

NSV Energy LLC
35 Hickory Springs Industrial Drive
Canton GA 30115



Stcok# G32

Manufacturer: ABB

Serial no. 8267649

Type: AMS 1000 LL Synchronous Generator end

Rated Power: 20326 KVA

KW: 18000 kw

Voltage: 13,800 v , 3 phase, 60 hz

Amps: 850 amps

PF: 0.9

Speed: 1800 rpm

Type : Brushless air cooled (TEAAC)

Exciter: 72 v 7.6 amps

Rotation CW from drive end (can be changed to CCW)

Year built 2007 Start up 2009 and shutdown 2011, dismantled and stored in warehouse 2020

Approximate shipping size: Generator 180" L x 114" W x 95" H 74,600 lbs

Air cooler duct 288" L x 144" W x 82" H 19,810 lbs

Terminal box 40" L x 36" W x 98" H 3790 lbs

Misc parts (1 box)

Made in Sweden



DATE : 2006-01-10

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ENCLOSURE	NUMBER
INSPECTION PLAN	XYK 210 044-EMV

GENERATOR CHARACTERISTIC CURVES :	XYK 210 094-EMV
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SHORT CIRCUIT EQUATIONS	XYK 210 089-EMV
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DZ005886

Prep. ATAP/MKE T.H.	2006-01-10	Technical Specification			No. of sh.
Appr. Sjöberg Lars G	2007-03-09	A			
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A. RATED DATA at cooling air temperature 41°C

Output	kVA : 20326
Power factor (overexcited)	: 0.90
Power factor (underexcited)	: 0.95
Voltage	V (±5%) : 13800
Frequency	Hz (±2%) : 60
Speed	rpm : 1800
Current	A : 850
Exciter type	: GLA 600B
Excitation	V/A : 72 / 7.6

F**B. STANDARDS**

Applicable standards	: NEMA
Insulation class stator and exciter	: F
Insulation class main rotor	: H
Temperature rise, stator within class	: B
Temperature rise, rotor within class	: B

C. OTHER PERFORMANCE DATA

Note: The losses from the fan motors, 15 kW, are not included in the efficiency.

Efficiency at P.F. 0.90 and 100 / 75 / 50 / 25 % load	% : 98.04 97.76 97.06 94.75
Efficiency at P.F. 1.00 and 100 / 75 / 50 / 25 % load	% : 98.30 98.04 97.41 95.31

Reactances:

- X_d	(±15%) % : 156
- X_d' unsat/sat	" % : 26.0 / 22.8
- X_d'' unsat/sat	" % : 17.4 / 15.0
- X_0	% : 7.6
- X_2	% : 19.9

Time constants:

- T_d'	s : 0.92
- T_d''	s : 0.026
- T_{d0}'	s : 7.97
- T_a	s : 0.22

Sudden short circuit current (peak)	kA : 16
Short circuit ratio	% : 71

Max. field forcing for 10 seconds (percentage of rated excitation)	% : 194
Sustained short circuit, stator current for 10 seconds at symmetrical conditions	% : 300

Max. permissible overspeed	rpm : 2160
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Max. continuous negative sequence current	% : 10
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D. SITE CONDITIONS

Ambient temperature range	°C : -19 to +41	°F : -1 to +100	A
Altitude	m : < 1102	ft : < 3615	
Location	: Indoors		
Hazardous area classification	: Non hazardous area		

F. INSTALLATION DATA

Protection form/cooling form	: IP55 TEAAC	.
Heat losses:		
- Cooling air	kW : 345 (at rated load)	
- Lubrication oil	kW : 30.6	
Arrangement form	: IM 1005	
Sleeve bearings:		
- Max. axial play towards D-end	mm : 12.0	in : 0.473 C
- Max. axial play towards N-end	mm : 12.0	in : 0.473 C
- Max. permissible axial thrust	kN : 0	lbf : 0
- Min. barring speed without jacking oil	rpm : 30	.
- Required oil flow to bearings (Total)	l/min : 39.3	gpm : 10.4
- Oil temperature range to bearings	°C : 20 - 71	°F : 68 - 160 .
- Required oil pressure at 40 °C	kPa : 90	psi : 13.1 .
At higher pressure an orifice should be used.		
- Supply oil pressure min/normal	bar : 0.9 / 2.5	.
- Type of oil	: ISO VG 46	
- Degree of purity for oil	: 17/15/12 acc. to ISO 4406:1999	
Weights:		
- Total (complete machine, excluding terminal box)	kg : 41700	lb : 91900 .C
- Stator	kg : 16600	lb : 36600
- Rotor	kg : 11900	lb : 26200 C
- Terminal box	kg : 1720	lb : 3790
Rotor inertia	kgm ² : 1297	lb-ft ² : 30779 C
Direction of rotation (at drive end, facing shaft end)	: CLOCKWISE	
First lateral critical speed (based on stiff foundation)	rpm : 2420	C
Noise level (at 1m acc.to ISO 3744)	dB(A) : 82 , Tol. +3 dB(A)	
Static force on each machine foot	kN : 51	lbf : 11500 .C
Dynamic force on each machine foot	kN : ± 177	lbf : ± 39822
Auxiliary equipment power supply:		
- Anticondensation heaters in the main machine	V, ph, W : 480, 3, 1950	B
- Anticondensation heater in the exciter	V, ph, W : 480, 3, 380	B
- Anticondensation heater in main terminal box	V, ph, W : 480, 3, 650	B
- Separate fan motors for external cooling air	V, ph, kW : 480, 3, 15 for 2 motors (3 x 50%)	.



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G. INCLUDED ACCESSORIES

Cooling arrangement IC6 A1A6 / TEAAC

Self circulating inner air circuit cooled by built-on air-air heat exchanger.

External air stream provided by separate fans, normally 2 fans of 3 in service, 1 in stand-by.

The tube package is hot dip galvanized, the rest of the cooler is epoxy painted.

Protection form IP55.

Exciter

Main brushless exciter type GLA for DC excitation complete with diode bridge, thyristors, RC-circuits and control box.

Pilot Exciter (PMG) single phase type.

MCB - PMG over current protection: 20 A.

Mounting arrangement IM 1005

Horizontal machine with two bearings, one shaft extension.

DE shaft end forged flange.

Provision for coupling guard.

Foundation details

Machine provided with 8 feet.

Long sole plate kit for grouting with non-shrinking grout including:

Foundation plates (2 pcs), anchoring bolts, holding down bolts, mounting shims, dowel pins and horizontal machine jacking bolts.

No alignment or grouting included in ABB scope of supply.

Jacking bolts vertical adjustment.

Bearings

Sleeve bearings suitable for flood oil lubrication provided by others.

Connection at common point. Inlet at left hand side of machine and outlet at right hand side of machine.

D

The lube oil drain pressure must be less than or equal to the machine ambient pressure.

An oil drain pressure of 200-1000 Pa lower than the bearing ambient is recommended.

Customer connection flange acc. to ANSI B16.5, Cl.150.

Inlet pipe in stainless steel.

Outlet pipe in stainless steel.

Orifice for pressure reduction.

C,D

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Pressure switch in oil inlet.
Jacking oil adaptation including oil pipes, motor and pumps.

Emergency oil supply required for run down
minimum 1.5 l/min per bearing.

Main terminal

Heaters in HV terminal box.
Large stator terminal box, right side.
Complies with IEEE/ANSI.

Stator terminal box protection IP56 with all 6
ends brought out and neutral point terminated
inside the box. Connection from underneath.
Grounding clamps inside and outside.
Drainage in terminal box and auxiliary junction boxes.

The main terminal box is delivered as a loose item,
assembly on site is not included in ABB's scope of supply.

The main terminal box needs to be supported from beneath.
Supports are not included in ABB's scope of supply.
For terminal box weight see section F.

Line side

3 - Surge capacitors
3 - Lightning arrestors
3 - Voltage transformers with 2 cores
3 - Current transformers with single core, 1200/5A, C400
Earthing device 3 phase, ball-bolt.

C
E

Neutral side

6 - Current transformers with single core, 1200/5A, C400
6 - Current transformers with single core, 1200/5A, 0.6 B9
Neutral grounding transformer with secondary
resistor, 10A for 10 sec.

C,E

Anticondensation heaters

Standard elements for 1 phase supply.

In both main machine, exciter and terminal box.

Termination in separate boxes (normally opposite
main supply side).

The anticondensation heaters should always be
connected during stand still.

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Measurement and control

Resistance temperature detectors

All PT100 double elements (excl. stator) ANSI.

6 in the stator winding

1 in each bearing

2 in cold air

1 in hot air

Lube oil thermometer

2 in each bearing

Flow control glass in oil outlet,
stainless steel, 1 per bearing.

Vibration control proximity type in two radial
planes, 90° apart

2 probes per bearing mounted outboard the bearing centerline

2 proximitors per bearing

including mounting and intercables.

Acceptance test for shaft run-out measurement is made in V-blocks.

Burnishing surface for proximity type of vibration probes,
maximum combined electrical and mechanical run out 16 µm (0.63 mils) peak-to-peak.

Rotor ground fault brush and slipring.

Shaft grounding brush on D-end.

Pressure transmitters on Jacking oil pump outlet, 1 per outlet.

D

Surface treatment

Standard industrial coating acc. to ISO 12944 C2.

Primer coating - modified epoxy¹

: 60 µm 2.4 mils

Top coating - modified epoxy¹

: 60 µm 2.4 mils

¹The binder is an acid cured epoxidized oil.

Standard colour

: Blue NCS 4822-B05G



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H. WORKSHOP TESTS

ABB Automation Technologies standard procedure is to perform a type test for a single machine order. If two or more identical machines are ordered, then a type test is performed on the first machine and routine tests on the remaining machines.

Proposed workshop tests according to enclosed **INSPECTION PLAN** are part of our manufacturing program and are part of the quoted price of the machine.

Witnessing of testing

Participation in a test specially arranged, time to be agreed between ABB Automation Technologies and customer, 2 weeks advance notice, date will be confirmed 1 week prior to scheduled test date.
The performance calculations are carried out and presented to customer during his visit.

