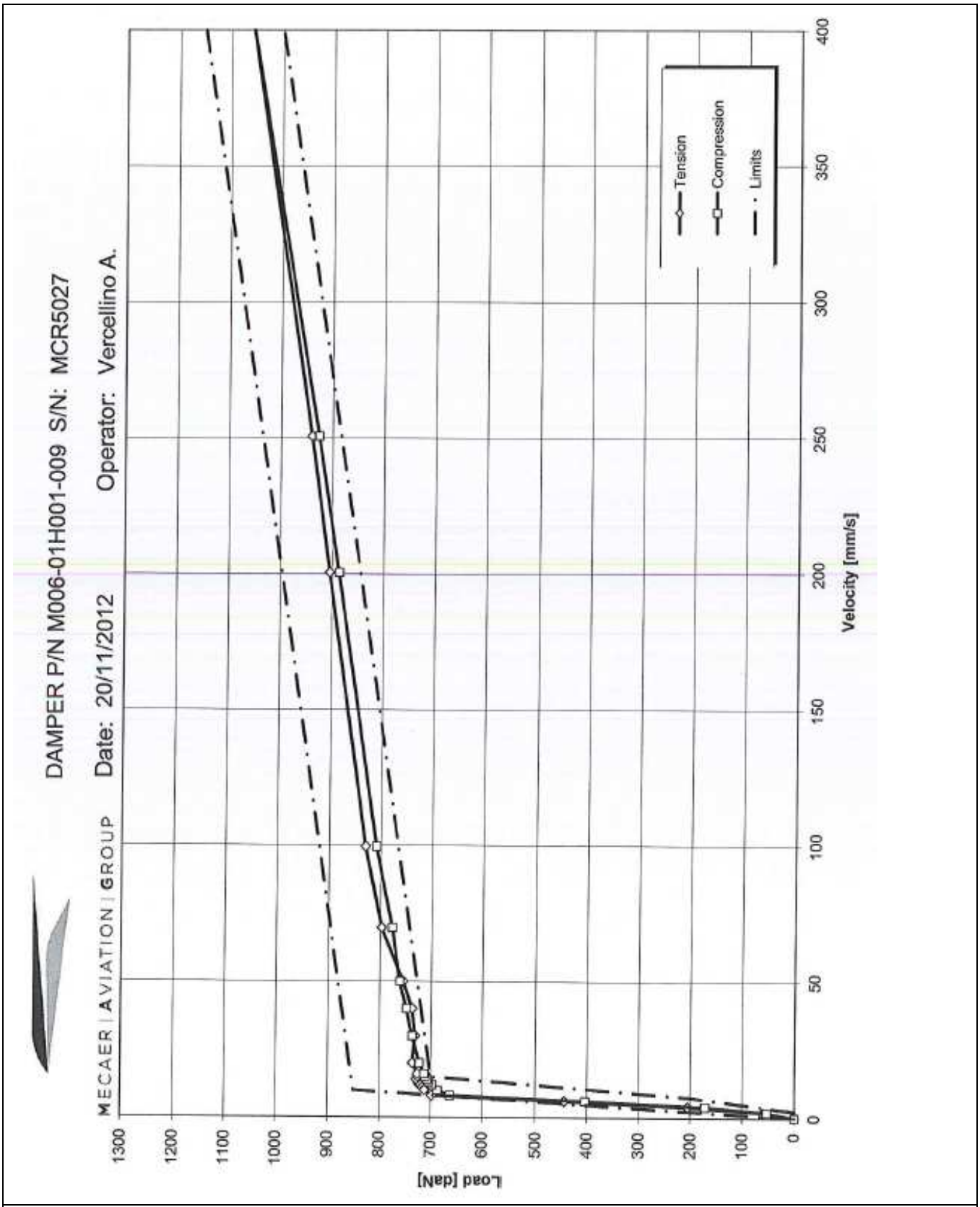


S/N 1602 – Load- velocity characteristics curve (FH 250,8)

