



ENGINE FACTORY, AVADI

PROCESS SCHEDULE

DESCRIPTION :- **GENERATOR DRIVE SHAFT**.....

COMPT. No :- **20-39-68-3**.....

MFG. SHOP :- **SPS**.....

REV. No : 00

DATE - 27.10.96



ENGINE FACTORY AVADI

FORM No :EFA/P-038

PROCESS SCHEDULE

NOMENCLATURE :
 DRAWING No : 20-39-68-3
 MATL SPECIFICATION :

OPN No	DESCRIPTION OF OPERATION	SHT No	WORK CENTRE	SET UP TIME	OPN TIME	REMARKS
080	INSPECTION	-	BENCH			
090	CENTRE CORRECTION	11	CENTRE HOLE GRNDG. MIC.			
100	GRINDING - EXTERNAL GRINDING	12	CYL. GRINDING MIC. HMT. K-130/800P.			
110	TURNING	13	CNC - LATHE GDM-65/2A - HMT.			
120	INSPECTION	-	BENCH			
130	GEAR SHAPING	14	GEAR SHAPE MIC - HMT. LEIBHERR.			
140	DEBURRING	15	BENCH			
150	WASHING	-	WASHING PLANT.			

PREPARED BY		CHECKED BY		APPROVED BY		AUTHORISED BY						
SIGN	<i>[Signature]</i>	SIGN	<i>[Signature]</i>	SIGN	<i>[Signature]</i>	<i>[Signature]</i>						SHT. No
DATE	23-10-96	DATE	26.10.96	DATE	27.10.96	27/10/96						2 OF 24
CM-i /PDO		CM-i /PDO		HOS/PDO		DO/PDO		PDO REF	ISSUE	DATE	SIGN	



ENGINE FACTORY AVADI

FORM No :EFA/P-038

PROCESS SCHEDULE

NOMENCLATURE :
 DRAWING No : 20-39-68-3
 MATL. SPECIFICATION :

OPN No	DESCRIPTION OF OPERATION	SHT No	WORK CENTRE	SET UP TIME	OPN TIME	REMARKS
240	PASSIVATION	-	H.T.P.			
250	TURNING	23	CNC. LATHE GDM-65/2A HMT.			
260	DRESSING	-	BENCH			
270	INSPECTION : CRACK TEST & DE-MAGNETIZING	-	MAGNETIC FLAW DETECTOR.			
280	WASHING	-	WASHING PLANT			
290	FINAL INSPECTION	24	BENCH			
300	MARKING : MARK THE PART No. (SPARE PARTS ONLY)	-	BENCH			
310	INSPECTION	-	BENCH			

PREPARED BY		CHECKED BY		APPROVED BY		AUTHORISED BY						SHT. No
SIGN	<i>[Signature]</i>	SIGN	<i>[Signature]</i>	SIGN	<i>[Signature]</i>	SIGN	<i>[Signature]</i>					4 OF 24
DATE	23.10.96	DATE	26.10.96	DATE	27.10.96	DATE	27.10.96					
	CME /PDO		CME /PDO		HOS/PDO		DO/PDO	PDO REF	ISSUE	DATE	SIGN	

PLANNING SHEET - PDO/EFA

FORM No: EFA/P-039

NOMENCLATURE

GENERATOR DRIVE SHAFT.

DRAWING NO. 20.39.68-3

ISSUE

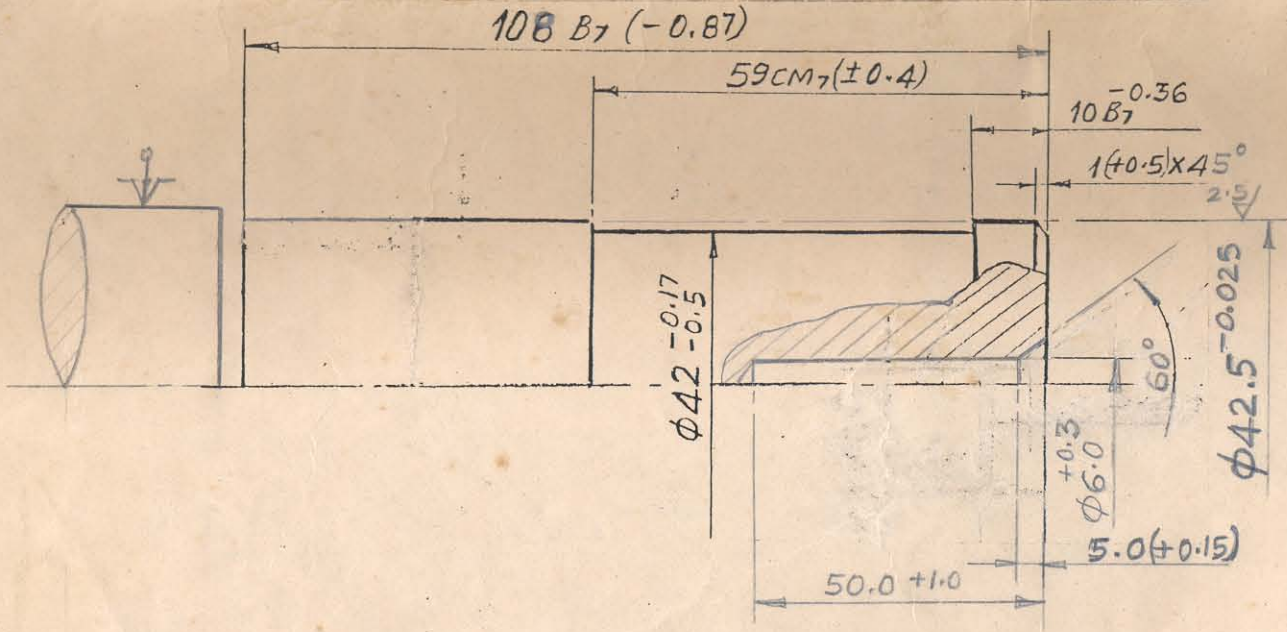
OPN. No. 010

OPERATION TURNING

STEEL 18X2HAMA
HARDNESS BHN 269 TO 302
($d_{3-7.70}$ 3.5 mm)

RA5 (d)

MACHINE: CNC-LATHE
HMT-GDM-65/2A.



STD. TOOLS & GAUGES

TURNING & FACING TOOL HOLDER INSERT	PCLNR 252512
CENTRE DRILL A4 X 10 - IS: 6708-77	CNMG120A TK35 -12
DRILL $\phi 6.0$	
C'SINK CUTTER 60°	
PARTING TOOL HOLDER INSERT	70703009 44315523 TH20

SPECIAL TOOLS & GAUGES -

SNAP GAUGE $\phi 42.5_{-0.025}$	025/09/59
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<i>QSV</i>	<i>QSV</i>	<i>QSV</i>
PRED.	CHD.	APPD

PLANNING SHEET-PDO/EFA FORM No: EFA/P-039

NOMENCLATURE

GENERATOR DRIVE SHAFT.