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REVISION

Rev. ind.	Page (P) Chapt.(C)	Description	Date Dept./Init.
A	P3	Ambient temp range changed from –19 to +38 °C	2006-02-23 MVO/LS
B	P3	Anticondensation heaters in main machine was 3200W Anticondensation heater in exsiter was 400W Anticondensation heater in Main Terminal Box was 400W	2006-02-24 MVO/LS
C	P3 P4 P5	Max. play in sleeve bearing increased from 7 to 12 mm. Weight of rotor increased 100 kg according to final drawing and total weight decreased with 2800 kg due to proper CACA-cooler data. Rotor inertia, critical speed and static force changed accordingly. Orifice changed to lockable valve. Removed 3 VT's with single core. AVR uses metering VT according to NP SOK 4410573/1 Changed from 3 CT's with 3 cores to 9 CT's with single core, multi-ratio type.	2006-09-22 MAE/TH
D	P4	Connection at common point, inlet – left side, outlet – right side included. Lockable valve changed back to orifice. Pressure transmitters on Jacking oil pump outlet, 1 per outlet included,	2006-11-14 MAS/LS
E	P5	CT's updated from multi ratio types.	2007-01-21 MAS/LS
F	P2	Excitation data updated according to test results	2007-03-09 MAS/LS

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Formulas for torsional analysis calculations

Airgap torque equation - 3-phase short circuit

$$\text{Torque}(t) = 7.08 * e^{(-t/0.127)} * \sin(wt) + 1.27 * e^{(-t/0.118)} \text{ p.u.}$$

Max. torque = 8.09 p.u. after 4.09 ms

Airgap torque equation - 2-phase short circuit

$$\text{Torque}(t) = 5.94 * e^{(-t/0.202)} * \sin(wt) - 2.98 * e^{(-t/0.605)} * \sin(2wt) + 1.42 * e^{(-t/0.318)} \text{ p.u.}$$

Max. torque = 8.96 p.u. after 5.55 ms

Rated torque: 1.0 p.u. = 98.88 kNm

t = time in seconds

w = 2 * pi * 60 at 60 Hz line frequency

ISSUED	0	Nuovo Pignone	VDR POSITION:	JOB	LANG. A
DESCRIZIONE DESCRIPTION	REV.	FIRENZE	N.	SOK8821837 / 4	TAV.-SH 2/3

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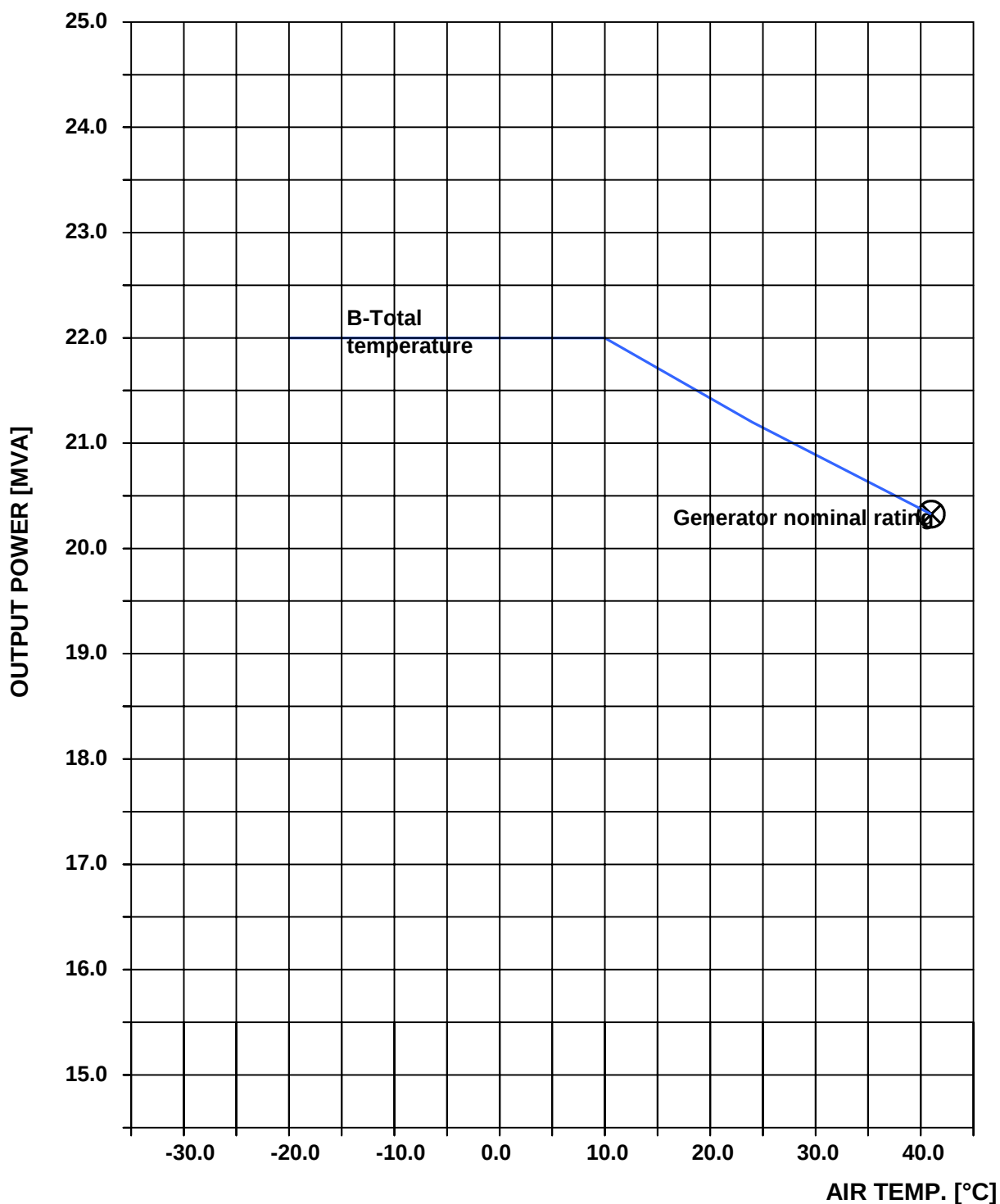
REVISION

Rev. ind.	Page (P) Chapt.(C)	Description	Date Dept./Init.
A	-	NP labels included	2006-02-15 MVO/LS
B	-	NP document number corrected on all pages.	2006-02-23 MVO/LS

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GENERATOR OUTPUT VS. COOLING AIR TEMP.

AMS 1000LL 20326 kVA 60 Hz 0.90 PF 13800 V 850 A 1800 rpm



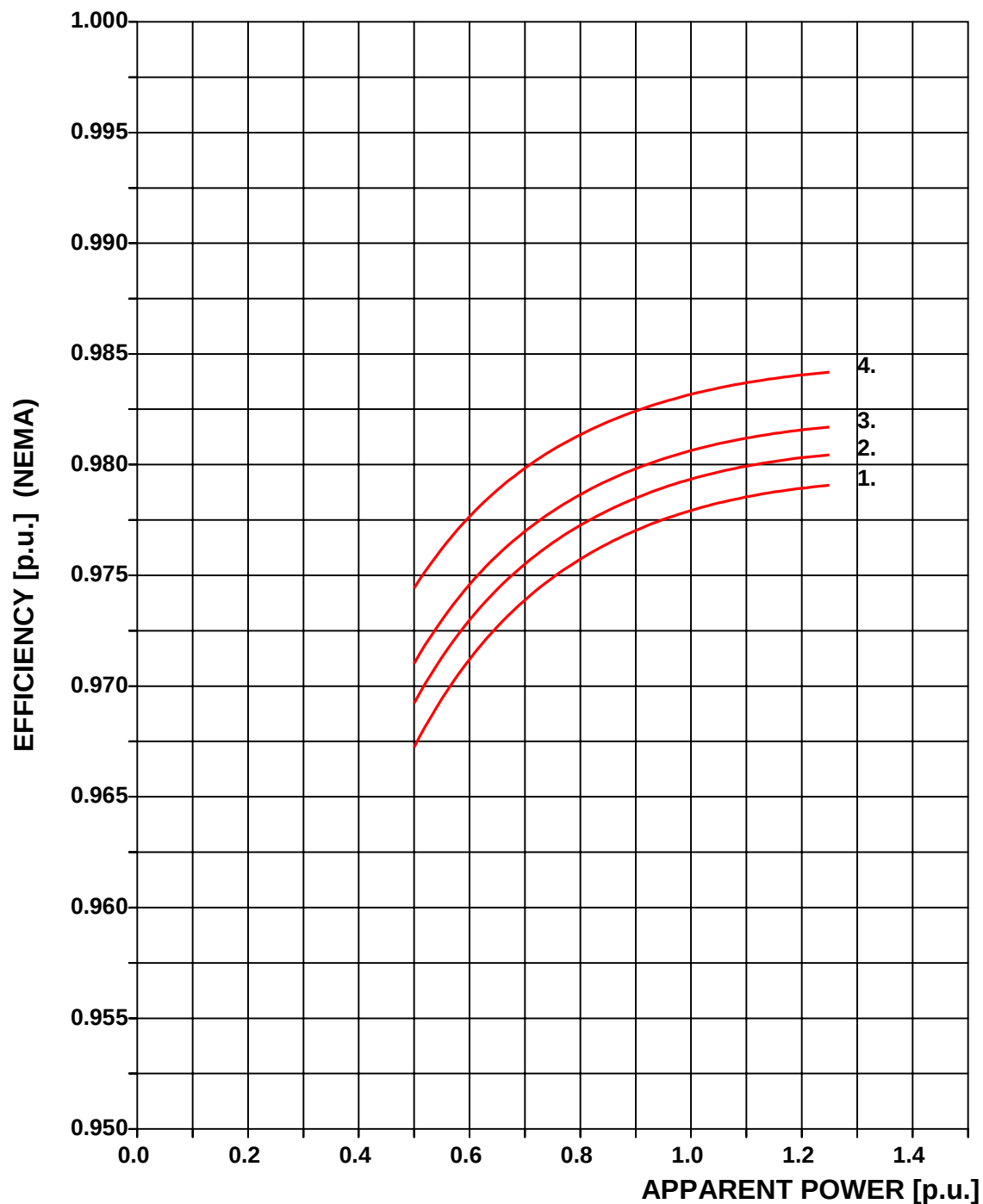
Class B: max 120°C in Stator and 120°C in Rotor

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EFFICIENCY CURVES

AMS 1000LL 20326 kVA 60 Hz 0.90 PF 13800 V 850 A 1800 rpm



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DESCRIZIONE DESCRIPTION	REV.

