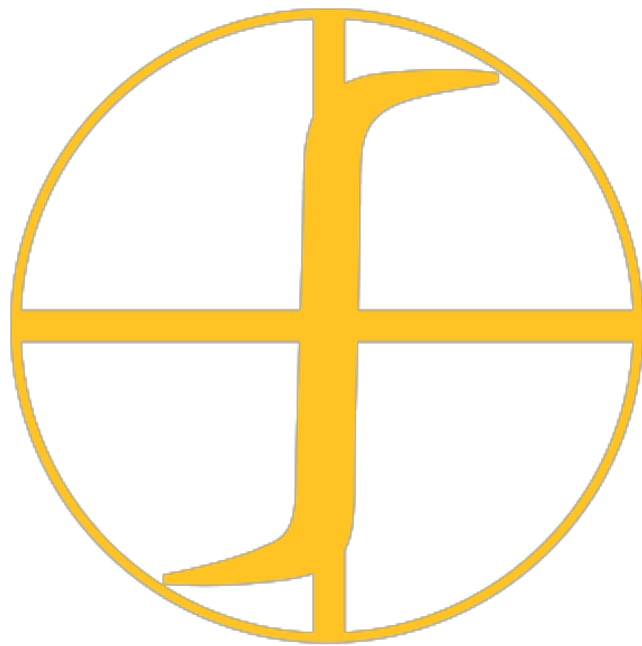




Advanced Induction Materials and Technology

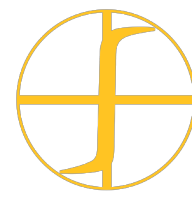


O n l i n e I n d u c t i o n H e a t i n g C o u r s e

0. Introduction

Basics of Induction Technique and
Magnetic Flux Control

by. Dr. Valentin Nemkov

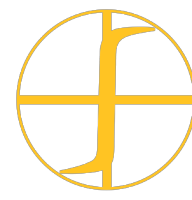


O n l i n e I n d u c t i o n H e a t i n g C o u r s e

Course Contents

INTRODUCTION

- Ia. BASIC OF INDUCTION TECHNIQUE - PART 1
- Ib. BASIC OF INDUCTION TECHNIQUE - PART 2
- II. INDUCTION INSTALLATIONS
- III. INDUCTION COIL STYLES
- IV. COMPUTER SIMULATION
- V. MAGNETIC FLUX CONTROL
- VI. APPLYING FLUXTROL TO INDUCTION COILS
- VII. CASE STORIES
- VIII. HISTORICAL OVERVIEW
- GLOSSARY



O n l i n e I n d u c t i o n H e a t i n g C o u r s e

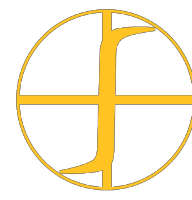
Introduction

This Training Course is developed for people with different technical levels (technology users, designers, coil manufacturers, businessmen etc.) for better understanding of:

- How induction heating works
- Equipment used for induction heating applications
- How to design optimal processes and induction coils using computer simulation
- The benefits of using magnetic flux controllers (concentrators)
- Proper material selection and fabrication
- The application of Fluxtrol controllers to induction coils
- What results have been achieved in selected applications (case stories)

It is not possible to describe in a short course all the features and numerous applications of induction heating.

The main emphasis will be placed on the theory, understanding and practice of magnetic flux control in induction heating systems.

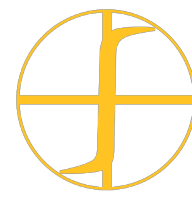


O n l i n e I n d u c t i o n H e a t i n g C o u r s e

Considerations

- Induction technique is a complicated method involving Electrical, Magnetic and Thermal phenomena
- Heating intensity and temperature distribution depend upon many factors (frequency, part size and shape, material properties, operating conditions) and may vary during the process of heating
- Magnetic Flux Controllers effect not only the induction coil performance but influence (improve) operation of the whole induction installation
- Induction technique has its own language, which the user needs to know for adequate communication with customers – see Glossary

See Glossary

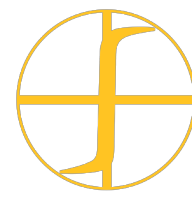


O n l i n e I n d u c t i o n H e a t i n g C o u r s e

History of Induction Heating

- Induction heating is based on fundamental works within the field of Electromagnetism and on scientific and technical contributions of a number of individuals in USA, Russia, Germany, France and other countries.
- Historical knowledge of induction heating allows the reader to see the role this unique technology has played within the industrial revolution and equipment development
- Some ideas of this pioneering period (50-70 years ago) have been implemented in practice only recently due to a new level of industrial demand, development of advanced materials, machines and control systems
- A short History Overview composed by Professor Alfred Muehlbauer (Hanover University, Germany) may be found in a separate file

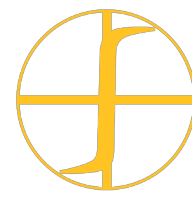
[See Historical Overview](#)



O n l i n e I n d u c t i o n H e a t i n g C o u r s e

Specific Features of Induction Heating

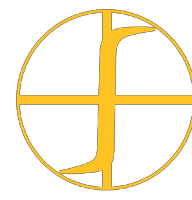
- Heat generation occurs inside the part
- Heating is contactless
- Method can provide very high power densities
- Heating may be highly selective in the depth and along the surface
- Any processing atmosphere (air, protective gas, vacuum)
- Very high temperature may be created
- Stand-by losses of equipment are very low
- Fast start-up
- Heating may be easily programmed and automated
- No contamination of treated material may be provided (important for medical material, semiconductors etc.!)
- No pollution of surrounding space



O n l i n e I n d u c t i o n H e a t i n g C o u r s e

Advantages of Induction Heating

- Short heating cycles and high production rates
- Better metallurgical results due to fast and clean heating
- Energy savings due to selectivity and high efficiency
- Good control and repeatability
- Minimal or no surface oxidation and decarburization
- Lower distortions
- Favorable for industrial environment (in-line heating, no pollution, “push button” performance)
- Some processes may not be accomplished other than by induction



O n l i n e I n d u c t i o n H e a t i n g C o u r s e

Major Applications of Induction Heating

HEATING TREATING

FORMING & FORGING

MELTING

WELDING

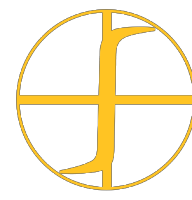
BRAZING & SOLDERING

BONDING

SHRINK-FITTING

**INDUCTIVELY COUPLED
PLASMA**

CRYSTAL GROWTH



O n l i n e I n d u c t i o n H e a t i n g C o u r s e

Latest Achievements in Induction Heating Technique

- Compact and efficient transistor power supplies with wide frequency range operation
- Intelligent control and monitoring systems
- Simultaneous dual frequency hardening
- Robotic induction installations
- Computer simulation technology and CAD of induction processes and coils
- Magnetic flux control techniques and concentrator materials