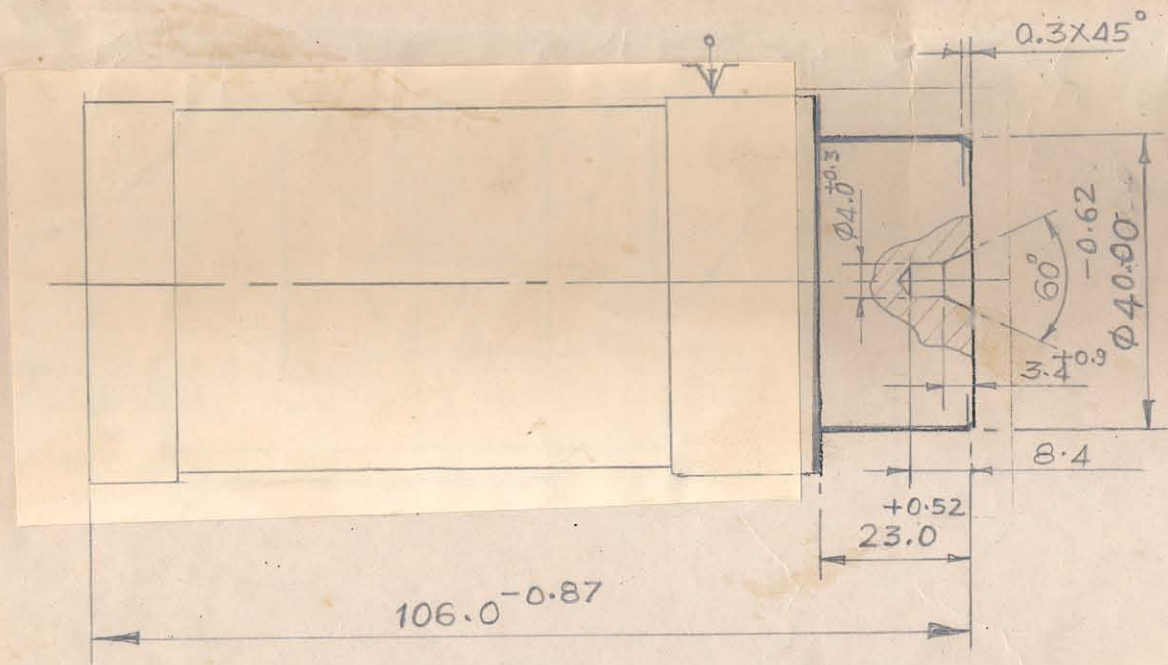
DRAWING No.
20.39.68-3

ISSUE

OPN. No. 020
OPERATION TURNING

Ra 5

MACHINE: CNC LATHE
HMT-GDM-65/2A



STD. TOOLS & GAUGES

TURNING & FACING PCLNR
TOOL HOLDER 252512
INSERT CNMG1204
-12
TK 35

CENTRE DRILL
A 4.0x10.0 IS:670B

SPECIAL TOOLS & GAUGES

SOFT JAWS. 200536

PRED.	CHD.	APPD

GENERATOR DRIVE SHAFT

DRAWING No.
20.39.68-3

ISSUE

OPN. No.
030

OPERATION
DRILLING

MACHINE:
RADIAL DRILLING M/C
HMT RM 63

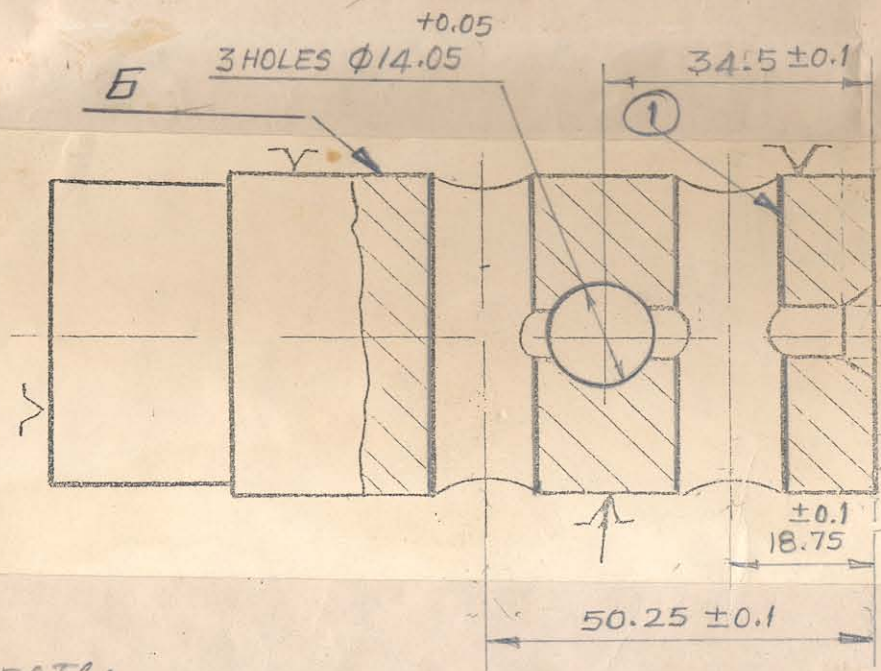
STD. TOOLS & GAUGES

- DRILL $\phi 12$
- - - $\phi 13.6$
- DRILL $\phi 10$
- DRILL $\phi 11.6$

202121
(H5)
12-11-124
21-3-7-11

SPECIAL TOOLS & GAUGES

- DRILL JIG 201194(A)
- PLUG GAUGE $\phi 14.05^{+0.05}$ 020/05/12
- ~~RECEIVER GAUGE FOR CHECKING $\phi 14.05^{+0.05}$ 203256~~
- ~~3 HOLES $\phi 14.05$ DELETED~~
- REAMER $\phi 14.05^{+0.05}$ 202121
- REAMER $\phi 14.05^{+0.05}$ (CT) 04117



TECH. REPTS:-

1. NON PERPENDICULARITY OF HOLE ① WITH RESPECT TO AXIS OF SURFACE 'E' SHOULD NOT EXCEED 0.2MM. OVER A LENGTH OF 100MM.
2. OVALITY AND CONICITY OF HOLE $\phi 14.05$ MM. SHOULD BE WITHIN THE LIMITS OF 0.05MM.
3. COORDINATES OF HOLES ARE TO BE ENSURED BY DRILL JIG AND D/JIG IS TO BE CHECKED IN STANDARD ROOM ONCE A MONTH.
4. PRESENCE OF MARKS AND TRACES DUE TO PRELIMINARY MACHINING ARE ALLOWED ON SURFACE $\phi 14.05^{+0.05}$; SURFACE FINISH IS ACCEPTED AS PER THE STANDARD.

			125	1	20/04/01
PRED.	CHD.	APPD	PDO REF	ISSUE	DATE

PLANNING SHEET - PDO/EFA FORM No: EFA/P--039

NOMENCLATURE

GENERATOR DRIVE SHAFT.

DRAWING No.

20.39.68-3

ISSUE

OPN. No.

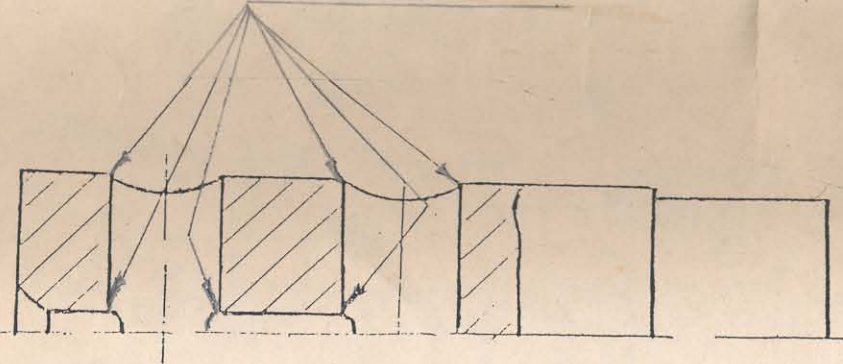
040

OPERATION

DEBURRING

MACHINE: BENCH

DRESS BURRS.



