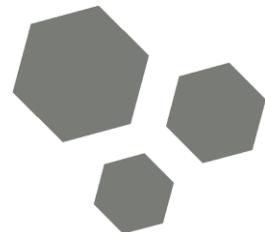




ERS[®] User Manual

AC3 Thermal System TS010

AC3



User Manual • AC3 Thermal System TS010
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1 Usage and Data

1.1 Copyright

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1.2 Use of this User Manual

1.2.1 Purpose

This User Manual contains the information required for the proper use of the product. The User Manual is delivered with the product and is an essential part of the product. It must be kept in an accessible, visible place next to the product.

Product Life Phase

The User Manual describes all the product life phases of the product. It consists of the following system conditions and applications that come after manufacturing: transport, installation, commissioning, operation, maintenance, service, storage and finally disposal.

Each related chapter can be found easily with the table of contents in this User Manual.

1.2.2 User Qualification

This User Manual applies exclusively to technically qualified personnel, who have been trained by ERS® or have completed an instruction course for the product. This instruction course must have been carried out with the authorization of ERS® electronic GmbH.

Only technically qualified personnel are capable of interpreting correctly the safety regulations contained in the product Manual and in this User Manual and applying them in practice in a concrete situation.

Personnel who have not been trained by ERS® or who have not received ERS® authorized training on the product are not considered as authorized working personnel.

Unauthorized personnel are not permitted to carry out any kind of work on the product. ERS® declines all liability for any claims for damages which occur when stipulations are disregarded.

Important Safety Information

Be sure to read the Safety Information prior to performing any work with or on the product! It contains important information that is significant for your own personal safety. This chapter must have been read and understood by all persons who perform any kind of work on or with the product during any stage of its serviceable life.

1.3 Intended Use

The AC3 Thermal System TS010 is designed for temperature regulation of AC3 Chucks. The AC3 Thermal System TS010 is equipped with a AC3 Control Unit. The AC3 Thermal System TS010 uses electrical power for heating and dry air for cooling AC3 Chucks.

For all processes carried out with the AC3 Thermal System TS010, the safety instructions in Chapter 2 Safety Page 12 must be adhered to.

Any application exceeding the bounds of these specifications is considered improper use and can lead to serious personal injury or material damage. ERS® will not be held responsible for any damages resulting in such a case.

Further requirements of proper use are that you:

- Read and adhere to this User Manual.
- Adhere to the technical data. See Chapter 1.9 Installation Data Page 11
- Complete the maintenance work on schedule. See Chapter 6 Maintenance and Service

Improper Use and Non-Adherence to Regulations

Other uses of the AC3 Thermal System TS010 are permissible only with written permission from ERS® electronic GmbH. Any application not adhering to specifications contained in this manual are considered improper use. ERS® will not be held responsible for any personal injury or material damage resulting from improper use.

1.4 Residual Dangers

The AC3 Thermal System TS010 employs state of the art technology and was built to comply with recognized safety regulations. It has been subjected to comprehensive safety test and approval processes. However, it is not possible to completely rule out any danger involved in the use of the AC3 Thermal System TS010. There are dangers involved

- for the life and well-being of the user
- for the AC3 Thermal System TS010 and other materials of the end user

as well as detrimental effects on the efficient working on and with the AC3 Thermal System TS010.

For this reason, it is necessary that all activities involving the AC3 Thermal System TS010 are carried out by trained personnel in accordance with the guidelines in this User Manual. The technical data must be adhered to.

1.5 Scope of delivery

The delivery consists of the following components.

Qty	Component	
1	AC3 Thermal System TS010	
1	Hose Assembly	
1	Thermal System Kit	

Tab 1.1 Scope of delivery

1.6 Type label

A type label (Fig 1.1) is attached to the AC3 Thermal System TS010. It identifies the component and provides information about customer-specific adaptations, if such exists. When communicating with ERS®, you should always supply all the details on the type label. With this information, the ERS® customer service can provide you with the support you need in the shortest possible time.

The type label is located at the rear side of the AC3 Thermal System TS010

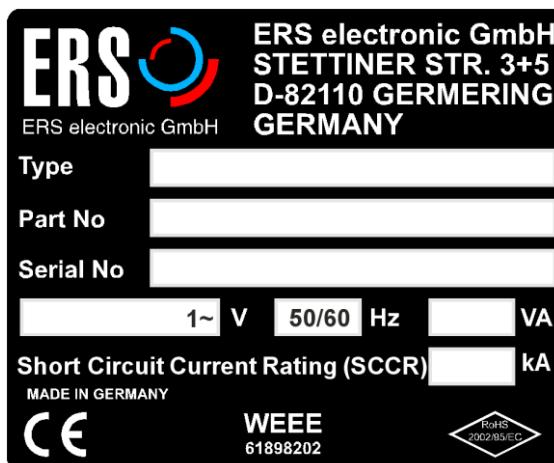


Fig 1.1 Type label of AC3 Thermal System TS010

1.7 Dimensions and Weights

The following illustration shows the dimensions of the AC3 Thermal System TS010



Fig 1.2 Dimensions of the AC3 Thermal System TS010 in mm

Width	Height	Depth	Weight
422 mm 16.6 inch	1020 mm 40.2 inch	500 mm 19.7 inch	140 kg 308.6 lbs

Tab 1.2 Dimensions and weights of the AC3 Thermal System TS010

1.8 Performance data

Cooling capability	Air down to -80°C
Cooling system	Two stage refrigerating unit
Refrigerants	R507 (nonflammable), CFC-free 0.4 kg R170 (flammable), CFC-free 0.042 kg
Air dryer integrated	Type TC-80
Smallest temperature preselection step	± 0.1°C
Chuck temperature display resolution	0.01°C
Control method	DC / PID
Sound level	65 dB(A)

Tab 1.3 Performance data AC3 Thermal System TS010

1.9 Installation Data

1.9.1 Ambient Conditions

The AC3 Thermal System TS010 requires the following environmental conditions during operation:

Temperature	+18°C through +28°C
Relative air humidity	20% through 60%
Location	Dry room (in house)

Tab 1.4 *Ambient Conditions*

1.9.2 Electrical Data

Power supply	208 to 230 VAC
Frequency	50 Hz / 60 Hz
Power consumption	2 400 VA
Protection Class	IP 20
Short Circuit Current Rating (SCCR)	10 kA

Tab 1.5 *Thermal features of the AC3 Thermal System TS010*

1.9.3 Compressed Air Supply

Air purity	99.9%, 3 µm filtered
Residual oil volume	0.01 mg/m³ at 20°C and 7 bar
Operating pressure	6.0 bar (0.6 MPa, 87 psi)
Maximum pressure	8.0 bar (0.8 MPa, 116 psi)
Dew point	≤ -45°C
Temperature	≤ +26°C
Consumption	Max. 480 l/min (17 cfm)

Tab 1.6 *Compressed Air Supply*

2 Safety

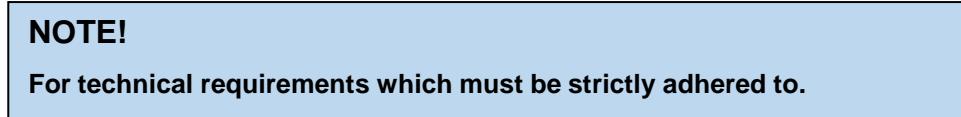
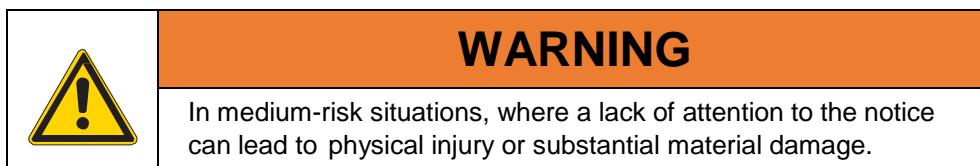
2.1 Compulsory Reading Material

Read this chapter prior to performing any work with or on the AC3 Thermal System TS010! It contains important information that is significant for your own personal safety. This chapter must have been read and understood by all persons who perform any kind of work with or on the AC3 Thermal System TS010 during any stage of its serviceable life.

2.2 Safety and technical information

2.2.1 Structure of the Safety notes

The following safety notes are for indicating the different danger levels



2.2.2 Safety stickers on the product

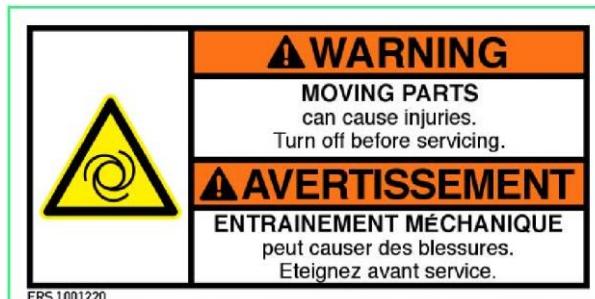
The following safety stickers are on the AC3 Thermal System TS010.
Do not remove these safety stickers. You must replace any sticker that are missing and any stickers that are no longer clearly legible.



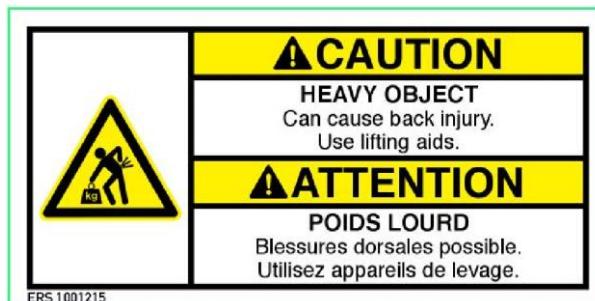
Location in close vicinity to the transparent panel at the rear side



Location in close vicinity to the compressed air inlet at rear side



Location Rear side of the AC3 Thermal System TS010



Location in close vicinity to the right handle of the AC3 Thermal System TS010

2.2.3 Safety Data Sheet

Obtain material safety data sheets (MSDS) for all the used substances (cleaning agents, etc.)
The safety data sheets for the refrigerants can be found at the end of this manual.

2.3 Safety related responsibilities

The responsibilities for the safety of the AC3 Thermal System TS010 are assigned as follows:

- ERS® is responsible for the safety of the AC3 Thermal System TS010.
- The end user is responsible for safety in the vicinity of the AC3 Thermal System TS010.
- The end user is responsible for the adherence to the general safety guidelines in all work carried out on and with the AC3 Thermal System TS010.

Areas of Responsibility for ERS

AC3 Thermal System TS010	Areas of responsibility
Electrical supply	From the interface between the electrical supply and the AC3 Thermal System TS010.
Grounding	From the interface between the ground connection cable and the AC3 Thermal System TS010
Compressed air inflow	From the interface between the air supply line and the AC3 Thermal System TS010

End User's Areas of Responsibility

Surrounding area of the AC3 Thermal System TS010	Areas of responsibility
Electrical supply	Connecting cables to the connections of the AC3 Thermal System TS010 in accordance with specifications written in this manual
Groundings	To the connector of the AC3 Thermal System TS010
Compressed air inflow	Compressed air supply pipes to the media connection of the AC3 Thermal System TS010 in accordance with specifications written in this manual
Personnel	Ensuring that information is passed on when operating, maintenance or service personnel are substituted or changed. Providing training courses.
Safety data sheets	Obtaining safety data sheets for all the used materials (cleaning agents, etc.).

2.4 General Safety Guidelines for the End User

2.4.1 Personnel

All personnel who work with the AC3 Thermal System TS010 must have the required technical qualifications and have received appropriate instruction and training. They must be informed about all conceivable dangers and risks which exist in conjunction with this system.

Unauthorized persons are not allowed access to the AC3 Thermal System TS010.

2.4.2 Operation

The AC3 Thermal System TS010 must not be used for purposes other than those stipulated. All work instructions and operational procedures which could impair personnel safety or cause damage to the AC3 Thermal System TS010 are strictly prohibited. In addition, branch-specific and local regulations concerning prevention of accidents must always be followed.

2.4.3 Workplace

Condition

With appropriate instructions and checks, the end user guarantees a work place and working environment around the AC3 Thermal System TS010 that is in meticulous order and clean.

Safety Devices

The end user must draw up a safety concept and provide the required safety devices if adaptations are made to the AC3 Thermal System TS010 or if the system is incorporated in an overriding production line.

Warning Notice Plates

Clearly visible warning notice plates on the operational premises must notify personnel of residual dangers caused by the system.

Waste Materials

The end user is responsible for the eco-friendly disposal of ecologically harmful waste materials produced by processes.

2.4.4 User Manual

Reading and Understanding

The end user is responsible for making sure that each person who performs work on or with the AC3 Thermal System TS010 during any stage of its serviceable life has read and understood the relevant parts of this User Manual. This applies especially to Chapter 2 Safety Page 12.

Safekeeping

The User Manual is delivered with the AC3 Thermal System TS010 and is considered to be an integral part of the product. This manual must always be at hand near the AC3 Thermal System TS010 at a defined location that is clearly visible. End users can order further copies of this User Manual from ERS®. You will find our contact address on the title page of this User Manual.

Completeness

Always use a complete and original copy of this User Manual! Text passages in this User Manual contain cross-references to other sections of the manual which, in turn, include important information. Incomplete copies of the manual or copies of single, separate pages cannot convey all the necessary information of the User Manual.

WARNING	
	<p>Incomplete User Manual. Missing safety instructions resulting from an incomplete copy of the User Manual can lead to serious or fatal injuries and material damage. You must always work with a complete original copy of this User Manual! Do not copy individual pages.</p>

2.4.5 Installation

Power Supply

The end user provides the connections for the supply of electricity to the AC3 Thermal System TS010 with the required performance and quality levels. See Chapter 4 Installation Page 35 and any supplementary information in the technical specifications.

Supply Lines

Electrical supply cables and air pipes must be kept separate from one another and must be routed to the AC3 Thermal System TS010 under protection from mechanical stress. They must be routed in such a way that the safety and reliability of the AC3 Thermal System TS010 is not affected negatively. The mains connection of the AC3 Thermal System TS010 must have access anytime. All supply lines of the AC3 Thermal System TS010 must be installed without tripping points.

2.4.6 Maintenance and Service

The end user is obliged to only operate the AC3 Thermal System TS010 in a technically faultless condition. All maintenance and service work must be carried out in accordance with Chapter 6 Maintenance and Service Page 75.

Lockout/Tagout

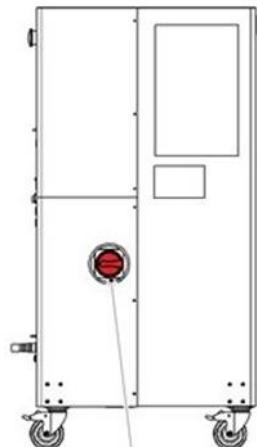
Make sure that the relevant system parts are de-energized and they cannot be switched on again for the duration of the maintenance or service work. This must be done according to the lockout/tagout procedure described in Chapter 6.2 Lockout / Tagout Procedure Page 76

Shutting Down

Use the Mains Switch (EMERGENCY OFF) to deenergize the TS010 system.

Left side

The switch is located on the left side of the TS010.



For all maintenance and service work, you must have the AC3 Thermal System TS010 in the operating state specified for that work. Make sure that the power supply to the relevant system parts is switched off, and is secured against switching on inadvertently. Use warning signs for this purpose. See Chapter 6.2 Lockout / Tagout Procedure Page 76.



Safety Equipment

Only remove safety equipment after the AC3 Thermal System TS010 has been brought to a complete stop and lockout/tagout. Before switching on the system again, make sure that all the safety equipment removed has been reinstalled.

Spare Parts

WARNING	
	<p>Non-original spare parts. The use of non-approved parts can lead to malfunctions. This can lead to serious or fatal injuries or considerable material damage. When carrying out maintenance and service work, only use original OEM or PMA spare parts only</p>

Adaptations

Consult ERS® before modifying the system. Unauthorized adaptations and alterations which affect the safety of the AC3 Thermal System TS010 are not permitted and will void warranty.

Checks

Final Checks

After maintenance or service work, check that all the safety equipment is installed and functioning properly. Check the safety equipment especially after working on the electrical system. This applies in particular to the ground, ground wire, current path, and the safety circuits.

Revision Check

The end user is responsible for having performed revision checks according to the local regulations concerning prevention of accidents. This applies in particular to the electrical equipment of the system, pressure containers and cryo-technical components.

Notification Rule

The end user is obliged to notify ERS® immediately as to any changes or irregularities that have been observed in the AC3 Thermal System TS010.

2.4.7 Disposal

The end user must adhere to the pertinent regulations when disposing of the AC3 Thermal System TS010. End users must hand over the system to either a licensed private or public disposal company or he must recycle the unit himself or dispose of it in accordance with the pertinent regulations. See Chapter 8 Storage, Disposal Page 86

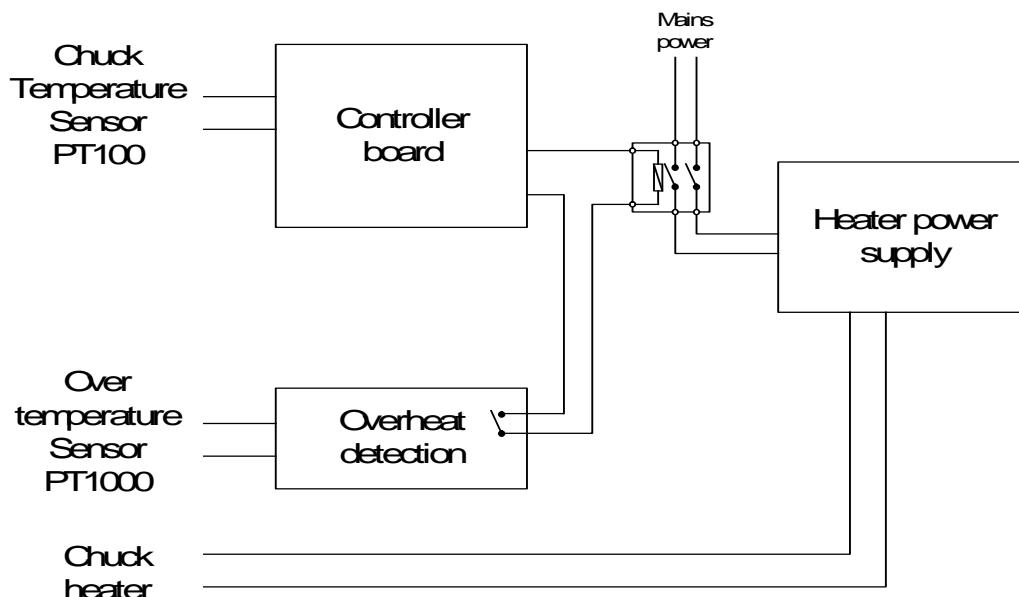
2.5 Safety Circuit

2.5.1 Overtemperature Protection

Principle

The AC3 Controllers are equipped with an over temperature detection circuit that operates independently of the temperature control PCB.

Therefor the Chucks contain an extra sensor (PT1000) for over temperature detection. As the AC3 control board does not allow to set temperatures higher than the maximum allowed range of the chuck, the over temperature alarm circuit provides double security in case of a malfunction of the electronics or the power supplies.



2.5.2 Overtemperature Alarm

The over temperature circuit will switch off the power supply relay of the chuck heaters and trigger an alarm message at the display. The alarm is not self-resetting, a restart must be performed

As standard setting the alarm temperature is set 20°C higher than the maximum set temperature of the chuck.

Setting the Overtemperature Alarm Temperature

	WARNING
<p>Safety Circuit</p> <p>Setting a higher temperature than the maximum allowed temperature of the connected chuck will not protect the chuck from overheating and can cause damage of the chuck.</p>	

- 1 Remove the right rear cover of the AC3 Chiller TS010.

- 2 Locate the over temperature circuit



- 3 Press P at the device, the display will show SP and the set value.



- 4 Use the arrow keys up / down to change the value
The device will store the changed value and return to normal operation one minute after the last key stroke.

	WARNING
No warranty for unauthorized change of settings ERS will take no warranty for damages that result from wrong setting of the overheat protection.	

2.5.3 Emergency Stop (optional)

In standard use the AC3 Thermal system is an integral part of a superior system. As such, it should be integrated in the overall safety concept devised specifically for the system. This means that the electric power of the TS010 is shut off when the system is shut off.

NOTE!

If the AC3 Thermal system TS010 is integrated in an overall safety circuit, the main disconnect and main over current protection must be rated at least 10000 AIC.

For stand-alone use the AC3 Thermal System TS010 is optionally equipped with a safety-relevant electric circuit. The corresponding safety relays are placed inside the AC3 Thermal System TS010.

The safety circuit is triggered by pressing the EMERGENCY-STOP button which is mounted on the AC3 Thermal System TS010. See Fig. 2.1.

NOTE!

Pressing the EMERGENCY-STOP button switches off the AC3 Thermal system TS010 only. If the AC3 Thermal system TS010 is integrated in an overall safety circuit, the overall system will not be affected. To completely de-energize the system turn off the main Switch (EMERGENCY OFF) or pull the mains connector.

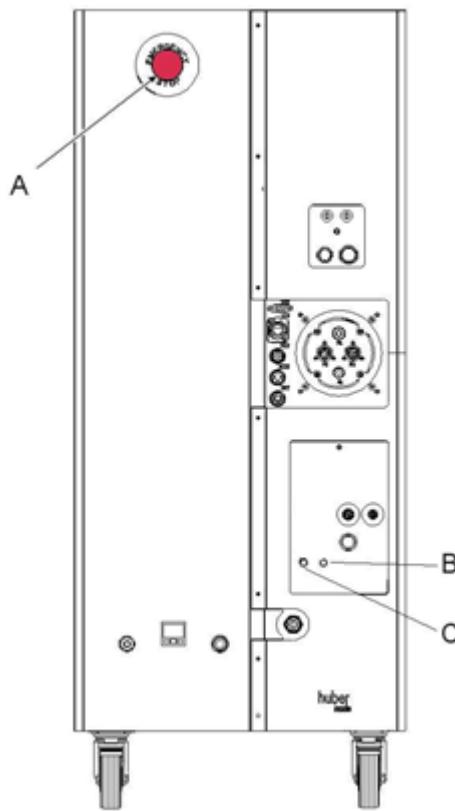


Fig 2.1 Position of the optionally EMERGENCY-STOP button and EMS-Connectors

- | | |
|---|--|
| A | EMS button (optional) |
| B | BNC2 connector external EMS Signal in (equipped with Dummy plug) |
| C | BNC1 connector (EMS-Signal out) |

EMERGENCY STOP

Pressing the EMERGENCY-STOP button immediately interrupts the working of the AC3 Thermal System TS010. The supply of the cooling system and of the heater power supplies is interrupted.

Switching the System On Again

Switching the system on again after an EMERGENCY-STOP is described in Chapter 5.2.3 Restarting Operation after an EMERGENCY-STOP (option) Page 47.

2.6 Residual Dangers



Fig 2.2 Residual dangers at the AC3 Thermal System TS010

- Danger of lethal electrical shock at live parts connected to the mains
- Danger of serious crushing, fractures or back strain injury during transportation
- Danger of burns from hot tubes
- Danger of injuries from moving fan
- Danger through pressurized tubes connected to the connected terminal
- Health hazard through refrigerant in the cooling unit
- Danger of fire by refrigerant R170

Personnel working with the AC3 Thermal System TS010, must take note of the following safety guidelines. The Type of Hazard energy is Type 3.

WARNING	
	<p>Mains voltage. The AC3 Thermal System TS010 contains live voltage which are connected to the mains. Touching these parts causes a lethal electrical shock. The AC3 Thermal System TS010 must be turned off and in a voltage-free state before you carry out any work in the danger areas. Ground the equipment and secure the system against switching on inadvertently. Ensure that nobody is remaining in the danger areas before you switch the system on again.</p>

NOTE!
<p>Only personnel with electro technical training are permitted to carry out work on the electrical equipment.</p>

WARNING	
 	<p>Massive component. Improper handling during transportation can lead to serious crushing, fractures or back strain injury.</p> <p>Measures:</p> <ul style="list-style-type: none">• Do not lift the AC3 Thermal System TS010 by hand. Push it on its casters by two people or use a lifting device.• Do not remain stationary under suspended loads.• Secure the AC3 Thermal System TS010 before transportation.

NOTE!
<p>Only authorized personnel may operate forklifts, crane, trucks, and lifting devices.</p>

CAUTION
  <p>Hot Parts. The tubes inside the AC3 Thermal System TS010 can heat up to 60°C. Wait until the tubes have cooled down to room temperature before carrying out maintenance work. Wear protective gloves and work clothes with long sleeves.</p>

WARNING
 <p>Rotating fan. The rotating fan inside the AC3 Thermal System TS010 can cause injuries. Turn the fan off and wait until it has come to a standstill before carrying out maintenance work.</p>

WARNING
 <p>Compressed air system. It is dangerous to open or damage a pressurized system part. It can lead to serious eye or skin damage. Shut off the supply to the AC3 Thermal System TS010 and release the pressure before carrying out any work on these parts.</p>

CAUTION	
	Refrigerants R507 and R170 in the cooling unit.
	The inhalation of the refrigerant R507 may cause narcotic effects and health hazards.
	The refrigerant R170 is flammable and may form explosive mixtures with air in a concentration of more than 3%.
	Measures:
	<ul style="list-style-type: none">• Read carefully through the safety data sheets for the refrigerants• Do not maintain or service the refrigerant or refrigeration units yourself. Only ERS-electronic specialists are authorized to repair the refrigeration units.