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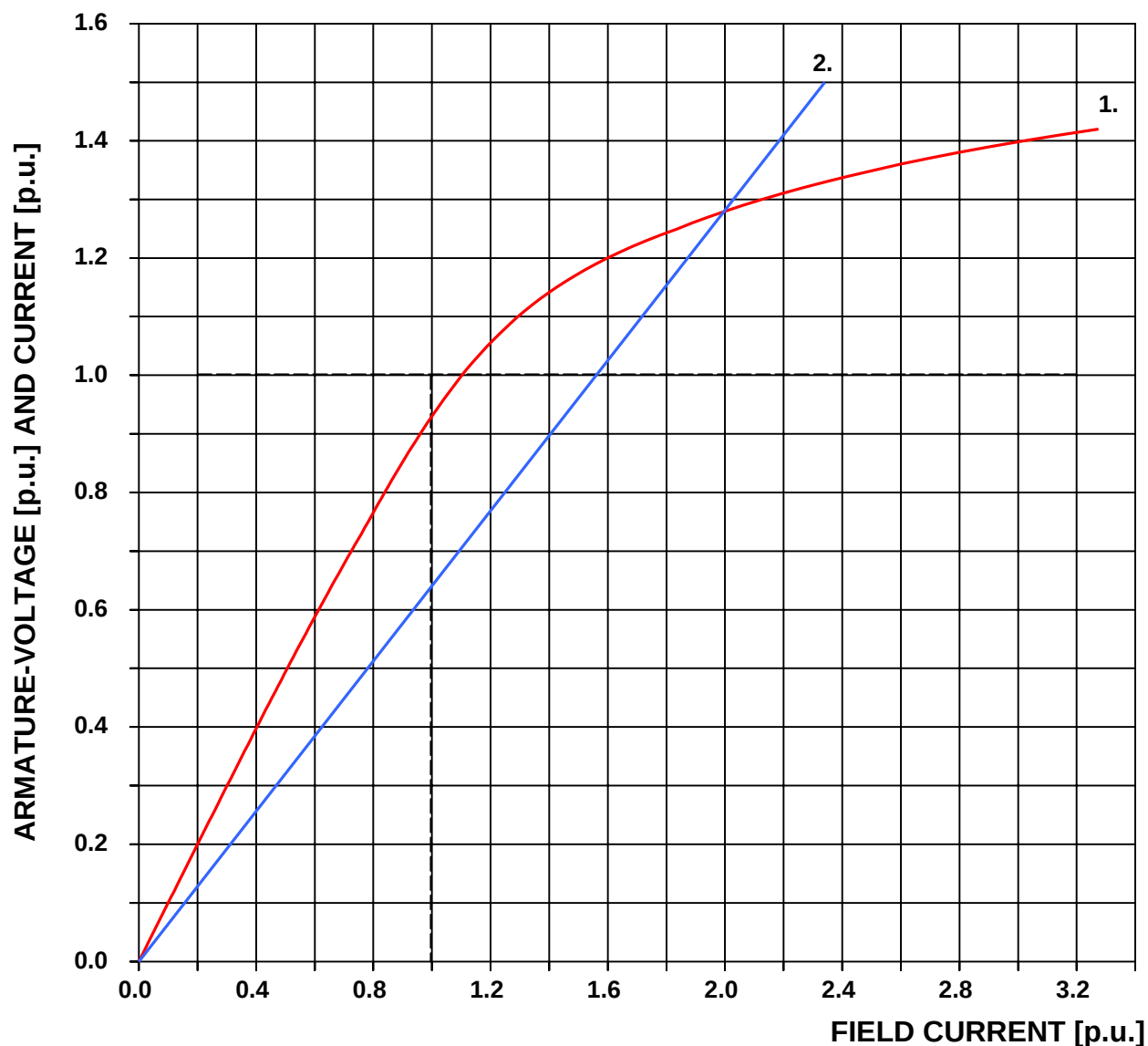
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SATURATION CURVES - A**AMS 1000LL 20326 kVA 60 Hz 0.90 PF 13800 V 850 A 1800 rpm**

1. OPEN -CIRCUIT SATURATION
2. SHORT-CIRCUIT SATURATION

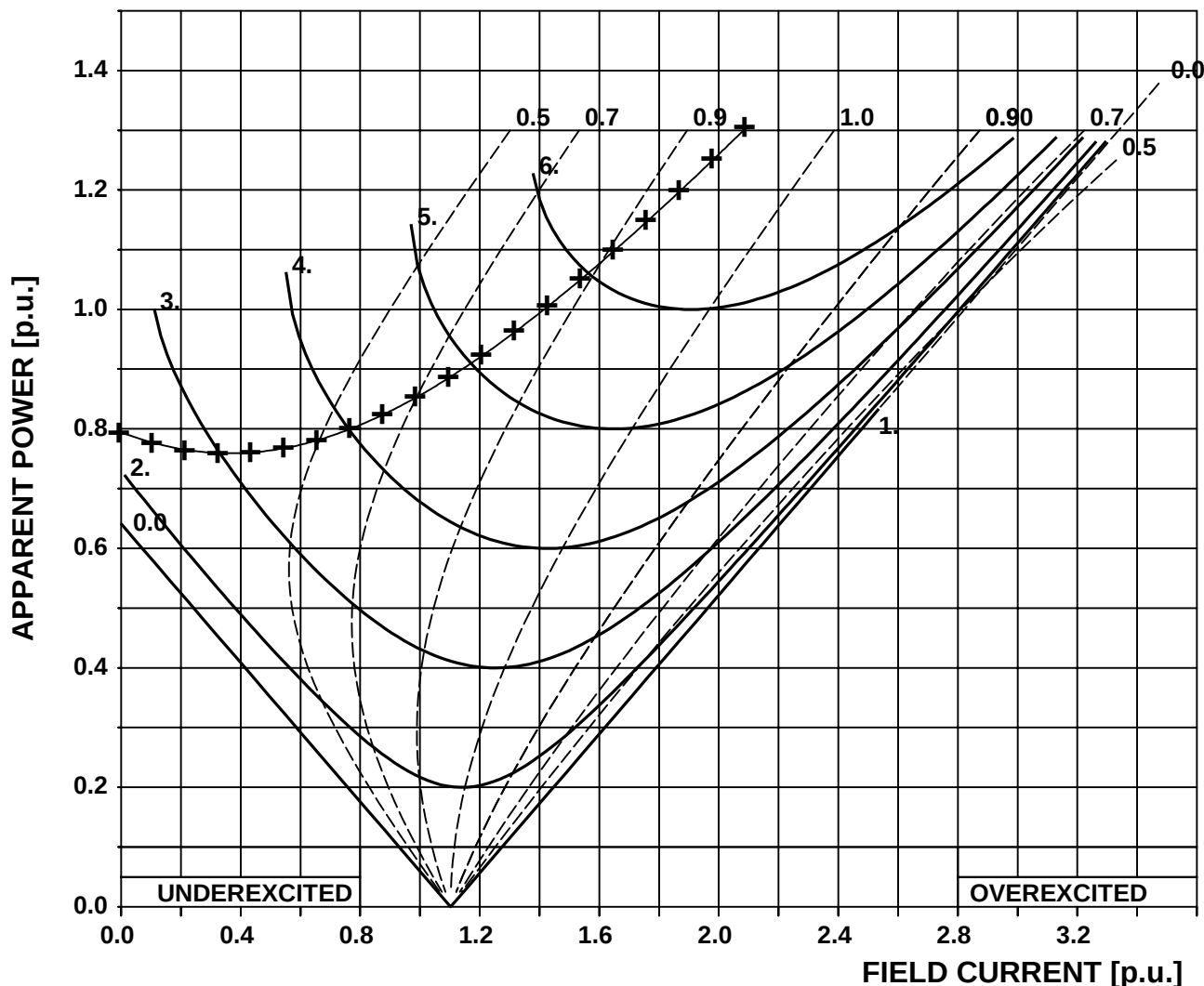
ARMATURE VOLTAGE 1 p.u. = 13800 V
ARMATURE CURRENT 1 p.u. = 850 A
FIELD CURRENT 1 p.u. = 173 A

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V-CURVES

AMS 1000LL 20326 kVA 60 Hz 0.90 PF 13800 V 850 A 1800 rpm



1. ACTIVE OUTPUT [p.u.] = 0.00
2. ACTIVE OUTPUT [p.u.] = 0.20
3. ACTIVE OUTPUT [p.u.] = 0.40
4. ACTIVE OUTPUT [p.u.] = 0.60
5. ACTIVE OUTPUT [p.u.] = 0.80
6. ACTIVE OUTPUT [p.u.] = 1.00

GENERATOR OUTPUT 1 p.u. = 20326 kVA
FIELD CURRENT 1 p.u. = 173 A

+++ PRACTICAL STABILITY LIMIT
--- POWER FACTOR
— ACTIVE OUTPUT

NOTE: $\frac{P}{P_N} = 1$ IS EQUAL TO p.u. = 0.90
 P_N = Nominal active output

ISSUED	0
DESCRIZIONE DESCRIPTION	REV.

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N. SOK6621835 / 4	TAV-SH 5/6	



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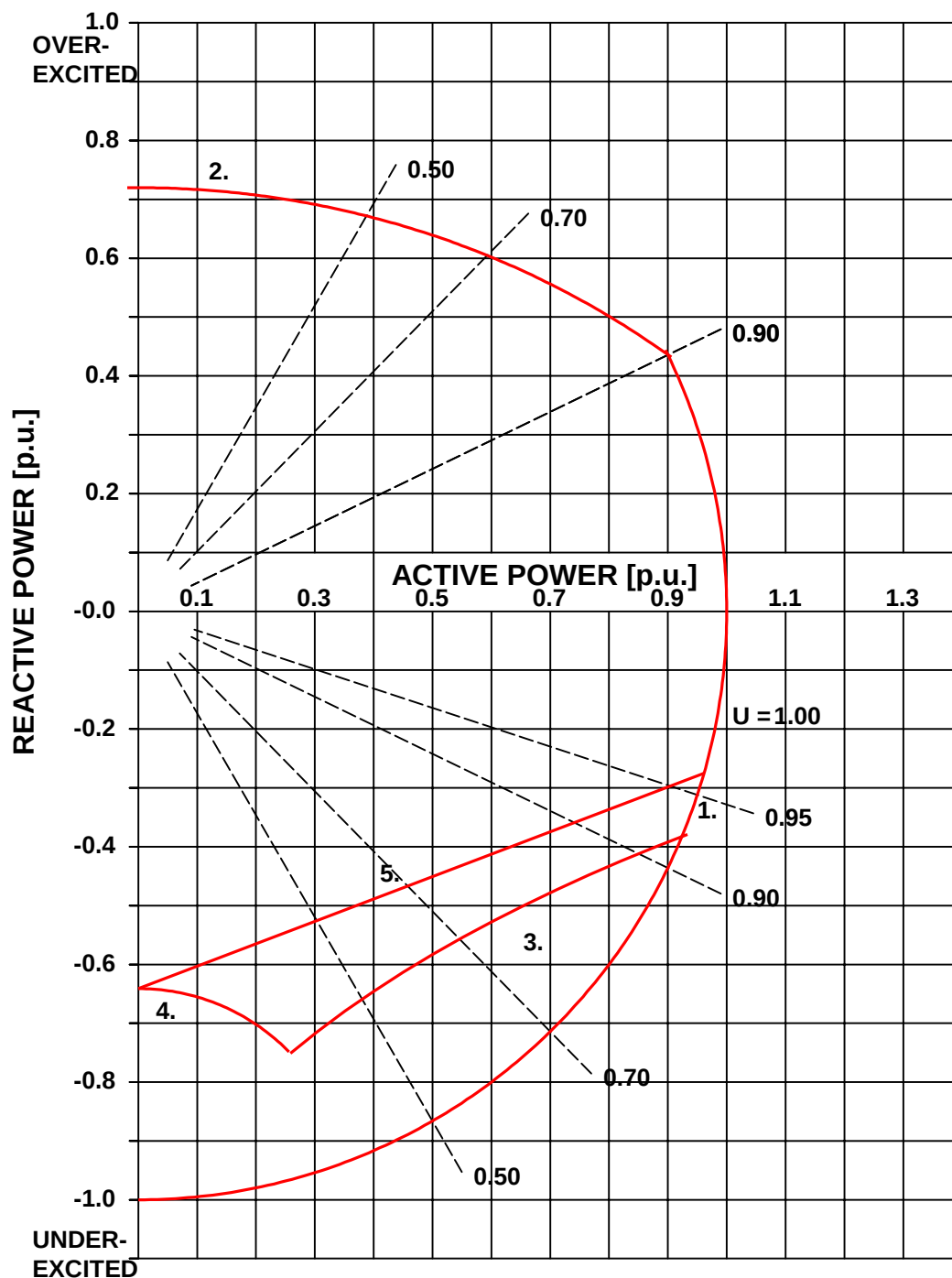
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CAPABILITY DIAGRAM AT COOLING AIR TEMPERATURE OF 41.0°C

AMS 1000LL 20326 kVA 60 Hz 0.90 PF 13800 V 850 A 1800 rpm



BASE APPARENT POWER 1 p.u. = 20326 kVA

- 1. STATOR HEATING LIMIT
- 2. ROTOR HEATING LIMIT
- 3. PRACTICAL STABILITY LIMIT
- 4. ZERO FIELD-CURRENT LIMIT
- 5. CORE END HEATING LIMIT

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DESCRIZIONE DESCRIPTION	REV.

