SOGO fine-TD THERMAL DEMAGNETIZER

The smallest magnetic noise field produced by heater-currents Thermal Demagnetizer!

General description

Thermal demagnetization is one of major lab measurements to recognize and remove secondary magnetization, and is routinely performed in paleomagnetic laboratories using thermal demagnetizers to heat specimens to specified temperature and then cool them in a low magnetic field environment. Most commercial available thermal demagnetizers are made with a temperature-controlled electric furnace and Permalloy shield assembly. Direct-current (DC) magnetic fields are attenuated by the shield assembly so that the instrument can be operated in a laboratory environment. It is vitally important to ensure that there are not only no DC but also no alternating current (AC) magnetic stray fields operating over the specimens during thermal demagnetization, especially during the cooling procedure as the specimens would acquire a spurious moment proportional to and in the direction of the stray fields. AC magnetic stray fields are possible cause serious spurious high-temperature weak-field isothermal remanence (TIRM) and high-temperature anhysteretic remanent magnetization (TARM) in paleomagnetism and paleointensity experiments (Zheng *et al*. 2010).

Sogo fine-TD Thermal Demagnetizer is designed with special attention to minimize the magnetic noise emanating from heater-currents. A new technique was developed to shorten the safety distance between oppositely coiled cable-type wires to a minimum (about 5 mm) and successfully minimized the noise field to 200nT per Ampere in central oven chamber position.

The Sogo fine-TD thermal demagnetizer has a single tube chamber in which the samples are heated and cooled. The tube oven is enclosed in a two-layer Permalloy shield and the residual field inside the oven is normally less than 30nT, it is not necessary to align the instrument along an E/W

axis. The oven chamber is 900 mm in length with a diameter of 50-75 mm. It can hold up to 10 specimens for paleointensity study, and 30 specimens for paleomagnetic directional study. The furnace is made by carefully selected non-metallic materials. The temperature controller is microprocessor based PID type one which is tuned to minimize temperature overshoot during heating and maximize temperature stability at the setpoint. The temperature control and reproducibility are both less than 1ºC. This oven can allow the acquisition of thermal remanent magnetization (TRM) in any applied field direction with field intensities up to 1000 μT. The magnetic shield of the oven is also specially designed so that any stray fields trapped inside the oven can be easily demagnetized by alternating-field (AF) attachment coils. Sogo fine-TD consumes maximum power about 2.4 KVA.

Specifications

AC magnetic field emanating from heater current : ~200nT/Ampere	
Absolute Temp. Accuracy	<1。C
Temp. Repeatability	<1°C
Max. Temp. Gradient:	Less than 5% Over Sample Region of Oven Chamber.
DC field in Heating & Cooling Chambe	Less Than 30nT, typical 10nT.
Heating Time:	From 25°C to 600°C in 50 Minutes
Cooling Time:	From 600°C to 30°C in 30 Minutes
Maximum Samples in a Single Batch Treatment: 30	
Cooling of Furnace	Water Cooling System by A Copper Jacket
Temperature Controller:	Multi-temperature Controller with PID Levels, 2 Pattern, 200-230 V, 15 A
Magnetic Shield	2-Layer Supermalloy (Ni80Mo5, Thickness 1mm, Φ260, 280mm) with covers in Cylinder Sides)
DC Field Coil	Produce an Axial Field Approximately 700μT per Ampere of Applied Current
DC Power Supply	200-220V, 50-60 Hz
Maximum Power Consumer	2.4kVA
SIZE & Weight	
Oven Unit	250mm×250mm×900mm, 38 kg
Control Unite Unit	160mm×260mm×350mm, 4 kg
Wooden Stand	200mm×300mm×1400mm, 8 kg
Highlight Characters:	(1) Very Small AC Magnetic Noise Field produced by Heater Current. (2)High Temperature Accuracy and Repeatability. (3) Furnace is made by Carefully Selected Non-magnetic Materials. (4) Magnetic Shield Are Designed to Be Easily Demagnetized by An Attachment AF coil .