STD. TOOLS & GAUGES

SPECIAL TOOLS & GAUGES

PRED.	CHD.	APPD

PLANNING SHEET--PDO/EFA FORM No: EFA/P--039

NOM. CLATURE

GENERATOR DRIVE SHAFT

DRAWING No.
20.39.68-3

ISSUE

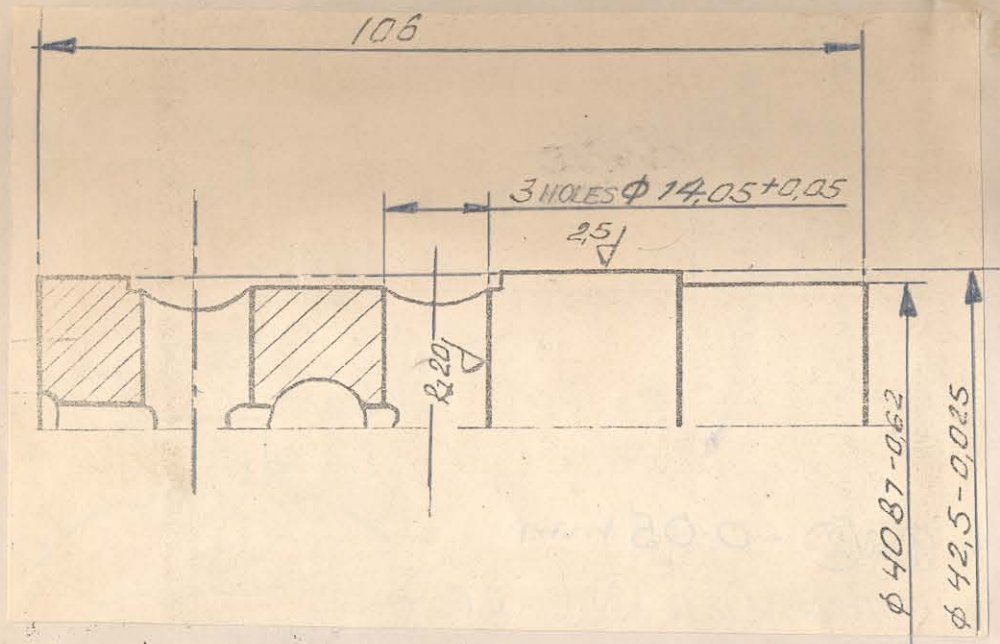
OPN. No.
070

OPERATION
HEAT TREATMENT

MACHINE:
CARBURIZING

STD. TOOLS & GAUGES

SPECIAL TOOLS & GAUGES



TECH. REQTS:-

1. CARBURIZE ALL OVER.
2. DEPTH OF CARBURIZED LAYER IS 0.9 TO 1.2mm.

NOTE:- 5 TO 6 COMPONENTS REJECTED WHILE MACHINING A BATCH OF COMPONENTS, IF AVAILABLE, ARE TO BE SENT ALONG WITH THE BATCH OF COMPONENTS TO BE HEATTREATED FOR USING AS SAMPLE PARTS FOR CONTROLLING THE DEPTH OF CARBURIZING.

PRED.	CHD.	APPD

PLANNING SHEET - PDO/EFA

FORM No: EFA/P-039

NOM. RELATURE

GENERATOR DRIVE SHAFT.

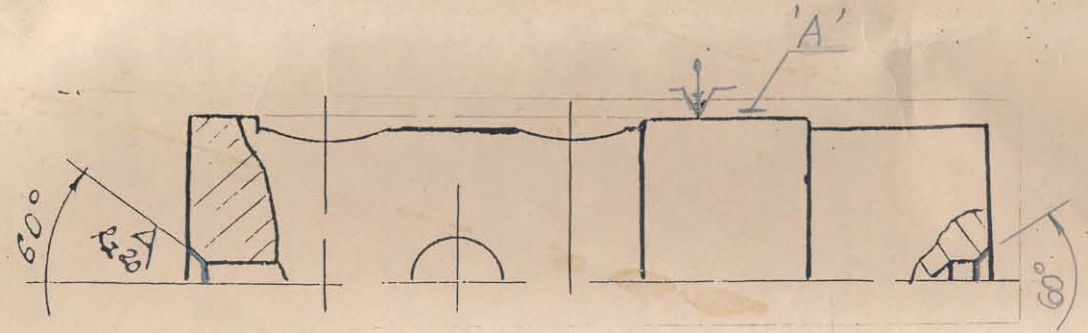
DRAWING NO. 20.39.68-3

ISSUE

OPN. No. 090

OPERATION CENTRE CORRECTION

MACHINE: CENTRE HOLE GRINDING M/C



TECH. REQ:-

RUNOUT OF SURFACE 'A' WITH RESPECT CENTRE CHAMFERS SHOULD NOT EXCEED 0.05mm.

STD. TOOLS & GAUGES

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SPECIAL TOOLS & GAUGES

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PRED.	CHD.	APPD

PLANNING SHEET - PDO/EFA FORM No: EFA/P-039

NOTIFICATION

GENERATOR DRIVE SHAFT.

DRAWING No.
20.39.68-3

ISSUE

OPN. No.
100

OPERATION
GRINDING

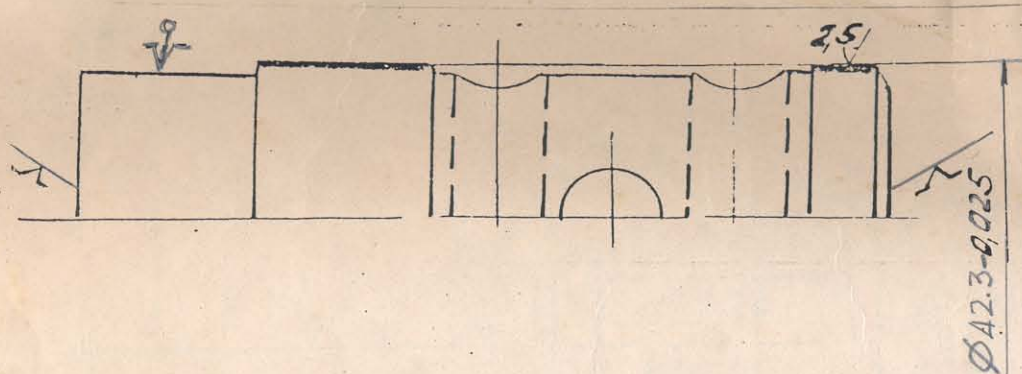
MACHINE: CYLINDRICAL
GRINDING M/C
K-130/800P

Ra 2.5

STD. TOOLS & GAUGES

SPECIAL TOOLS & GAUGES

SNAP GAUGE
-0.025 025/04/56
φ42.3



TECH. REQT:-

RUNOUT OF SURFACE $\phi 42.3$ WITH RESPECT TO AXIS OF CENTRES SHOULD NOT EXCEED 0.02 mm.

PRED.	CHD.	APPD

PLANNING SHEET - PDO/EFA FORM No: EFA/P-039

NOMENCLATURE

GENERATOR DRIVE SHAFT.