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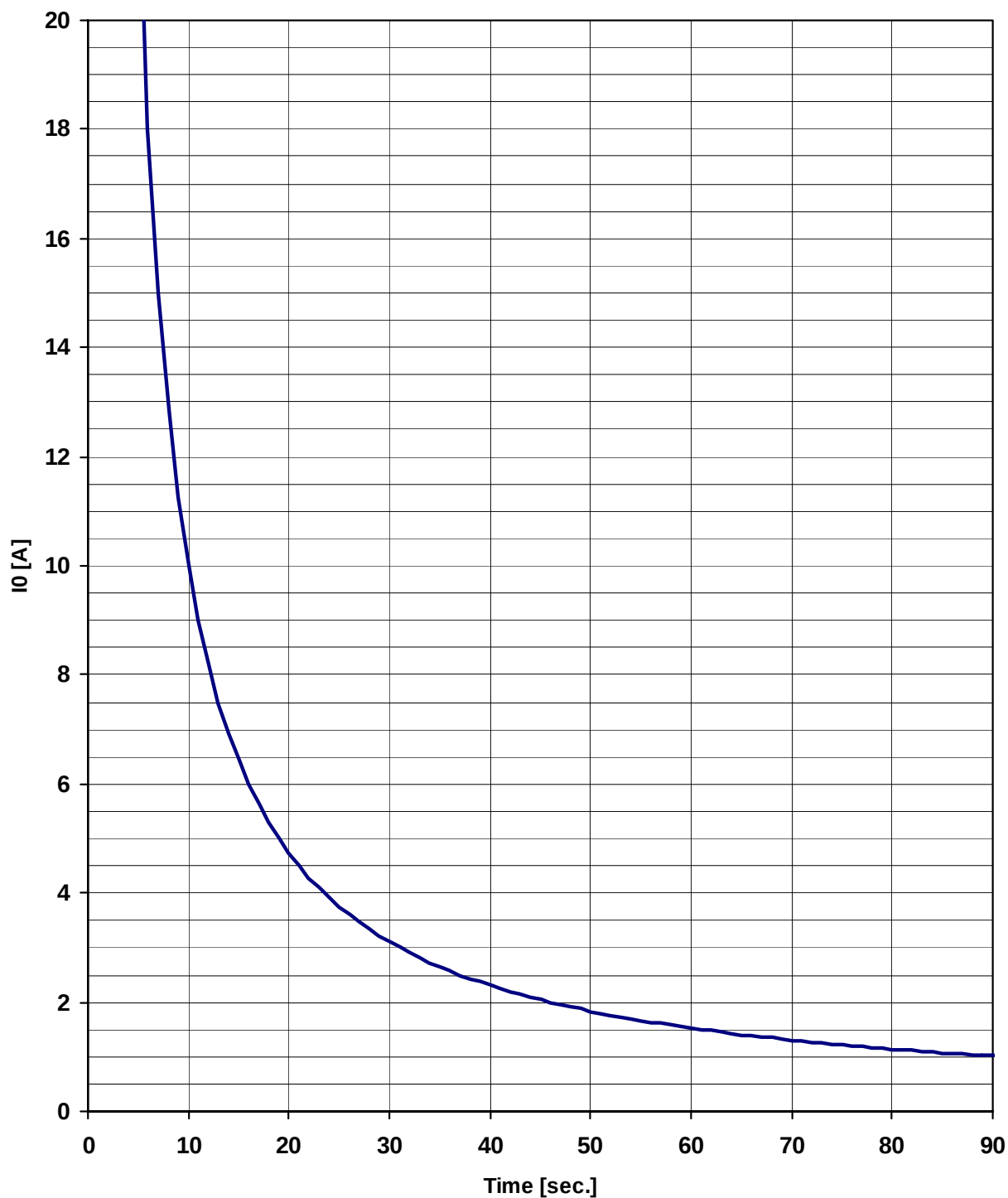
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ZERO SEQUENCE CURRENT CAPABILITY CURVE

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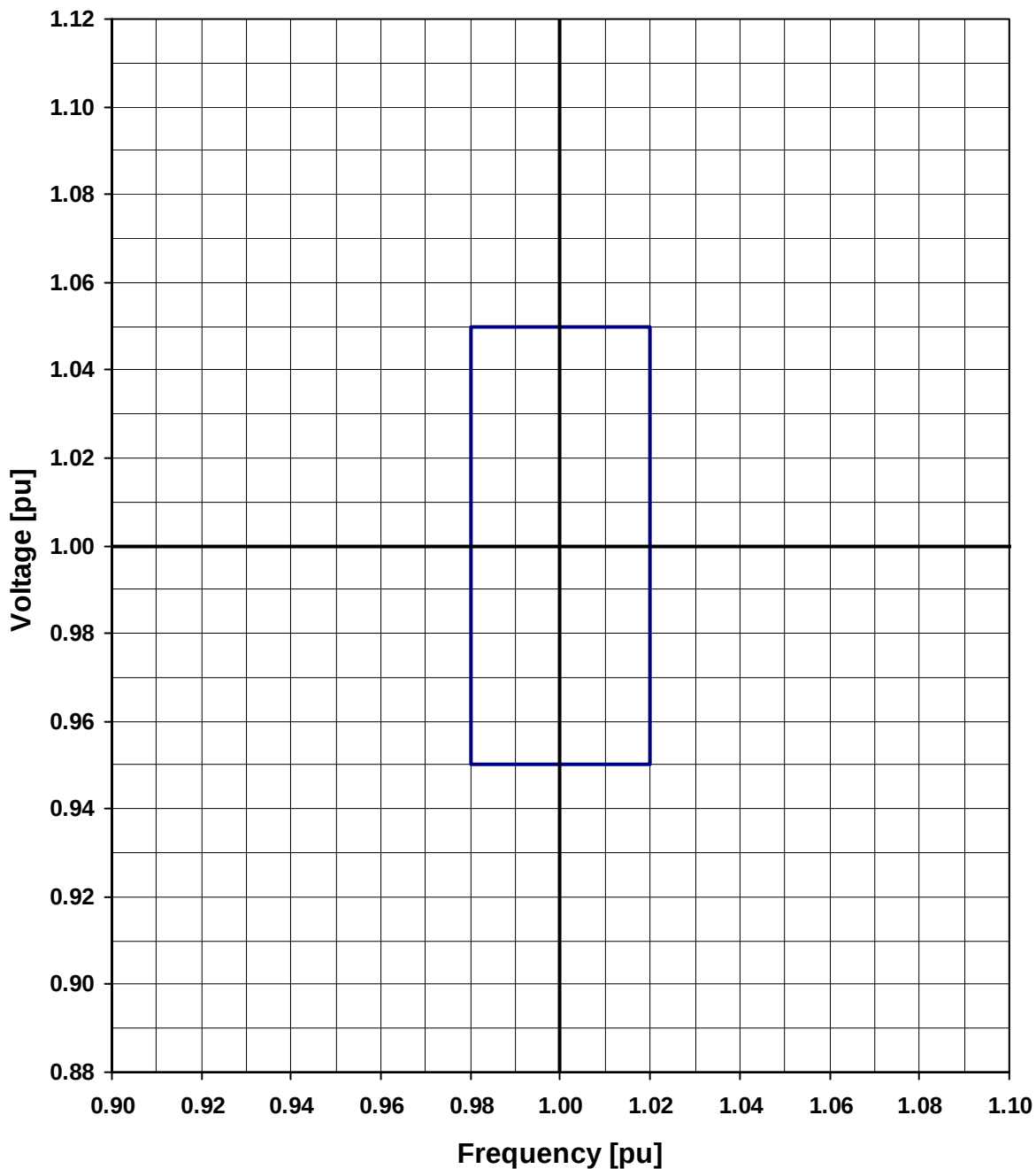