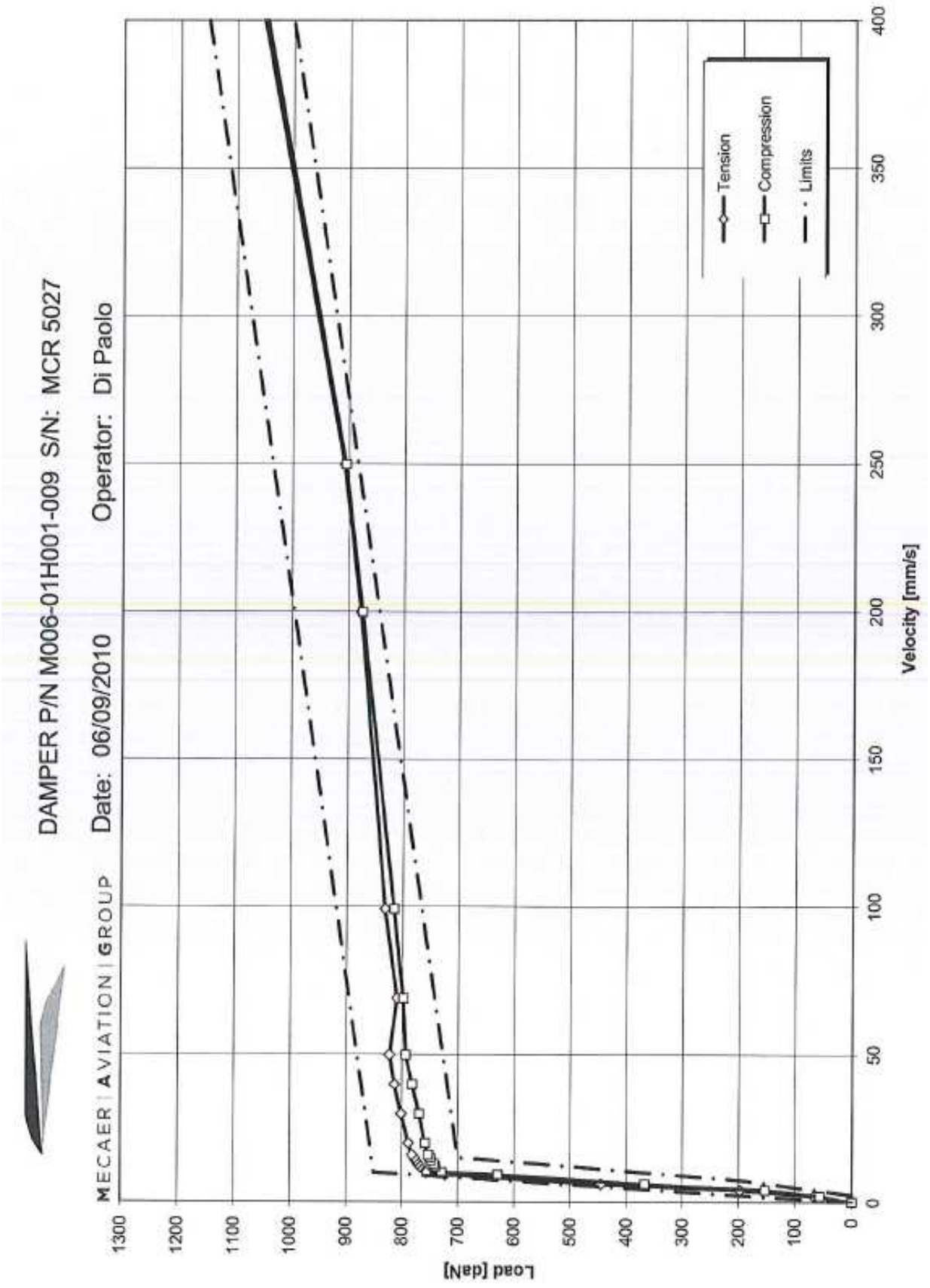


S/N 1602 –Last MRO delivery (FH 68,5)- Load- velocity characteristics curve

Damper P/N M006-01H001-009 (AW 3G6220V01352) S/N **MCR5027**



S/N MCR5027– Load- velocity characteristics curve (FH 897,78)



S/N MCR5027 –Manufacturing delivery (FH 00:00) - Load- velocity characteristics curve