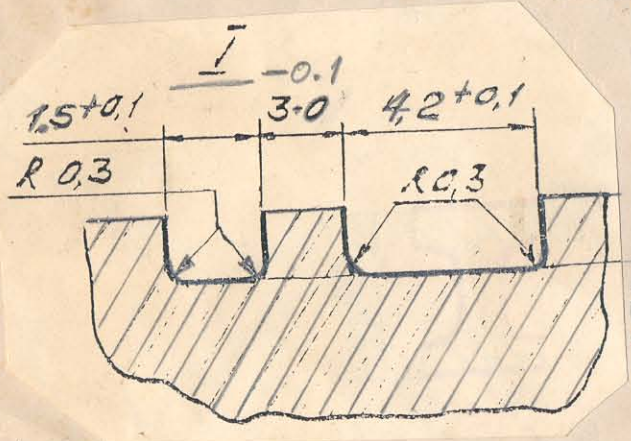
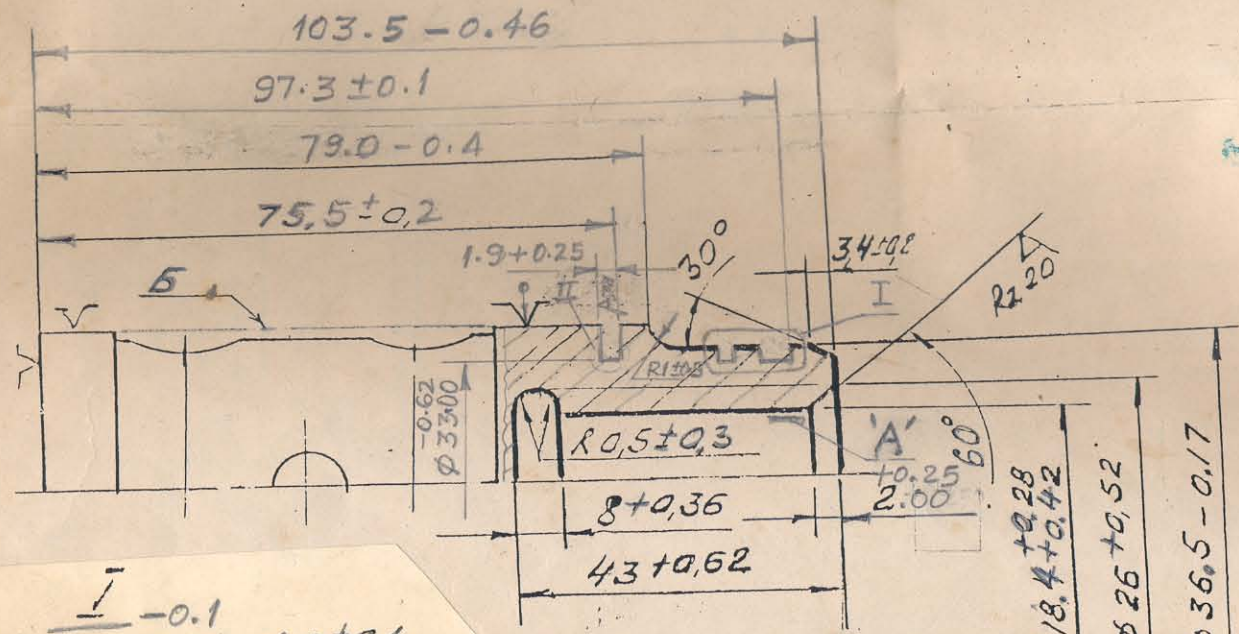
DRAWING No. 20.39.68-3

ISSUE

OPN. No. 110 OPERATION TURNING

MACHINE: CNC-LATHE HMT-GDM-65/2A

Ratio (✓)



TECH. REQ'T:-

RUNOUT OF SURFACE 'A' WITH RESPECT TO SURFACE 'B' SHOULD NOT EXCEED 0.05mm.

ALT. { EXT. GROOVING TOOL FOR C/LATHE } 202123
 { TOOL FOR C/LATHE } 202128
 { } 202124

GROOVE WIDTH GAUGE 1.9 } 055/3
 GROOVE POSITION GAUGE 4.2 ± 0.1 } 203130

Gauge for checking 203132
 WIDTH GAUGE FOR 8 ± 0.36 } 208131
 GAUGE TO CHECK 75.5 ± 0.2 } 051/15.
 SPECIAL SNAP GAUGES FOR
 i) φ 33.0 -0.62 } 076/8
 ii) φ 33.0 -0.34 } 076/9
 iii) 3.0 -0.1 } 083/22

STD. TOOLS & GAUGES	
TURNING & FACING TOOL HOLDER INSERT	PCLNR 252512 CNMG120412 TK35
BORING TOOL HOLDER INSERT	S12KSLC09 CCMM090304 TK15
DRILL φ 17 SLDT DRILL φ 18	
INTERNAL GROOVING TOOL (4)	202122 FOR C/LATHE 202361 FOR GDM LATH
EXT. GROOVING TOOL HOLDER (1.9)	6932703210 202208 (44415778) TTS
EXT. GROOVING TOOL HOLDER (1.5mm)	6932703210
INSERT	44415778 TTS
EXT. GROOVING TOOL HOLDER (4.2mm)	6932741610
INSERT	44415821 TTS
SPECIAL TOOL & GAUGES	
SOFT JAWS	091/02/002
SNAP GAUGE φ 36.5 -0.17	200536 025/03/75
GAUGE FOR 97.3 ± 0.1	203134
PLUG GAUGE φ 18.4 (+0.28) (+0.42)	020/05/19
GROOVE GAUGES	055/4
i) 1.5 ± 0.1	055/5
ii) 4.2 ± 0.1	

PRED.	CHD.	APPD

GENERATOR DRIVE SHAFT.

DRAWING No. 20.39.68-3

ISSUE

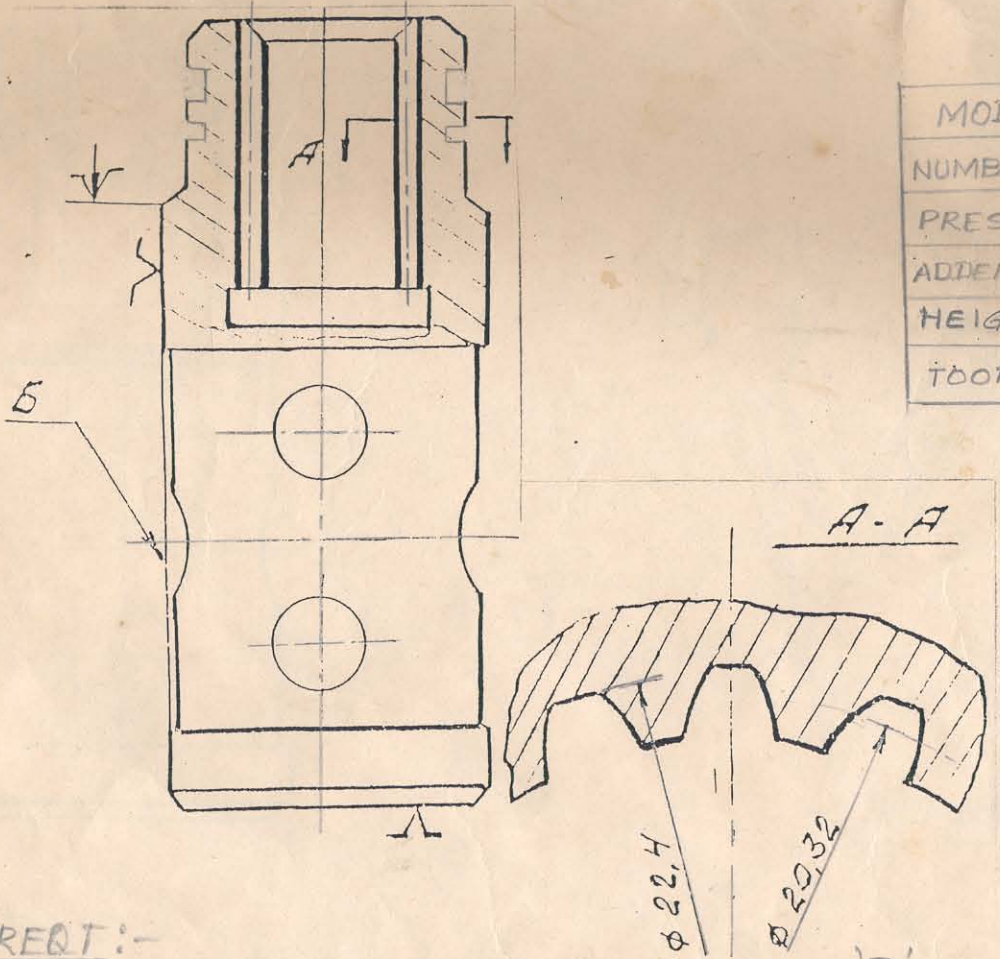
OPN. No. 130 OPERATION GEAR SHAPING

MACHINE: GEAR SHAPING HMT, LEIBHERR M/C

Rad. 5/

STD. TOOLS & GAUGES

MODULE	m	1.27
NUMBER OF TEETH	Z	16
PRESSURE ANGLE	α	30°
ADDENDUM CO-EFFICIENT	f	0.666
HEIGHT OF TOOTH	h	0.845
TOOTH SPACE	S	2.04 ^{+0.03}