NOTE!

Also note the special safety instructions for specific tasks in Chapter 2.4.6 Maintenance and Service Page 17.

3 Description



Fig 3.1 AC3 Thermal System TS010

The AC3 Thermal System TS010 uses dry air for cooling and electric power for heating an ERS Chuck. The AC3 Thermal System TS010 in conjunction with an ERS Chuck provides a precise temperature and a precise temperature transmission to the wafer.

The AC3 Thermal System TS010 continuously monitors the Chuck surface temperature using a precise platinum RTD sensor which is connected to a microprocessor controlled close loop temperature management system. It is operated via an ergonomically arranged touch screen display. The AC3 Thermal System TS010 is designed with small footprint for easy integration at the customer's site. The AC3 Thermal System TS010 is equipped with four swivel casters with parking brakes.

For a remote operation via PC or prober software, a RS232C interface is available. The RJ45 interface (Connector XC3) is used for service and software update.

3.1 Main Components

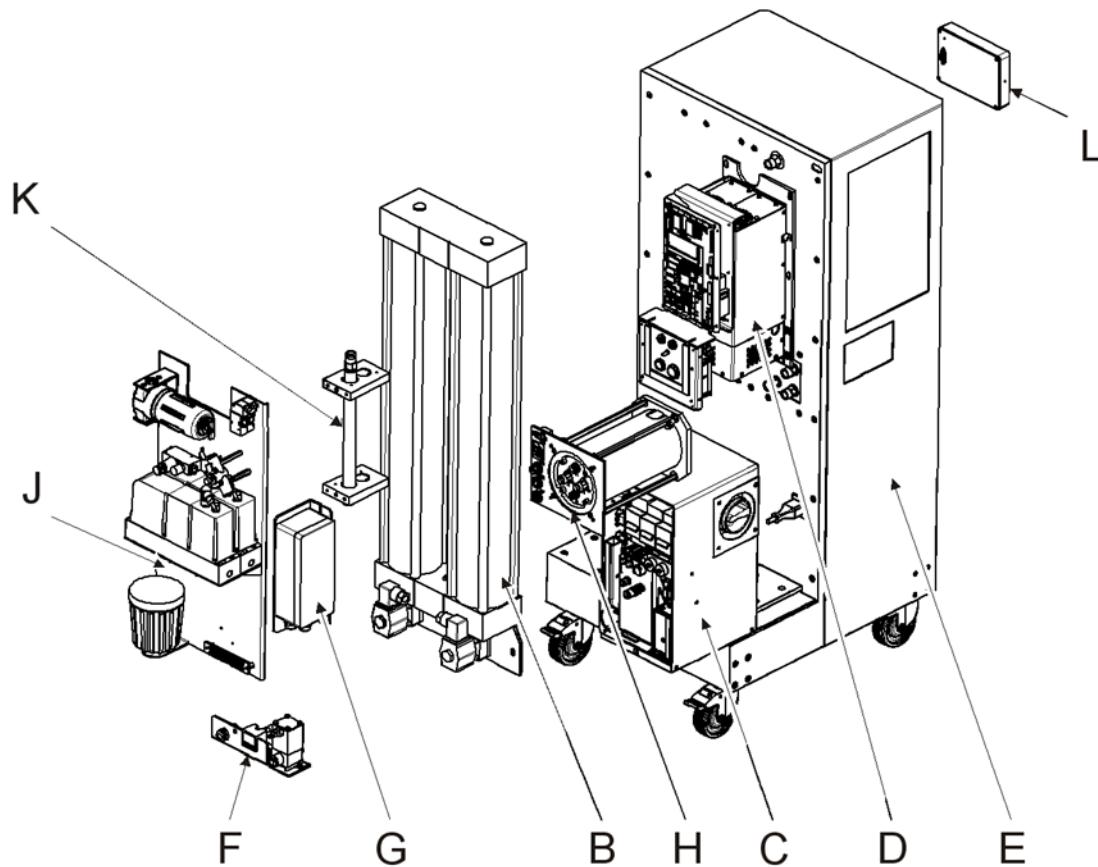


Fig 3.2 Main components of the AC3 Thermal System TS010

Item	Component	Remark
A	Covers (not shown)	
B	Air Dryer	See 3.1.1
C	Power supply unit	See 3.1.2
D	Controller unit ASM110	See 3.1.3
E	Cooling unit	Contains a two-stage refrigerating system which cools down the air to -80°C
F	Pneumatic inlet, Pressure display	
G	Controller for air dryer	
H	AC3 Thermal System TS010 interface	
J	Pneumatic panel	See 3.1.1
K	Dry air diffusor	
L	Touch screen display	

3.1.1 Air Dryer and pneumatic panel

The Air dryer reduces the humidity of the compressed air in order to avoid condensation on the system components and in the prober station.

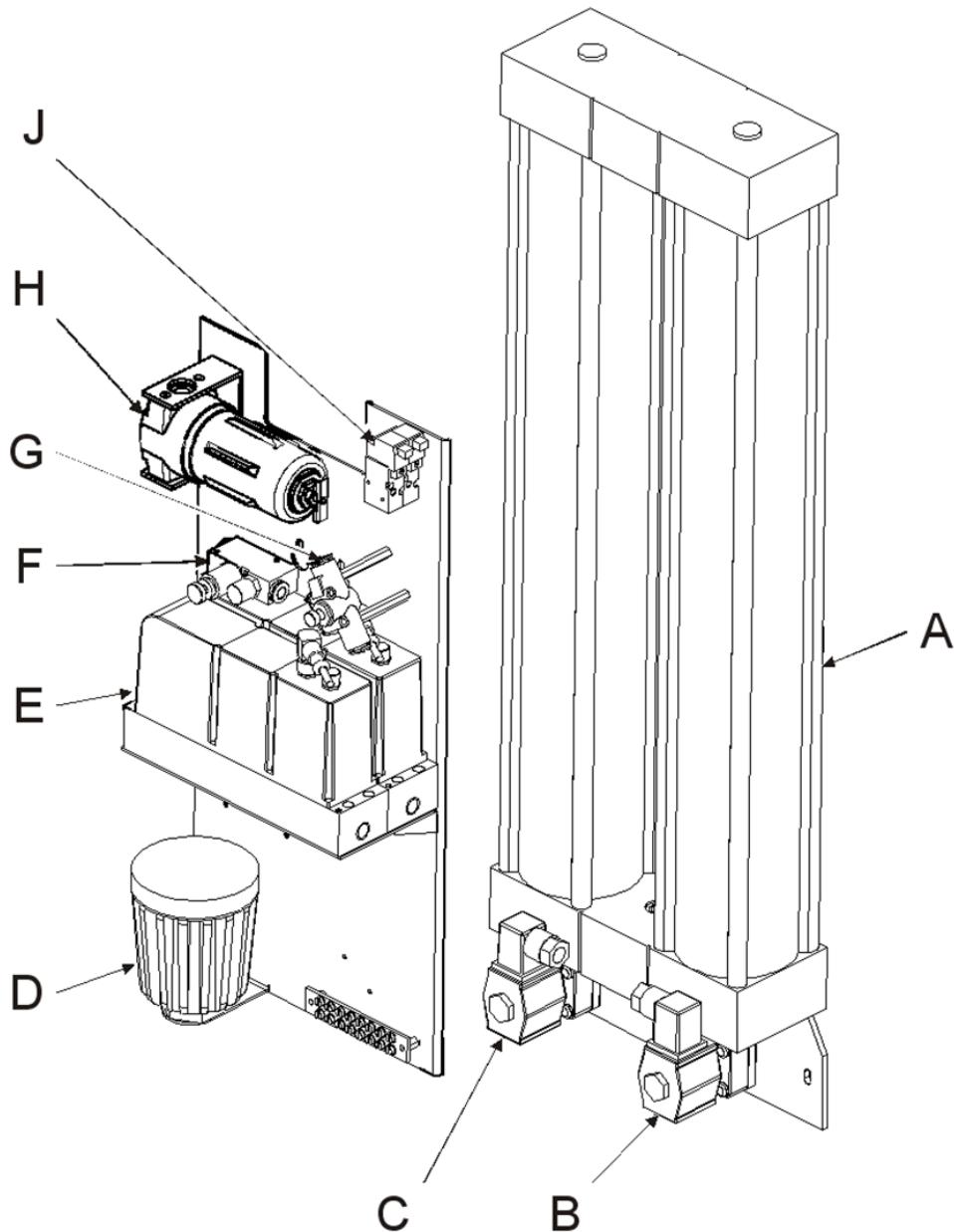


Fig 3.3

Air dryer and Pneumatic panel of the AC3 Thermal System TS010

- A Air dryer TC80
- B Solenoid valve M2
- C Solenoid valve M1
- D Silencer
- E Flow control valves

- F Pressure control valve
- G Nozzle
- H Air filter AF1
- J 3/2 way-valve

3.1.2 Power Supply Unit

The AC3 Thermal System TS010 components are supplied with the required voltage by power supply unit.

Front and left view:

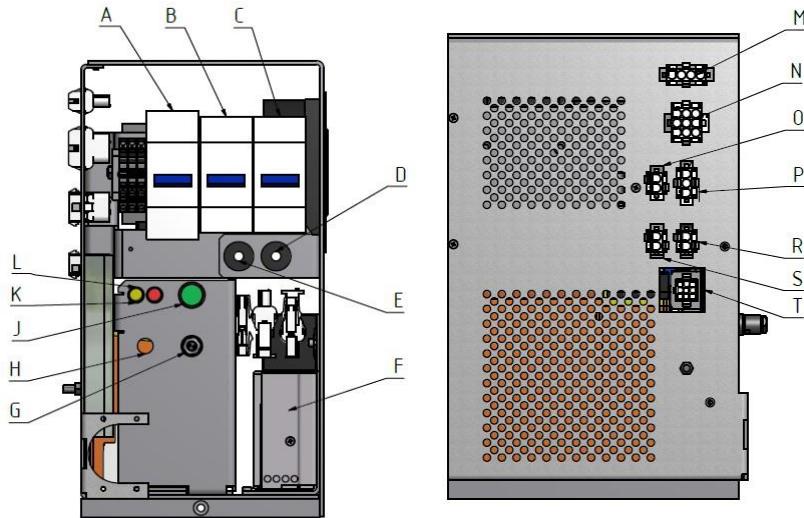


Fig 3.4 Front and left view of power supply unit G60

A Leakage breaker Fi1	G Connection EMO in BNC2	N Connector XG2
B Over current breaker Si1	H Connection EMO out BNC1	O Connector XG4
C Over current breaker Si2	I Push Button Reset / Power On	P Connector XG3
D Automatic Fuse Si4	K Indicator: Error	R Connector XG5
E Automatic Fuse Si3	L Indicator: Supply	S Connector XG6
F Power supply	M Connector XG1	T Connector X1

Rear view:

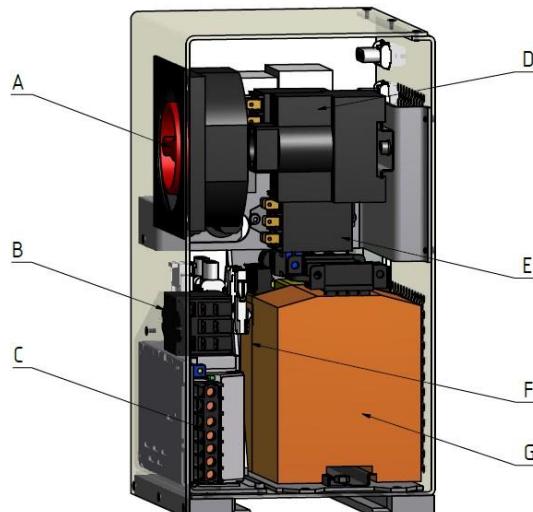


Fig 3.5 Rear view of power supply unit G60

A Main switch S01	D Relay KX	F EMO Module p1p
B Relay KX32	E Relay KX	G EMO Modul po3.2p
C Power Supply		

3.1.3 Electronic Unit

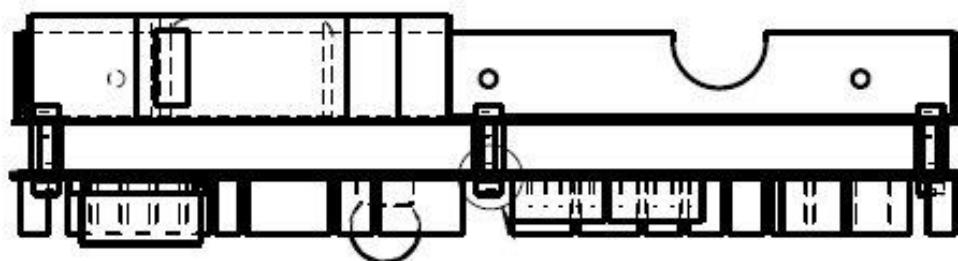
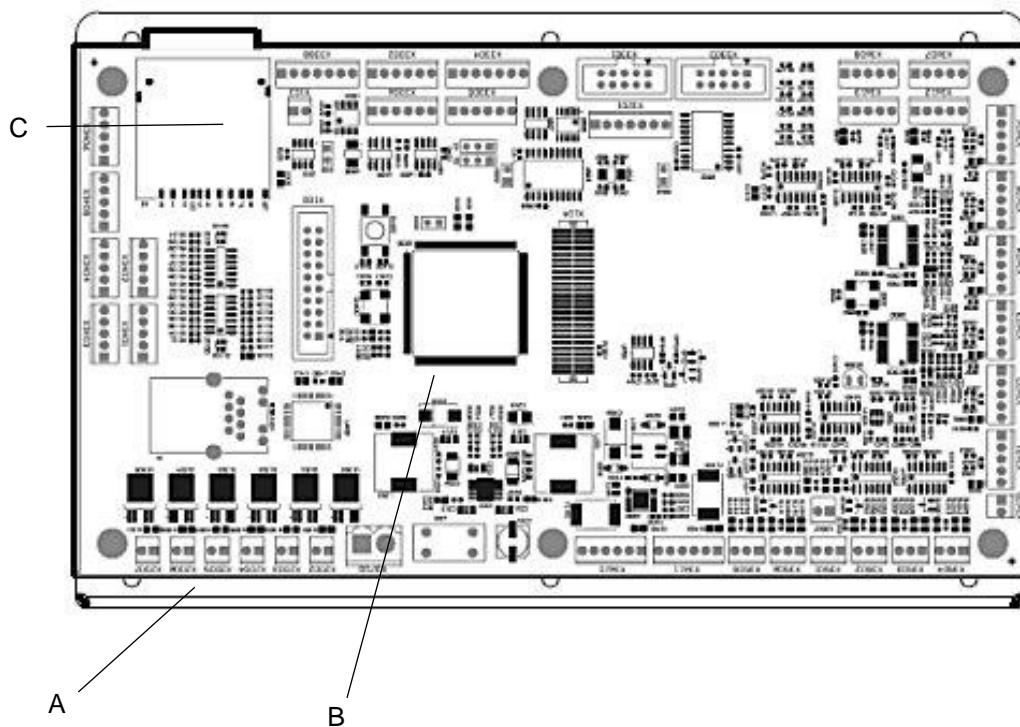


Fig 3.6

Electronic unit of the AC3 Thermal System TS010

- A ASM110 mounting plate
- B Printed Board ERS 180880
- C Socket for SD Card

3.2 Media Supply

3.2.1 Compressed Air Diagram

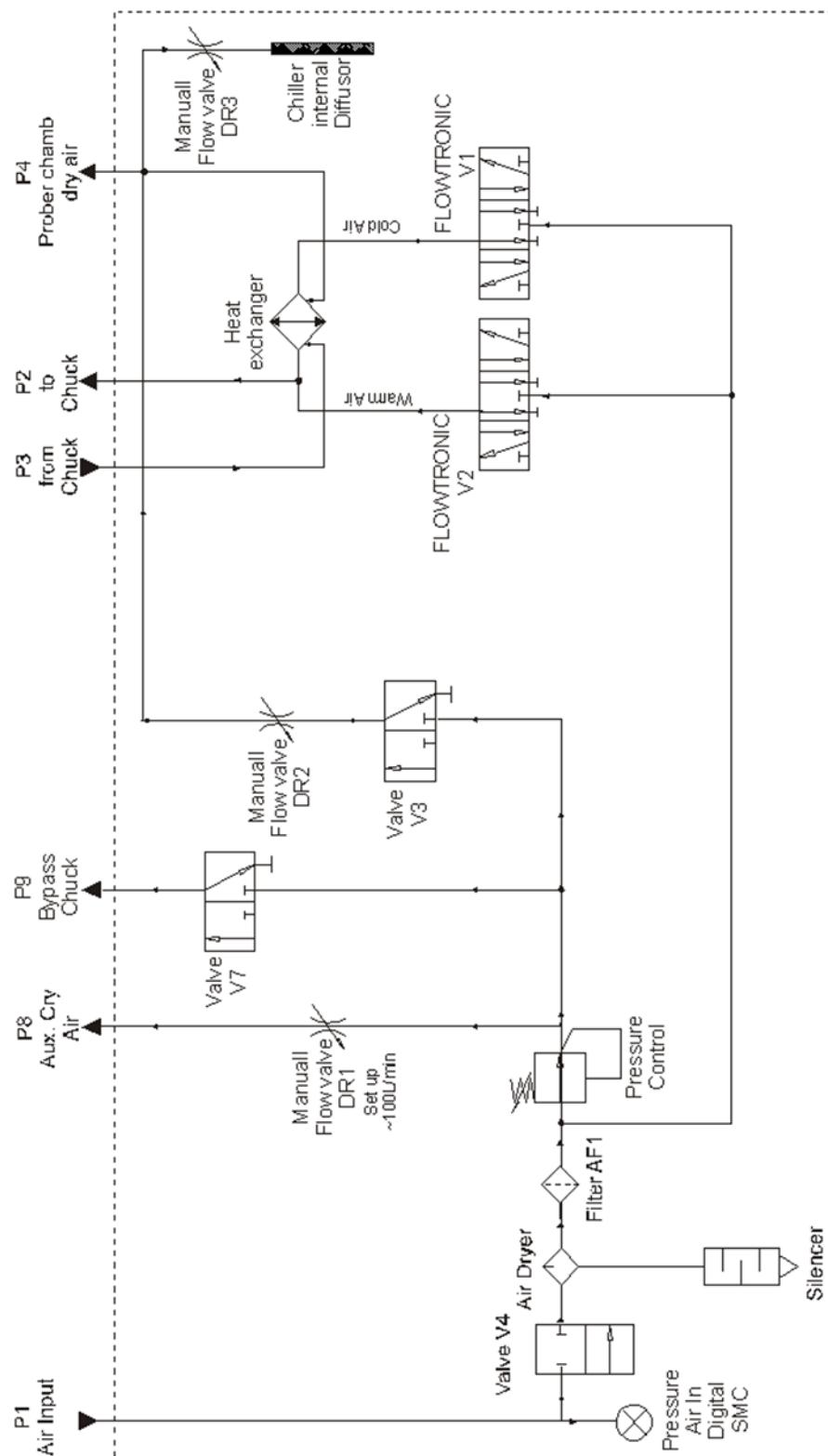


Fig 3.7 Compressed air diagram of the AC3 Thermal System TS010

3.2.2 Pneumatic Components

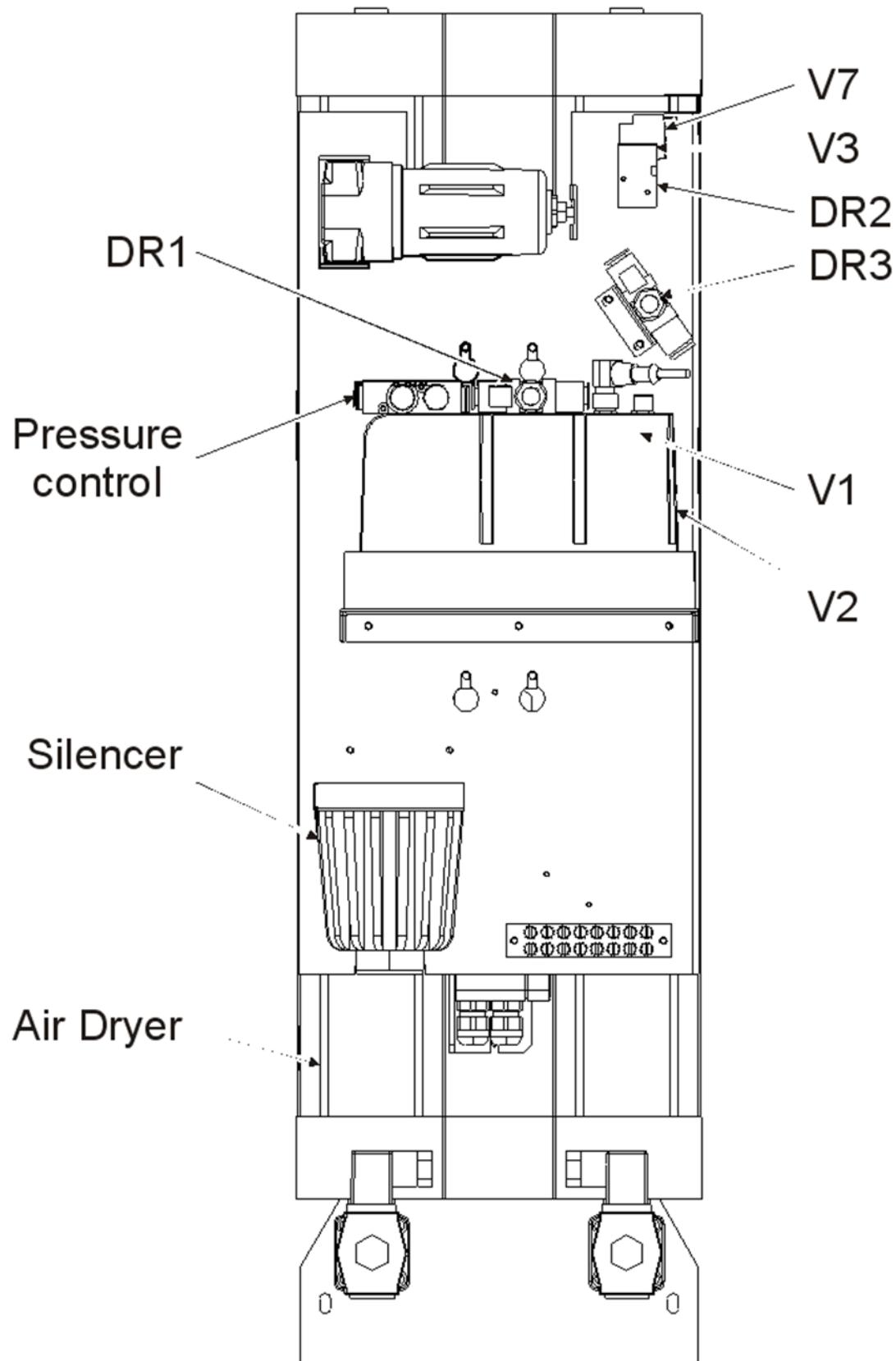
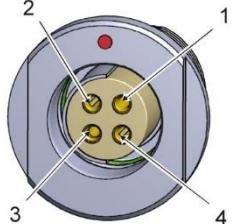


Fig 3.8 Pneumatic components of AC3 Thermal System TS010

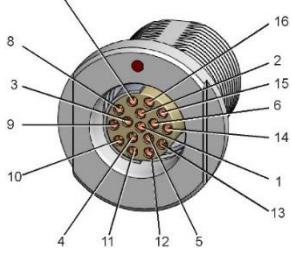
3.3 Interfaces

3.3.1 Connector CN4

Name	CN4	
Location	Rear of the AC3 Thermal System TS010	
Connection	4 pin connector for Chuck Heater	
Pin assignment	Pin 1: 6 or 8 inch positive Pin 2: 6 or 8 inch negative Pin 3: 12 inch positive Pin 4: 12 inch negative	

Tab 3.1 Connector CN4

3.3.2 Connector CN5

Name	CN5	
Location	Rear of the AC3 Thermal System TS010	
Connection	16 pin connector for Chuck control	
Pin assignment	1	not connected
	2	not connected
	3	not connected
	4	not connected
	5	not connected
	6	not connected
	7	not connected
	8	Ground
	9	Pt 100
	10	Pt 100
	11	Pt 100
	12	Pt 1000
	13	Pt 1000
	14	KTY
	15	KTY
	16	KTY

Tab 3.2 Connector CN5

3.3.3 RS232 Interface XR2

Name	XR2	
Location	Rear of the AC3 Thermal System TS010	
Connection	D-Sub, 9 pin for external controller linkage	
Pin assignment	Pin 2: sent data Pin 3: received data Pin 5: ground	
Standard setup:		
	Bits/sec	9600
	Parity	N
	Bits per symbol	8
	Stop bit	1

Tab 3.3 Interface RS232 XR2

3.3.4 Connector X21

Name	X21	
Location	Rear of the AC3 Chiller TS010	
Connection	Remote ON/OFF and serial interface	
1	1	GND
	2	TX (connected to XR2 pin2)
	3	RX (connected to XR2 pin3)
	4	n.c
	5	external contact *
	6	external contact *
	7	n.c

Tab 3.4 Connector X21

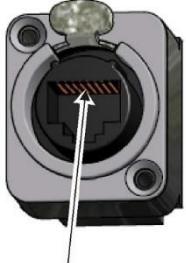
* an external potential-free contact (relay) may be connected to enable / disable the operation of the system.