Damper piston and valves

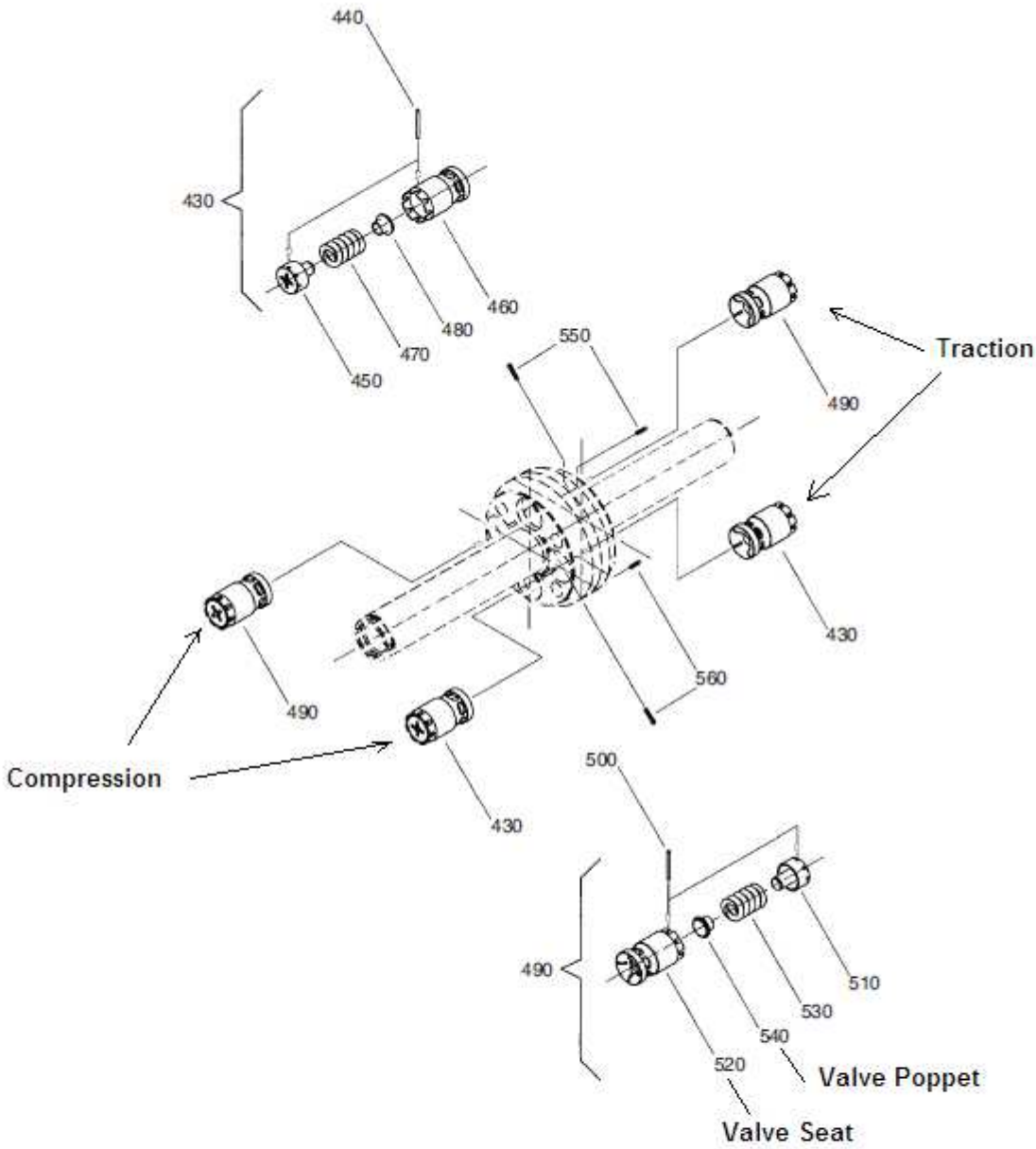


Figure 1. Main Rotor Lag Damper Assembly (sheet 3 of 3).

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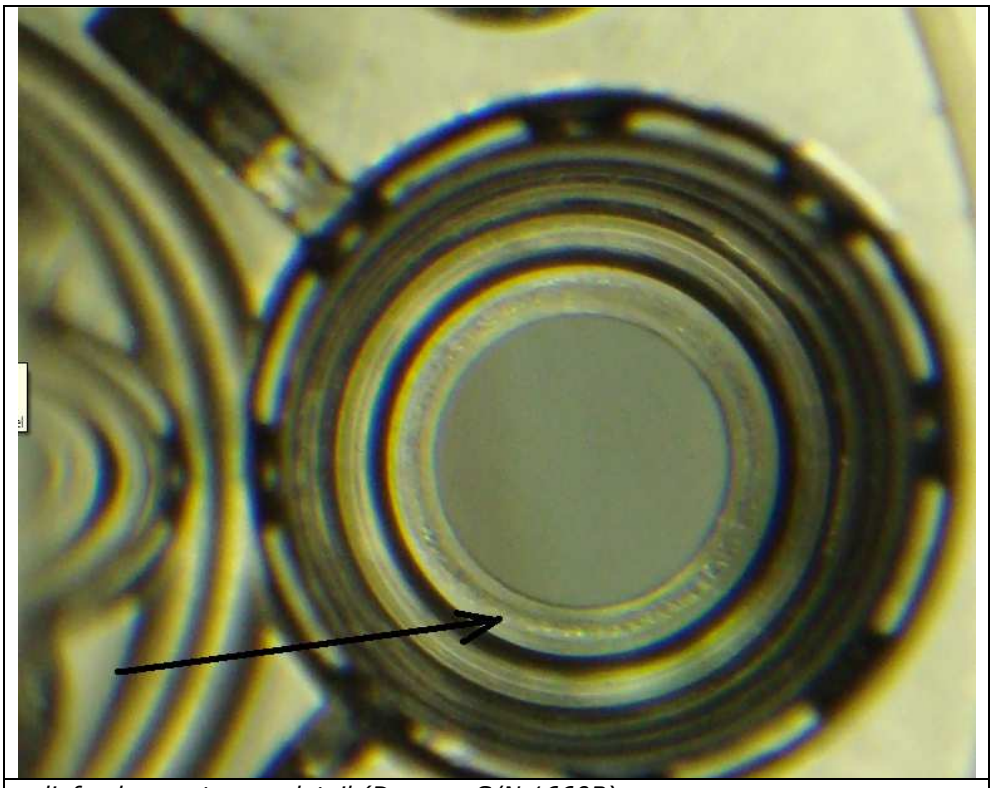
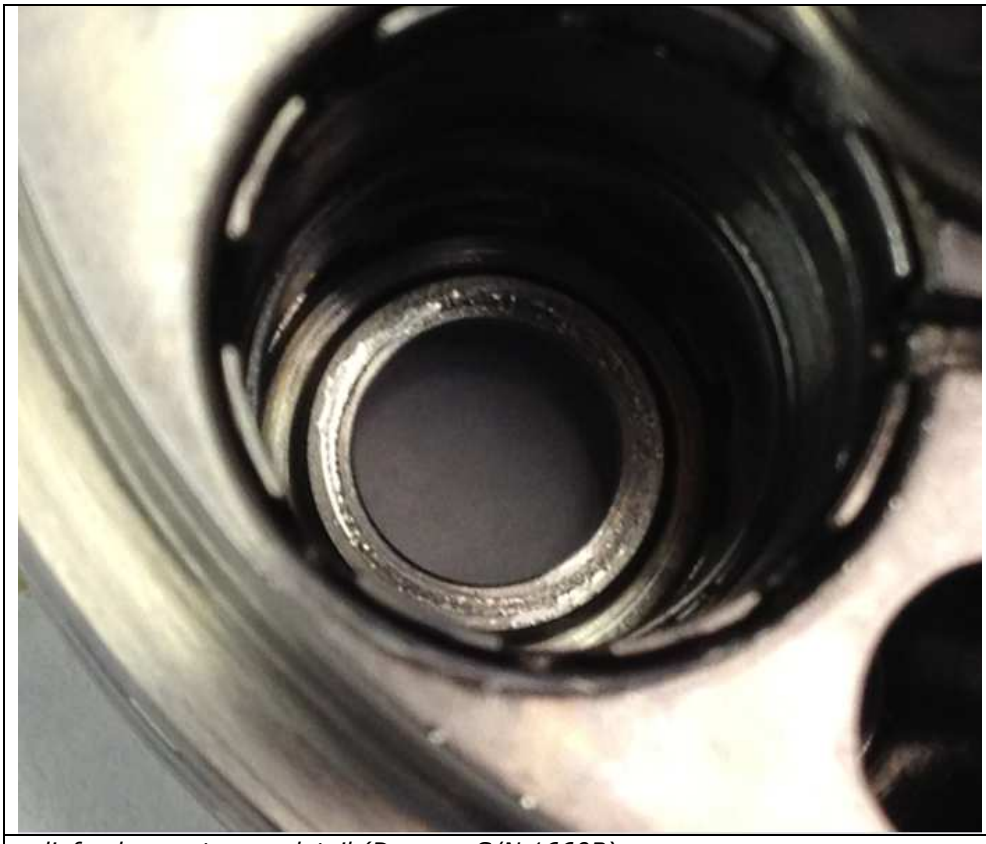
CMM IPL extract - Piston and Valves