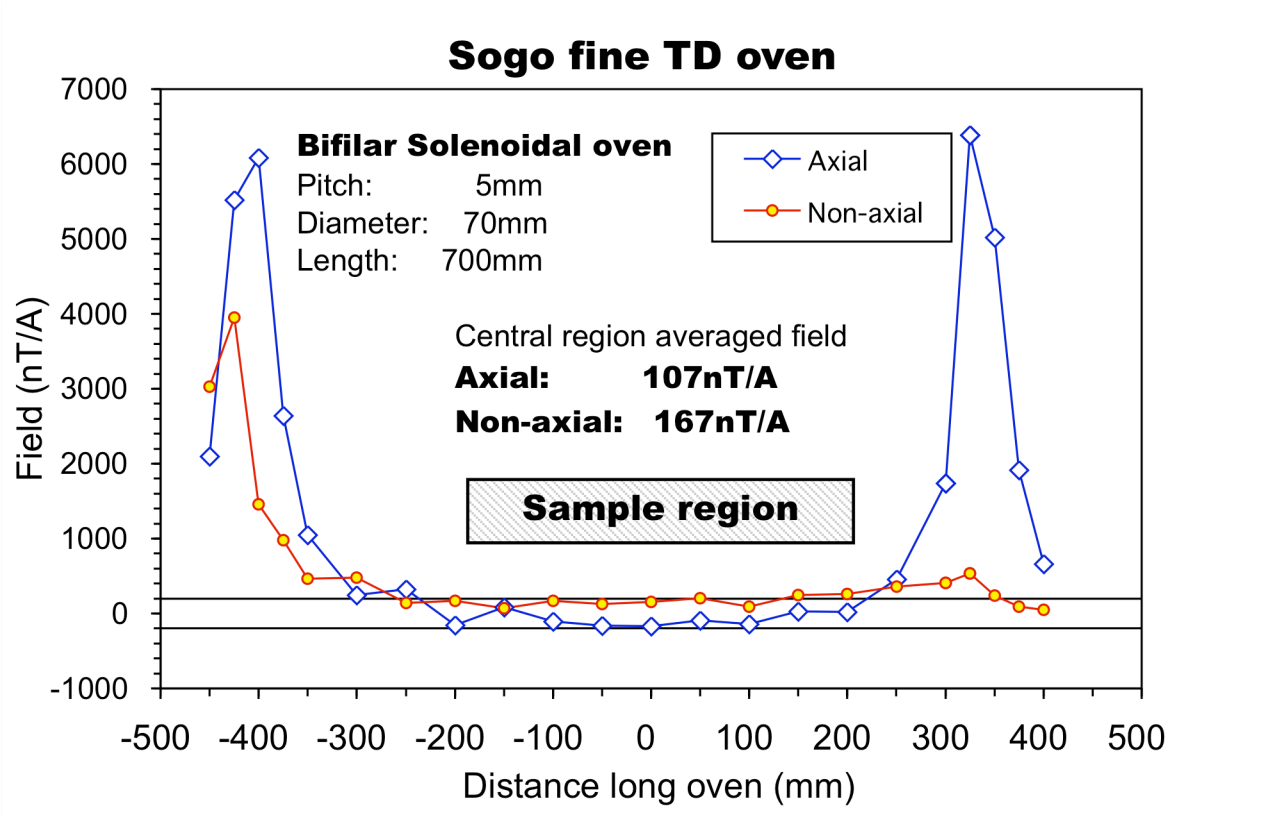

Figure1. Graph of field along central axis of oven generated by passing direct current through the heater winding. In the sample region an average value of axial component to be 107 nT/A and no-axial component to be 167 nT/A.

Table1. Magnetic Field due to Furnace Currents Inside Thermal Demagnetizers Measured at Central Sample Position[a]

	Sogo fine-TD (nT)			Natsuhara, JP (nT)			ASCTD48, USA[c] (nT)			MMTD80, UK (nT)		
Current[b](A)	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
0.00	8	7	14	7	-3	8	40	30	10	-1	14	-68
0.10	24	10	36				900	80	60	0	62	16
0.20	42	13	45				1700	190	40	3	115	80
0.30	64	16	63	820	270	510	2280	280	40	7	169	148
0.40	76	16	79	1060	360	640	2950	390	20	9	223	218
0.50	91	22	94	1310	460	790	3590	480	20	11	276	289
0.60	112	29	112	1540	550	910	4580	580	20	13	330	360
0.70	128	32	130				6230	730	150	14	384	434
0.80	146	35	143				7350	890	270	18	437	504
0.90	164	38	164							20	491	573
1.00	183	41	179							22	545	643
10	**2.4μT[e]**			**32μT[e]**			**72μT[e]**			**8.9μT[e]**		

[a]X:Axial, Y: Horizontal, Z: Vertical

[b]A direct current was applied to the heating elements. The generated field was measured near the central sample position by a tri-axial fluxgate magnetometer. A corrigendum on MMTD80 oven and an aditional verification on Sogo fine-TD oven was performed and the original data were updated.

[c]Between the three sets of heater elements of the ASCTD48, only the middle one (longest heater) was given electric currents.

[e]Extrapolated.

Reference

Zheng, Z., X. Zhao, and C. Horng (2010), A new high-precision furnace for paleomagnetic and paleointensity studies: Minimizing magnetic noise generated by heater currents inside traditional thermal demagnetizers, *Geochem. Geophys. Geosyst.,* **11**, Q04Y08, doi:10.1029/2010GC003100.

Zheng, Z., X. Zhao, and C. Horng (2010), Reply to comment by John Shaw on “A new high-precision furnace for paleomagnetic and paleointensity studies: Minimizing magnetic noise generated by heater currents inside traditional thermal demagnetizers”, *Geochem. Geophys. Geosyst.*, **11**, Q11Y12, doi:10.1029/2010GC003295.

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