NOTE!

If no external connection is used a dummy plug must be inserted to connect pin 5 and 6.

3.3.5 Connector XC3

Name	XC3	
Location	Rear of the AC3 Thermal System TS010	
Connection	RJ45 Connector for Controller Programming /update/ service	
Pin assignment	1	D1+
	2	D1-
	3	D2+
	4	D3+
	5	D3-
	6	D2-
	7	D4+
	8	D4-



1, 2, 3, 4, 5, 6, 7, 8

Tab 3.5 Service Interface CN3

4 Installation

4.1 Personnel Qualifications

The standard of professional knowledge and experience which is usual for transport company personnel is an adequate qualification if the system is packaged and transported in accordance with the instructions given by a specially trained and authorized person. Only personnel with electro technical training are permitted to install the system.

4.2 Transport

The AC3 Thermal System TS010 may only be transported in its original packaging. The commissioned transport company must be specialized in the transport of heavy and delicate commodities

CAUTION	
	<p>Damage to the system. Improper handling during transportation can damage the system.</p> <p>Measures:</p> <ul style="list-style-type: none">• Pay attention to the packing symbols during transport.• Always transport the AC3 Thermal System TS010 in its upright position and avoid shocks.

The AC3 Thermal System TS010 is equipped with four swivel casters with parking brakes. You can simply push the AC3 Thermal System TS010 to the desired location. To activate the parking brakes, push down the brake lever, release by pushing back the lock lever (see Fig 4.1).

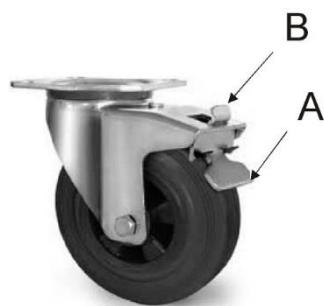


Fig 4.1

Swivel Caster

- A Break lever
B Release lever

WARNING	
 	<p>Massive component. Improper handling during transportation can lead to serious crushing, fractures or back strain injury.</p> <p>Measures:</p> <ul style="list-style-type: none">• Do not lift the AC3 Thermal System TS010 by hand. Push it on its casters by two people or use a lifting device.• Do not remain stationary under suspended loads.• Secure the AC3 Thermal System TS010 before transportation.• Use all parking brakes on desired location.

NOTE!
Only authorized personnel may operate forklifts, crane trucks and lifting devices.

4.3 System Location Requirements

4.3.1 Environmental Conditions

At the AC3 Thermal System TS010 site, the environmental conditions stipulated in Chapter 1.9.1 Ambient Conditions, Page 11 must be guaranteed.

4.3.2 Operating Media

The AC3 Thermal System TS010 must be supplied with the required operating media during operation. See Chapter 1.9.2 Electrical Data, Page 11 and 1.9.3 Compressed Air Supply, Page 11.

The supply lines must be routed in keeping with the local safety regulations.

4.3.3 Space Requirements

Refer to Chapter 1.7 Dimensions and Weights, Page 10 for the dimensions of the AC3 Thermal System TS010.

The safety clearance for the escape routes must be in line with the local safety regulations. Safety covers, etc., must be installed in such a way that the AC3 Thermal System TS010 remains accessible for maintenance and service work.

Placement of AC3 Thermal System TS010

The AC3 Thermal System TS010 must be placed on a flat, stable floor. For proper operation, the AC3 Thermal System TS010 must have sufficient air flow. Allow minimum 4 inches of space on both sides and top of AC3 Thermal System TS010. **DO NOT** block air vents. **DO NOT** place the AC3 Thermal System TS010 near a hot surface. The Main switch on the left side of AC3 Thermal System TS010 must be operable anytime.

4.4 Unpacking

NOTE!

Transport malpractices can damage the system. Pay attention to the transport symbols and keep the AC3 Thermal system TS010 upright!

Proceed as follows to unpack the AC3 Thermal System TS010:

- 1 Check the delivery papers to make sure the goods delivered match the specified equipment
- 2 Move the crate to the installation site by means of a fork lift, hand truck or another suitable means of conveyance
- 3 Remove the top and side covers of the crate.
- 4 Locate the chamfered wooden beams and laths, see the following figure.



Fig 4.2 Locating the beams and laths

- 5 Place a wooden beam to support one side cover that is to be used as a ramp, see the following figure

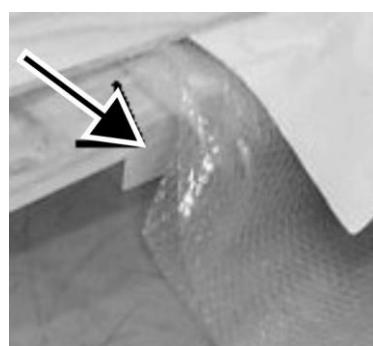


Fig 4.3 Using the side cover as a ramp

- 6 Place the two laths under the wheels of the AC3 Thermal System TS010 in order to roll the AC3 Thermal System TS010 off the crate, see the following figure.

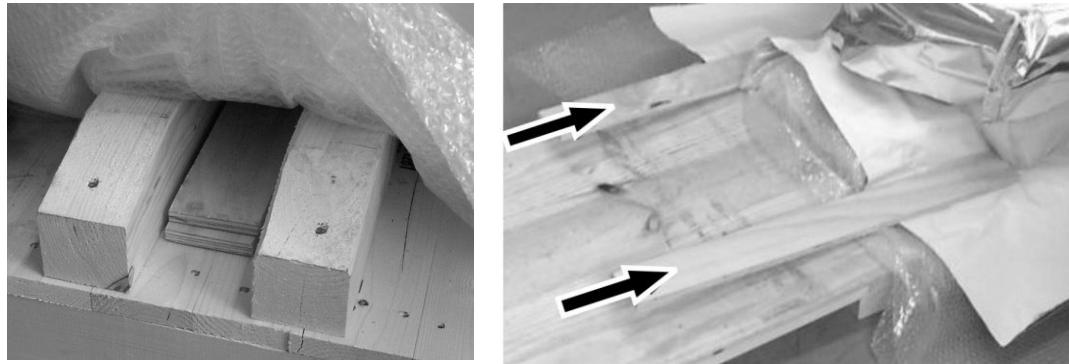


Fig 4.4 Placing the laths

- 7 Carefully roll down the AC3 Thermal System TS010 by two people via the ramp (side cover), see the following figure.

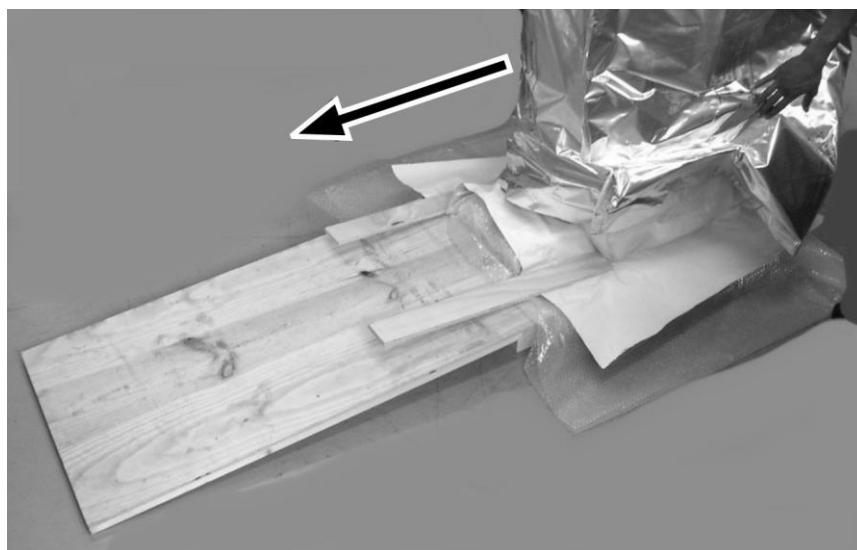


Fig 4.5 Rolling down the AC3 Thermal System TS010

NOTE!

Keep the special packaging materials for later use. You will need them to transport and store the system. See Chapter 8.2 Storage, Page 86

- 8 Examine the system for signs of transport damage
- 9 Make sure the system is complete. See Chapter 1.5 Scope of delivery Page 9
- 10 Lodge any complaints immediately

4.5 Set up and connections

4.5.1 Setting up the AC3 Thermal System TS010

NOTE!

We recommend the end user set up the AC3 Thermal System TS010 to meet the requirements of SEMI S8.

1. Set up the AC3 Thermal System TS010 in accordance with the connections overview of your superior system and lock the caster.
2. Install mechanical protection devices for the supply lines leading from the media supply to the system (electric cables, compressed air lines, etc.)

4.5.2 Connections

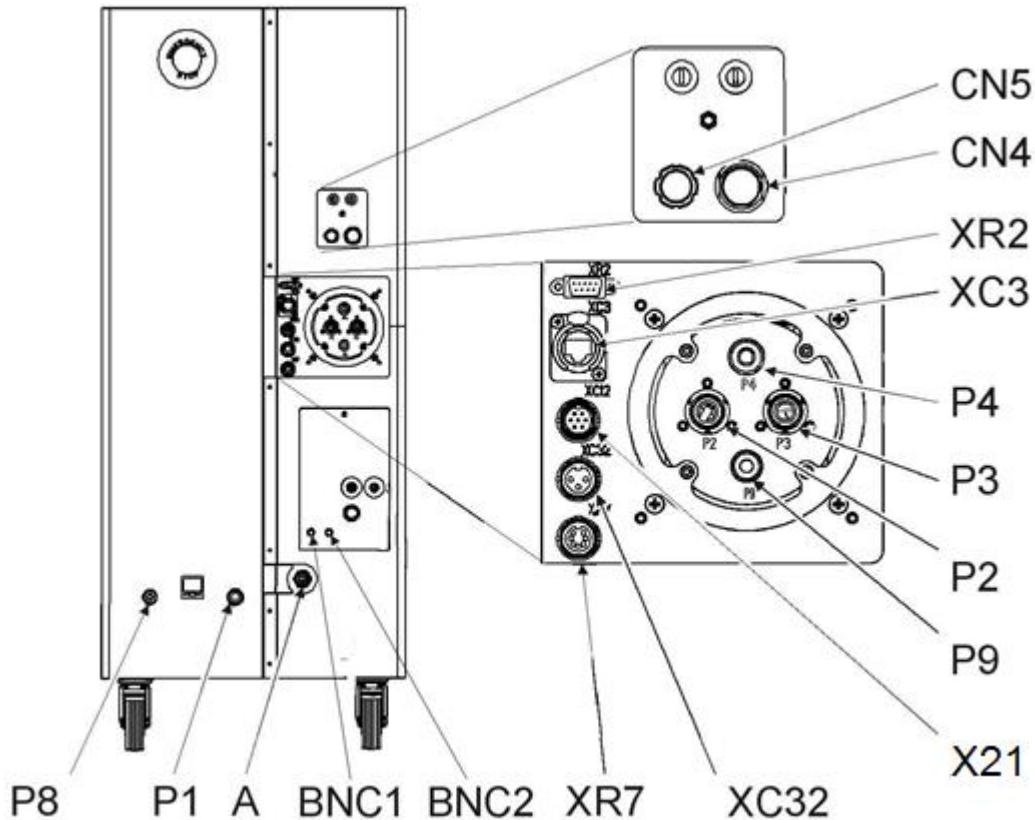


Fig 4.6 Connections at the AC3 Thermal System TS010

A	Power supply	XR2	RS232 Interface
BNC1	EMO Signal out	XR7	external Display
BNC2	external EMO Signal in	P1	Compressed air supply
CN4	Chuck heater connector	P2	Cold Air Out
CN5	Chuck control connection	P3	Air return
XC3	RJ45 Interface	P4	Dry air to prober
X21	Controller connection	P8	Air Purge (extra output, always on)
XC32	Dew point sensor connection	P9	Bypass valve control

4.5.3 Connecting the AC3 Thermal System TS010 to the Mains

NOTE!

Adhere to the stipulations for the electric supply in Chapter 1.9.2 Electrical Data Page 11 when making electrical connections.

The mains plug must be accessible for disconnection any time.

The AC3 Thermal System TS010 must be connected to an isolated ground receptacle.

The AC3 Thermal System TS010 is designed for operation at input voltages 208 VAC to 230VAC.

The default settings are:

USA 208V / 60Hz

EU 230V / 50Hz

WARNING

Mains voltage.

The AC3 Thermal System TS010 contains live parts which are connected to the mains. Touching these parts causes a lethal electrical shock.

Measures:

- The AC3 Thermal System TS010 must be turned off and in a voltage-free state before you carry out any work in the danger areas.
- Ground the equipment and secure the AC3 Thermal System TS010 against switching on again.
- Tagout the main switch.
- Ensure that nobody is remaining in the danger areas before you switch the systems on again.

Proceed as follows to connect the AC3 Thermal System TS010 to the mains:

1. Connect the power supply cable to the mains.
2. The AC3 Thermal System TS010 is equipped with grounding point at the rear down side (screw thread M5)
3. If an EMO option is present, connect the EMO BNC cable to the AC3 Thermal System TS010 or insert dummy plug if no external EMO contact is used.

4.5.4 Connecting the AC3 Thermal System to the Probe Station

Connecting air tubes

The Air tube are connected via two metal tube fittings. See Fig 4.7

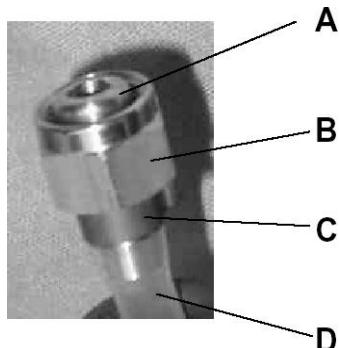


Fig 4.7 Air tube fitting

A	Metal fitting
B	Metal nut
C	Hose clip
D	Tube

There are no additional gaskets. The tube fitting seals via the contact area (A) and the corresponding surface in the connection hole.

Before connecting a tube make sure, that the contact area (A) is clean.

Installing the air tubes

1. Remove the protection caps from the tubes. See A in Fig 4.8
2. Remove the protection caps from the tubes. See B in Fig 4.8

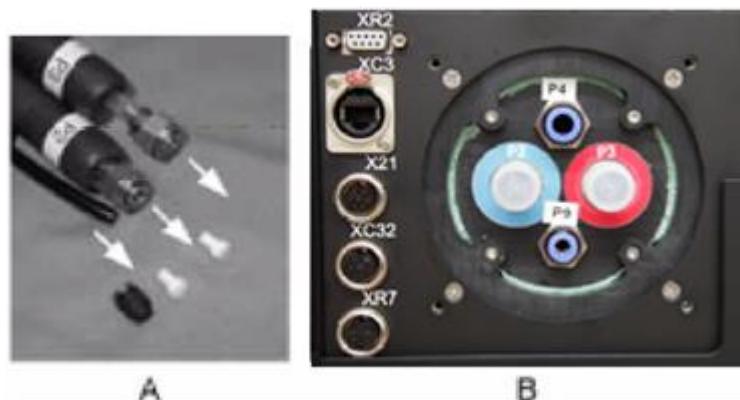


Fig 4.8 Removing the protection caps

1. Connect the tubes to the connections P2, P3, P4 and P9 at the connection terminal of the probe station. See Fig 4.9. Be sure that the nuts are tightened firmly.

NOTE!

Connect cooling line male joint by hand. Then tighten with open ended wrench (19mm) while keeping male joint from rotation with open ended wrench (13mm)



Fig 4.9 Connecting the tubes

- 2 Cover the connections with isolating material ACM 210. See A in Fig 4.10.
- 3 Cover all tubes with isolating material ACM 209. See B in Fig 4.10.
- 4 Fix the protective tube AC 051 to the adapter plate using four screws of size M4x20. See C in Fig 4.10.

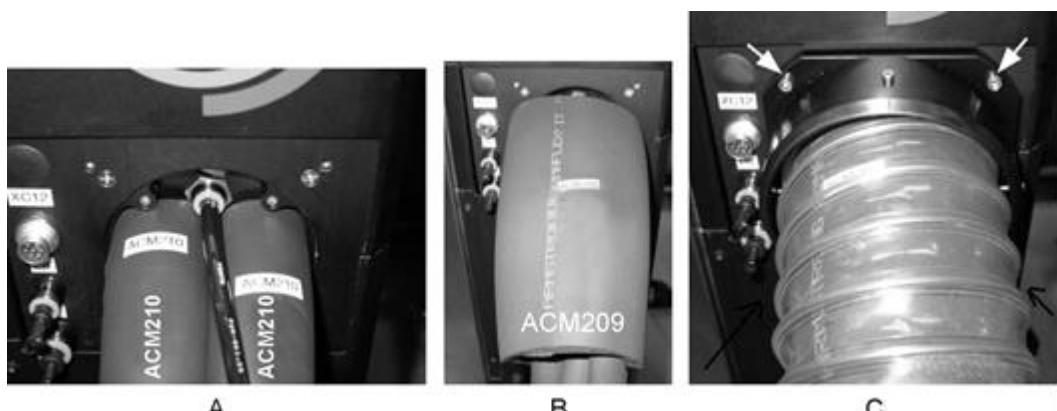


Fig 4.10 Installing the isolation material and protective tubing

4.5.5 Connecting the Compressed Air

NOTE!

Adhere to the stipulations in Tab 1.6 Compressed Air Supply when connecting the compressed air supply to the AC3 Thermal system TS010.

NOTE!

The end user must mount a lockable main valve for the compressed air supply right next to the system.

WARNING



Compressed air system.

It is dangerous to open or damage a pressurized system part. It can lead to serious eye or skin damage.

Shut off the compressed air supply to the system and release the pressure before carrying out any work on these parts.

To connect the compressed air supply, connect the inlet (P1 in Fig 4.11) at the rear side of the AC3 Thermal System TS010 to the compressed air supply

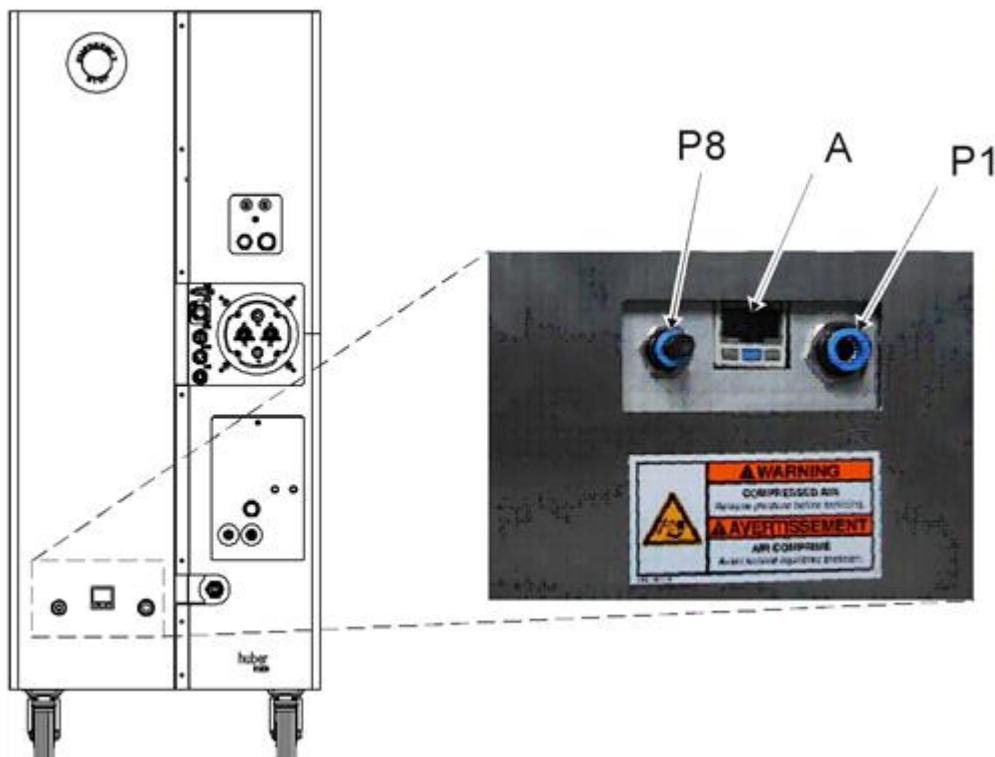


Fig 4.11 Compressed Air connection at the rear side

P8 Auxiliary dry air outlet
A Pressure monitor
P1 Compressed Air inlet

4.5.6 Connecting the Dew Point Sensor (Option)

If the prober is equipped with a dew point sensor, connect it to the XC32 socket at the connection panel on the rear side of the AC3 Thermal System TS010. See Fig 4.6.

4.6 Checks

4.6.1 Checks after Installation

Visual Inspection

Carry out a careful visual check to make sure that you have made all the required mains connections (including ground conductor) correctly during installation. Also check the conductors which were removed for transport.

Pay particular attention to the following when you make a visual inspection:

- The cables must be connected to the correct terminals
- The terminals must be correctly isolated (no single wires projecting from flexible cables or trapped wire remnants)
- The cable connections must be tight. Flexible cables should be fitted with cable brackets, cable casings or forced-on pin-type cable lugs.

Safety Circuits

Test the safety circuit. See Chapter 4.6.2 Revision Checks Page 44.

4.6.2 Revision Checks

In accordance with the DIN IEC 703/VDE 0721 regulation, section 6, as well as the relevant national safety regulations, a revision checks of the electrical equipment (safety circuit and protective conductor system) must be carried out every 6 months. The revision check is also required when technical changes are carried out on the safety circuit.

Safety Circuit

After changes are made to the system, or following maintenance work, whereby safety-related components are affected, the function of the safety circuit must be tested

- 1 Test the safety circuit. Activate the EMERGENCY-STOP switch several times (at least five times).
- 2 Test the protective conductor system and the protective conductor connections of the AC3 Thermal System TS010, especially the connection points, by means of a visual and manual check. We also recommend you measure the protective conductor's resistance between the main connection and different conductive system parts.
- 3 Check that all the contacts are good.

4.7 Initial Start-Up

Proceed as follows to initially start-up the system:

- 1 Check the system as described in Chapter 4.6.1 Checks after Installation Page 43
- 2 Make sure that no air tube is bent or squeezed
- 3 Switch on the compressed air supply to the AC3 Thermal System TS010
- 4 Check the EMS-Button is released
- 5 Switch on the AC3 Thermal System TS010
- 6 Press the «Reset/Power On» button
- 7 After moving or re-installation of the AC3 Thermal System TS010 or down time longer than six months, wait approximately 12 hours before you continue to let the air dryer regenerate
- 8 Close all covers of the probe shield and set the AC3 Thermal System TS010 into purge mode
- 9 Purge the whole system to which the AC3 Thermal System TS010 is connected for 2 hours with dry air
- 10 Set the AC3 Thermal System TS010 into normal operating mode

NOTE!

Purging the system is for removing any humidity from inside the probe station and should be repeated after any longer period of downtime or after opening of the air tube connections.

The dew point inside the probe station will decrease if a test head is provided with fans and/or the probe card area is exposed to air draft (e.g. by air-conditioning)

5 Operation

5.1 Operating Elements of the AC3 Thermal System TS010

The operating elements of the AC3 Thermal System TS010 are located on the front panel.