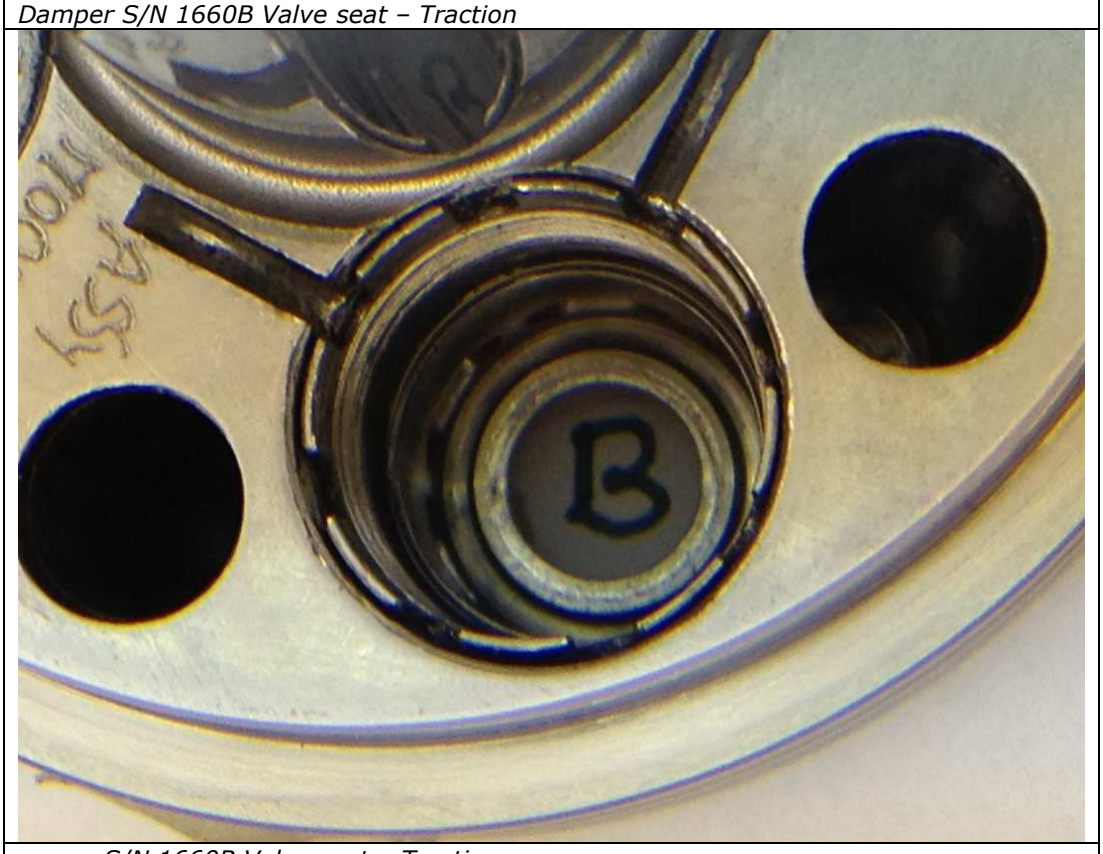


relief valve seat wear detail (Damper S/N 1660B)