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		FIRENZE			

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ALLOWED VOLTAGE AND FREQUENCY VARIATIONS DURING OPERATION

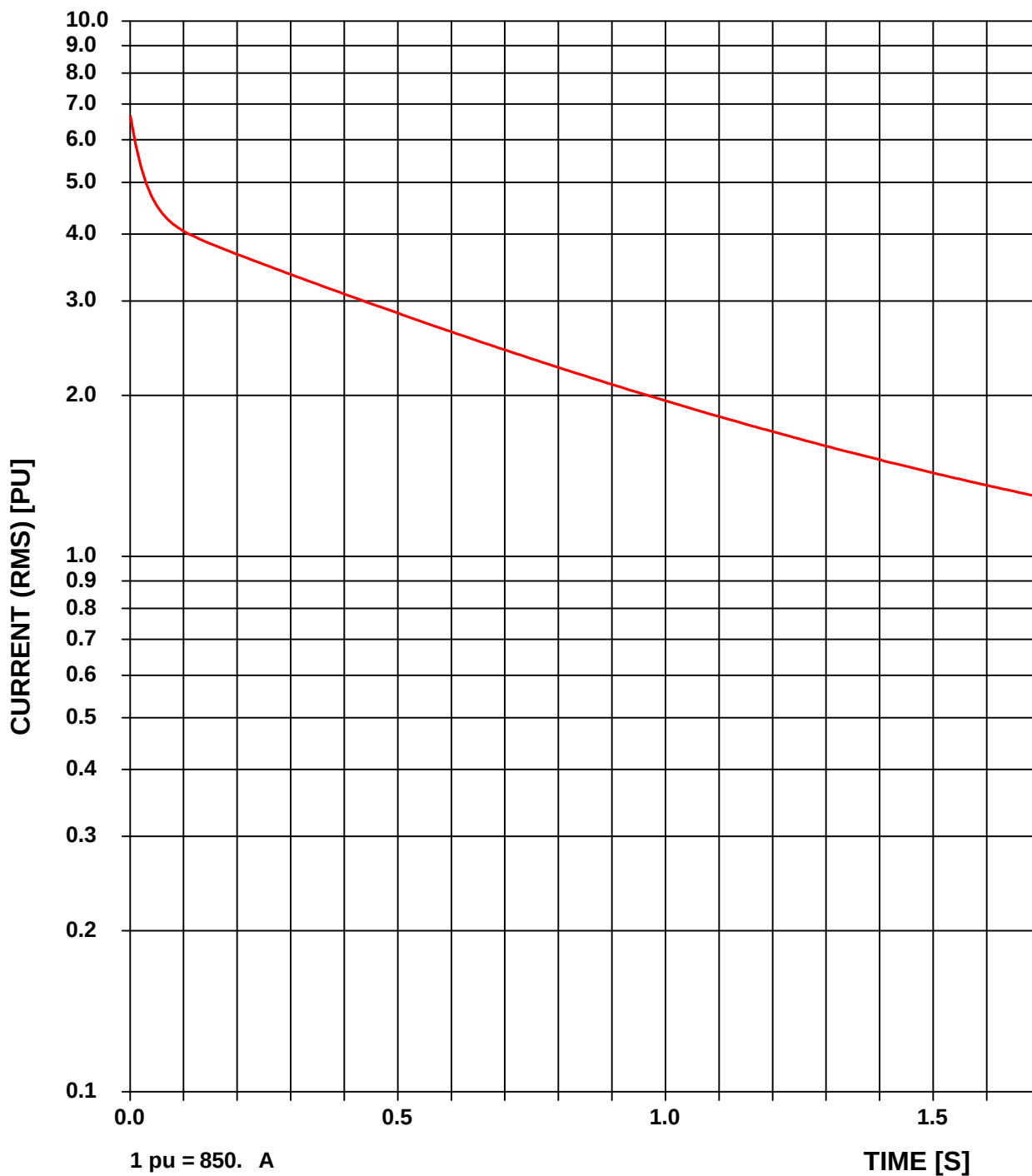
AMS 1000LL 20326 kVA 60 Hz 0.90 PF 13800 V 850 A 1800 rpm



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DECREMENT CURVE 3-PH. SHORT CIRCUIT

AMS 1000LL 20326 kVA 60 Hz 0.90 PF 13800 V 850 A 1800 rpm



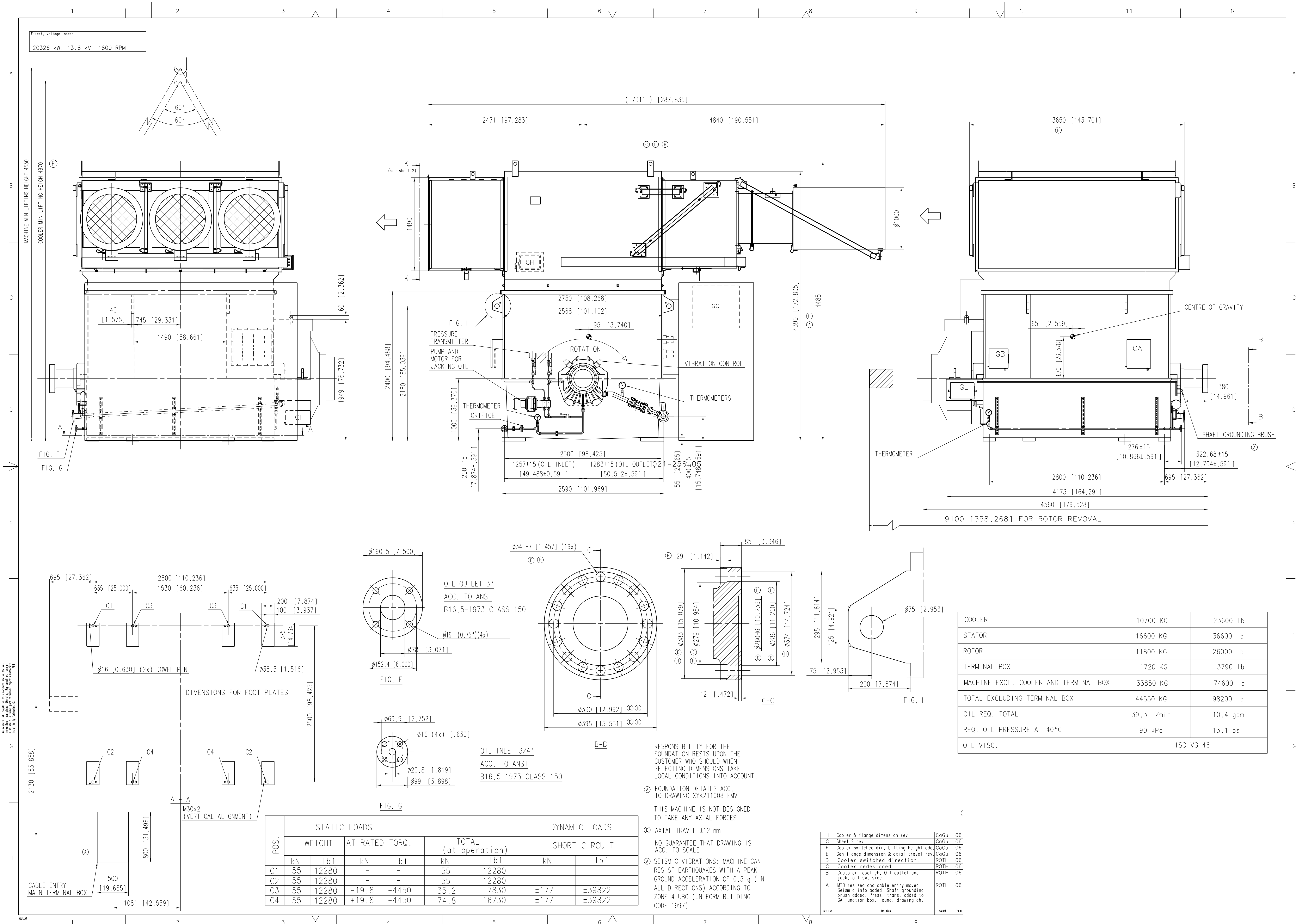
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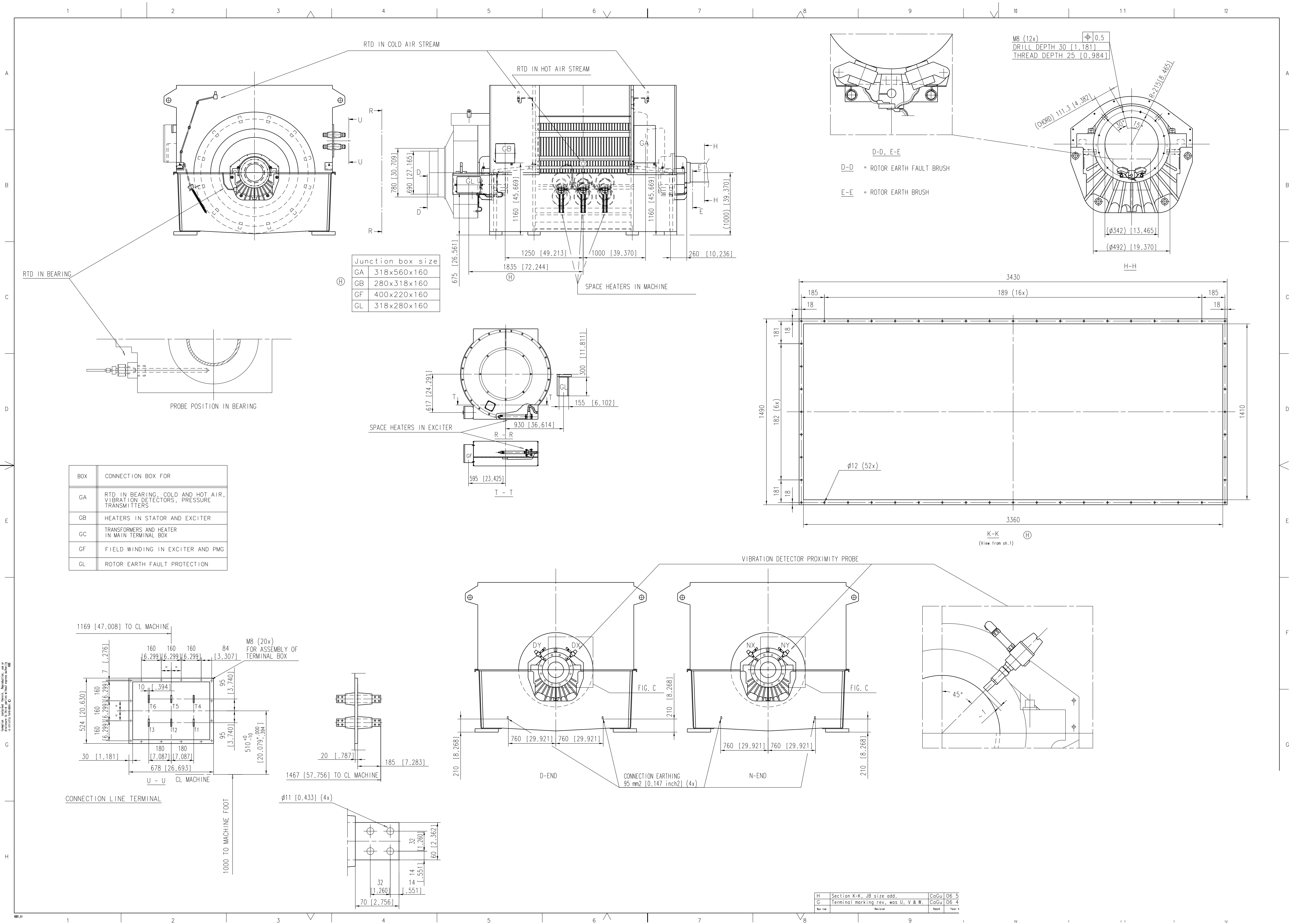
REVISION

Rev. ind.	Page (P) Chapt.(C)	Description	Date Dept./Init.
A	P 1,2,6-9	Added five graphs, page 1 and 6-9 plus added two efficiencies to page 2.	2006-02-13 MKE / T.H.
B	P 2, 6	Changed nominal temp to 41 °C	2006-02-24 MKE / T.H.