TECH. REQ:-

RUNOUT OF SPLINES WITH RESPECT TO SURFACE 'B' SHOULD NOT EXCEED 0.05 mm.

SPECIAL TOOLS & GAUGES

GEAR SHAPING CUTTER	202204
GEAR SHAPING FIXTURE	WSI-F2-0001
SPLINE GAUGE 'GO'S' 'NOGO'	203160 OR 203234
INSPECTION FIXTURE	200516
CUTTER ADAPTOR	201580
PLATE GAUGE	

DESIGN	CHKD.	APPD.
PREP.	CHD.	APPD.

PLANNING SHEET - PDO/EFA FORM No: EFA/P--039

PLANNING SHEET-PDO/EFA FORM No: EFA/P--039

NON-DECLATURE

GENERATOR DRIVE SHAFT.

DRAWING No.
20.39.68-3

ISSUE

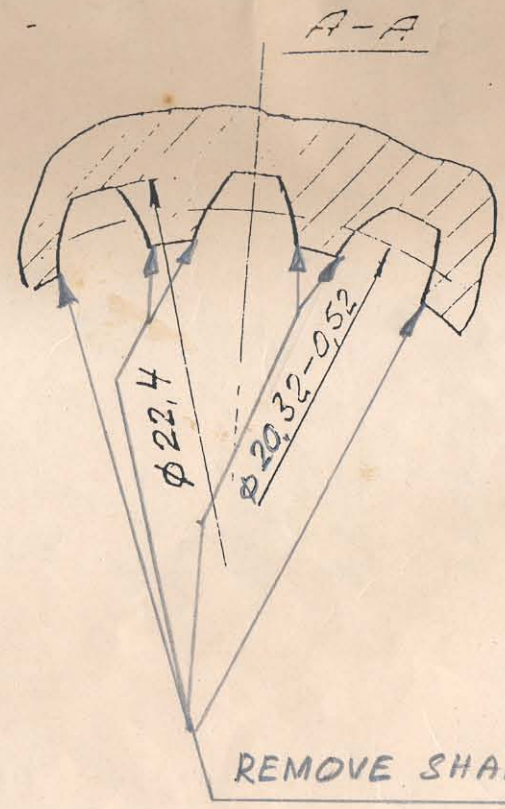
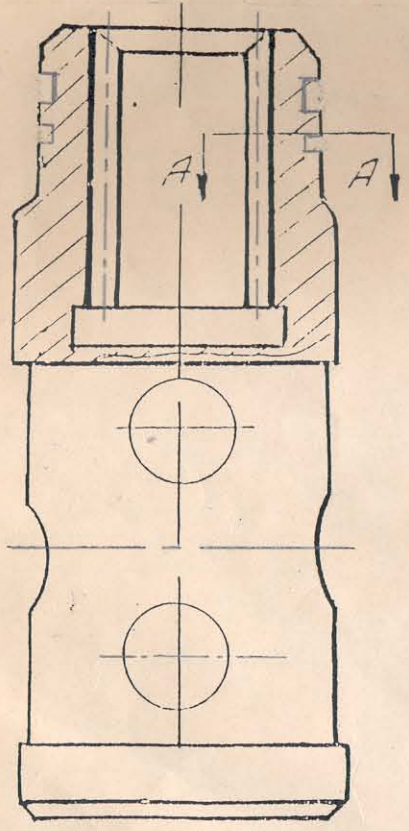
OPN. No.
140

OPERATION
DRESSING

MACHINE: BENCH

STD. TOOLS & GAUGES

SPECIAL TOOLS & GAUGES



PRED.	CHD.	APPD

PLANNING SHEET - PDO/EFA FORM No: EFA/P--039

NOMENCLATURE

GENERATOR DRIVE SHAFT.