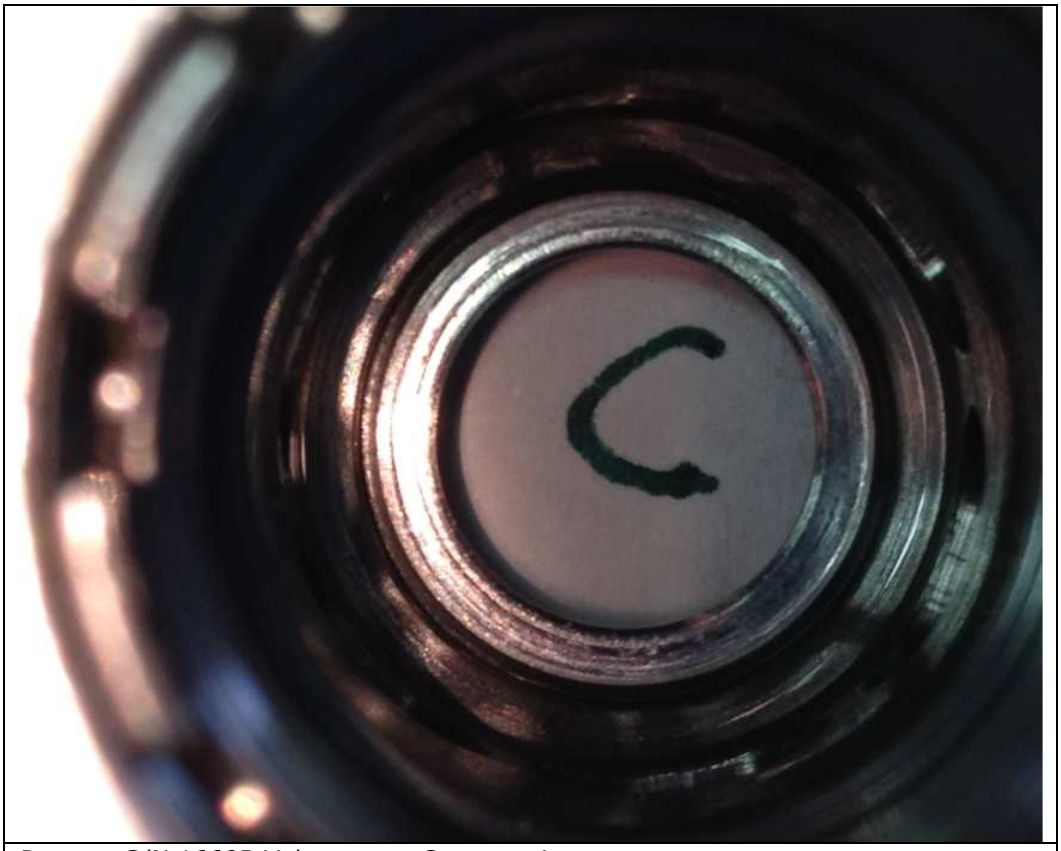


relief valve seat wear detail (Damper S/N 1660B)