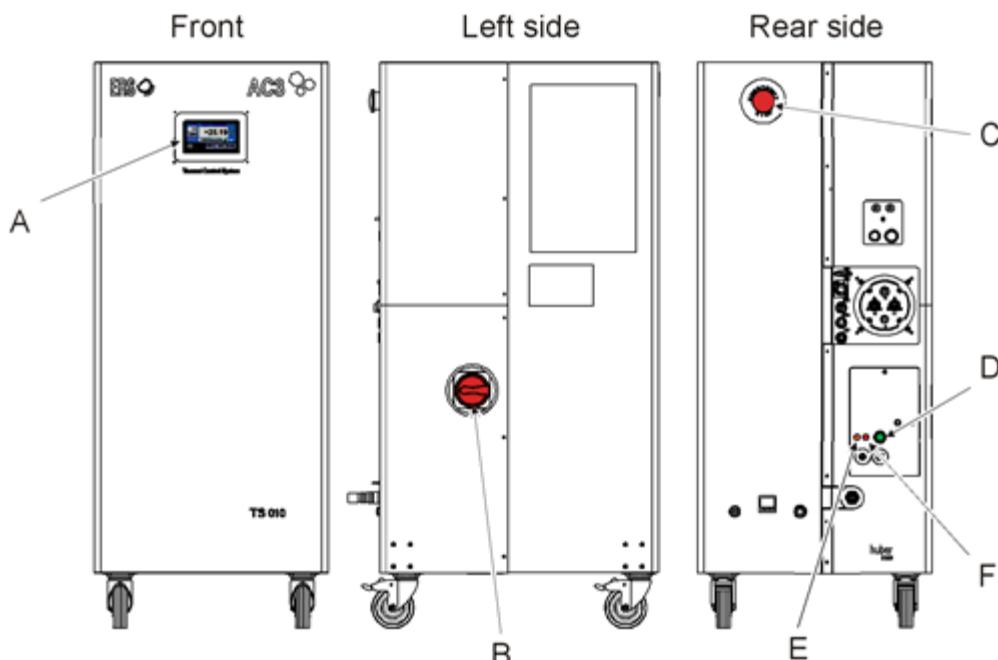


Fig 5.1 Operating Elements of the AC3 Thermal System TS010

A	Touch Screen Display	B	ON/OFF main switch
C	Emergency Stop Button	D	Reset/Power ON button
E	Power Indicator	F	Error lamp

- A The AC3 Thermal System TS010 is operated by a Touch-screen display. See Fig.
- B The Main switch energizes and de-energizes the electrical power from AC3 Thermal System TS010. When the AC3 Thermal System TS010 is energized the power indicator (E) is orange.
The main switch is equipped with two holes to lock it in OFF position by using a padlock.
- C The Emergency Stop button de-energizes the electrical power of the AC3 Thermal System TS010.
To release the Emergency Stop button, turn the button clockwise.
- D The Reset/Power ON button turns on AC3 Thermal System TS010 and glows green.
- E Power ON lamp:
 - orange if the AC3 Thermal System TS010 is energized
 - green if the AC3 Thermal System TS010 is switched ON.
- F The red Error lamp indicates that an error occurred in the Emergency Stop Circuit

5.2 Switch the AC3 Thermal System TS010 ON and OFF

5.2.1 Switching the AC3 Thermal System TS010 On

NOTE!

If the AC3 Thermal system TS010 has been switched off for a longer period of downtime, refer to Chapter 4.7 Initial Start-Up 45.

NOTE!

If the system was switched off; disconnected from the main power supply or the EMO- Button was activated, you must press the «Reset/Power On button» button to switch the system on.

Proceed as follows to switch the AC3 Thermal System TS010 on:

- 1 Complete the installation work and check the system. See Chapter 4 Installation
- 2 Check all power and air connections
- 3 Make sure that no air tube is bent or squeezed
- 4 Prepare the compressed air supply, open valve - check the correct working pressure of 6 bar
- 5 Check that the EMERGENCY-STOP switch is unlocked (option)
- 6 Energize the AC3 Thermal System TS010 by turning the main switch to position ON
- 7 Press the «Reset / Power On» button to start the AC3 Thermal System TS010

5.2.2 Switching the AC3 Thermal System TS010 Off

- 1 Switch off the AC3 Thermal System TS010 by turning the main switch to position OFF.
- 2 Close the compressed air supply line at the main valve.

5.2.3 Restarting Operation after an EMERGENCY-STOP (option)

Perform the following steps to restart operation after an EMERGENCY-STOP:

- 1 Eliminate the danger which prompted activation of the EMERGENCY-STOP button
- 2 Check to make sure that the AC3 Thermal System TS010 is safe and ready for operation. See Chapter 5.2.1 Switching the AC3 Thermal System TS010 On Page 47, steps 2, 3, and 4.
- 3 Unlock the EMERGENCY-STOP button by turning it clockwise.
- 4 Press the «Reset / Power On» button.

5.3 Navigation map



Fig. 5-2 Navigation map

5.4 Menu Screens

5.4.1 Operation Main screen

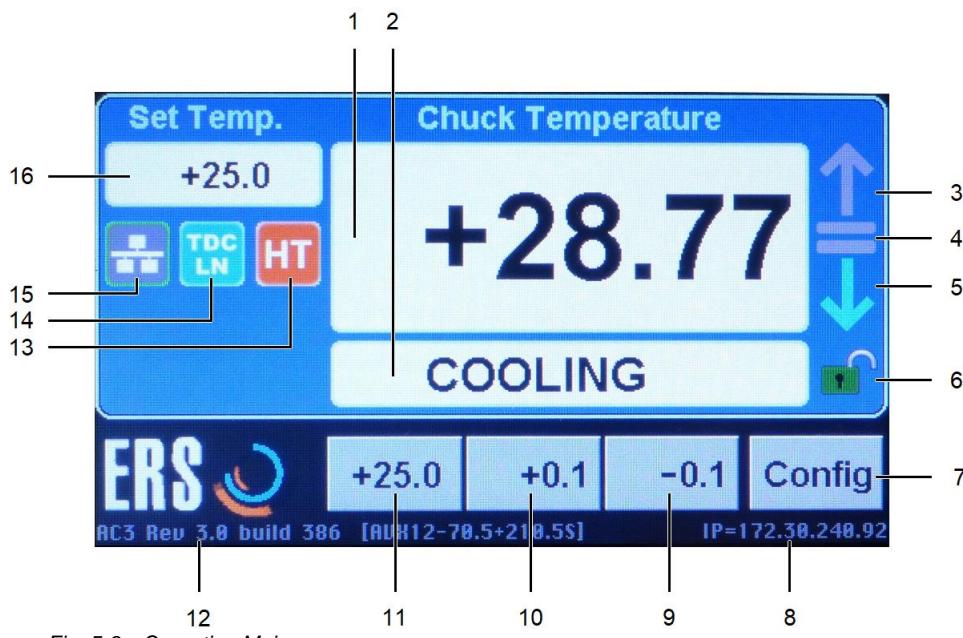


Fig. 5-3 Operation Main screen

Elements of the Operation Main screen:

1 Present Value (PV) or "Chuck Temperature":

This field shows the chucks present temperature. In case the chuck temperature is compensated using a compensation table or command, two temperature values are displayed. The first line (bigger font) shows the compensated temperature whereas the second line (smaller font) shows the uncompensated temperature.

2 Operation mode / Control status /Error Message area:

This field shows the Operation Modes, Control Status and Error messages. Operation Modes include BOOT, INIT, AUTO, Go to Standby, Standby Mode, Hold Mode, Defrost Mode and Purge Mode. Control States are HEATING, COOLING and CONTROLLING.

3 Red arrow upwards: indicates that the device is heating up.

4 This symbol turns green when the chuck temperature has reached the set temperature and it is stable within $\pm 0.25^{\circ}\text{C}$ range. It flashes when the chuck temperature is within control range but yet steady or when the user has activated the Hold Mode.

5 Blue arrow downwards: indicates that the device is cooling down.

6 Lock/unlock sign:

The screen can be locked by sending a special command to the controller. The symbol shows an open lock in green if the user can operate the controller manually. If the prober sends a command to lock the touch screen the symbol changes to a red closed lock.

7 Config: Press this button to access the configuration windows.

8 TCP/IP Address.

The controllers are preconfigured to 172.30.240.x with 255.255.0.0 subnet mask. The IP-Address can be changed in the user configuration menu. Access to the configuration Menu is password protected. It must be entered before making changes.

9 Button 2:

Button 1 and Button 2 can be configured to set temperatures, step values or Hold Mode. Refer to the section "Option Button Configuration Screen"

10 Button 1:

Button 1 and Button 2 can be configured to set temperatures, step values or Hold Mode. Refer to the section "Option Button Configuration Screen".

11 "25°C" quick set button:

Press this button to set the Temperature to 25°C.

12 Software Release Version

13 Shows the active "Thermal system Usage Mode", see Special Controller Modes Screen.

14 This field displays the configured Temperature Dynamic Control Mode. There are three control modes; Low Noise (TDC LN), Standard (TDC STD) and Progressive Mode (TDC PRR).

15 This symbol shows the probe-controller communication activity. It turns blue when communicating otherwise remains gray.

16 "Set Temperature":

This field displays the Set Value (SV). Touch this field to open the temperature input window.

5.4.2 Temperature Input screen

After touching the area „Set Temperature“ the display shows the Temperature input screen.

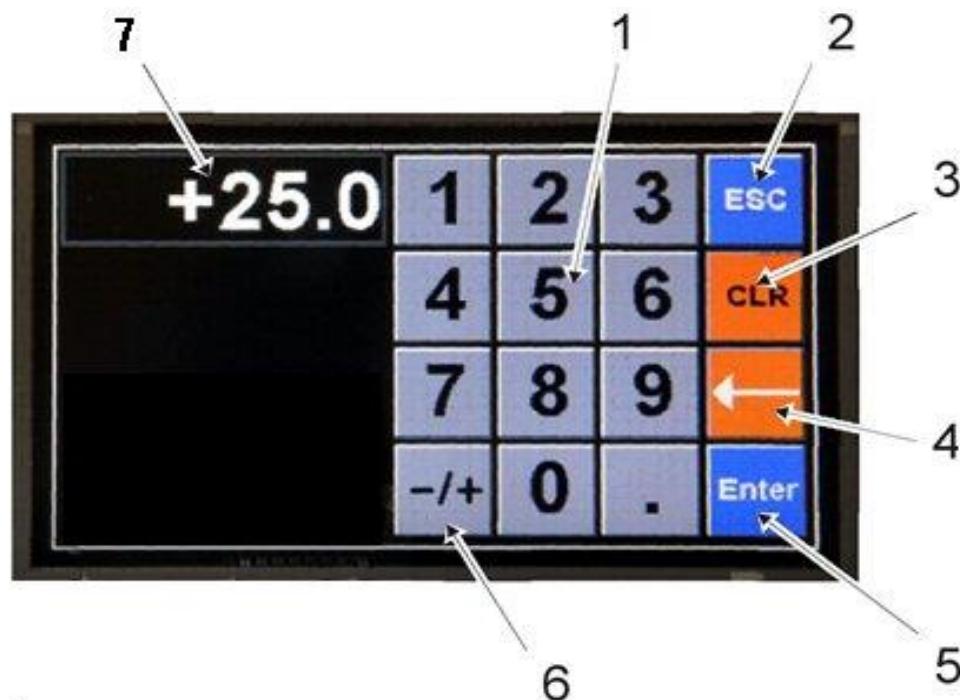


Fig. 5-4 Temperature input screen

Elements of the Temperature Input Screen:

- 1 Numeric Touch Pad for entering a new Set Value.
- 2 ESC: discard input and return to main screen.
- 3 CLR: Delete entered value.
- 4 Back key. Delete the last entered value.
- 5 Enter: Confirm input and return to main screen
- 6 \pm Key: Toggle between negative and positive input.
- 7 Input field

5.4.3 Configuration screen

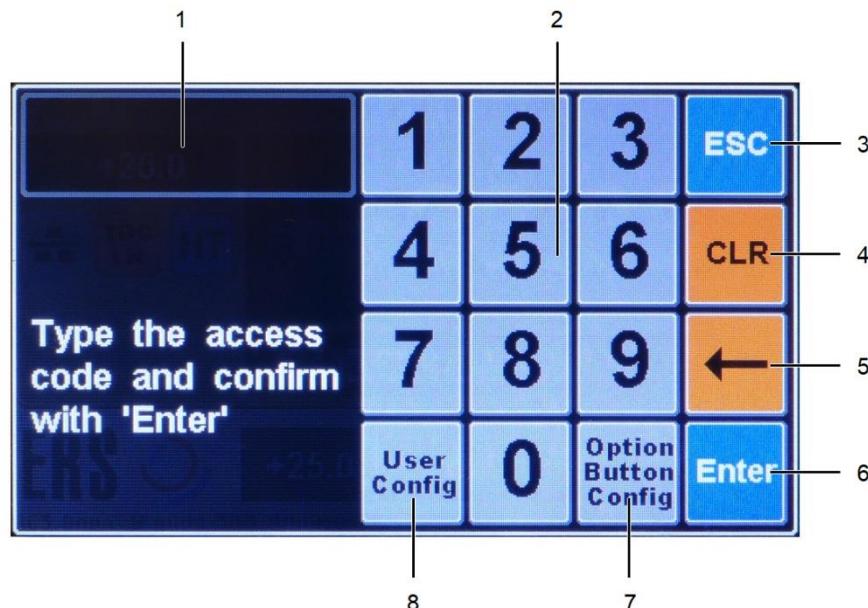


Fig. 5-5 Configuration screen

Elements of the Configuration screen:

- 1 Input field.
- 2 Numeric touch pad for the input of pin codes (for service personnel only).
- 3 ESC: Return to Main Screen
- 4 CLR: Delete entered pin code
- 5 Back key: Delete the last entered digit
- 6 “Enter”: confirm the input
- 7 “Option Button Config” Opens the Option Button Configuration screen, see Fig 4-6
- 8 “User Config” opens the Special Controller Modes screen, see Fig 4-7

5.4.4 Option Button Configuration Screen

In the Main Screen press "Config" to open the "Configuration" screen.

Press "Option Button Config" to access the "Option Button Configuration" menu.

The changes made here affect the buttons described under Chapter 5.4.1 Operation Main screen, page 49. These buttons can be configured to either represent offsets to a set temperature or to offer buttons to select / activate the hold modes.

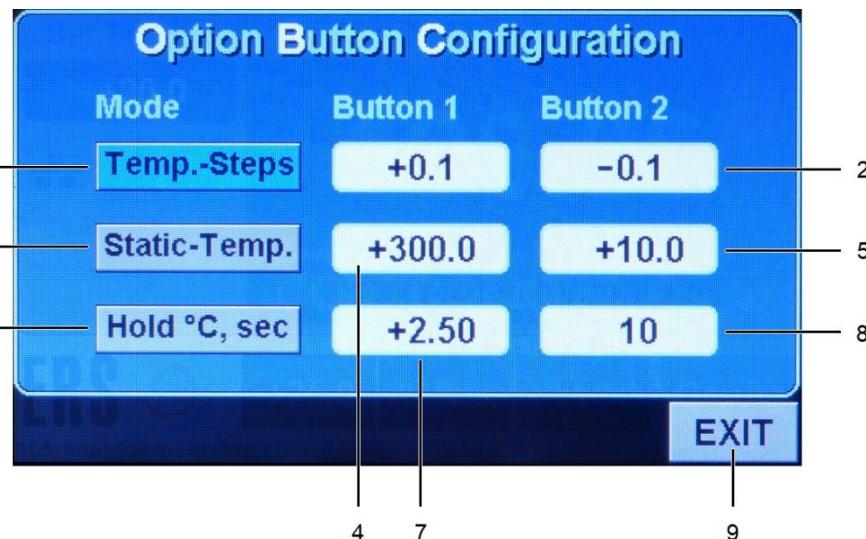


Fig. 5-6 Option Button Configuration screen

Elements of the Option Button Configuration screen:

- 1 "Temp Steps" Touch to select the Temperature step mode

Select this mode to configure "Button 1" and "Button 2" with the same offset value.

Button 1 will be preset with the positive offset and Button 2 will be preset with the negative value. Useful when the temperature has to be increased or decreased by small steps.

- 2 Touch this field to open an Input Window. The minimum and maximum values are -9.9°C and +9.9°C respectively n. The Buttons 1 and 2 will reflect your changes.

- 3 "Static Temp.": Touch to select the static temperature mode.

- 4 Field to enter preset temperature for "Button 1"

- 5 Field to enter preset temperature for "Button 2".

- 6 "Hold" Touch to select the hold selection mode

Touch this field to enter the deviation range in which the hold mode will stay active. If the temperature drifts away more than this value the system will go into controlling mode. the allowed values are within 0.25 and 9.99. See also the **RHR** interface command

- 7 Touch this field to enter the delay (waiting) time before the hold mode gets active. Allowed values between 10 seconds and 999 seconds (16.67 minutes) the default value is 60 seconds. See also the **RDT** interface command

- 8 Press the "Exit" Button to save the entered values and return to the main screen.

The Buttons 1 and 2 will reflect your changes

5.4.5 Special Controller Modes Screen

Touching the button „User Config“ opens the “Special Controller Modes” Screen.

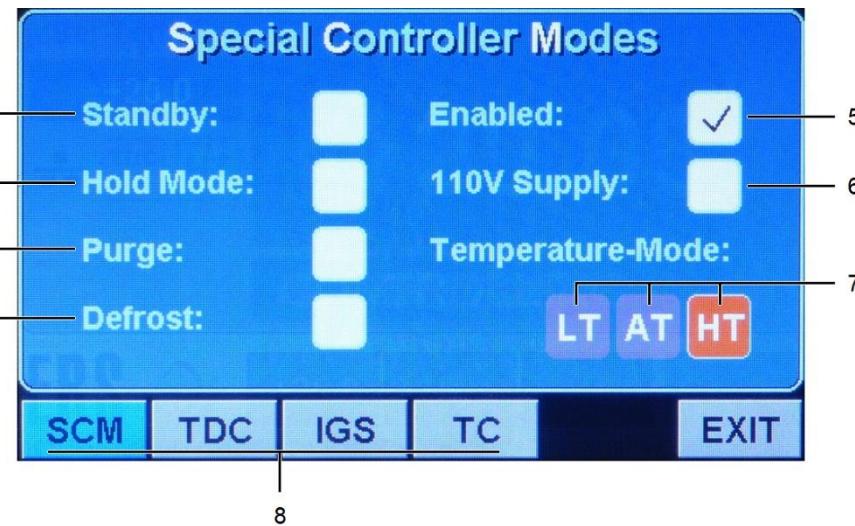


Fig. 5-7 Special Controller Modes screen

Elements of the "Special Controller Modes" screen:

Each mode will be activated and deactivated by touching the required white field. The activated mode is marked in a check box. When exiting the "Special Controller Modes" screen the operation main screen displays the activated mode in the Status / Message area.

- 1 Stand by. Activates or deactivates “Stand by” Mode, see Standby Mode,
- 2 Hold Mode, see Hold Mode
- 3 Purge Mode (optionally), see Purge Mode,
- 4 Defrost Mode (optionally), see Defrost Mode,
- 5 Enable / disable temperature control (must be on to operate)
- 6 No use with TS010 systems
- 7 Three different operating modes may be selected:

LT Low Temperature Mode

- Refrigeration is permanently on immediate cooling power available
- waste of energy when no cooling is needed
- recommended for frequent temperature cycling.

AT Automatic Mode

- At set temperatures above 50° C the refrigeration is turned off
- For lower set temperatures the refrigeration is turned on
- Energy saving, recommended as standard mode

HT High Temp Mode

- The refrigeration is permanently off
- Hot only mode, for lower temperatures AT or LT must be selected
- Recommended for longtime high temp testing

-
- 8** Tabs to switch between user configuration modes:
- "SCM": Special Controller Modes Screen, the active screen
- "TDC": switches to Temperature Dynamic Control Screen,
- "SCC" "SCC": switches to System Check Control Screen,
(This button and screen is optional)
- "TC": switches to "Temperature Compensation Tables",
- "CDCS": switches to Loop Dew Point Control Screen,
(This button and screen is optional)

5.4.6 Close Loop Dew point control screen (Optional)

This screen will be present if an optional dew point sensor installed.

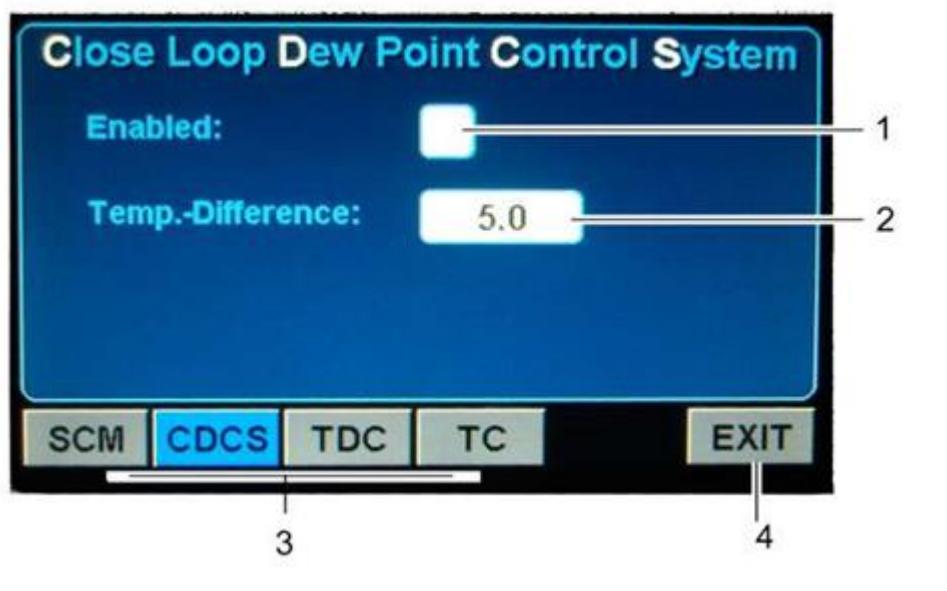


Fig. 5-8 Close Loop point Control screen

Elements of the Close Loop Dew Point Control screen:

- 1 Enable / disable "Close loop Dew Point Control System".
- 2 Opens the Temperature Input Screen. This value determines how close the chuck temperature is allowed to approach the dew point temperature.
- 3 Tabs to switch between user configuration modes. See Chapter 5.4.5 Special Controller Modes Screen, page 54.
- 4 "EXIT": Returns to operation main screen.

Close Loop Dew Point Control

The AC3 Thermal System provides a dew point closed loop system to avoid any ice-formation on the wafer.

Condensation of moisture or ice-formation will occur if the chuck temperature is below the dew point of the ambient air. To prevent this situation, the chuck temperature may be controlled by the dew point monitoring system to ensure that the chuck temperature will not drop below the dew point of the ambient air.

The dewpoint must always be lower than the chuck temperature. To ensure that, a configurable dewpoint offset is saved on the system. A value of 0.5 to 9.9°C can be set as distance of the chuck temperature to the dew point. Thus, the chuck system will not reach a temperature set point (target temperature) that is lower than the dew point of the ambient air. The default value is 5.0°C.

To avoid condensation on the wafer and air tubes, the dewpoint in the Prober has to be constantly monitored. The monitoring evaluates dewpoint sensor results, and if required, adapts the chuck set temperature and submits warnings.

- Remote control via RS232: send the interface command «SD1» to enable, or «SD0» to disable

5.4.7 Temperature Dynamic Control screen

The Button "TDC" navigates to the Temperature Dynamic Control screen.

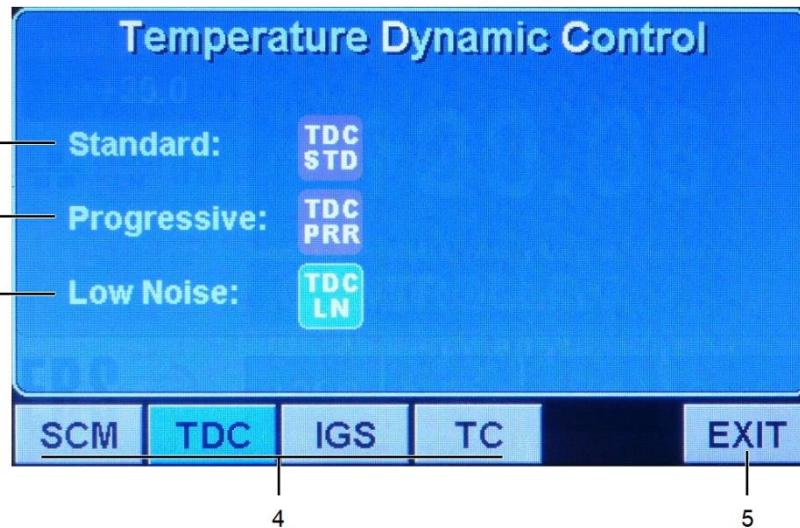


Fig. 5-9 Temperature Dynamic Control screen

Elements of the Temperature Dynamic Control screen:



The turquoise colored button is indicating the current selected mode, as well as its symbol will be shown on the operation main screen. You might switch between these modes by simply touching one of the three Buttons at the center of this screen.

1 Standard mode:

Compromise between very stable temperature controlling and minimizing the low noise distortions produced by the controller.

2 Progressive mode:

The controller tries to maintain the set temperature. No limits on current change. This controlling method is the best suited for applications that have varying power sources on the chuck.

3 Low Noise mode:

The controller limits the maximum control current allowed to stabilize the chuck temperature. This controlling method is best suited for low noise measurements. The controller will react slowly to external influences to the chuck.

Please refer to "Hold Mode" for further low noise stability.

4 Tabs to switch between user configuration modes. See Chapter 5.4.5 Special Controller Modes Screen, page 54.

5 "EXIT": Returns to operation main screen

5.4.8 Temperature Compensation Tables screen.

The Button "TC" navigates to the Temperature Compensation Tables screen.