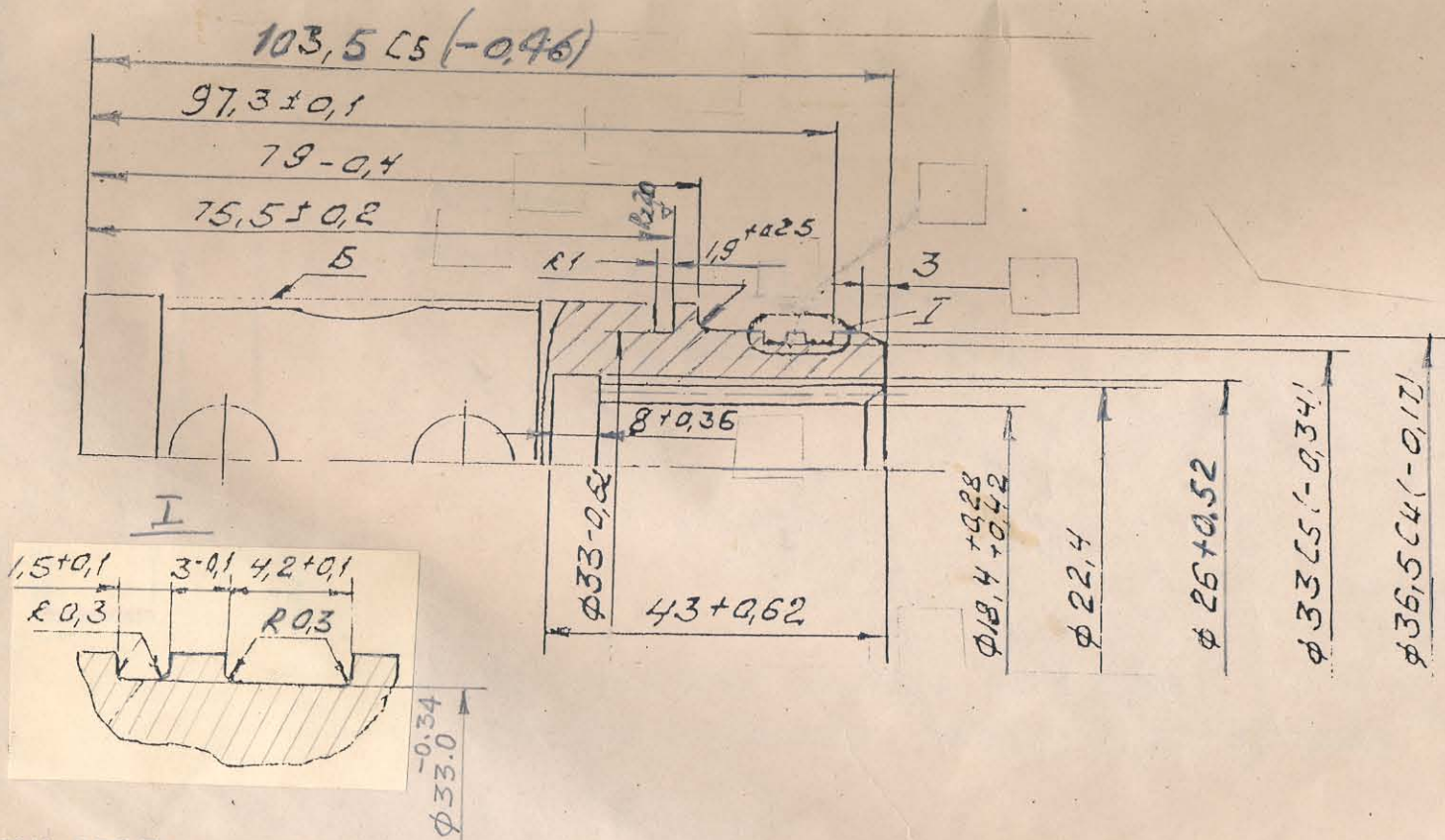
DRAWING NO.
20.39.68-3

ISSUE

OPN. No. 160
OPERATION INSPECTION

MACHINE:

Ra10 (A)



SPL. TOOLS & GAUGES

GAUGE FOR CHECKING $\phi 26^{+0,52}$ 203132

INSPECTION FIXTURE 200516

SPLINE GAUGE 'GO' & 'NO GO' SPECIAL SNAP GAUGE FOR 3.6 ± 0.1 203160

SPECIAL TOOLS & GAUGES

SNAP GAUGE $\phi 36.5^{-0.17}$ 025/03/75

PLUG GAUGE $\phi 18.4^{+0.28}$ $+0.42$ 020/05/12

GROOVE GAUGE
 i) 1.5 ± 0.1 055/4
 ii) 4.2 ± 0.1 055/5
 iii) 8.0 ± 0.36 203131
 iv) 1.9 ± 0.25 076/8
 GAUGE FOR } 203134
 97.3 ± 0.1

SPECIAL SNAP GAUGES FOR
 i) $\phi 33.0^{-0.62}$ 076/8
 ii) $\phi 33.0^{-0.34}$ 076/9

TECH. REQ.T:

RUNOUT OF SPLINES WITH RESPECT TO SURFACE 'B' SHOULD NOT EXCEED 0.05mm.

PRED.	CHD.	APPD.

GENERATOR DRIVE SHAFT

DRAWING No.
20.39.68.3

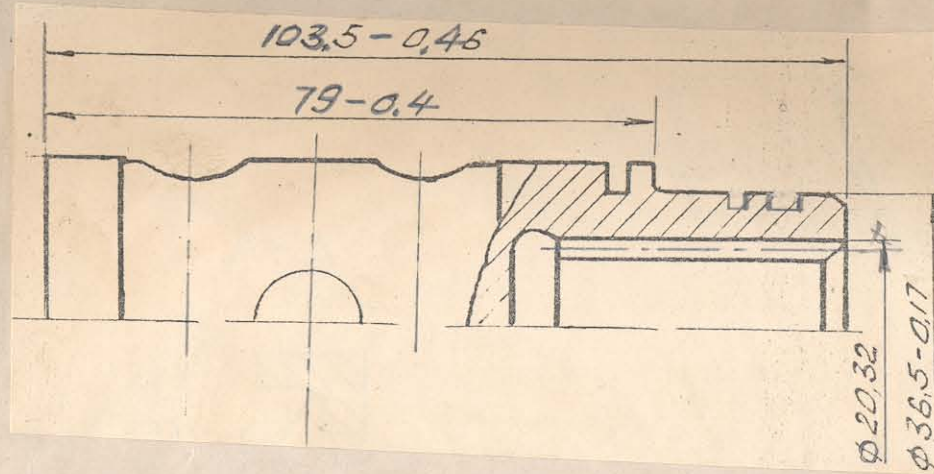
ISSUE

OPN. No.
170

OPERATION
HEAT TREATMENT

MACHINE: HARDENING
AND TEMPERING

STD. TOOLS & GAUGES



TECH. REQ.T:-

1. HARDNESS OF CARBURIZED SURFACE HRC ≥ 58 .
2. HARDNESS OF NON-CARBURIZED SURFACE HRC 35 TO 45.

SPECIAL TOOLS & GAUGES

FITNESS GAUGE
FOR SPLINES 203235

PLANNING SHEET - PDO/EFA FORM No: EFA/P-039

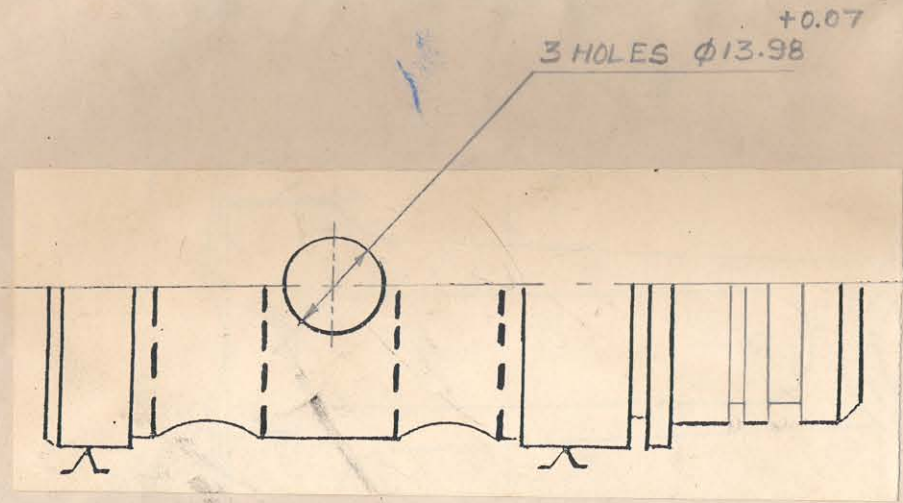
PRED.	CHD.	APPD

PLANNING SHEET - PDO/EFA

FORM No: EFA/P-039

NOMENCLATURE: GENERATOR DRIVE SHAFT. DRAWING NO. 20.39.68-3 ISSUE: 1.25/

OPN. No. 190 OPERATION REAMING
 MACHINE: RADIAL DRILLING M/C
 HMT RM63.



TECH. REQ. :-

CONICITY OF HOLES SHOULD NOT EXCEED 0.02MM.

STD. TOOLS & GAUGES

SPECIAL TOOLS & GAUGES	
HSS REAMER Ø 14.05 ^{+0.03}	202121 04/03/09
DRILL JIG.	201194
R... Ø 14.05	202121
LAPPING STICK Ø 14.05	202137
CT REAMER Ø 14.05 ^{+0.05}	04/00/7
PLUG GAUGE Ø 14.05 ^{+0.05}	020/05/12
RECEIVER GAUGE	203256 DELETED ①

Q&V	125	1	20/04/09
CHD.	PDO REF	ISSUE	DATE
APPD			

PLANNING SHEET--PDO/EFA FORM No: EFA/P--039

NOMENCLATURE

GENERATOR DRIVE SHAFT.

DRAWING NO.

20.39.68-3

ISSUE

OPN. No.