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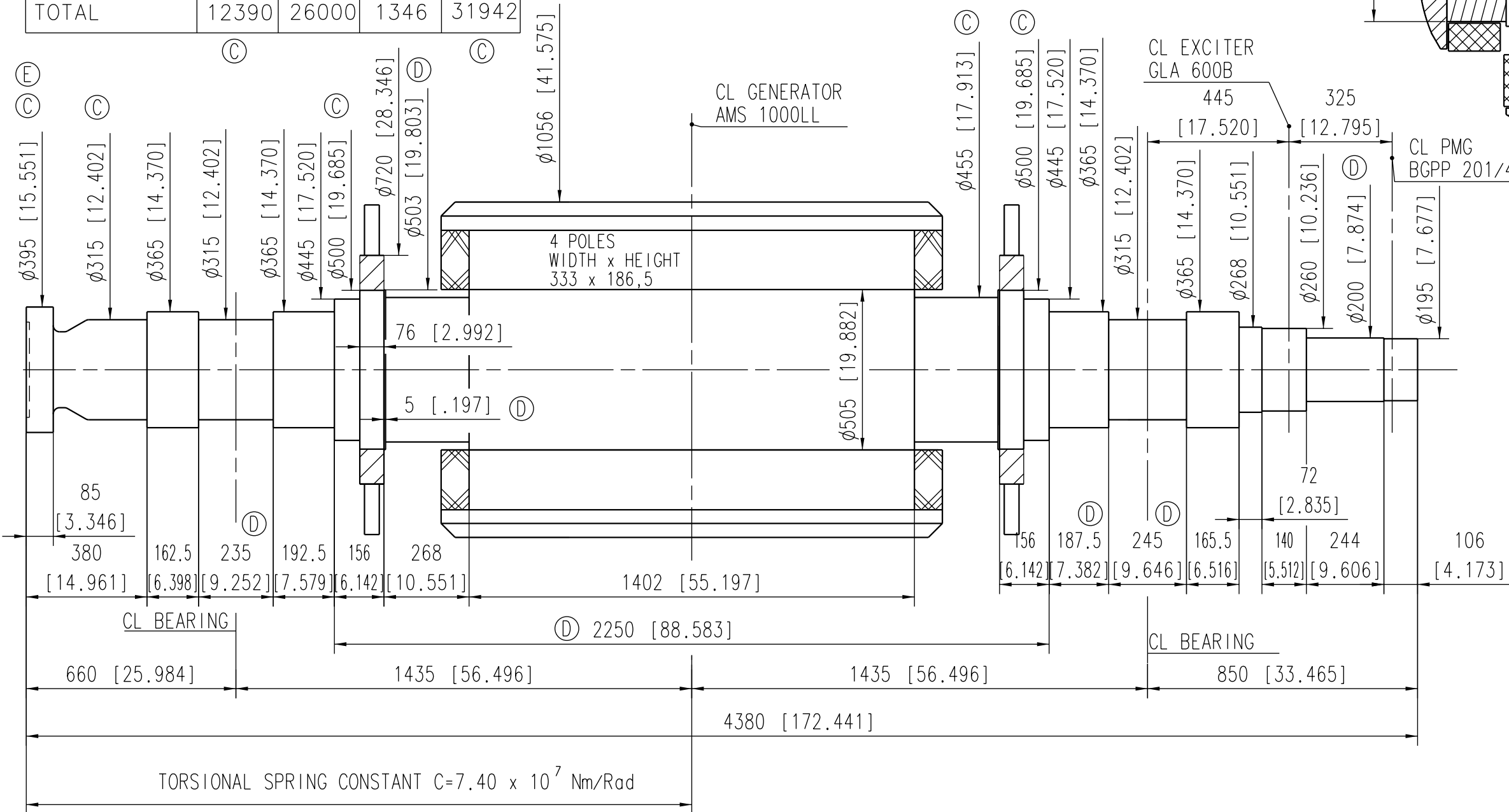


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AMS	Weight		WR ²	
	Kg	lb	Kgm ²	lb ft ²
ROTOR	11880	26190	1297	30779
EXCITER/RECT.	450	992	46	1092
PMG	60	132	3	71
TOTAL	12390	26000	1346	31942