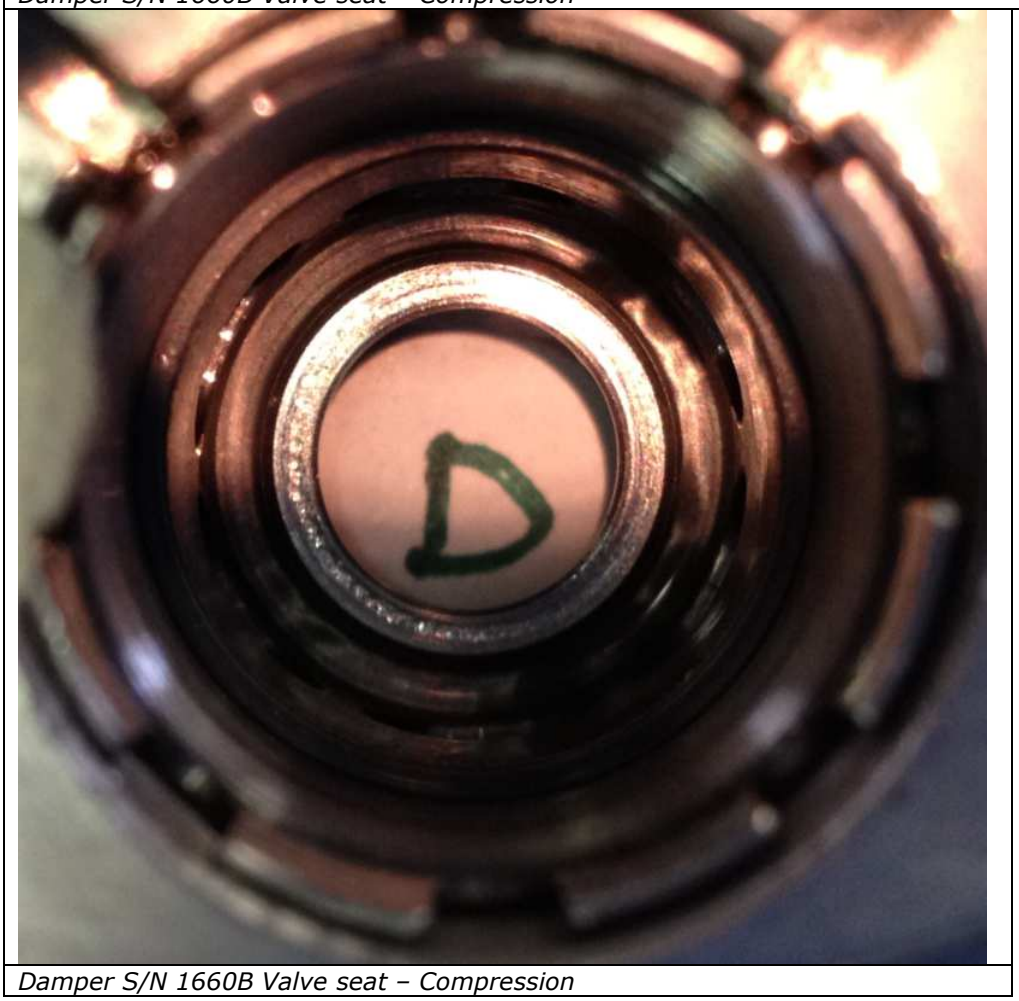
Damper S/N 1660B Valve seat – Traction



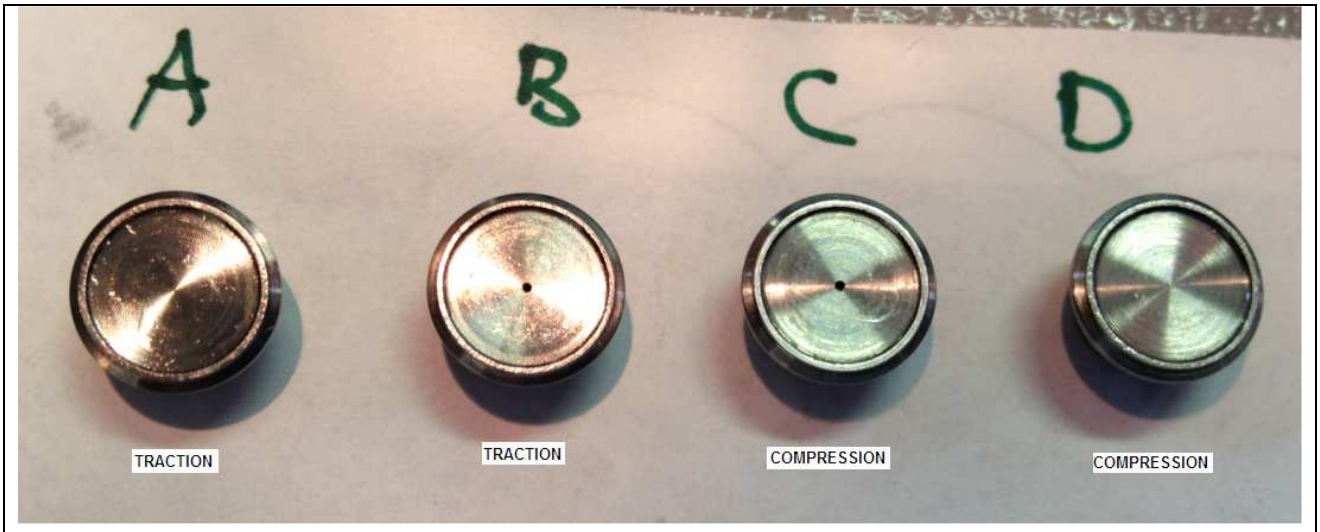
amper S/N 1660B Valve seat – Traction



Damper S/N 1660B Valve seat – Compression

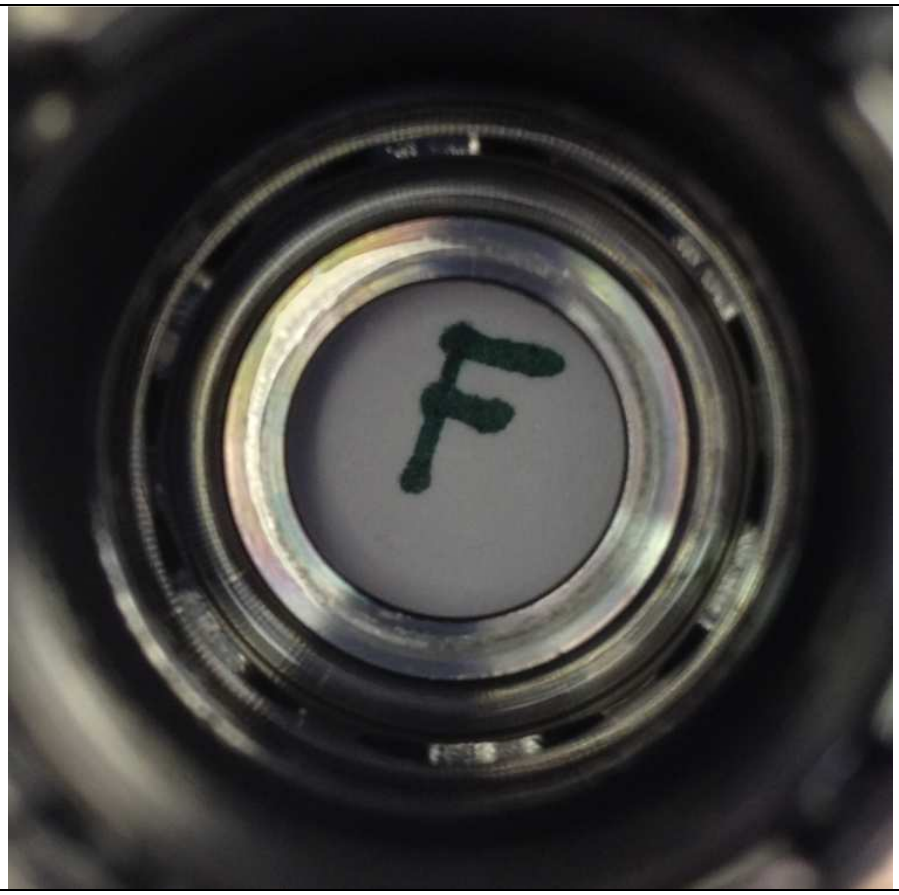


Damper S/N 1660B Valve seat – Compression



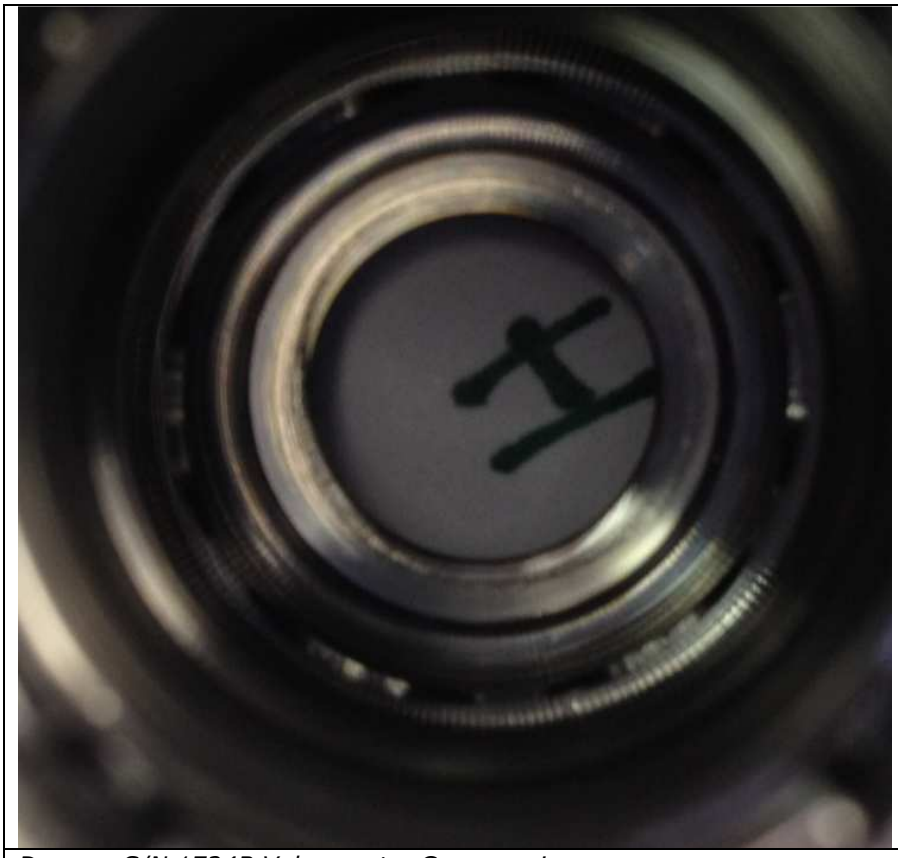
Damper S/N 1660B Valve poppets

Damper S/N 1724B Valve seat – Traction



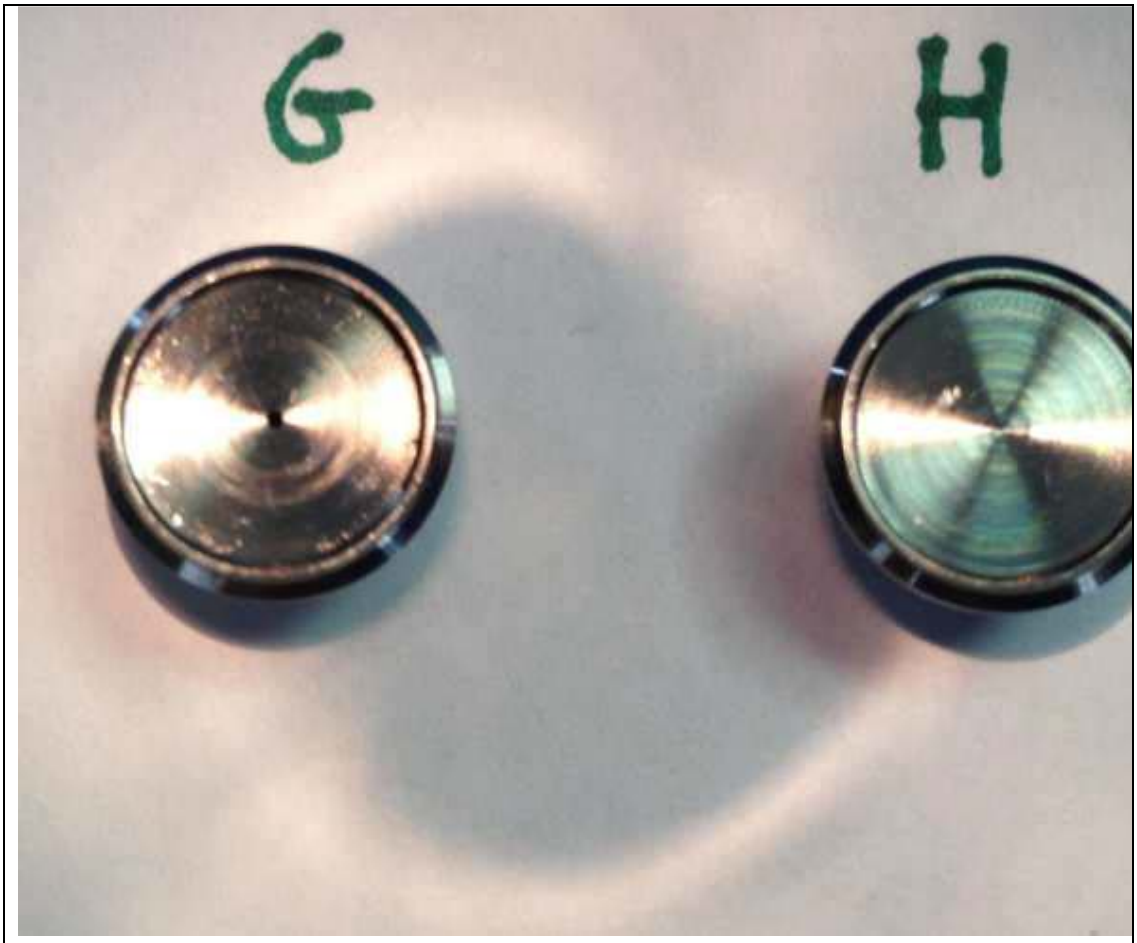
Damper S/N 1724B Valve seat – Traction

Damper S/N 1724B Valve seat – Compression



Damper S/N 1724B Valve seat – Compression

Damper S/N 1724B Valve poppets – Traction



Damper S/N 1724B Valve poppets – Compression

Damper S/N 1602 Repair Order Extract

Date : 08-27-12 [14:26]
Macaer America LIVE

ADDITIONAL NOTES
(Original)
********** ROUTING TYPE----> PD09 **********

Page : 1
Company : 100

Item/Article : RU3G6220V01352 MAIN ROTOR LAG Material :
Revision :
Project :
Customer/Client:
Selection Code: 000 No Code
Whse/Magasin : 850 MRO Customer Owned Property
Ordre.rev : Resp.rout : 0
SLS1:571894 SLS2: 0 SLS3: 0 SLS4: 0 SLS4: 0
Refer.:SPM 1362 Refer.: Refer.: Refer.: Refer.:
QualCode : QualCode : QualCode : QualCode : QualCode :