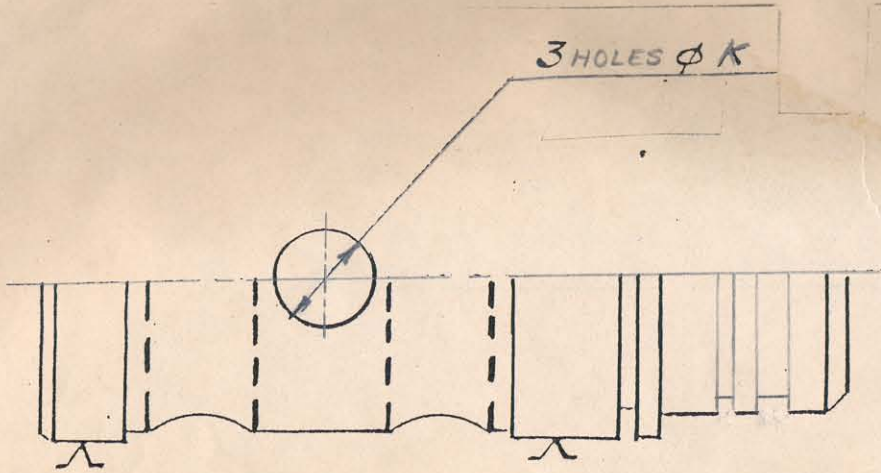
200

OPERATION

GROUPING

MACHINE: BENCH

1.25/
▽



GROUP No	φ K
I	φ 14.0 ^{+0.03}
II	φ 14 ^{+0.06} _{+0.03}
III	φ 14 ^{+0.09} _{+0.06}
IV	φ 14 ^{+0.12} _{+0.09}
V	φ 14 ^{+0.15} _{+0.12}
VI	φ 14 ^{+0.18} _{+0.15}

TECH. REQTS:-

1. OVALITY AND CONICITY OF φ K SHOULD NOT EXCEED 0.03 mm. FOR EACH GROUP.
2. ENLARGING OF φ K UPTO 0.01 mm. OVER A LENGTH OF UPTO 4 mm. FROM EDGE IS ALLOWED

NOTE: MARK THE GROUP NEAR THE HOLES φ K BY ELECTROGRAPH METHOD.

STD. TOOLS & GAUGES

SPECIAL TOOLS & GAUGES

PLUG GAUGE	
i) φ 14.0 ^{+0.03}	020/05/1
ii) φ 14.0 ^(+0.06) _(+0.03)	020/05/2
iii) φ 14.0 ^(+0.09) _(+0.06)	020/05/3
iv) φ 14.0 ^(+0.12) _(+0.09)	020/05/4
v) φ 14.0 ^(+0.15) _(+0.12)	020/05/5
vi) φ 14.0 ^(+0.18) _(+0.15)	020/05/6

PRED.	CHD.	APPD

PLANNING SHEET - PDO/EFA FORM No: EFA/P-039

NOMENCLATURE

GENERATOR DRIVE SHAFT.

DRAWING No. 20.39.68-3

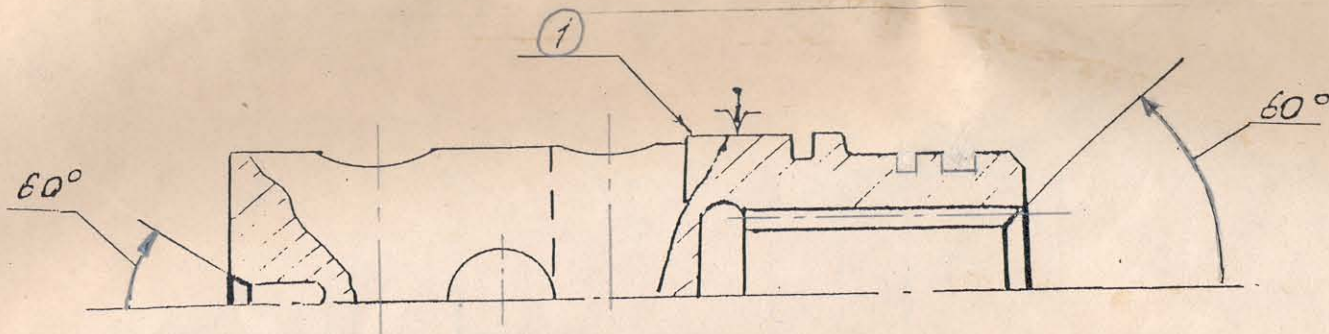
ISSUE

OPN. No. 210

OPERATION CENTRE CORRECTION

MACHINE: CENTRE HOLE GRINDING M/C

STD. TOOLS & GAUGES



TECH. REQT:-

RUNOUT OF SURFACE ① WITH RESPECT TO CENTRE CHAMFERS SHOULD NOT EXCEED 0.05mm.

SPECIAL TOOLS & GAUGES

PRED.	CHD.	APPD

PLANNING SHEET - PDO/EFA FORM No: EFA/P--039

NOMENCLATURE GENERATOR DRIVE SHAFT.

DRAWING NO. 20.39.68-3

ISSUE

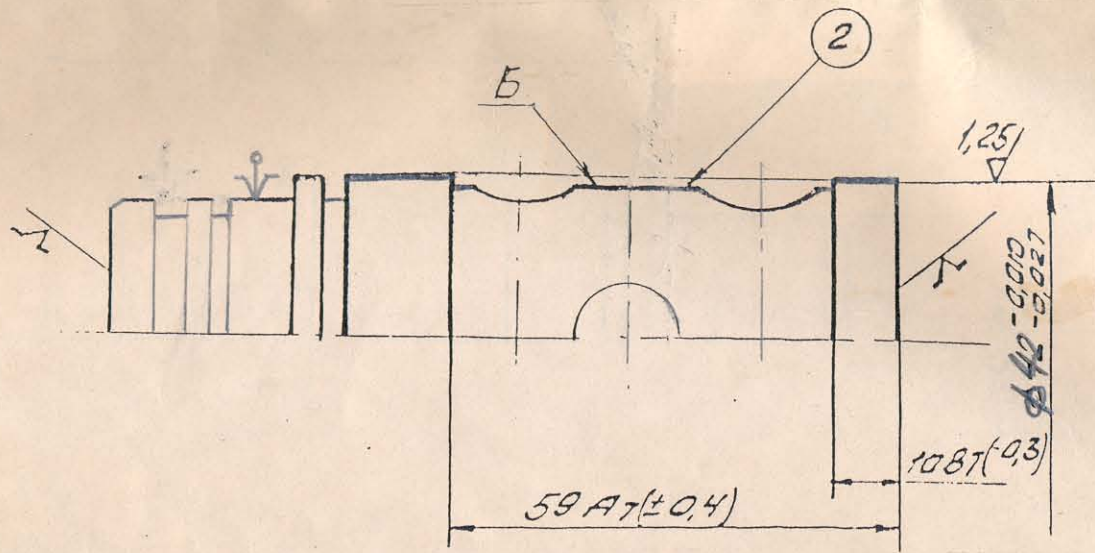
OPN. No. 220

OPERATION GRINDING

MACHINE: CYLINDRICAL GRINDING M/C K130/800P

STD. TOOLS & GAUGES

SPECIAL TOOLS & GAUGES
SNAP GAUGE
 $\phi 42.0 \begin{matrix} +0.010 \\ -0.020 \end{matrix}$ 025/04/29



TECH. REQ:-

RUNOUT OF $\phi 42$ mm. WITH RESPECT TO AXIS SHOULD NOT EXCEED 0.02 mm.

<i>QSV</i>	<i>QSV</i>	<i>QSV</i>	316	B	24-2-31
PRED.	CHD.	APPD	DATE REF	ISSUE	DATE

PLANNING SHEET - PDO/EFA

FORM No: EFA/P-039

NOMENCLATURE

GENERATOR DRIVE SHAFT.