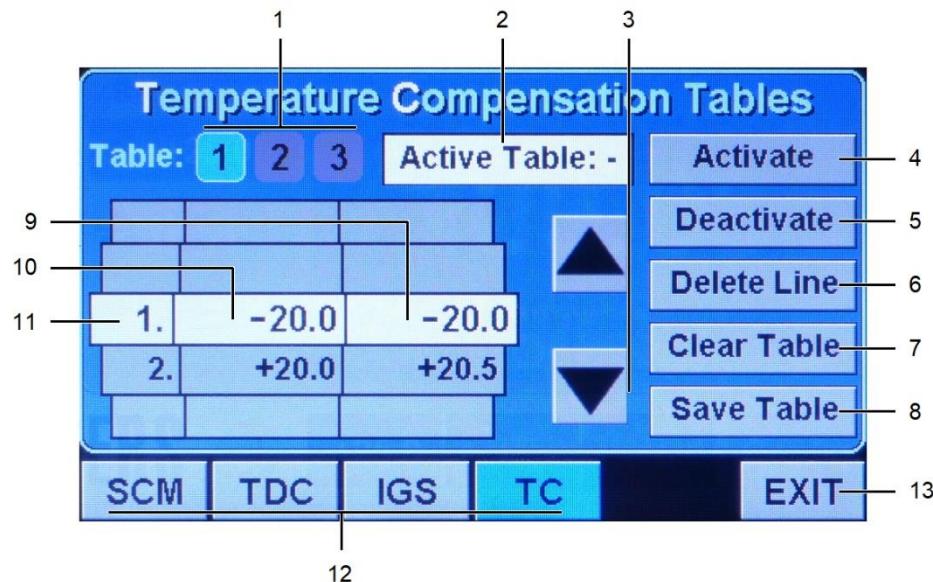


Fig. 5-11 Temperature Compensation Tables screen

Elements of the Temperature Compensation Tables screen:

- 1 Table numbers: Selects the required temperature compensation table.
- 2 Indicates the Active Table.
- 3 Scroll keys: Scrolls the lines in selected temperature compensation table up or down.
- 4 "Activate": Activates the selected temperature compensation table.
- 5 "Deactivate": Deactivates the selected temperature compensation table.
- 6 "Delete Line": Deletes the highlighted line in selected temperature compensation table
- 7 "Clear Table": Deletes all lines in selected temperature compensation table.
- 8 "Save Table": Saves table values.
- 9 Compensation value. Touch this area to input or change the value. The maximum offset to the set value is $\pm 9,99^{\circ}\text{C}$.
- 10 Value to be compensated. Touch this area to input or change value.
- 11 The high-highlighted line that is being edited.
- 12 Tabs to switch between user configuration modes. See Chapter 5.4.5 Special Controller Modes Screen, page 54
- 13 "EXIT": Returns to operation main screen

5.4.9 System Setup screen

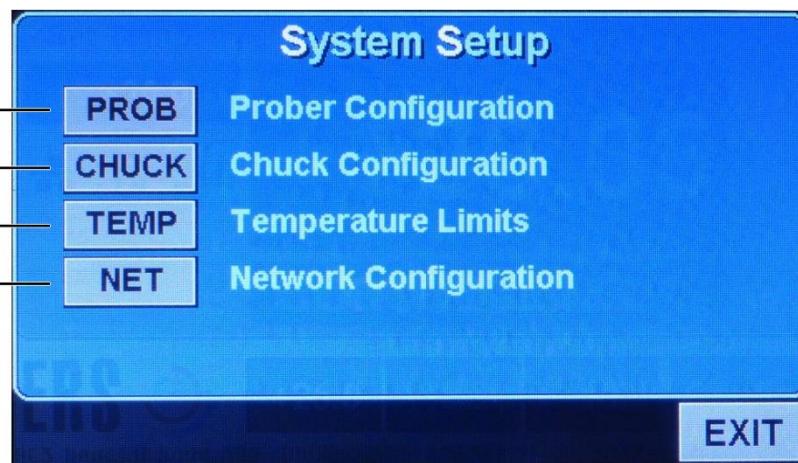


Fig. 5-12 System Setup screen

- 1 Button to enter Prober Configuration
- 2 Button to enter Chuck Configuration
- 3 Button to enter Temperature Limits Setup
- 4 Button to enter Network Configuration

5.4.10 Chuck Configuration screen

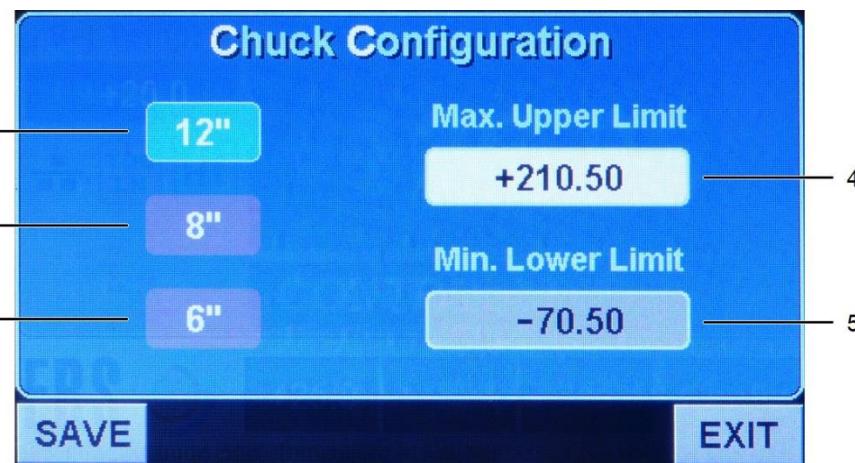


Fig. 5-13 Chuck Setup screen

- 1 Chuck diameter of 12 inch
Touch the Button according to your present Chuck size.
The turquoise Colore indicates the activated Mode.
- 2 Chuck diameter of 8 inch
- 3 Chuck diameter of 6 inch
- 4 Set the maximum Upper Temperature Limit according to your Chuck model and equipment

-
- 5 The minimum Lower Temperature Limit depends on your Chiller and Chuck model

5.4.11 Temperature Limits screen



Fig. 5-14 Temperature Limits screen

- 2 Set the Upper Limit according to your work process
- 4 Set the Lower Limit according to your work process and ambience conditions, if the automated dewpoint Control isn't activated.

5.4.12 Network Configuration screen

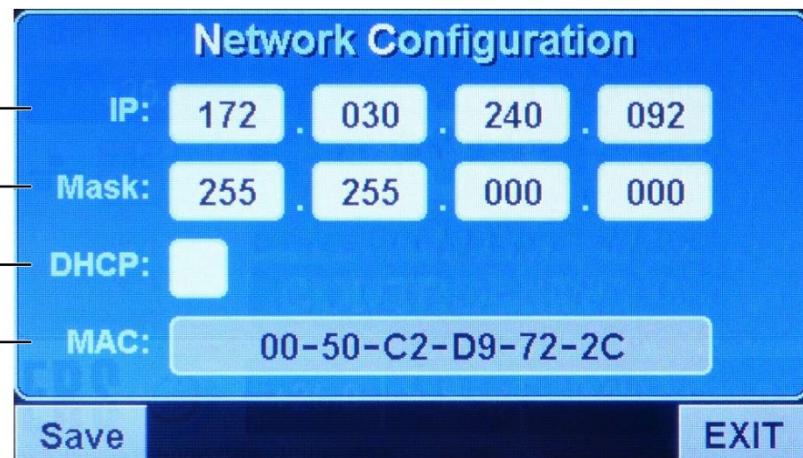


Fig. 5-15 Network Configuration screen

- 1 Set the Controllers IP address
- 2 Set the Subnet Mask
- 3 Enable/Disable Dynamic Host Configuration Protocol by checking/unchecking the Box
- 4 Mac address of your device

5.4.13 Diagnose Screen 1



Fig. 5-16 Diagnose screen 1

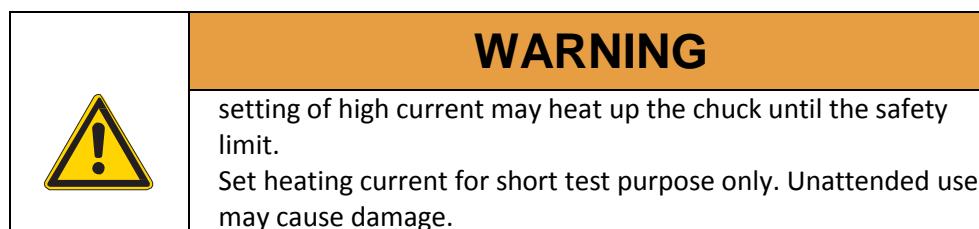
- Actual chuck temperature
- Chiller air out temperature
- Chuck base temperature (if available)
- Internal temperature of controller electronics
- Measured dew point (set to 20 if no sensor present)

5.4.14 Diagnose Screen 2



Fig. 5-17 Diagnose screen 2

- Monitors setting, voltage, and current of chuck heating circuits. Set range is 0 to 100%
- Voltage and current are depending on the chuck type connected.



- The power relay may be turned off for checking the function.
- Pressing EXIT lets the controller return to normal operating mode

5.4.15 Diagnose Screen 3

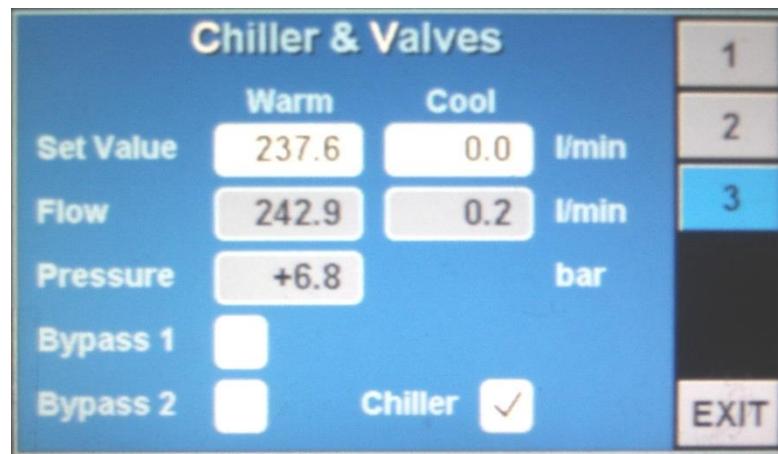


Fig. 5-18 Diagnose screen 3

- The set and measured flow rates of cold and warm(ambient) are displayed.
- Flow values may be entered for test purposes.
- Pressing EXIT lets the controller return to normal operating mode

5.5 Special Operating Modes

5.5.1 Hold Mode

To eliminate the influence of changing current through the chuck's heating system, on sensitive measurements, the AC3 Thermal System is equipped with a feature called «Hold Mode». In this mode the current and air flow are locked at the present values while Hold Mode becomes active.

When the controlling current and air flow are locked, the Chuck temperature may drift off the set Temperature.

ERS recommends to deactivate the «Hold Mode» after testing has finished.

Choose the Hold selection in the Option Button (Chapter 5.4.4) screen for an easy accessibility.

5.5.2 Auto Hold Mode (A-Hold)

Auto Hold Mode can be set by pressing A-Hold, or selecting Hold mode in the Special Controller Mode Screen or by issuing the SH1 command to the AC3 System.

A-Hold (**Auto Hold Mode**), becomes effective when the Chuck temperature has reached the set value and stabilized within a fixed Hold Mode Chuck Temperature deviation range of $\pm 1.20^{\circ}\text{C}$. The time needed to go to Hold Mode is automatically determined by the System. This time depends on the Set temperature, Prober environment, Purge air, open cover and time the System has already been at the Set Temperature. Depending on these conditions it may take several minutes (6 minutes or more), until the system goes to Hold Mode.



Fig. 5-19 Main screen Auto-Hold

The Display will show “going to Hold”

When the conditions are stable the button will turn to green and the status display will show Hold Mode.

With the interface request command RH the answer is
“H10” for Hold Mode set but not yet reached (Going to Hold)
“H11” for Hold Mode set and reached (Hold Mode)

As the conditions are stable the temperature is expected to drift away slowly. Once the temperature differs by more than $\pm 1.20^{\circ}\text{C}$, the controller will return in its "GOTO HOLD" state and is going to repeat this cycle until Hold Mode is unset.

5.5.3 Instant Hold Mode. (I-Hold)

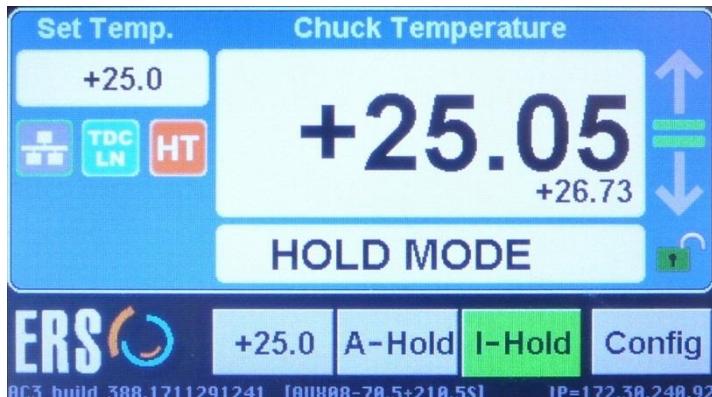


Fig. 4-20 Main screen Instant-Hold

This mode allows the Operator to set Hold Mode instantly while the following conditions are met:

The System will immediately go into Hold Mode when the Chuck temperature has been within $\pm 0.25^{\circ}\text{C}$ for a period time which is determined by the Operator in the option button setup. This can be set to 10 till 999 seconds (16.67 minutes). This mode can be activated through the Probers serial Interface or the Display Menu. Depending on the conditions the temperature may drift out of range.

Display:

While the AC3 Thermal System is in «Hold Mode» the Operation Main screen will display «Hold Mode» in the Status / Message area. The control current will not change as long as the chuck temperature is within a range from the set temperature.

NOTE!

While in «Hold Mode» the chuck temperature may very slowly drift away from the set temperature. This is normal because of the locked temperature control (no current change).

After deactivating the «Hold» operation the AC3 Thermal system will instantly start to correct to the proper temperature.

Activating the «Hold Mode»

- Touch screen input:
Press "Config" to enter "Special Controller Modes" screen and touch the check-box next to Hold Mode
- Remote control via RS232: send the command «SH1»

Deactivating the «Hold Mode»

- Touch screen input:
Press "Config" to enter "Special Controller Modes" screen and touch the check-box next to Hold Mode
- Remote control via RS232: send the command «SH0»

5.5.4 Purge Mode

The purge mode is used as initial operation of the system and in case humidity has accidentally entered the systems tubing.

In the purge mode the refrigeration unit is switched off, the chuck temperature is set to +25°C and a specific amount of dry air is purged through all pneumatic parts of the chuck and the prober.

Activating the «Purge Mode»

- Touch screen input: Press "Config" to enter "Special Controller Modes" screen and touch the checkbox next to Purge Mode

The «Purge Mode» will be displayed in the Operation Main screen at the Status / Message area

Deactivating the «Purge Mode»

- Touch screen input: Press "Config" to enter "Special Controller Modes" screen and uncheck the check-box next to Purge Mode

5.5.5 Defrost Mode

The «Defrost Mode» is provided to warm up all system parts to safe, ice and moisture free conditions.

- the chuck temperature is set +60°C
- the AC3° refrigeration system is switched off and the air purging is set to the maximum value.

Activating the «Defrost Mode»

- Touch screen input: Press "Config" to enter "Special Controller Modes" screen and touch the checkbox next to Defrost
- Remote control via RS232: send the interface command «S03»

The «Defrost Mode» will be displayed in the Operation Main screen at the Status / Message area

Deactivating the «Defrost Mode»

- Touch screen input: Press "Config" to enter "Special Controller Modes" screen and touch the checkbox next to Defrost
- Remote control via RS232: send the interface command «S01»
- Set new temperature value

5.5.6 Standby Mode

When the system is set into «Standby Mode» the heater and the cooling air are switched off. Only a purge air is supplied to the prober.

If the actual chuck temperature is below +15°C or above +40°C the system will set +25°C for safety reasons first before going to «Standby Mode».

Display

When the user or prober sets the AC3 Thermal System to «Standby Mode» the display will show „**Go to Standby**“ if the Chuck temperature is below +15°C or above +40°C. The display will change to „**Standby Mode**“ when the Chuck temperature is with +15°C - +40°C range.

NOTE!

If the Chuck temperature is in the range of +15°C to +40°C the AC3 Thermal system goes immediately to «Standby Mode»

Activating the «Standby Mode»

- Touch screen input: Press "Config" to enter "Special Controller Modes" screen and touch the check-box next to Standby
- Remote control via RS232: send the interface command «SO2»

Returning from «Standby Mode» into Regular Operation

- Touch screen input: Press "Config" to enter "Special Controller Modes" screen and touch the check-box next to Defrost
- Remote control via RS232: send the interface command «SO1»
- Set new set temperature.

5.6 Temperature Compensation

Temperature compensation is intended to eliminate a known difference between the Device Under Test (DUT) and the value shown at the AC3 Thermal System's display.

Several influences, such as wafer thickness, wafer surface, thermal conductivity, additional layers, airflow, etc. may DUT temperatures to be different from the temperature generated at the chuck surface. The AC3 Thermal System can store three different compensation tables in order to compensate for different working conditions. The user may select the compensation table 1, 2, 3, or deactivate, if no compensation is needed.

Each table may consist of up to 10 manually set temperature values with its corresponding compensation values. The AC3 Thermal System will interpolate between given compensation points. The maximum allowed compensation range is $\pm 9.9^{\circ}\text{C}$. A value pair of the compensation table consists of the set temperature and the compensated set point value. One table can contain up to 10 value pairs and it is recommended to store at least 2 value pairs, that the system can interpolate compensation offsets between these 2 values.

All temperatures between the minimum and maximum of the table values have either a stored offset or the offsets are interpolated. For set temperatures less than the table's minimum, the minimum offset is used. Likewise, for set temperatures greater than the table's maximum, the maximum offset is used accordingly.

5.6.1 Creating Compensation Tables

Entering compensation temperature values

The compensated temperature value is the temperature necessary to obtain the desired set point temperature at the measured point.

An example of a Compensation List will be shown in Chapter 9.1 Temperature compensation list, page 91.

NOTE!

If the measured chuck temperature is colder than set temperature, add the difference to obtain the compensated temperature. If warmer, subtract.

Example of interactively creating a compensation Table:

Aim: Compensate Temperature at $+85^{\circ}\text{C}$.

- 1 Attach a temperature sensor on the DUT (e. g. wafer to test, additional layer) at the top of the chuck. Connect the sensor to a calibrated temperature measuring device.
- 2 Set the Temperature on the main screen to $+85^{\circ}\text{C}$.
- 3 The controller will start heating, cooling or controlling depending on the present chuck temperature. Wait until the chuck temperature has reached the set value and the temperature has stabilized (Controlling).
- 4 Note the actual value of your temperature measuring device (e.g. 84.5°C) and its corresponding set value (e.g. $+85^{\circ}\text{C}$). While $+85^{\circ}\text{C}$ is the value to be compensated (left column on the TC screen), -0.5°C is the measured offset and $+0.5^{\circ}\text{C}$ is the required

action, so +85.5°C is your compensation input value (right column on the TC screen)

- 5 Set a new value and repeat the steps (1) till (4) to create a list of pair values, that can be entered into a Temperature Compensation Table.

5.6.2 Define a new compensation table

Proceed as follows to define a new compensation table.

- 1 Select the compensation table n by selecting the Config → User Config → TC screen
- 2 Select the table (1, 2, or 3) you want to edit (see Fig 4-9)
- 3 Touch the “set field” (active row) to open the input windows, insert the compensation value and confirm with “Enter”, to return to the compensation table. If you don't want to compensate the value, just enter the same value in both fields.
- 4 Select the next row by using the up and down buttons. Repeat step 3 for all rows you want to edit.
- 5 To delete a line, press "Delete Line"
- 6 To delete a complete table press "Clear Table".
- 7 Press "Save Table" to store the table

5.6.3 Using Compensation Table

Selecting a Compensation Table

- Select the compensation table n by selecting the Config → User Config → TC screen (See Chapter 5.4.7, Page 57)
- Select the table number and press “Activate”.
- The operation main screen (See Chapter 5.4.1 Operation Main screen, page 49) shows now in the first line the compensated DUT temperature and in a small second line the actual chuck temperature value.

Disabling Temperature Compensation

- Select the compensation table n by selecting the Config → User Config → TC screen (See Chapter 5.4.1 Operation Main screen, page49).
- Press “Deactivate”

5.7 Remote Control via RS232

On delivery the RS232 interface is preconfigured according to the customer's prober maker and model. Only an ERS® Service can change this configuration. Therefore, customers cannot change this configuration.

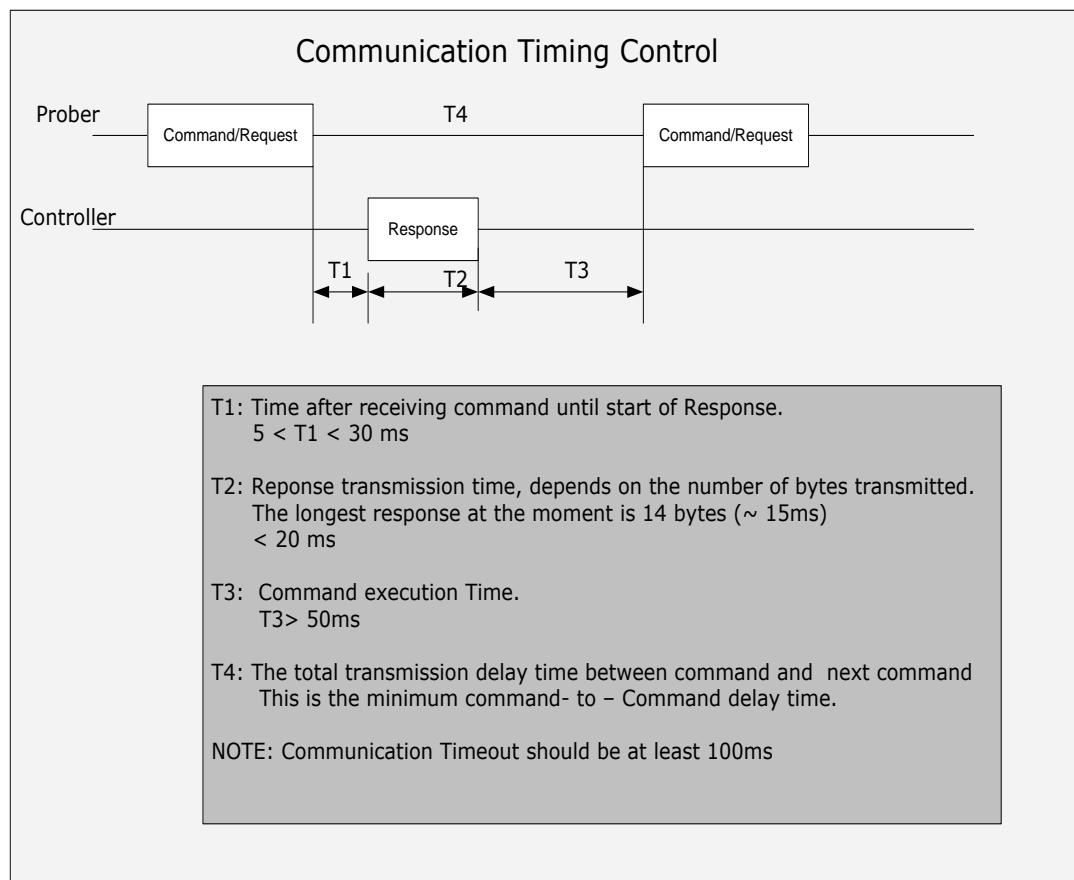
5.7.1 Command Interface

The AC3 Thermal system is able to support several transmission protocols among which are ASCII <CR><LF>; <ENQ><ACK> and other binary protocols.

Default is ASCII <CR><LF>.

5.7.2 Command Timing

The Prober commands have to be synchronized with the Responses from the Controller. This means that the Prober has to wait for a Response from the ERS Controller before issuing the next command or Request. ERS recommends that the Prober has to observe a Timeout delay between a command or request and a Response from an ERS AC3 System.



communication Timing defined by ERS

The controller will not respond to new commands or request while a command is executed. Wait for the response of a command and at least 100ms after a set command before addressing the controller again.

See Appendix (9.1) for more details

5.7.3 Sending Commands via RS232

All ASCII Protocols have the same command format embedded between control codes.
The commands listed below are supported by all ERS® AC3 Systems.
The response messages are examples of ERS® Standard <CR><LF> protocol.

NOTE!

All commands must be written in capital letters.