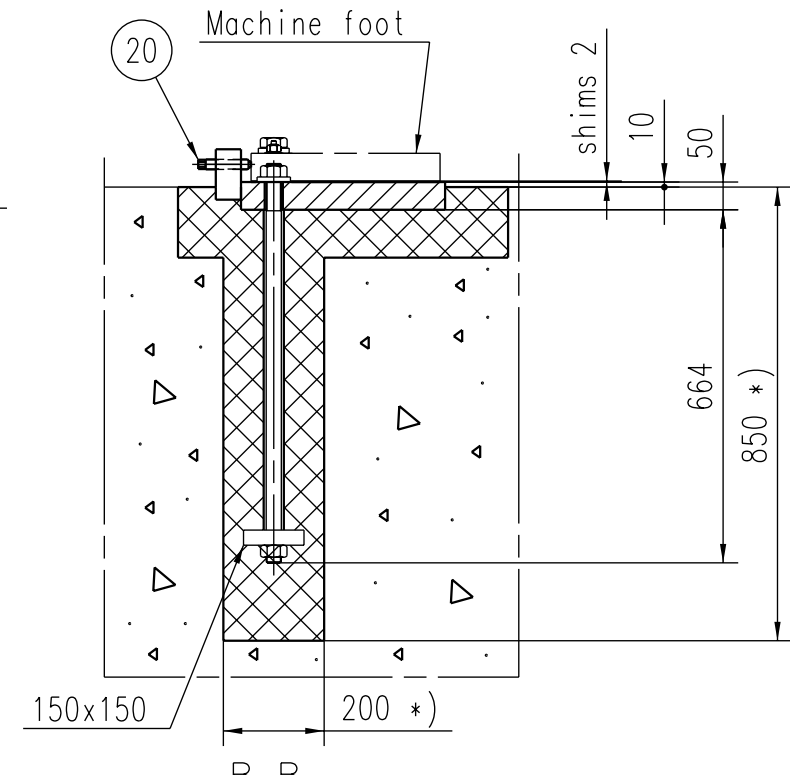
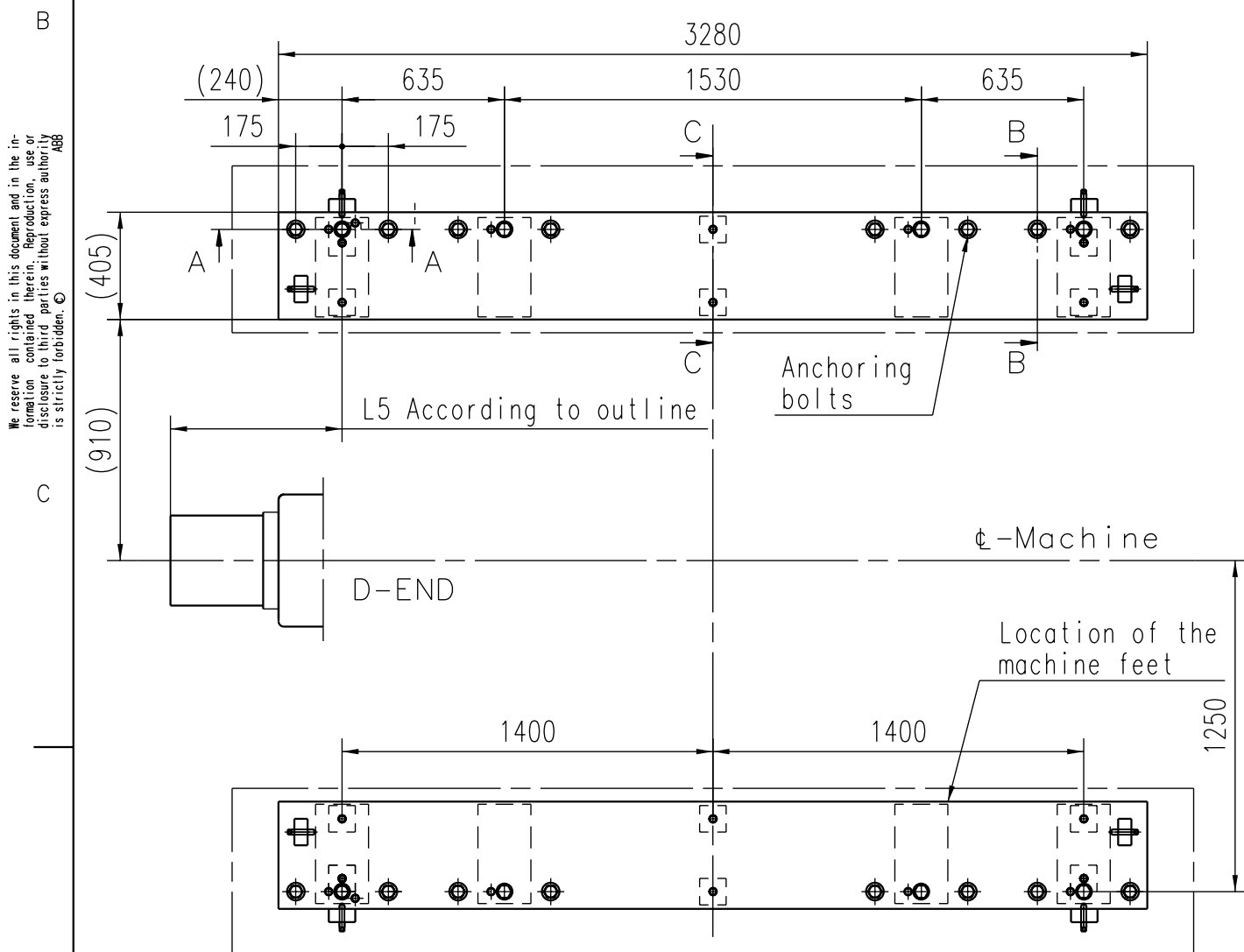
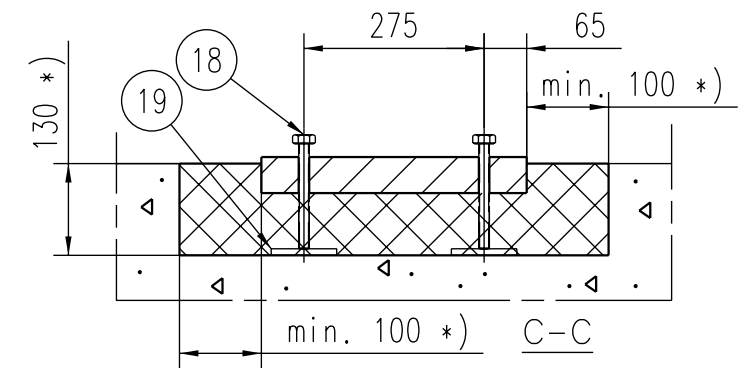
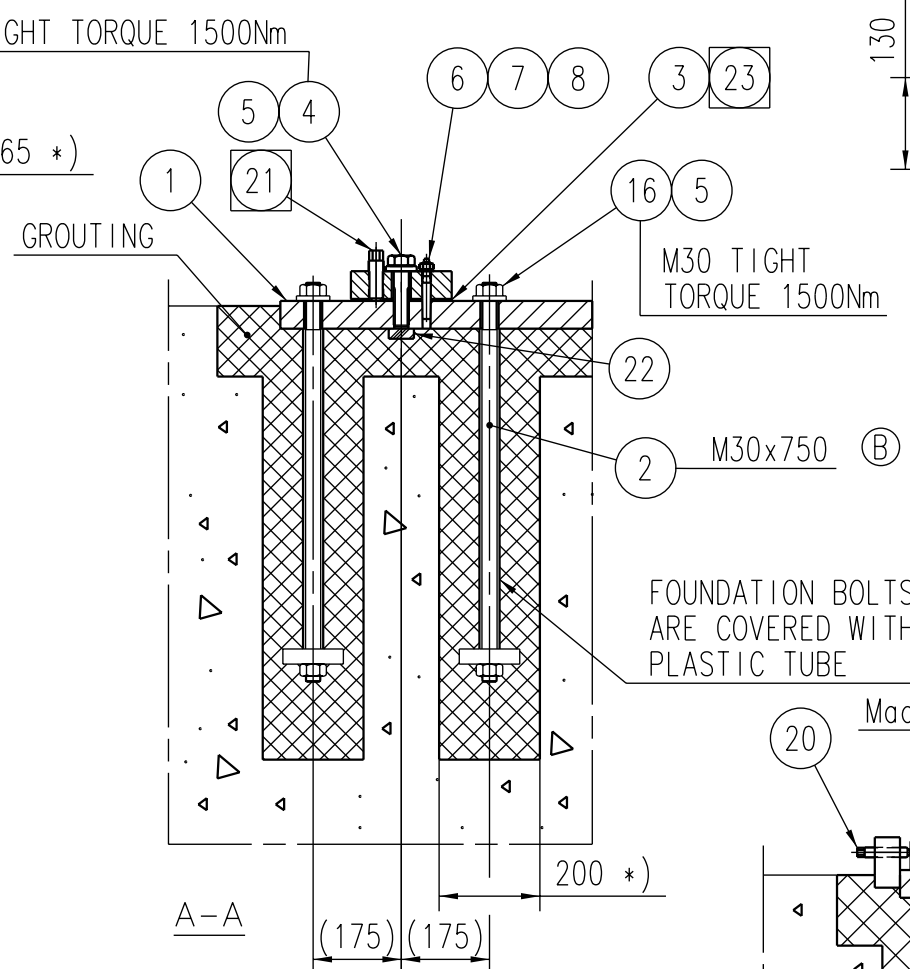
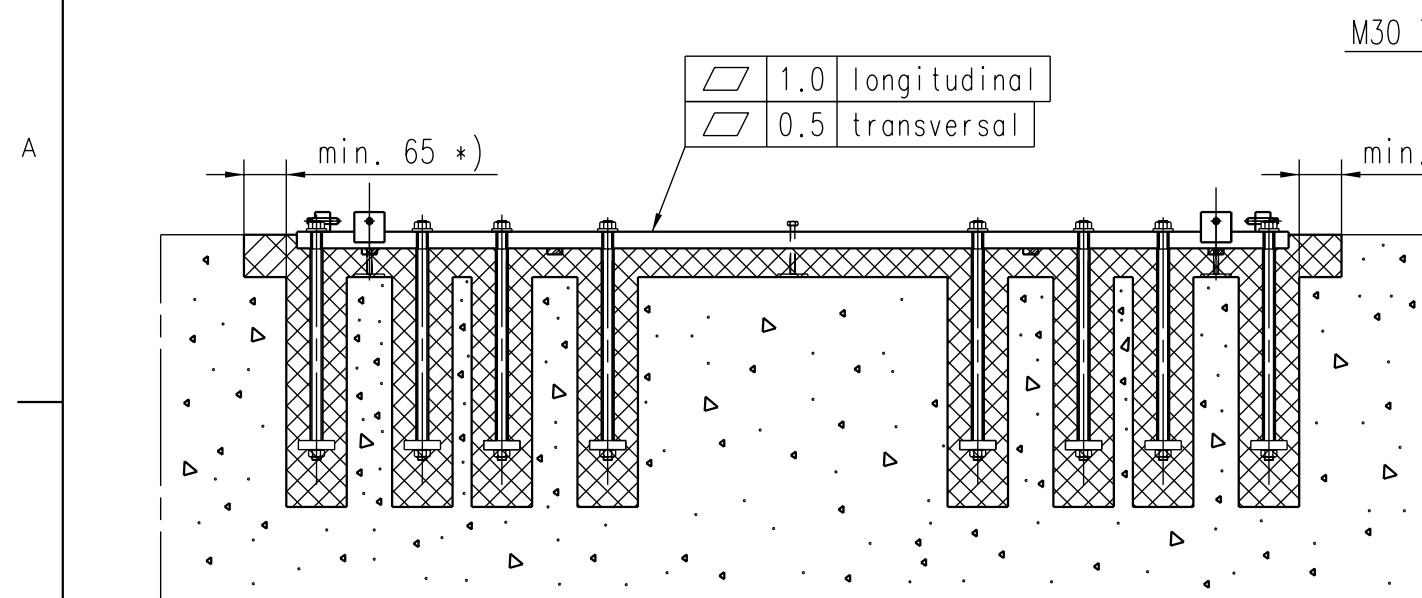
ROTOR BODY MATERIAL 2 2244-05 (ABB STD).
(EQUIVALENT TO ASTM A304-79, GRADE 4140-H)