Prod. Order : 603003
Size :
Standard :
Inventory Locatio:
Planned End Date : 09-17-12/ 83
Qty Ord. : 1.0000
Qty Cons. : 0.0000
Inventory Unit : EA
Rout.State : LastUpdate : Rout.Rev. : 0

EAI Req'd ☐

S/N. 1602 SPM 1433 S/O. 571921

[redacted] [redacted]

26 SEP. 2012

999

Date : 27 Aout 2012

Signature : [redacted]

Remarks :

Hagner America LIVE
Date : 08-27-12 [14:26]

Production Order

(Original)

Item/Article : RU3G6220V01352 MAIN ROTOR LAG	Characteristic 1 :	Prod. Order	: 603003
Revision :			
Project :	Characteristic 4 :	Planned End Date	: 09-17-12/ 03
Customer :	Characteristic 5 :	Qty Ordered	: 1.0000
Selection Cde: 000 No Code		Qty Cons.	: 0.0000
Whse/Magasin : 850 HMO Customer Owned Property	Inventory Locatio:	Inventory Unit	: EA
Drw.rev : Resp.rout : 0	Rout.State : LastUpdate	: Rout.Rev.	: 0

Run 1 | Setup 2 | WO 603003

Opr	Task	Description	Work Ctr.	Description	Mach.	Setup Time	Unit Runtime	Check B	S	OK

ACTUAL I/D OF EYE END or BODY END (to be able to choose the correct Bearing O/D needed to maintain the clearance/interference fit, as specified ABOVE; and/or to install the already chosen Bearing required for the O/S Dia.)

[EYE END]
Record S/N of Bearing and O.D. : S/N _____ O.D. N/A Replaced

Record S/N of Eye End and I.D. : S/N _____ I.D. _____

Record Fit : _____

[BODY END]
Record S/N of Bearing and O.D. : S/N 15142 O.D. 1,8510

Record S/N of Body End and I.D.: S/N 184RW I.D. 1,8507

Record Fit : 0,0003

SEP 24 2012

[redacted]

[OP.100M / ASSEMBLY / HYDRAULIC PRESS - INSTALL BEARING]

1) RECORD TORSIONAL & FLEXIONAL FRICTION OF THE UNINSTALLED BEARING:
A) TORSIONAL FRICTION REQUIRED 2.30 - 10.00 NM

EYE END BEARING ___/___ BODY END BEARING 10 N.m

FLEXIONAL FRICTION REQUIRED 1.15 - 5.00 NM

EYE END BEARING ___/___ BODY END BEARING 5 N.m

B) STAKE LOAD REQUIRED 13700 - 14000 KG (30203 - 30865 lbs)

EYE END BEARING ___/___ BODY END BEARING 30500 lbs

2) AFTER STAKING THE BEARING;

Macmar America LIVE
Date : 08-27-12 [14:26]

Production Order

(Original)

Item/Article :	RU3G622OV01352	MAIN ROTOR LAG	Characteristic 1 :	Prod. Order :	603003
Revision :					
Project :			Characteristic 4 :	Planned End Date :	09-17-12/ 83
Customer :			Characteristic 5 :	Qty Ordered :	1.0000
Selection Cde:	000 No Code			Qty Cons. :	0.0000
Whse/Magasin :	850 HRO Customer Owned Property		Inventory Locatio:	Inventory Unit :	EA
Drw.rev :	Resp.rout : 0		Rout.Statu : LastUpdate :	Rout.Rev. :	0

Run 1 Setup 2 MO 603003

Opr	Task	Description	Work Ctr.	Description	Mach.	Setup Time	Unit Runtime	Check B	S	OK

C) APPLY AXIAL LOAD 846 KG (1865 LBS) FOR 30 SEC. AND RECORD AXIAL PLAY;

EYE END ASSY ✓ BODY END ASSY NONE

D) CHECK TORSIONAL FRICTION VALUE IS LOWER THAN 20 NM;

EYE END ASSY ✓ BODY END ASSY 15 N.m

E) CHECK FLEXIONAL FRICTION VALUE IS LOWER THAN 10 NM;

EYE END ASSY ✓ BODY END ASSY 5 N.m

F) COUNTERMARK STAKED BEARING WITH THE FOLLOWING COLORED MARKS:
YELLOW, GREEN & BLUE

SEP 21 2012 [redacted]

[OP.100P & 100Q / ASSEMBLY]

1) RE-ASSEMBLE DAMPER AS PER CMM 62-21-06 pg.701 THRU 709

2) RECORD MFG. DATES AND/OR EXPIRY DATES OF SEALS ON PAGE 5.

Note: EYE END ASSEMBLY IS CRITICAL
PERFORM A DOUBLE INSPECTION TO ENSURE CORRECT INSTALLATION
RECORD ACTUAL VALUES AND DOUBLE STAMP (OPERATOR AND WITNESS)

RECORD ACTUALS & DOUBLE STAMP (OPERATOR & INSPECTOR or 2nd OPERATOR) FOR:

Eye End Assy:

A) INSTALL BROACHED RING NUT (1-40) AND BROACHED RING (1-50)
ON THE PISTON; SCREW THE EYE END ASSY ON PISTON

B) WITH TORQUE WRENCH AND ADAPTER M006-01T029,
APPLY TO EYE END (1-60) A TORQUE LOAD OF 50 Nm,