Response from Controller to valid Request Commands:
"Response"<CR><LF> otherwise: "?"<CR><LF>

(s = + or -, x or y= digit 0 – 9)

Command	Description	Answer
STsxxxx	Set new set temperature [1/10 °C resolution] i.e. ST+0305 sets +30.5°C as new set temperature	OK: New temperature accepted ?: Error during transmission or invalid temperature
SOy	Set Operating Mode y = 1: set normal mode operation y = 2: set standby mode y = 3: set defrost mode y = 4: set purge mode	OK: New mode is accepted ?: Mode Invalid or not possible
SLy	Keyboard lock y = 0: release keyboard lock y = 1: set keyboard lock	OK: command is accepted ?: command not accepted
SR+xx-yy	Set deviation range for status display «=> and RI-Request answer «0» <ul style="list-style-type: none">• +xx: max. positive deviation in 1/10°C• -yy: max. negative deviation in 1/10°C Example: SR+12-08 sets the range from set temperature +1.2°C to set temperature -0.8°C	OK: command is accepted ?: command not accepted
SHy	Set «Hold Mode» ON or OFF <ul style="list-style-type: none">• y = 0: deactivate Hold Mode• y = 1: Activate Hold Mode	OK: command is accepted ?: command not accepted
SIHy	Activate Instant Hold Mode <ul style="list-style-type: none">• y = 0: deactivate instant Hold Mode• y = 1: Activate instant Hold Mode	OK: command is accepted ?: command not accepted
SDTnnn	Set Hold Mode Delay Time nnn = 010..999 Seconds Default: 60 seconds for Instant Hold Mode, 360s (6 Min) for Auto Hold Mode	OK: command is accepted ?: command not accepted
SHRnnn	Set Hold Mode Temperature Range nnn=025 .. 999 (0.25°C .. 9.99°C) default: 1.2°C Valid for both modes	OK: command is accepted ?: command not accepted
SCIn	Initialize the compensation process with table n (n = 1, 2, 3) See Chapter Entering compensation temperature values	OK: command is accepted ?: command not accepted
SCPn; vxxxx; vyyyy	Define the compensation table position n (n = 0 through 9) <ul style="list-style-type: none">• xxxx: set temperature• yyyy: compensated temperature	OK: command is accepted ?: command not accepted

	See Chapter Entering compensation temperature values	
SCS	Save the selected compensation table in EEPROM	OK: command is accepted ?: command not accepted
SCC	Close the compensation process	OK: command is accepted ?: command not accepted
SCT0	Disable temperature compensation	OK: command is accepted ?: command not accepted
SCTn	Select and activate the temperature compensation table n (n = 1, 2, 3)	OK: command is accepted ?: command not accepted
SDX	command «SD1» to enable, or «SD0» to disable close loop dewpoint control	OK: command is accepted ?: command not accepted

Tab. 5-1 RS232 Sending Commands

5.7.4 Request Commands via RS232

NOTE!

All commands must be written in capital letters otherwise the AC3 Thermal system will not accept the command and will therefore answer with «?».

(s = + or -, n or x or y = digit 0 – 9)

Command	Description	Answer
RC	Request actual temperature of Chuck [1/10°C resolution]	Csxxx example: response: C-600 (means: Thermal system temperature is -60.0°C)
RE	Request error status	Eyyy Example: E003 means that Error 03 has occurred. See Chapter 7 Troubleshooting
RF	Request measured dewpoint value	Fxxxxx Example: F-0585 (means actual dewpoint is -58.5°C)
RH	Request «Hold Mode» set / status	Hy y = 0: «Hold Mode» not active y = 1: «Hold Mode» active See Chapter 5.5.1 Hold Mode
RH Changed from firmware 330. up	Request status of automatic Hold Mode	Hy y = 00: «Hold Mode» not active y = 10: «Hold Mode» set but not yet reached yy = 11: «Hold Mode» set and reached
RIH	Request status of instant Hold Mode	IHy y = 0: instant Hold Mode not active y = 1: instant Hold Mode not active
RI	Request controlling status information	In n = 0: set temperature reached and controlling n = 1: heating up Chuck n = 2: cooling down Chuck n = 8: error
RL	Request keyboard lock status (see SL command)	Lx x = 0: keyboard is not locked x = 1: keyboard is locked
RM	Request allowed Minimum and Maximum Temperature limits	M sxxxx syyyy" xxxx = minimum set value yyyy = maximum set value that the controller can accept.
RO	Request operation mode	Oy y = 0: unit is off (not supported) y = 1: normal operation y = 2: «Standby Mode» active y = 3: «Defrost Mode»

RR	Request deviation range	R+xx-yy +xx: max. positive deviation in units of 1/10°C -yy: max. negative deviation in units of 1/10°C Example: R+05-08 means that the deviation range is set +0.5°C to 0.8°C from set temperature
RT	Request set temperature with 1/10 °C resolution	Txxxx Example: T-0105 means that the set temperature is -10.5°C
RD	Request dew point control status	Dy y = 0: dew point control is off y = 1: dew point control is on
RCT	Request temperature values of compensation table position number (n = 0 through 3)	CTn n = 0: temperature compensation disabled n = 1 or 2 or 3: active table
RCPn	Request compensation temperature pair at position n of the active table	CPn; set; setc n = 0 through 9: table position number set: set temperature setc: compensated temperature

Tab. 5-2 RS232 Request Commands

6 Maintenance and Service

6.1 Introduction

This chapter provides an overview of all the measures necessary for proper maintenance and servicing of the AC3 Thermal System TS010.

The system can be operated with a minimum of difficulty when the measures for preventive maintenance and the specified working conditions and regulations are adhered to.

6.1.1 Safety Information

NOTE!

Before carrying out maintenance and service work on the AC3 Thermal system TS010, the appointed personnel must have read and fully understood Chapter 2 Safety.

In particular, the safety instructions contained in Chapter 2.6 Residual Dangers Residual Dangers Page 22 must be strictly adhered to.

6.1.2 Personnel Qualifications

Carrying out maintenance and service work applies only to personnel who have the required technical qualifications and have received appropriate instruction and training.

6.1.3 Use of Spare Parts and Aid Materials

Spare Parts:

System parts affected by wear or defects may only be replaced by original ERS® spare parts.

Aid Materials:

The term aid materials covers all usage and cleaning materials required for the maintenance and service of the AC3 Thermal System TS010. Essentially, they are the cleaning and operating materials used.

Cleaning materials used:

- Dust-free, lint-free cloth
- Clean water, with detergent

6.2 Lockout / Tagout Procedure

Maintenance and service work can be extremely dangerous if the serviced components are not shut down, de-energized and tagout properly. Contact with live parts, the release of stored energy, or the unexpected start-up of the serviced component can cause serious injury to personnel and also damage the equipment.

These hazards can be avoided through the strict use of the tagout procedure. In short, this means that you have to shut down, de-energize and tag out the component before servicing it. In Chapter 6.2.1 Applying Lockout / Tagout Devices Page 76 this procedure will be described in detail.

6.2.1 Applying Lockout / Tagout Devices

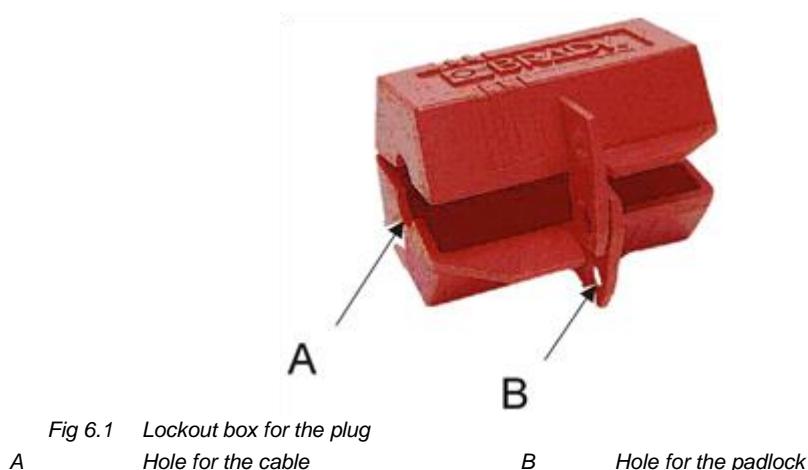
Before beginning any maintenance or service work, the following steps must be performed in the given order:

Shut down

- 1 Prepare the AC3 Thermal System TS010 for shutdown (if necessary). Also make sure that the shutdown of the AC3 Thermal System TS010 will not affect running processes.
- 2 Shut-off the compressed air inlet, disconnect the air supply, wait until all pressure is released. Watch the Pressure Monitor (see 4.5.5)
- 3 Shut off the AC3 Thermal System TS010. See Chapter 5.1 Operating Elements of the AC3 Thermal System TS010 Page 46.

Lock out

- 4 Disconnect the AC3 Thermal System TS010 from the mains
- 5 Place the plug into the lockout box. See Fig 6.1



- 6 Place the lockout box on top of the AC3 Thermal System TS010 so that is clearly seen or lock the main switch in OFF position by using a padlock.

Tag out

- 7 Post a prominent tag onto the power cord for the plug. See Fig 6.2. This tag is a warning to others that the AC3 Thermal System TS010 must not be put back into operation until the tag have been removed by the authorized person. Tags must be written in a language that can be understood by all personnel. They must contain the following information:
- A warning text or prohibitive sign
 - Name and phone number of the person in charge
 - Date and time when the component has been locked out



Fig 6.2 Front and back of a lockout tag (example)

Release stored energy

- 8 Release the compressed air of AC3 Thermal System TS010 and the supply line.
9 Allow hot parts to cool down
10 Allow moving parts to come to a standstill

Verify

- 11 Verify the isolated and de-energized state of the AC3 Thermal System TS010.

6.2.2 Removing Lockout / Tagout Device

WARNING	
	<p>Personnel who work on de-energized components may be seriously injured or killed if someone removes tagout devices and re-energizes the component without their knowledge.</p> <p>Respect tagout devices! Tags must not be removed by anyone except the person who attached them.</p>

Before removing tagout devices, the following steps must be performed:

- 1 Inspect the AC3 Thermal System TS010 to ensure that it is operationally intact and that nonessential items are removed from the area
- 2 Make sure that everyone is positioned safely and away from the component
- 3 Unlock the lockout box and remove the tag
- 4 Make sure that all employees who work with the AC3 Thermal System TS010 know that the safety box has been unlocked and that the system will be energized
- 5 Energize the AC3 Thermal System TS010. See Chapter 4.7 Initial Start-Up

6.3 Maintenance

6.3.1 Maintenance Schedule

The required maintenance work at the AC3 Thermal System TS010 must be carried out at regular intervals. In addition, you should always listen for unusual noises and pay immediate attention to any malfunction that occurs in the system during the interim period between official system inspection procedures.

Maintenance Verification

ERS® recommends that a record of all maintenance work performed on the AC3 Thermal System TS010 be kept in a logbook. This is particularly important if various different personnel are responsible for maintenance work on one system. A logbook allows the end user to keep a reliable check on the type and date of performed maintenance work.

Component	Action	Interval	Instructions
AC3 Thermal System TS010	Basic Cleaning	Weekly	See Chapter Basic Cleaning
	Cleaning Dry air filter cartridge	Process-specific	See Chapter Servicing the Dry Air Filter
	Replace Dry air filter cartridge	Process-specific at least every year	See Chapter Servicing the Dry Air Filter

Tab. 6-1 Maintenance

6.3.2 Basic Cleaning

NOTE!

Before cleaning the AC3 Thermal system TS010 shut off the power supply.

Wipe dirt off the AC3 Thermal System TS010 surface with a dust-free, lint-free cloth.

Use only a damp cloth to clean the touch screen display and use only purified water on the cloth wiring out all excess water prior to wiping the screen. Do not use any cleaners or chemicals to clean the screen. In most cases a dry dust-free, lint-free cloth will do!

Consult ERS® electronic GmbH before using a different cleaning agent

6.3.3 Servicing the Dry Air Filter

The dry air filter is a component of the air dryer unit. See Fig. Fig 3.3, The following maintenance at the dry air filter must be performed:

- Replacing the dry air filter cartridge, see Fig. Fig 6.3, and Fig. Fig 6.4,
- The dry air filter cartridge has to be replaced every 12 months.

Proceed as follows to replace the filter cartridge:

- 1 Shut off the compressed air supply and release the pressure.

WARNING	
	Compressed air system. It is dangerous to open or damage a pressurized system part. It can lead to serious eye or skin damage. Shut off the supply to the AC3 Thermal System TS010 and release the pressure before carrying out any work on these parts.

- 2 Lockout / Tagout the AC3 Thermal System TS010,
See Chapter 6.2.1 Applying Lockout / Tagout Devices Page 76
- 3 Remove the right rear cover of the AC3 Thermal System TS010.
- 4 Unscrew the cap of the dry air filter by turning it counterclockwise and remove it.
See Fig. Fig 6.3



Fig 6.3 Removing the cover of the dry air filter

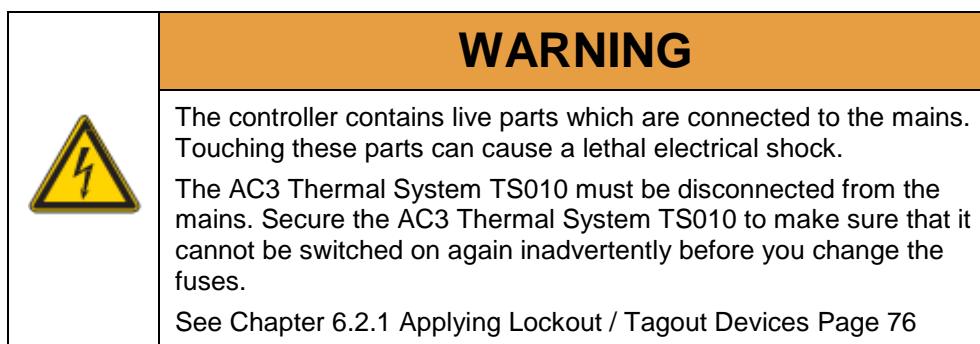
-
- 5 Pull out the filter cartridge and remove it. See Fig 6.4



Fig 6.4 Removing the filter cartridge

- 6 Install the dry air filter cartridge and close air dry filter in reverse order.
- 7 Reinstall cover.
- 8 Remove Lockout / Tagout Devices, See Chapter 6.2.2 Removing Lockout / Tagout Device Page 78
- 9 Shut on the compressed air.
- 10 Switch on the electrical power of AC3 Thermal System TS010

6.3.4 Changing Fuses



The AC3 Thermal System TS010 is equipped with two safety fuses, four automatic fuse and one GFCI. These fuses are easy to access at the rear side of the AC3 Thermal System TS010. See Fig 6.5

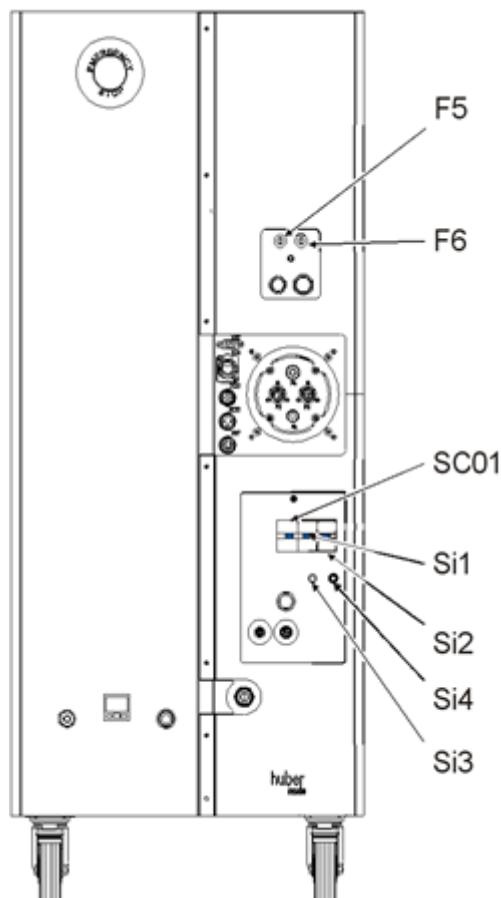


Fig 6.5 Location of the fuses at the AC3 Thermal System TS010 bakside

The fuses F5 and F6 can be changed by means of a screwdriver. Only use the fuses listed:

- F5 T8A250V L 8.00 Amp. TYPE time lag ERS 2001628
- F6 T8A250V L 8.00 Amp. TYPE time lag ERS 2001628

Tab 6.2 Fuses to be used all operating voltages

7 Troubleshooting

7.1 Error Messages and Recovery

If an error message is displayed a dead-end error has occurred. To reset the error condition cycle power switch off the AC3 Thermal System TS010.

If you cannot solve the problem by means of the descriptions in the following table, contact ERS® electronic GmbH to get further assistance.

Error message	Problem	Possible causes and recovery
ERR01 OVER TEMP	The Chuck temperature has passed the maximum temperature limit by more than 2°C.	Power source is out of control Reset the error when the temperature has dropped below the maximum value. If the error returns power supply or wiring is defective
ERR04 CHUCKCABLE	The Chuck sensor cable is broken or the Chuck sensor is defective.	Check the Chuck sensor cable for damages. Check the Chuck sensor resistances
ERR07 BASE SENSOR	The base sensor cable is broken or the base sensor is defective.	Check the Chuck sensor cable for damages. Check the Chuck sensor resistances
Dewpoint Warning	The dew point is too close to the Chuck temperature. Chuck temperature waits for better dew point	Too little purge air or bad sealing. Check purge air supply and check prober sealing
ERR17 DEWP. ALARM	The dew point changed abruptly	Prober cover opened. Close prober cover.
ERR18 DEWP. SENSOR	Dew Point Sensor not connected or defect.	Check dew point cable and Sensor.
ERR61 OVERCUR CH1	The protective circuit has detected too much current to the Chuck heater No. 1. The AC3 Controller will shut off the Chuck power supply.	Switch the AC3 Controller Off, then ON again. Check CN4 for short circuit. If the error appears again replace power supply.
ERR62 PWR DEF CH1	Power Supply defect. The protective circuit measures no voltage and current.	Switch the AC3 Controller Off. Check and replace fuse. If the error appears again replace power supply.
ERR63 UNDERCUR CH1	The protective circuit has detected too low current in Channel 1. The circuit can measure voltage, but no current.	Check Cable to Chuck. Check Chuck resistance Check fuses F5 and F6
ERR70 INTERNAL TEMP	The AC3 Controller internal temperature is too high (> 60°C)	Check air inlet on bottom side for obstructions. Check cooling fans. Switch the AC3 Controller Off, then ON again
ERR72 SAFETY SHUTDOWN	The Chuck temperature has exceeded the maximum allowed limit and the Safety Switch has switched off controlling power source. (Dead end error)	Power source is out of control Switch the AC3 Controller Off, then ON again after Chuck cool down.

ERR81 OVERCUR CH2	The protective circuit has detected too much current to the Chuck heater No.2. The AC3 Controller will shut off the Chuck power supply.	Switch the AC3 Controller Off, then ON again. Check CN4 for short circuit. If the error appears again replace power supply.
ERR82 PWR DEF CH2	Power Supply defect. The protective circuit measures no voltage and current.	Switch the AC3 Controller Off. Check and replace fuse. If the error appears again replace power supply.
ERR83 UNDERCUR CH2	The protective circuit has detected too low current in Channel 2. The circuit can measure voltage, but no current.	Check Cable to Chuck. Check Chuck resistance Check fuses F5 and F6
ERR97 AIR PRESS LOW	Air pressure low. Warning Message The controller does not stop	Check air supply

7.2 Wiring of AC3 Thermal System TS010

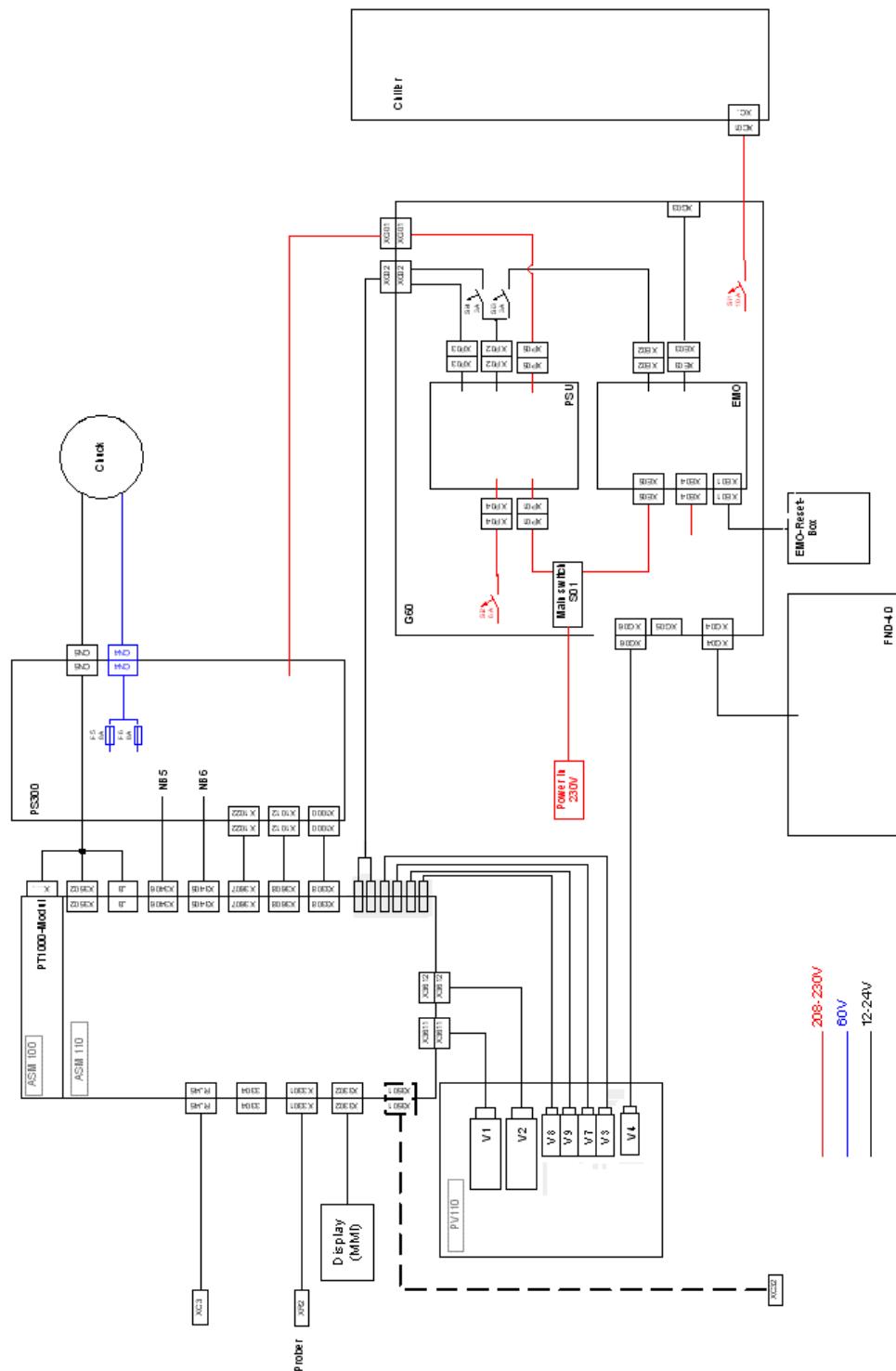


Fig 7.1 Block diagram of AC3 Thermal System TS010

7.3 Block diagram of Power Supplies

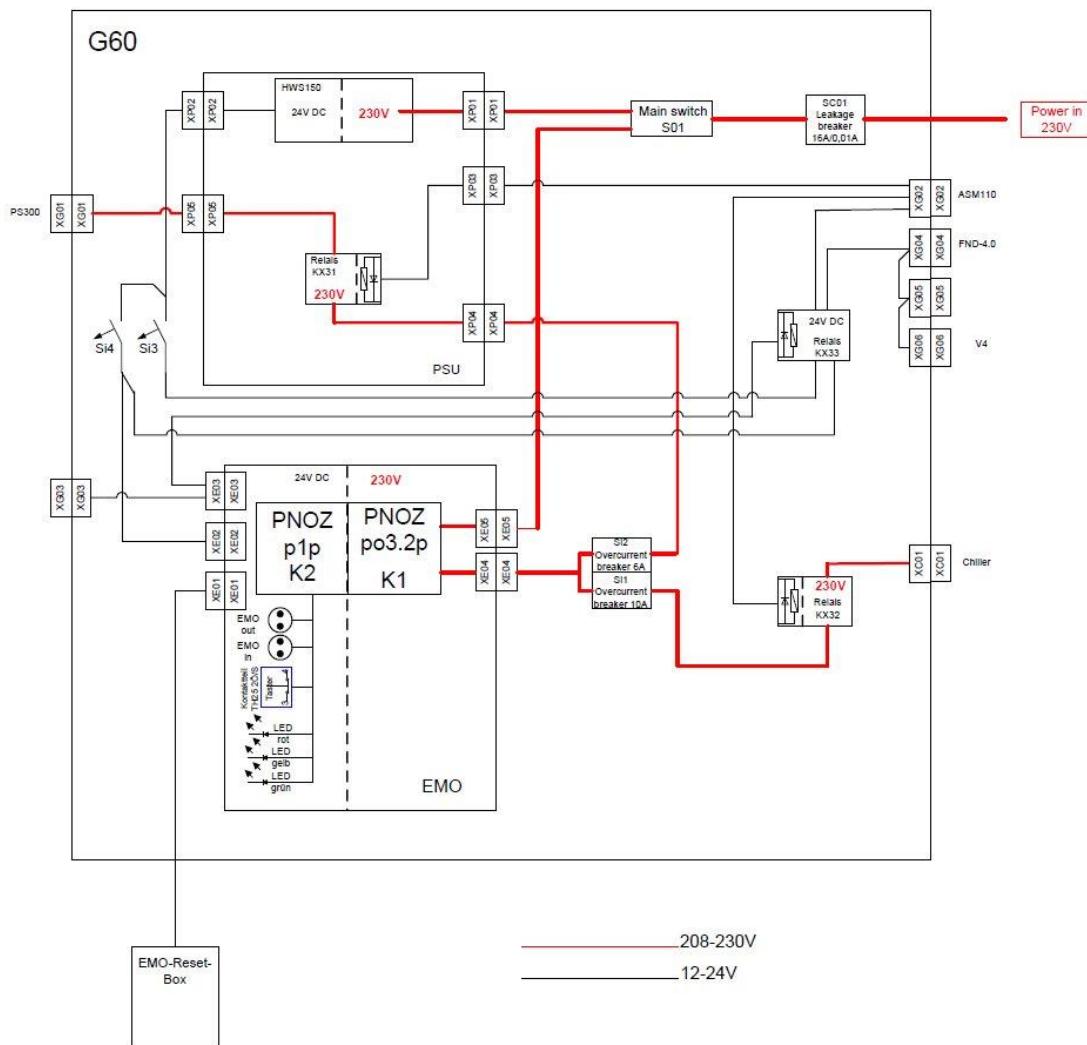


Fig 7.2 Block diagram of power supplies

8 Storage, Disposal

8.1 Safety Regulations

Read Chapter 2 Safety Page 12, before you dispose of the system or put it into storage. Adhere to the danger notes which appear in this chapter.