Yield Strength: min 460 N/mm
Tensile Strength: min 690 N/mm



E	Flange dimension rev.	CaGu	06 51
D	Dimension rev.	CaGu	06 33
C	Dimension rev.	CaGu	06 33
B	Customer label changed.	RoTh	06 10
A	Customer label add.	RoTh	06 09
Rev Ind	Revision	Appd	Year Week

For grouting with soleplate separate from machine



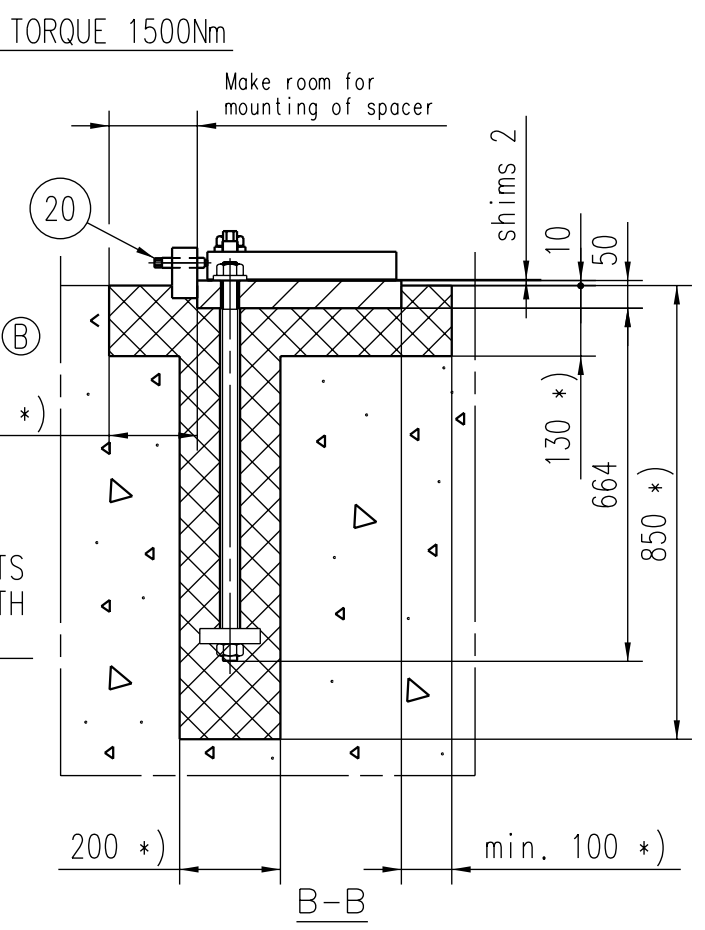
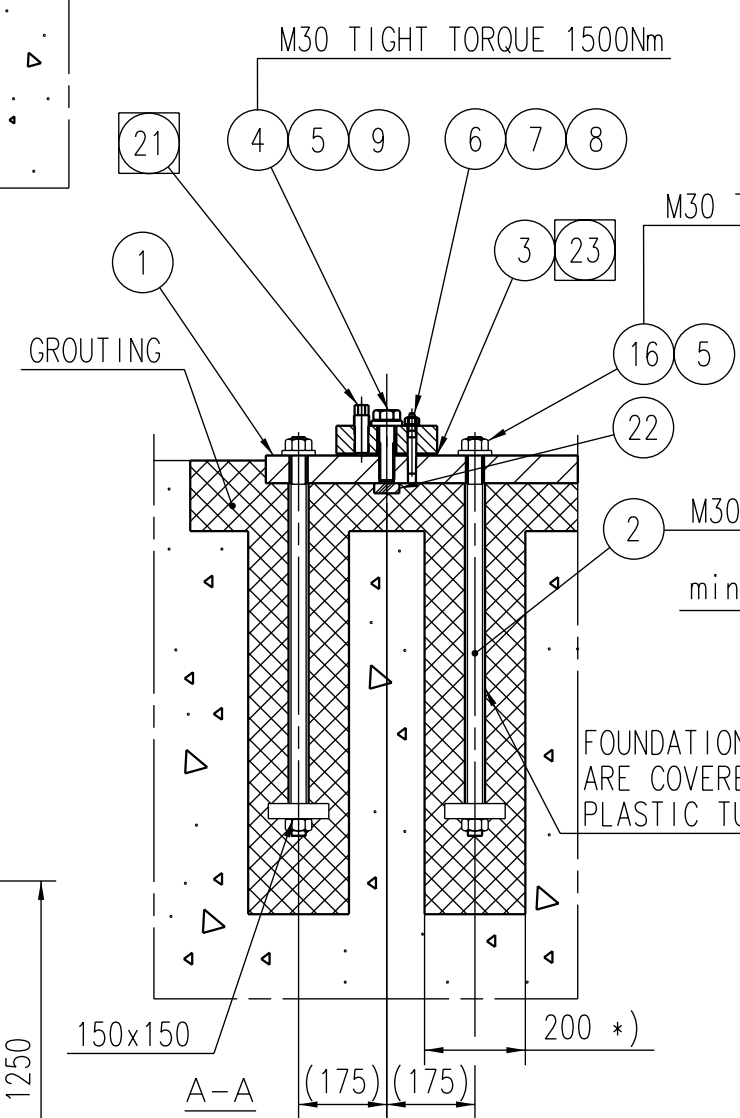
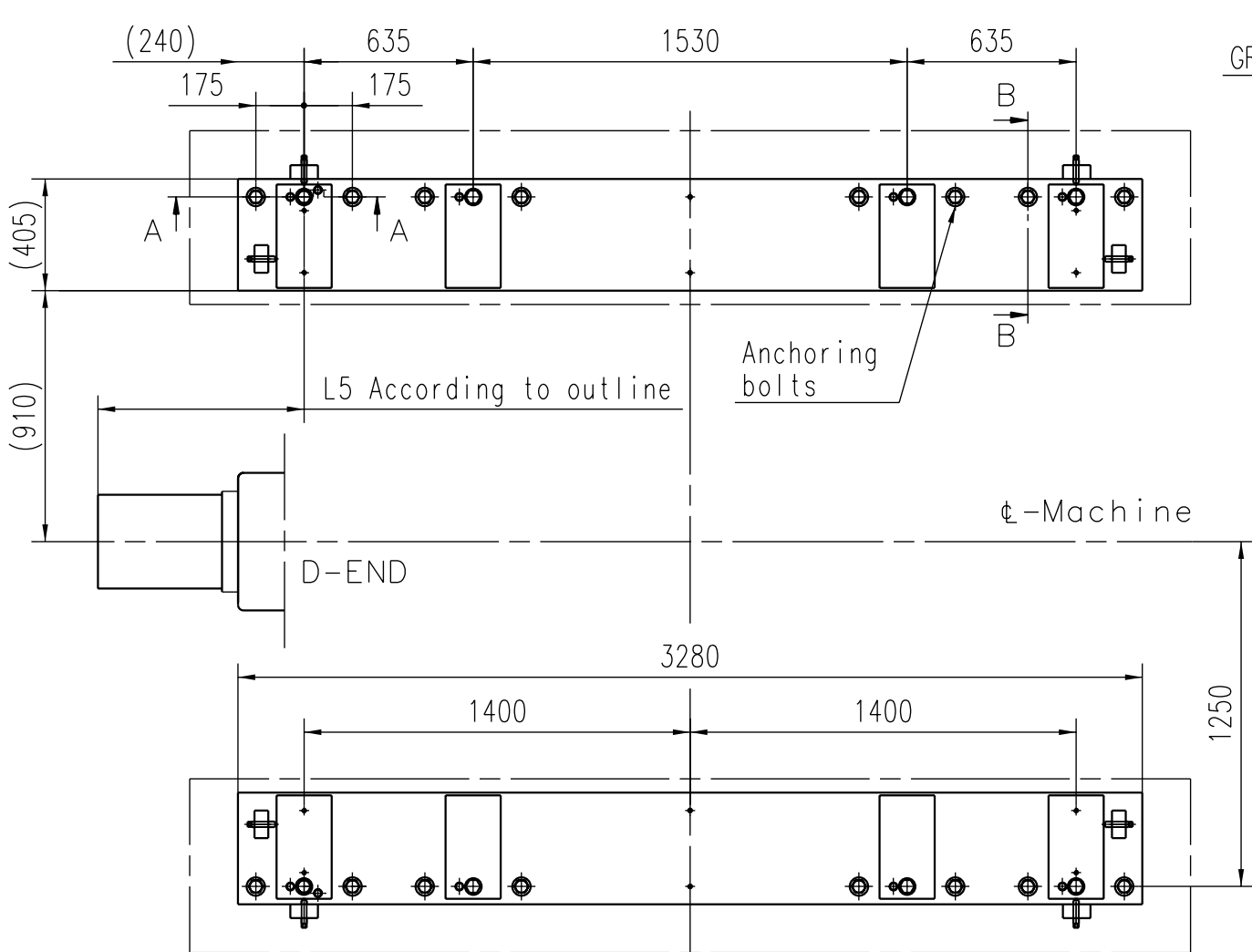
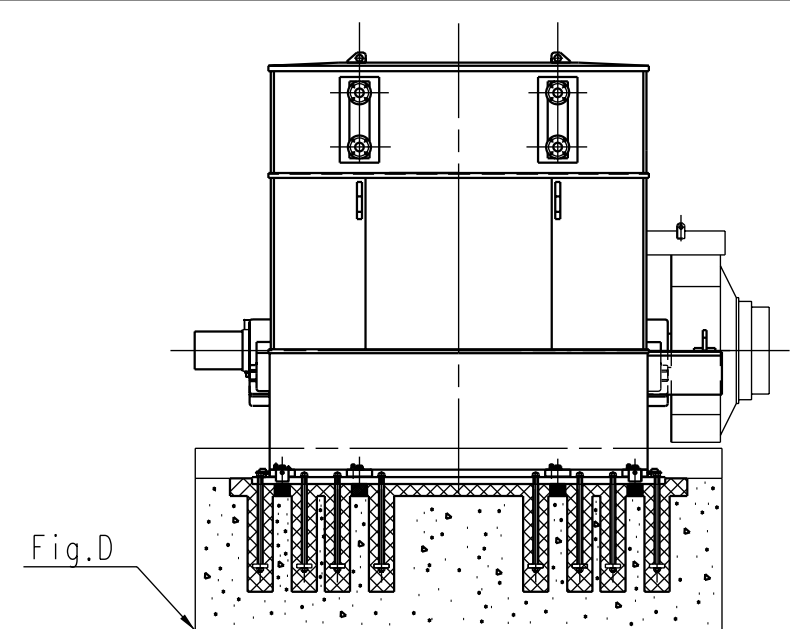
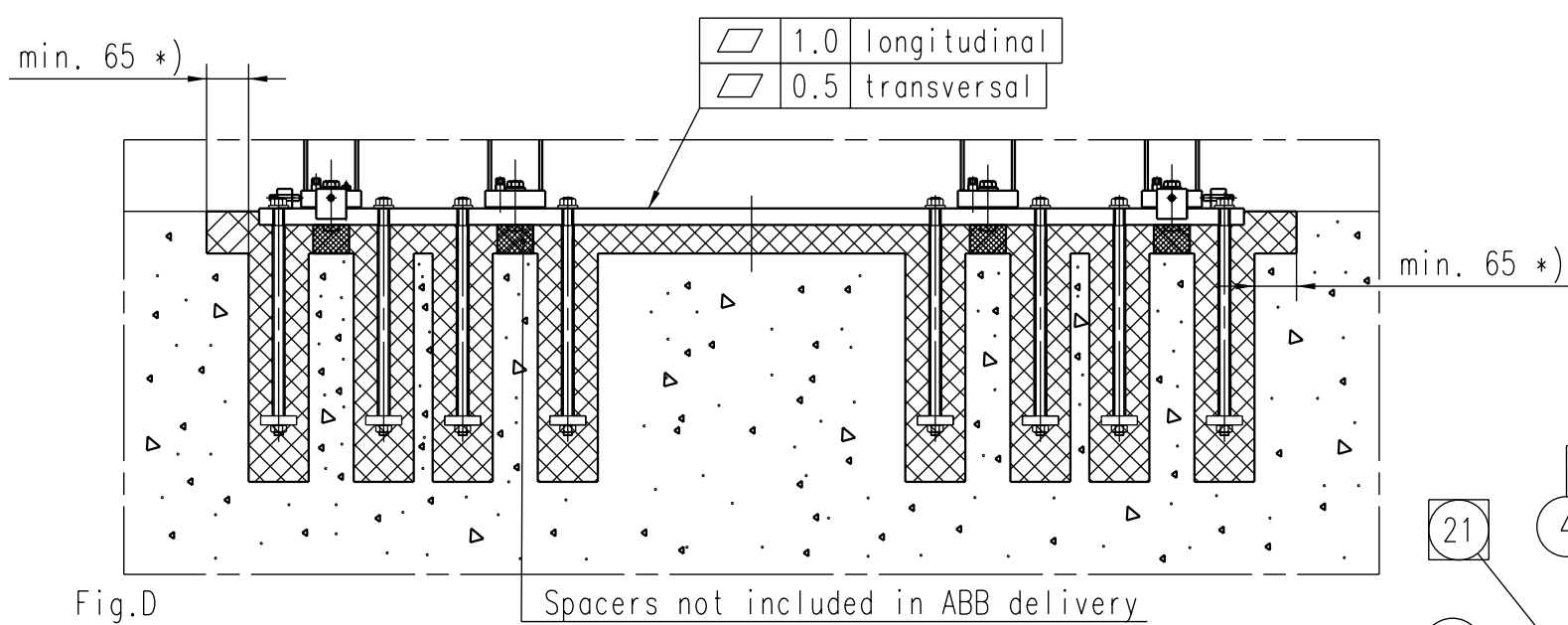
The dimensions on this drawing are intended for customizing the foundation. Bill of material will be sent with shipping information.

GROUTING INSTRUCTIONS; 3BSM 007280

- *) Consideration must be taken to type of grouting compound.

RESPONSIBILITY FOR THE FOUNDATION RESTS
UPON THE CUSTOMER WHO SHOULD, WHEN SELECTING
DIMENSIONS, TAKE LOCAL CONDITION INTO ACCOUNT

For grouting with machine mounted on soleplate



The dimensions on this drawing are intended for customizing the foundation. Bill of material are sent with shipping information.

GROUTING INSTRUCTIONS; 3BSM 007280

RESPONSIBILITY FOR THE FOUNDATION RESTS UPON THE CUSTOMER WHO SHOULD, WHEN SELECTING DIMENSIONS, TAKE LOCAL CONDITION INTO ACCOUNT

*) Consideration must be taken to type of grouting compound.

Effect, voltage, speed	Size
20326 kVA, 13.8 kV, 1800 RPM	4000

LOCATION OF AUXILIARY BOXES ACC. TO:
"GENERATOR GENERAL ARRANGEMENT" XYK 210 004-EMV (SOK4413580)

Item	Qty	Article No.	Type	Data	Name	Note
1	1	XYK 211 862-EMV			Junction box GA	
2	1	XYK 211 865-EMV			Junction box GB	
3	1	XYK 211 868-EMV			Junction box GF	
4	1	XYK 211 871-EMV			Junction box GL	
6	130	2663 107-1	UK 5-MTK-P/P	0.2-4 mm2, AWG 24-12	Terminal block GA	
7	16	2663 107-2	UK 10 N	0.2-10 mm2, AWG 24-6	Terminal block GB	
8	15	2663 107-2	UK 10 N	0.2-10 mm2, AWG 24-6	Terminal block GF	
9	9	9ABA 100037-1	UK 4-TG	0.2-4 mm2	Terminal block GL	
10	4	3BSM 005942-1			Proximity sensor	
11	2	5347 066-34			Auxiliary contact	
12	9	2672 063-7	PR 22.5	D=12.5-15	Cable gland	
13	1	5347 066-33			Mini circuit breaker	
14	1	3BSM 001857-1		110-220/55V 5VA	Current transformer	
15	1	4984 229-5		4mF 750VDC	Capacitor	
16	3			0.015mF 630VDC	Capacitor	

Rem: Acc. to supplier, ELFA 65-456-44