DRAWING No. 20.39.68-3

ISSUE

OPN. No. 230

OPERATION GRINDING

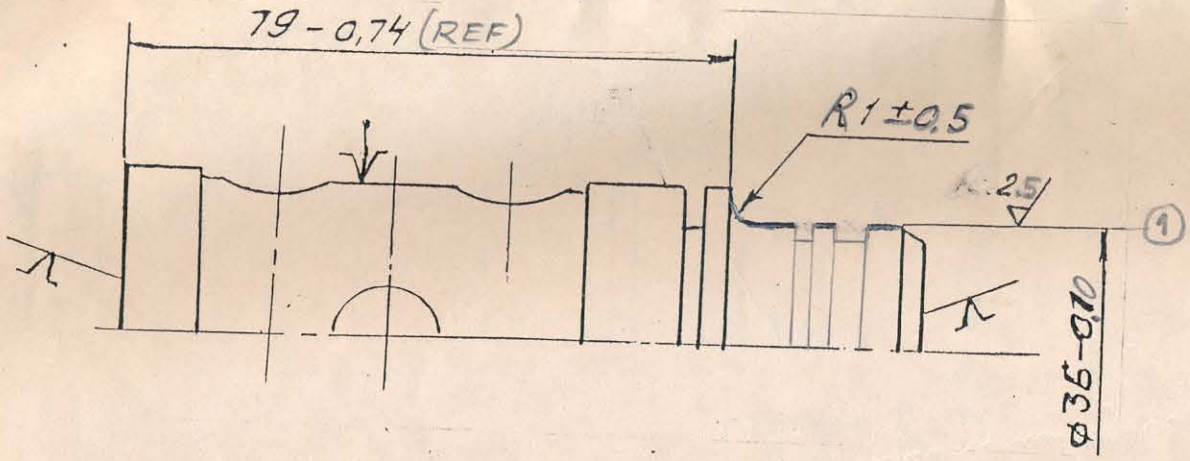
MACHINE: CYLINDRICAL GRINDING M/C K-130/800P

STD. TOOLS & GAUGES

SPECIAL TOOLS & GAUGES

SNAP GAUGE $\phi 36.0^{-0.1}$

025/04/27



TECH. REQT:

RUNOUT OF SURFACE ① WITH RESPECT TO AXIS SHOULD NOT EXCEED 0.03 mm.

PRED.	CHD.	APPD

GENERATOR DRIVE SHAFT.

DRAWING No. 20.39.68-3

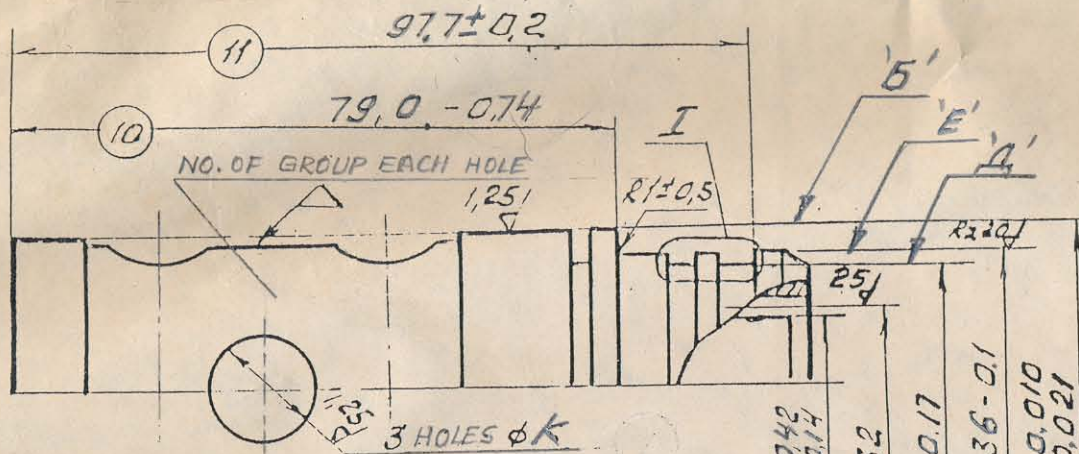
ISSUE

OPN. No. 290

OPERATION FINAL INSPECTION

Ra 10/ (A)

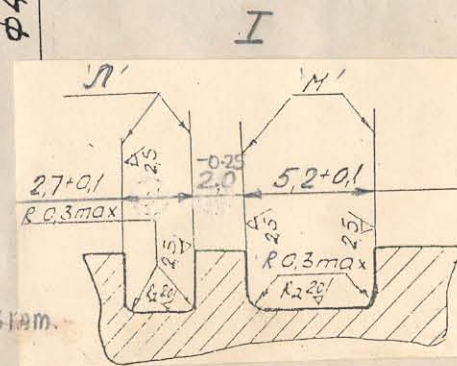
MACHINE:



GROUP NO:	φ K
I	14 + 0.03
II	14 + 0.06
III	14 + 0.03
IV	14 + 0.09
V	14 + 0.12
VI	14 + 0.05
VII	14 + 0.15
VIII	14 + 0.12
IX	14 + 0.18
X	14 + 0.15

TECH. REQTS :-

1. RUNOUT OF THE FOLLOWING SURFACES W.R.T. SURFACE "E":
 - i) BUTT ENDS "A" AND "M" SHOULD NOT EXCEED 0.02 mm.
 - ii) SURFACE "A" SHOULD NOT EXCEED 0.1 mm.
 - iii) SURFACE "E" SHOULD NOT EXCEED 0.02 mm.
 - iv) SPLINES SHOULD NOT EXCEED 0.1 mm.
2. NON-PERPENDICULARITY OF φ'K' SHOULD NOT EXCEED 0.3 mm. OVER A LENGTH OF 100 mm.
3. DVALITY AND CONICITY OF SURFACE 'K' SHOULD NOT EXCEED 0.3 mm.
4. ENLARGING OF φ'K' UPTO 0.01 mm. IS ALLOWED TO A DEPTH OF 4 mm. MAX. FROM GENERATIX OF SURFACE φ 42.
5. MARKS, TRACES CAUSED BY PRILIMINARY MACHINING ARE ALLOWED ON SURFACE 'K'. ACCEPT THE SURFACE FINISH ASPER THE STANDARD.



SPL. TOOLS & GAUGES

INSPECTION FIXTURES FOR	
i) CHECKING RUNOUT OF SPLINES	2005/6
ii) CHECKING PERPENDICULARITY OF HOLES	NOT READ
PLUG GAUGES	
i) 14.0 + 0.03	020/05/1
ii) 14.0 (+ 0.06, + 0.03)	020/05/2
iii) 14.0 (+ 0.09, + 0.06)	020/05/3
iv) 14.0 (+ 0.12, + 0.09)	020/05/4
v) 14.0 (+ 0.15, + 0.12)	020/05/5
vi) 14.0 (+ 0.18, + 0.15)	020/05/6

SPECIAL TOOLS & GAUGES

SNAP GAUGES	
i) φ 42.0 (-0.010, -0.021)	025/04/29
ii) φ 36.0 - 0.1	025/04/27
iii) 79.0 - 0.74	
SPECIAL SNAP GAUGES	
i) φ 32.0 - 0.17	025/03/76
ii) 2.6 - 0.25	083/23
PLUG GAUGE	
φ 18.4 (+0.42, +0.14)	020/05/18
GROOVE GAUGE	
i) 2.7 + 0.1	203132/1
ii) 5.2 + 0.1	203133/2
SPLINE GAUGE	
GO & NOGO	203160
POSITION GAUGE	080/3

* SPLINE FITNESS GAUGE 203235 SHEET 24 OF 24

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PRED.	CHD.	APPD