8.2 Storage

The AC3 Thermal System TS010 may only be stored in its original packaging. You must note the packaging symbols and adhere to the following storage conditions:

Storage Conditions:

Temperature	0 through 60 °C
Relative humidity	20 - 60% (non-condensing)

Tab 8.1 Storage conditions

Required Space:

AC3 Thermal System TS010	Approx. 900 mm x 620 mm x 1230 mm (35.4" x 24.4" x 48.4")
--------------------------	--

Tab 8.2 Required space for storage

8.2.1 Deactivating the System

- 1 Switch off the AC3 Thermal System TS010. See Chapter 5.1 Operating Elements of the AC3 Thermal System TS010 Page 46.
- 2 Disconnect the AC3 Thermal System TS010 from the mains supply.
- 3 Cover the system with plastic foil to protect it from dust.

8.3 Disposal

8.3.1 Personnel Qualifications

The end user can recycle or dispose of the system in accordance with the legal regulations. For the proper dismantling of the system and the sensible separation of materials, you require wide knowledge of mechanical work and in differentiating between waste materials.

NOTE!

ERS® electronic GmbH offers cost free recycling of the AC3 Thermal System TS010. For using this option send the AC3 Thermal System TS010 carriage paid to:

**ERS electronic GmbH
Stettiner Straße 3
82110 Germering.**

All components must be stored in its original packaging and declared with a recycling order.

Additional Qualifications

If dangerous materials as defined by guideline 91/689/EWG are being disposed of, the persons carrying out the work require additional knowledge in the following areas:

- Risks and dangers
- Disposal regulations
- Accident prevention regulations
- First aid measures

8.3.2 Statutory Basis

Responsibilities:

The end user is responsible for correct disposal of the AC3 Thermal System TS010. End users can either hand over the system to a licensed private or public disposal company or they can recycle the unit themselves or dispose of it in accordance with the pertinent regulations.

NOTE!

If the end user hands over the AC3 Thermal System TS010 to a disposal company, then he/she must also forward a copy of this User Manual to the company in question. This User Manual contains important information which is required for system disposal.

Obligation to Register:

Companies that dispose of and recycle their own waste material must be officially licensed to do so and are subject to official supervision. They can, under certain circumstances, be exempted from the obligatory license, provided that they are in a position to meet the demands for protection of the environment. These companies are obliged to register. For further information, contact the departmental office competent for environmental protection.

Environmental Statutes:

Waste material must be recycled or disposed of in a manner which does not present a health hazard. Use only procedures and methods which do not cause damage to the environment. In particular, make sure that

- Air, water and ground are not contaminated
- Flora and fauna are not endangered
- Irritation from noise and odors does not occur
- Environment and landscape are not adversely affected

Classification:

Subsequent to dismantling the system, you must sort the individual system parts into their respective waste categories. Do this in accordance with the classifications contained in the current European Waste Catalog (EWC) or other similar statutes. The EWC catalog is valid for all waste material irrespective of intention; i.e. if the material is destined for disposal or recycling.

Administration of Waste Material:

Adhere to the official handling and administration plans which outline the procedure for dealing with waste material. These plans comprise the following:

- Type, amount and origin of waste material
- General technical regulations
- Special arrangements for specific waste products
- Suitable regions for dumping grounds and other disposal installations

The plans also include the following information:

- Natural persons and legal entities who have authorization to deal with waste material
- The estimated costs for recycling and disposal
- Measures which can be implemented to rationalize collection, sorting and handling of waste material
- Identification labels for hazardous waste

8.3.3 Disposal of Assemblies and Components

Metals and Alloys

- Aluminum (casing, cover plates, etc.)
- Copper (electric lines)
- Steel (profiles, mounting materials such as screws, etc.)
- Stainless steel

Glass

- Glass cover plates
- Glass plates in display instruments

Synthetic Material and Rubber

- Synthetic material (command elements, tubing, casing, etc.)
- Rubber (seals, silicon tubing)

Composite Material

- Electrical material (cables, motors, components)
- Electronic material (printed circuit boards)

Packaging

- Wood (packing cases)
- Styrofoam (packing material)
- Plastic (foil)
- Iron (nails, etc.)

9 Appendix

9.1 Temperature compensation list

Compensation Table No.	Set temp. °C	Measured temp. °C	Temp. diff. °C	Action required °C	Comp. temp. input value °C
example	85	84.5	-0.5	+0.5	85.5
example	85	85.5	+0.5	-0.5	84.5
1 - 01					
1 - 02					
1 - 03					
1 - 04					
1 - 05					
1 - 06					
1 - 07					
1 - 08					
1 - 09					
1 - 10					
2 - 01					
2 - 02					
2 - 03					
2 - 04					
2 - 05					
2 - 06					
2 - 07					
2 - 08					
2 - 09					
2 - 10					

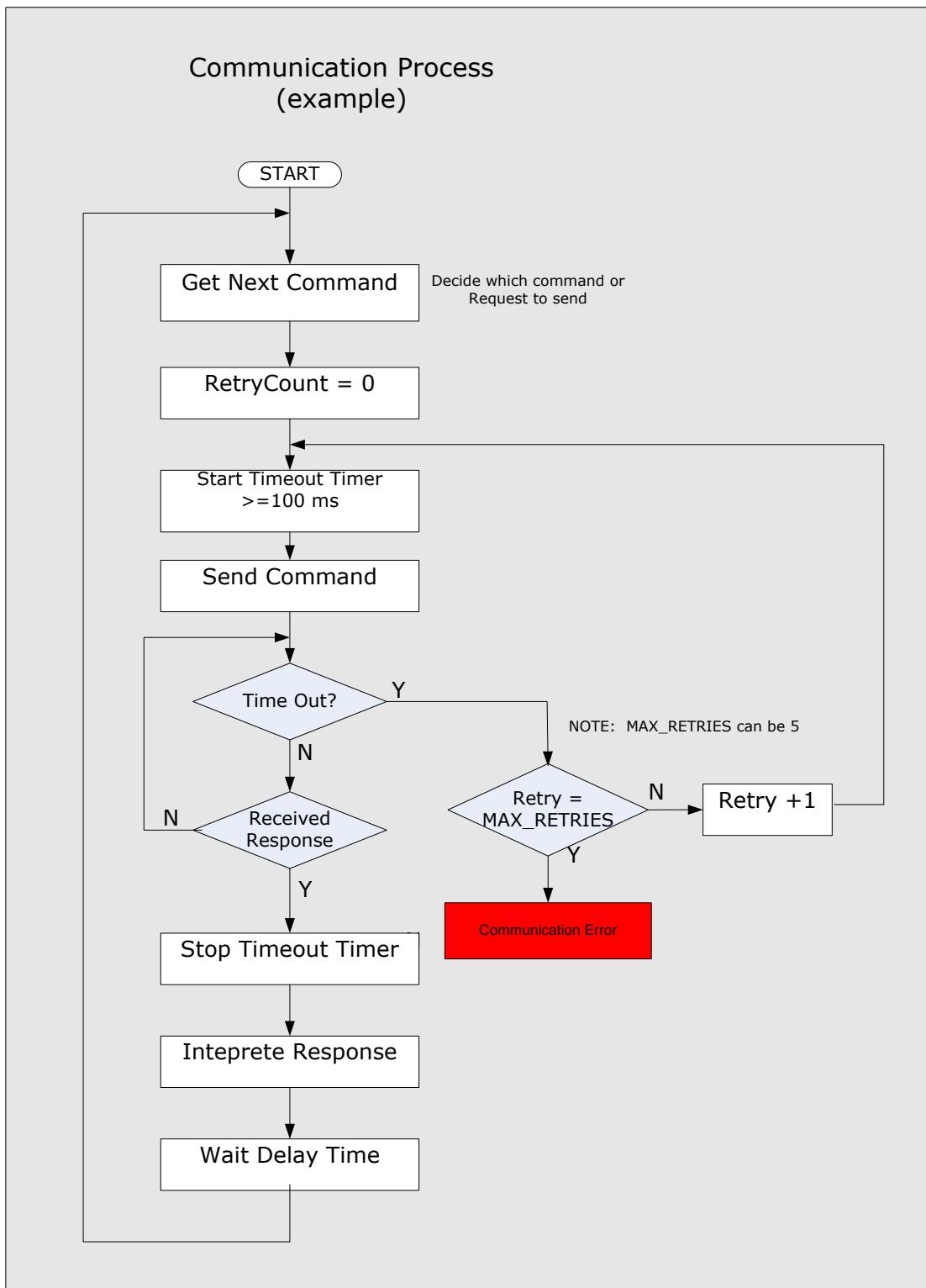
9.2 Resistance Values of Pt100 Sensors

Resistance values from -60 °C up to +299 °C in Ohm.

°C	0	1	2	3	4	5	6	7	8	9
-60	76,33	76,73	77,12	77,52	77,92	78,32	78,72	79,12	79,51	79,91
-50	80,31	80,70	81,10	81,50	81,89	82,29	82,69	83,08	83,48	83,88
-40	84,27	84,67	85,06	85,46	85,85	86,25	86,64	87,04	87,43	87,83
-30	88,22	88,62	89,01	89,41	89,80	90,19	90,59	90,98	91,37	91,77
-20	92,16	92,55	92,95	93,34	93,73	94,13	94,52	94,91	95,30	95,69
-10	96,09	96,48	96,87	97,26	97,65	98,05	98,44	98,83	99,22	99,61
0	100,00	100,39	100,78	101,17	101,56	101,95	102,34	102,73	103,12	103,51
10	103,90	104,68	104,68	105,07	105,46	105,85	106,24	106,63	107,02	107,40
20	107,79	108,18	108,57	108,96	109,35	109,73	110,12	110,51	110,90	111,28
30	111,67	112,06	112,45	112,83	113,22	113,61	113,99	114,38	114,77	115,15
40	115,54	115,93	116,31	116,70	117,08	117,47	117,85	118,24	118,63	119,01
50	119,40	119,78	120,17	120,55	120,93	121,32	121,70	122,09	122,47	122,86
60	123,24	123,62	124,01	124,39	124,77	125,16	125,54	125,92	126,31	126,69
70	127,07	127,45	127,84	128,22	128,60	128,98	129,37	129,75	130,13	130,51
80	130,89	131,27	131,66	132,04	132,42	132,80	133,18	133,56	133,94	134,32
90	134,70	135,08	135,46	135,84	136,22	136,60	136,98	137,36	137,74	138,12
100	138,50	138,88	139,26	139,64	140,02	140,40	140,77	141,15	141,53	141,91
110	142,29	142,66	143,04	143,42	143,80	144,18	144,55	144,93	145,31	145,68
120	146,06	146,44	146,81	147,19	147,57	147,94	148,32	148,70	149,07	149,45
130	149,82	150,20	150,58	150,95	151,33	151,70	152,08	152,45	152,83	153,20
140	153,58	153,95	154,32	154,70	155,07	155,45	155,82	156,19	156,57	156,94
150	157,32	157,69	158,06	158,44	158,81	159,18	159,55	159,93	160,30	160,67
160	161,04	161,42	161,79	162,16	162,53	162,90	163,27	163,65	164,02	164,39
170	164,76	165,13	165,50	165,87	166,24	166,61	166,98	167,35	167,72	168,10
180	168,47	168,83	169,20	169,57	169,94	170,31	170,68	171,05	171,42	171,79
190	172,16	172,53	172,90	173,26	173,63	174,00	174,37	174,74	175,10	175,47
200	175,86	176,22	176,59	176,96	177,33	177,69	178,06	178,43	178,79	179,16
210	179,53	179,89	180,26	180,63	180,99	181,36	181,72	182,09	182,46	182,82
220	183,19	183,55	183,92	184,63	184,65	185,01	185,38	185,74	186,11	186,47
230	186,84	187,20	187,56	187,93	188,29	188,66	189,02	189,38	189,75	190,11
240	190,47	190,84	191,20	191,56	191,92	192,29	192,65	193,01	193,37	193,74
250	194,10	194,46	194,82	195,18	195,55	195,91	196,27	196,63	196,99	197,35
260	197,71	198,07	198,43	198,79	199,15	199,51	199,87	200,23	200,59	200,95
270	201,31	201,67	202,03	202,39	202,75	203,11	203,47	203,83	204,19	204,55
280	204,90	205,26	205,62	205,98	206,34	206,70	207,05	207,41	207,77	208,13
290	208,48	208,84	209,20	209,56	209,91	210,27	210,63	210,98	211,34	211,70

9.1 Example of a synchronized Communication

synchronized communication with Timeout, and Error handling



Recommendation:

Since the Chuck Temperature doesn't change very fast, it's not necessary to request the Chuck Temperature every few milliseconds. It is enough if every 100 ms or better every second a request is sent to the Controller.

9.2 Temperature Conversion Table °C ↔ °F

°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F
25	77	71	159.8	117	242.6	163	325.4	209	408.2	255	491
26	78.8	72	161.6	118	244.4	164	327.2	210	410	256	492.8
27	80.6	73	163.4	119	246.2	165	329	211	411.8	257	494.6
28	82.4	74	165.2	120	248	166	330.8	212	413.6	258	496.4
29	84.2	75	167	121	249.8	167	332.6	213	415.4	259	498.2
30	86	76	168.8	122	251.6	168	334.4	214	417.2	260	500
31	87.8	77	170.6	123	253.4	169	336.2	215	419	261	501.8
32	89.6	78	172.4	124	255.2	170	338	216	420.8	262	503.6
33	91.4	79	174.2	125	257	171	339.8	217	422.6	263	505.4
34	93.2	80	176	126	258.8	172	341.6	218	424.4	264	507.2
35	95	81	177.8	127	260.6	173	343.4	219	426.2	265	509
36	96.8	82	179.6	128	262.4	174	345.2	220	428	266	510.8
37	98.6	83	181.4	129	264.2	175	347	221	429.8	267	512.6
38	100.4	84	183.2	130	266	176	348.8	222	431.6	268	514.4
39	102.2	85	185	131	267.8	177	350.6	223	433.4	269	516.2
40	104	86	186.8	132	269.6	178	352.4	224	435.2	270	518
41	105.8	87	188.6	133	271.4	179	354.2	225	437	271	519.8
42	107.6	88	190.4	134	273.2	180	356	226	438.8	272	521.6
43	109.4	89	192.2	135	275	181	357.8	227	440.6	273	523.4
44	111.2	90	194	136	276.8	182	359.6	228	442.4	274	525.2
45	113	91	195.8	137	278.6	183	361.4	229	444.2	275	527
46	114.8	92	197.6	138	280.4	184	363.2	230	446	276	528.8
47	116.6	93	199.4	139	282.2	185	365	231	447.8	277	530.6
48	118.4	94	201.2	140	284	186	366.8	232	449.6	278	532.4
49	120.2	95	203	141	285.8	187	368.6	233	451.4	279	534.2
50	122	96	204.8	142	287.6	188	370.4	234	453.2	280	536
51	123.8	97	206.6	143	289.4	189	372.2	235	455	281	537.8
52	125.6	98	208.4	144	291.2	190	374	236	456.8	282	539.6
53	127.4	99	210.2	145	293	191	375.8	237	458.6	281	541.4
54	129.2	100	212	146	294.8	192	377.6	238	460.4	284	543.2
55	131	101	213.8	147	296.6	193	379.4	239	462.2	285	545

Tab 9.1 Temperature Conversation table °C ↔ °F

9.3 Conversion PSI → bar

PSI	bar	PSI	bar	PSI	bar	PSI	bar
5	0.34	65	4.48	125	8.61	185	12.75
10	0.69	70	4.82	130	8.96	190	13.09
15	1.03	75	5.17	135	9.30	195	13.44
20	1.38	80	5.51	140	9.65	200	13.78
25	1.72	85	5.86	145	9.99	205	14.12
30	2.07	90	6.20	150	10.34	210	14.47
35	2.41	95	6.55	155	10.68	215	14.81
40	2.76	100	6.89	160	11.02	220	15.16
45	3.10	105	7.23	165	11.37	225	15.50
50	3.45	110	7.58	170	11.71	230	15.85
55	3.79	115	7.92	175	12.06	235	16.19
60	4.13	120	8.27	180	12.40	240	16.54

Tab 9.2 Pressure conversion table PSI → bar

9.4 Conversion bar → PSI

bar	PSI	bar	PSI	bar	PSI	bar	PSI
1	14.50	5	72.52	9	130.53	13	188.54
1.5	21.75	5.5	79.77	9.5	137.78	13.5	195.79
2	29.01	6	87.02	10	145.03	14	203.04
2.5	36.26	6.5	94.27	10.5	152.28	14.5	210.29
3	43.51	7	101.52	11	159.53	15	217.55
3.5	50.76	7.5	108.77	11.5	166.78	15.5	224.80
4	58.01	8	116.02	12	174.04	16	232.05
4.5	65.26	8.5	123.28	12.5	181.29		

Tab 9.3 Pressure conversion table bar → PSI

9.5 Safety Data Sheets

On the following pages you find the safety data sheets of:

- R170 Ethane
- R507



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Ethane**Safety Data Sheet P-4592**

according to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Date of issue: 01/01/1979 Revision date: 02/23/2015 Supersedes: 05/01/2009

SECTION: 1. Product and company identification**1.1. Product identifier**

Product form	:	Substance
Name	:	Ethane
CAS No	:	74-84-0
Formula	:	C ₂ H ₆

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the substance/mixture	:	Industrial use. Use as directed.
------------------------------	---	----------------------------------

1.3. Details of the supplier of the safety data sheet

Praxair, Inc.
 39 Old Ridgebury Road
 Danbury, CT 06810-5113 - USA
 T 1-800-772-9247 (1-800-PRAXAIR) - F 1-716-879-2146
www.praxair.com

1.4. Emergency telephone number

Emergency number	:	Onsite Emergency: 1-800-645-4633
------------------	---	----------------------------------

CHEMTREC, 24hr/day 7days/week — Within USA: 1-800-424-9300, Outside USA: 001-703-527-3887 (collect calls accepted, Contract 17729)

SECTION 2: Hazards identification**2.1. Classification of the substance or mixture****Classification (GHS-US)**

Flam. Gas 1 H220
 Compressed gas H280

2.2. Label elements**GHS-US labeling****Hazard pictograms (GHS-US)**

GH502

GH504

Signal word (GHS-US)

:

DANGER

Hazard statements (GHS-US)

:

H220 - EXTREMELY FLAMMABLE GAS

H280 - CONTAINS GAS UNDER PRESSURE; MAY EXPLODE IF HEATED

OSHA-H01 - MAY DISPLACE OXYGEN AND CAUSE RAPID SUFFOCATION.

CGA-HG04 - MAY FORM EXPLOSIVE MIXTURES WITH AIR

CGA-HG01 - MAY CAUSE FROSTBITE.

Precautionary statements (GHS-US)

:

P202 - Do not handle until all safety precautions have been read and understood

P210 - Keep away from heat, Open flames, sparks, hot surfaces. - No smoking

P271+P403 - Use and store only outdoors or in a well-ventilated place.

P377 - Leaking gas fire: Do not extinguish, unless leak can be stopped safely

P381 - Eliminate all ignition sources if safe to do so

CGA-PG05 - Use a back flow preventive device in the piping.

CGA-PG12 - Do not open valve until connected to equipment prepared for use.

CGA-PG06 - Close valve after each use and when empty.

CGA-PG11 - Never put cylinders into unventilated areas of passenger vehicles.

CGA-PG02 - Protect from sunlight when ambient temperature exceeds 52°C (125°F).

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2.3. Other hazards

Other hazards not contributing to the classification : Contact with liquid may cause cold burns/frostbite.

2.4. Unknown acute toxicity (GHS-US)

No data available

SECTION 3: Composition/information on ingredients

3.1. Substance

Name	Product identifier	%
Ethane (Main constituent)	(CAS No) 74-84-0	100

3.2. Mixture

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

- | | |
|---------------------------------------|---|
| First-aid measures after inhalation | : Remove victim to uncontaminated area wearing self contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing stopped. |
| First-aid measures after skin contact | : For exposure to liquid, immediately warm frostbite area with warm water not to exceed 105°F (41°C). Water temperature should be tolerable to normal skin. Maintain skin warming for at least 15 minutes or until normal coloring and sensation have returned to the affected area. In case of massive exposure, remove clothing while showering with warm water. Seek medical evaluation and treatment as soon as possible. |
| First-aid measures after eye contact | : Immediately flush eyes thoroughly with water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. Contact an ophthalmologist immediately. |
| First-aid measures after ingestion | : Ingestion is not considered a potential route of exposure. |

4.2. Most important symptoms and effects, both acute and delayed

No additional information available

4.3. Indication of any immediate medical attention and special treatment needed

None.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : Carbon dioxide, Dry chemical, Water spray or fog.

5.2. Special hazards arising from the substance or mixture

- | | |
|------------------|---|
| Fire hazard | : EXTREMELY FLAMMABLE GAS. If venting or leaking gas catches fire, do not extinguish flames. Flammable vapors may spread from leak, creating an explosive reignition hazard. Vapors can be ignited by pilot lights, other flames, smoking, sparks, heaters, electrical equipment, static discharge, or other ignition sources at locations distant from product handling point. Explosive atmospheres may linger. Before entering an area, especially a confined area, check the atmosphere with an appropriate device. |
| Explosion hazard | : EXTREMELY FLAMMABLE GAS. Forms explosive mixtures with air and oxidizing agents. |
| Reactivity | : No reactivity hazard other than the effects described in sub-sections below. |

5.3. Advice for firefighters

- | | |
|--|--|
| Firefighting instructions | : Evacuate all personnel from the danger area. Use self-contained breathing apparatus (SCBA) and protective clothing. Immediately cool containers with water from maximum distance. Stop flow of gas if safe to do so, while continuing cooling water spray. Remove ignition sources if safe to do so. Remove containers from area of fire if safe to do so. On-site fire brigades must comply with OSHA 29 CFR 1910.156 and applicable standards under 29 CFR 1910 Subpart L—Fire Protection. |
| Protection during firefighting | : Compressed gas: asphyxiant. Suffocation hazard by lack of oxygen. |
| Special protective equipment for fire fighters | : Standard protective clothing and equipment (Self Contained Breathing Apparatus) for fire fighters. |

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Specific methods

: Use fire control measures appropriate for the surrounding fire. Exposure to fire and heat radiation may cause gas containers to rupture. Cool endangered containers with water spray jet from a protected position. Prevent water used in emergency cases from entering sewers and drainage systems.

Stop flow of product if safe to do so.

Use water spray or fog to knock down fire fumes if possible.

Do not extinguish a leaking gas flame unless absolutely necessary. Spontaneous/explosive re-ignition may occur. Extinguish any other fire.

Other information

: Containers are equipped with a pressure relief device. (Exceptions may exist where authorized by DOT.).

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures

: Forms explosive mixtures with air. Immediately evacuate all personnel from danger area. Use self-contained breathing apparatus where needed. Remove all sources of ignition if safe to do so. Reduce vapors with fog or fine water spray, taking care not to spread liquid with water. Shut off flow if safe to do so. Ventilate area or move container to a well-ventilated area. Flammable vapors may spread from leak and could explode if reignited by sparks or flames. Explosive atmospheres may linger. Before entering area, especially confined areas, check atmosphere with an appropriate device.

6.1.1. For non-emergency personnel

No additional information available

6.1.2. For emergency responders

No additional information available

6.2. Environmental precautions

Try to stop release. Prevent waste from contaminating the surrounding environment. Prevent soil and water pollution. Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements.

6.3. Methods and material for containment and cleaning up

No additional information available

6.4. Reference to other sections

See also sections 8 and 13.



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SECTION 7: Handling and storage**7.1. Precautions for safe handling**

Precautions for safe handling

: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Use only non-sparking tools. Use only explosion-proof equipment.

Wear leather safety gloves and safety shoes when handling cylinders. Protect cylinders from physical damage; do not drag, roll, slide or drop. While moving cylinder, always keep in place removable valve cover. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. Never insert an object (e.g., wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Slowly open the valve. If the valve is hard to open, discontinue use and contact your supplier. Close the container valve after each use; keep closed even when empty. Never apply flame or localized heat directly to any part of the container. High temperatures may damage the container and could cause the pressure relief device to fail prematurely, venting the container contents. For other precautions in using this product, see section 16.

All piped systems and associated equipment must be grounded.

Leak-check system with soapy water; never use a flame.

May cause anesthetic effects.

Avoid breathing gas.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions

: Store only where temperature will not exceed 125°F (52°C). Post "No Smoking or Open Flames" signs in storage and use areas. There must be no sources of ignition. Separate packages and protect against potential fire and/or explosion damage following appropriate codes and requirements (e.g., NFPA 30, NFPA 55, NFPA 70, and/or NFPA 221 in the U.S.) or according to requirements determined by the Authority Having Jurisdiction (AHJ). Always secure containers upright to keep them from falling or being knocked over. Install valve protection cap, if provided, firmly in place by hand when the container is not in use. Store full and empty containers separately. Use a first-in, first-out inventory system to prevent storing full containers for long periods. For other precautions in using this product, see section 16.

OTHER PRECAUTIONS FOR HANDLING, STORAGE, AND USE: When handling product under pressure, use piping and equipment adequately designed to withstand the pressures to be encountered. Never work on a pressurized system. Use a back flow preventive device in the piping. Gases can cause rapid suffocation because of oxygen deficiency; store and use with adequate ventilation. If a leak occurs, close the container valve and blow down the system in a safe and environmentally correct manner in compliance with all international, federal/national, state/provincial, and local laws; then repair the leak. Never place a container where it may become part of an electrical circuit.

7.3. Specific end use(s)

None.

SECTION 8: Exposure controls/personal protection**8.1. Control parameters**

Ethane (74-84-0)	
ACGIH	Not established
USA OSHA	Not established

8.2. Exposure controls

Appropriate engineering controls

: An explosion-proof local exhaust system is acceptable. Local exhaust and general ventilation must be adequate to meet exposure standards. Mechanic (general) engineering controls: Use only in a closed system. Closed system, ventilation, explosion-proof electrical equipment and lighting.

Hand protection

: Wear working gloves when handling gas containers.



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Eye protection	: Wear safety glasses with side shields. Wear safety glasses with side shields or goggles when transfilling or breaking transfer connections.
Respiratory protection	: When workplace conditions warrant respirator use, follow a respiratory protection program that meets OSHA 29 CFR 1910.134, ANSI Z88.2, or MSHA 30 CFR 72.710 (where applicable). Use an air-supplied or air-purifying cartridge if the action level is exceeded. Ensure that the respirator has the appropriate protection factor for the exposure level. If cartridge type respirators are used, the cartridge must be appropriate for the chemical exposure (e.g., an organic vapor cartridge). For emergencies or instances with unknown exposure levels, use a self-contained breathing apparatus (SCBA). Self contained breathing apparatus (SCBA) or positive pressure airline with mask are to be used in oxygen-deficient atmospheres.
Thermal hazard protection	: None necessary.
Environmental exposure controls	: Refer to local regulations for restriction of emissions to the atmosphere.
Other information	: Consider the use of flame resistant anti-static safety clothing. Wear safety shoes while handling containers.

SECTION 9: Physical and chemical properties**9.1. Information on basic physical and chemical properties**

Physical state	: Gas
Appearance	: Colorless gas.
Molecular mass	: 30 g/mol
Color	: Colorless.
Odor	: Stenchant often added.
Odor threshold	: No data available
pH	: Not applicable.
Relative evaporation rate (butyl acetate=1)	: No data available
Relative evaporation rate (ether=1)	: Not applicable.
Melting point	: -183 °C
Freezing point	: No data available
Boiling point	: -88 °C
Flash point	: -135 °C TCC
Critical temperature	: 32.4 °C
Auto-ignition temperature	: 515 °C
Decomposition temperature	: No data available
Flammability (solid, gas)	: 3 - 12.5
Vapor pressure	: 3780 kPa
Critical pressure	: 4872 kPa
Relative vapor density at 20 °C	: No data available
Relative density	: 0.54
Specific gravity / density	: 0.506 - 0.583 g/cm³ (at 15 °C)
Relative gas density	: 1
Solubility	: Water: 61 mg/l
Log Pow	: 1.81
Log Kow	: Not applicable.
Viscosity, kinematic	: Not applicable.
Viscosity, dynamic	: Not applicable.
Explosive properties	: Not applicable.
Oxidizing properties	: None.
Explosive limits	: No data available

9.2. Other information

Gas group	: Compressed gas
Additional information	: Gas/vapor heavier than air. May accumulate in confined spaces, particularly at or below ground level.

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SECTION 10: Stability and reactivity**10.1. Reactivity**

No reactivity hazard other than the effects described in sub-sections below.

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

May occur.

10.4. Conditions to avoid

Keep away from heat/sparks/open flames/hot surfaces. – No smoking.

10.5. Incompatible materials

Oxidizing agents. Chlorine dioxide. Chlorine. Chlorine dioxide and ethane explode spontaneously; chlorine and ethane mixtures have been known to explode.

10.6. Hazardous decomposition products

At high temperature and low pressure, ethane decomposes to form hydrogen. Thermal decomposition may produce : Carbon dioxide. Carbon monoxide.

SECTION 11: Toxicological information**11.1. Information on toxicological effects**

Acute toxicity : Not classified

Ethane (f)74-84-0

LC50 inhalation rat (mg/l)	658 mg/l/4h
ATE US (vapors)	658.000 mg/l/4h
ATE US (dust, mist)	658.000 mg/l/4h

Skin corrosion/irritation	: Not classified pH: Not applicable.
Serious eye damage/irritation	: Not classified pH: Not applicable.
Respiratory or skin sensitization	: Not classified
Germ cell mutagenicity	: Not classified
Carcinogenicity	: Not classified
Reproductive toxicity	: Not classified
Specific target organ toxicity (single exposure)	: Not classified
Specific target organ toxicity (repeated exposure)	: Not classified
Aspiration hazard	: Not classified

SECTION 12: Ecological information**12.1. Toxicity**

Ecology - general : No ecological damage caused by this product.

12.2. Persistence and degradability**Ethane (74-84-0)**

Persistence and degradability : The substance is biodegradable. Unlikely to persist.

12.3. Bioaccumulative potential**Ethane (74-84-0)**

Log Pow : 1.81

Log Kow : Not applicable.

EN (English US)

SDS ID: P-4592

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Ethane (74-84-0)	
Bioaccumulative potential	Not expected to bioaccumulate due to the low log Kow (log Kow < 4). Refer to section 9.
12.4. Mobility in soil	
Ethane (74-84-0)	
Mobility in soil	No data available.
Ecology - soil	Because of its high volatility, the product is unlikely to cause ground or water pollution.
12.5. Other adverse effects	
Effect on ozone layer	: None.
Effect on the global warming	: No known effects from this product.
SECTION 13: Disposal considerations	
13.1. Waste treatment methods	
Waste disposal recommendations	: Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements.
SECTION 14: Transport information	
In accordance with DOT	
Transport document description	: UN1035 Ethane, 2.1
UN-No.(DOT)	: UN1035
Proper Shipping Name (DOT)	: Ethane
Department of Transportation (DOT) Hazard Classes	: 2.1 - Class 2.1 - Flammable gas 49 CFR 173.115
Hazard labels (DOT)	: 2.1 - Flammable gas
	
Additional information	
Emergency Response Guide (ERG) Number	: 115 (UN1035)
Other information	: No supplementary information available.
Special transport precautions	: Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. Before transporting product containers: - Ensure there is adequate ventilation. - Ensure that containers are firmly secured. - Ensure cylinder valve is closed and not leaking. - Ensure valve outlet cap nut or plug (where provided) is correctly fitted. - Ensure valve protection device (where provided) is correctly fitted.
Transport by sea	
UN-No. (IMDG)	: 1035
Proper Shipping Name (IMDG)	: ETHANE
Class (IMDG)	: 2 - Gases
MFAG-No	: 115
Air transport	
UN-No.(IATA)	: 1035
Proper Shipping Name (IATA)	: Ethane
Class (IATA)	: 2
Civil Aeronautics Law	: Gases under pressure/Gases flammable under pressure



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SECTION 15: Regulatory information

15.1. US Federal regulations

Ethane (74-84-0)

Listed on the United States TSCA (Toxic Substances Control Act) inventory

SARA Section 311/312 Hazard Classes

Immediate (acute) health hazard

Sudden release of pressure hazard

Fire hazard

15.2. International regulations

CANADA

Ethane (74-84-0)

Listed on the Canadian DSL (Domestic Substances List)

EU-Regulations

Ethane (74-84-0)

Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

15.2.2. National regulations

Ethane (74-84-0)

Listed on the AICS (Australian Inventory of Chemical Substances)

Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China)

Listed on the Japanese ENCS (Existing & New Chemical Substances) inventory

Listed on the Korean ECL (Existing Chemicals List)

Listed on NZIoC (New Zealand Inventory of Chemicals)

Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances)

15.3. US State regulations

Ethane(74-84-0)

U.S. - California - Proposition 65 - Carcinogens List

No

U.S. - California - Proposition 65 - Developmental Toxicity

No

U.S. - California - Proposition 65 - Reproductive Toxicity - Female

No

U.S. - California - Proposition 65 - Reproductive Toxicity - Male

No

State or local regulations

U.S. - Massachusetts - Right To Know List

U.S. - New Jersey - Right to Know Hazardous Substance List

U.S. - Pennsylvania - RTK (Right to Know) List

SECTION 16: Other information

Revision date

: 2/23/2015 12:00:00 AM



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Other information

- : When you mix two or more chemicals, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Before using any plastics, confirm their compatibility with this product.

Praxair asks users of this product to study this SDS and become aware of the product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this SDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Praxair, Inc. We believe that the information contained herein is current as of the date of this Safety Data Sheet. Since the use of this information and the conditions of use are not within the control of Praxair, Inc., it is the user's obligation to determine the conditions of safe use of the product.

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NFPA health hazard

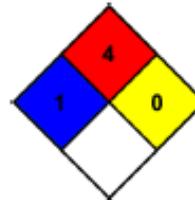
- : 1 - Exposure could cause irritation but only minor residual injury even if no treatment is given.

NFPA fire hazard

- : 4 - Will rapidly or completely vaporize at normal pressure and temperature, or is readily dispersed in air and will burn readily.

NFPA reactivity

- : 0 - Normally stable, even under fire exposure conditions, and are not reactive with water.

**HMIS III Rating****Health**

- : 1 Slight Hazard - Irritation or minor reversible injury possible

Flammability

- : 4 Severe Hazard

Physical

- : 3 Serious Hazard

SDS US (GHS HazCom 2012) - Praxair

This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.

**Safety Data Sheet according to Regulation (EC)
No. 1907/2006 (REACH)**

Printed 12.06.2013
revision 12.06.2013 (GB) Version 11.0
R 507
0055

**GERLING
HOLZ+CO**



SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier

Name of product R 507
Art-Nr(n): 0055

1.2. Relevant identified uses of the substance or mixture and uses advised against

Identified uses

Sector of uses [SU]

SU17 - General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment
SU22 - Professional uses: Public domain (administration, education, entertainment, services, craftsmen)
SU3 - Industrial uses: Uses of substances as such or in preparations at industrial sites

Product categories [PC]

PC16 - Heat transfer fluids

Recommended intended purpose(s)

Refrigerant.

1.3. Details of the supplier of the safety data sheet

Manufacturer/distributor

GHC Gerling, Holz & Co. Handels GmbH
Ruhrstraße 113, D-22761 Hamburg
Phone +49 (0) 40 853 123-0, Fax +49 (0) 40 853 123-66
E-Mail hamburg@ghc.de
Internet www.ghc.de

Advice

GHC Gerling, Holz & Co. Handels GmbH
Phone +49 (0) 40 853 123-0
Fax +49 (0) 40 853 123-66
E-mail (competent person):
msds@ghc.de

1.4. Emergency telephone number

Emergency advice

Giftinformationszentrum (Poison Control Centre) Mainz
Phone +49 (0) 6131 19240

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classification according to 67/548/EEC or 1999/45/EC

no

R-phrases

no

Classification according to Regulation (EC) No 1272/2008 [CLP/GHS]

Hazard classes and Hazard categories	Hazard Statements	Classification procedure
--------------------------------------	-------------------	--------------------------

Liquef. Gas	H280
-------------	------

Hazard statements for physical hazards

H280	Contains gas under pressure; may explode if heated.
------	---

**Safety Data Sheet according to Regulation (EC)
No. 1907/2006 (REACH)**

Printed 12.06.2013
revision 12.06.2013 (GB) Version 11.0
R 507
0055

**GERLING
HOLZ+CO**



2.2. Label elements

Labelling according to Regulation (EC) No 1272/2008 [CLP/GHS]



GHS04

Signal word
Warning

Hazard statements for physical hazards

H280 Contains gas under pressure; may explode if heated.

Precautionary Statements

Storage

P403 Store in a well-ventilated place.

Hazardous ingredients for labeling

1,1,1-Trifluoroethane (R 143a), Pentafluoroethane (R 125)

Supplemental Hazard information (EU)

Environmental properties

Contains fluorinated greenhouse gases covered by the Kyoto Protocol.

2.3. Other hazards

Adverse human health effects and symptoms

Contact with liquid may cause cold burns/frostbite.

Asphyxiant in high concentrations.

The inhalation of gas / vapour in high concentrations may cause cardiac arrhythmia.

Misuse or intentional inhalation abuse may cause death without warning symptoms, due to cardiac effects.

Information pertaining to special dangers for human and environment

Gas/vapour heavier than air. May accumulate in confined spaces, particularly at or below ground level.

Receptacle under pressure.

I SECTION 3: Composition/ information on ingredients

**3.1. Substances
not applicable**

3.2. Mixtures

Hazardous ingredients

CAS No	EC No	Name	[% weight]	Classification according to 67/548/EEC
354-33-6	206-557-8	Pentafluoroethane (R 125)	50	
420-46-2	206-996-5	1,1,1-Trifluoroethane (R 143a)	50	F+ R12

CAS No	EC No	Name	[% weight]	Classification according to Regulation (EC) No 1272/2008 [CLP/GHS]
354-33-6	206-557-8	Pentafluoroethane (R 125)	50	Liq. Gas, H280
420-46-2	206-996-5	1,1,1-Trifluoroethane (R 143a)	50	Liquef. Gas, H280 / Flam. Gas 1, H220

**Safety Data Sheet according to Regulation (EC)
No. 1907/2006 (REACH)**

Printed 12.06.2013
revision 12.06.2013 (GB) Version 11.0
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**GERLING
HOLZ+CO**



REACH

CAS No	Name	REACH registration number
354-33-6	Pentafluoroethane (R 125)	01-2119485636-25
420-46-2	1,1,1-Trifluoroethane (R 143a)	01-2119492869-13

! Additional advice

The text of the R-phrases is shown in section 16.
The text of the H-phrases is shown in section 16.
Contains fluorinated greenhouse gases covered by the Kyoto Protocol.

! SECTION 4: First aid measures

4.1. Description of first aid measures

General information

Remove contaminated soaked clothing immediately.
In the event of persistent symptoms receive medical treatment.
Adhere to personal protective measures when giving first aid.

In case of inhalation

Remove the casualty into fresh air and keep him immobile.
In case of respiratory standstill give artificial respiration by respiratory bag (Ambu bag) or respirator. Send for a doctor.

In case of skin contact

In case of contact with skin wash off with warm water.
In case of frostbite rinse with plenty of water. Don't remove clothing.
In case of frostbite spray with lukewarm (not hot) water for at least 15 minutes. Apply a sterile dressing. Obtain medical assistance.

In case of eye contact

Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Call for a doctor immediately.

In case of ingestion

Ingestion is not considered a potential route of exposure.

4.2. Most important symptoms and effects, both acute and delayed

! Physician's information / possible symptoms

The following symptoms may occur in case of strong exposition:

Unconsciousness
Cardiac arrhythmia (disordered cardiac rhythm).
Headache
Nausea
Confusion
Dizziness
Contact with liquid may cause cold burns/frostbite.

Physician's information / possible dangers

Long-term inhaling of separation products may cause pulmonary oedema.

4.3. Indication of any immediate medical attention and special treatment needed

Treatment (Advice to doctor)

Do not give any preparations of the adrenalin-ephedrine group.

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SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media

Product does not burn, fire-extinguishing activities according to surrounding.

Unsuitable extinguishing media

Full water jet

5.2. Special hazards arising from the substance or mixture

In case of fire formation of dangerous gases possible.

Formation of explosive gas mixtures in air.

Carbon monoxide (CO)

Hydrogen fluoride (HF)

Carbonyl fluoride.

5.3. Advice for firefighters

Special protective equipment for fire-fighters

Use breathing apparatus with independent air supply (isolated).

Wear full protective clothing.

Additional information

Cool endangered containers with water spray jet.

Exposure to fire may cause containers to rupture / explode.

I SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

See chapter 8.

Remove persons to safety.

Evacuate area.

6.2. Environmental precautions

If possible, stop flow of product.

Do not discharge into the drains/surface waters/groundwater.

Prevent spread over a wide area (e.g. by containment or oil barriers).

Do not discharge into the subsoil/soil.

6.3. Methods and material for containment and cleaning up

Ensure adequate air ventilation.

Allow to vapourise.

6.4. Reference to other sections

Safe handling: see section 7

Personal protection equipment: see section 8

I SECTION 7: Handling and storage

7.1. Precautions for safe handling

Advice on safe handling

Use only in thoroughly ventilated areas.

Transfer and handle only in enclosed systems.

Provide good room ventilation even at ground level (vapours are heavier than air).

Prevent cylinders from falling over.

Avoid release to the environment.

Ensure valve protection device is correctly fitted.

Ensure valve outlet cap nut or plug (where provided) is correctly fitted.

Open valve slowly to avoid pressure shock.

Do not allow backfeed into the container.

Suck back of water into the container must be prevented.

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No water to valves, flanges and other fittings.
Purging of pipes and valves with inert gases - to avoid: water, solvents.

I General protective measures

Do not inhale gases.

Hygiene measures

At work do not eat, drink and smoke.
Wash hands before breaks and after work.

Advice on protection against fire and explosion

The product is not flammable in air under ambient conditions of temperature and pressure.
When pressurised with air or oxygen, the mixture may become flammable. Certain mixtures of HCFCs or HFCs with chlorine may become flammable or reactive under certain conditions.
Pay attention to general rules of internal fire prevention.

7.2. Conditions for safe storage, including any incompatibilities

Requirements for storage rooms and vessels

Keep in closed original container.
Ventilate store-rooms thoroughly.
Only use containers that are approved specifically for the substance/product.
Suitable materials: Normalised steel and carbon steel, tempered steel, aluminium alloys, stainless steel.
Valve: Suitable materials: Brass, copper alloys, carbon steels, aluminium alloys, stainless steel.

Advice on storage compatibility

Do not store with spontaneously flammable materials.
Do not store together with combustible liquids or combustible solids.
Do not store together with animal feedstuffs.
Do not store together with explosives.
Do not store together with infectious substances.
Do not store together with radioactive material.
Do not store together with toxic liquids or toxic solids.
Do not store together with food.
Do not store together with oxidizing liquids or oxidizing solids.

Further information on storage conditions

Keep container tightly closed.
Store only in original container at temperature of 50°C maximum (=122°F).
Prevent cylinders from falling over.
Keep container in a well-ventilated place
Protect of heat.

7.3. Specific end use(s)

Recommendation(s) for intended use

Use in accordance with regulation (EC) No 842/2006 on certain fluorinated greenhouse gases.

I SECTION 8: Exposure controls/personal protection

8.1. Control parameters

Additional advice

Pentafluoroethane (R 125) (EC-No: 206-557-8; CAS-No: 354-33-6): DNEL (workers, inhalation, long-term, systemic effects): 16444 mg/m³.

Pentafluoroethane (R 125) (EC-No: 206-557-8; CAS-No: 354-33-6): DNEL (consumers, inhalation, long-term, systemic effects): 1753 mg/m³.

1,1,1-Trifluoroethane (R 143a) (EC-No: 206-996-5; CAS-No: 420-46-2): DNEL (workers, inhalation, long-term, systemic effects): 38800 mg/m³

1,1,1-Trifluoroethane (R 143a) (EC-No: 206-996-5; CAS-No: 420-46-2): DNEL (consumers, inhalation, long-term, systemic effects): 10700 mg/m³

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8.2. Exposure controls

! Respiratory protection

Breathing apparatus in the event of high concentrations.
Keep self contained breathing apparatus readily available for emergency use.
Do not use any filter apparatus.

Respiratory protection according to EN 137.

In case of rescue and maintenance activities in storage containers use environment-independent breathing apparatus because of risk of suffocation by edging out of air oxygen

Hand protection

Leather gloves
Protective gloves according to EN 374.

Eye protection

Safety goggles, in case of increased risk add protective face shield
Safety goggles with side protection according to EN 166.

Skin protection

Safety shoes with steel toe.
Body covering work clothing, or chemical resistant suit at increased risk.

Limitation and surveillance of the environment

Pentafluoroethane (R 125) (EC-No: 206-557-8; CAS-No: 354-33-6): PNEC (freshwater): 0,1 mg/l.
Pentafluoroethane (R 125) (EC-No: 206-557-8; CAS-No: 354-33-6): PNEC (water): 1 mg/l (intermittent emission).
Pentafluoroethane (R 125) (EC-No: 206-557-8; CAS-No: 354-33-6): PNEC (freshwater sediment): 0,6 mg/kg sediment
1,1,1-Trifluoroethane (R 143a) (EC-No: 206-996-5; CAS-No: 420-46-2): PNEC (freshwater): 0,35 mg/l.
See chapter 7.

Additional advice on system design

Transfer and handle only in enclosed systems.

I SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Form	Colour	Odour
Gaseous / liquefied under pressure.	colourless	etheral
! Odour threshold		
not determined		

Important health, safety and environmental information

	Value	Temperature	at	Method	Remark
pH value in delivery state	not applicable				
boiling point	-46,7 °C		1013 hPa		
Flash point	no				
Flammability (gas)	no				EN 378-1
Autoignition	> 750 °C				
Lower explosion limit	no			ASTM E-681	

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	Value	Temperature	at	Method	Remark
Upper explosion limit	no			ASTM E-681	
Vapour pressure	10611 hPa	21,1 °C			
Relative density	1,073 g/cm ³	20 °C			liquid phase
Vapour density	3,43				air = 1
Solubility in water	1,5 g/l				
Partition coefficient (log p_{OW})	1,48 - 1,73	20 - 25 °C		OECD 107	
Viscosity dynamic	12,24 mPa·s	26,1 °C			vapour phase

Oxidising properties
no

Explosive properties
no

9.2. Other information
Vapours are heavier than air.

I SECTION 10: Stability and reactivity

10.1. Reactivity

See section "Possibility of hazardous reactions".

10.2. Chemical stability

Stable under normal conditions.

10.3. Possibility of hazardous reactions

May react violently with oxidants.

When pressurised with air, oxygen or other oxidants, the mixture may become flammable.

Reactions with alkali metals.

Reactions with earth alkali metals.

Reactions with metals in powder form.

Reactions with metal salts in powder form.

10.4. Conditions to avoid

Heat sources / heat - risk of bursting.

Avoid contact with open flames, glowing metal surfaces, etc..

10.5. Incompatible materials

Materials to avoid

Metals in powder form.

Metallic salts in powder form.

Oxidants.

Alkali metals.

Earth alkali metals.

10.6. Hazardous decomposition products

Carbon monoxide

Fluorophosgene on contact open flame or glowing objects

Hydrogen fluoride

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Thermal decomposition

Remark No decomposition below 250°C.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity/Irritability/Sensitization

	Value/Validation	Species	Method	Remark
LD50 acute oral	not applicable			
LD50 acute dermal	not applicable			
LC50 acute inhalation	> 250000 ppm (4 h)	rat		R-143a
Irritability skin	non-irritant			
Irritability eye	non-irritant			
Skin sensitization	non-sensitizing			
Sensitization respiratory system	non-sensitizing			

Subacute Toxicity - Carcinogenicity

	Value	Species	Method	Validation
Subchronic Toxicity	NOAEL 40000 - 50000 ppm (90 d) Inhalation	Rat	OECD 408	No effects of toxicological significance.
Mutagenicity				No experimental information on genotoxicity in vitro and in vivo available.
Reproduction-Toxicity	NOAEL 137 - 245 mg/kg Oral. Inhalation	Rat	OECD 414	No indications of toxic effects were observed in reproduction studies in animals.
Carcinogenicity	NOAEL 300 mg/kg (1 a) Oral. R-143a	Rat		

Toxicity test (Additional information)

No experimental indication of genotoxicity in vitro (Ames-test negative).
No experimental indication of genotoxicity in vivo (micronucleus test negative).
No experimental indication of cancerogenic effects.

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Experiences made from practice
Inhalation causes disordered cardiac rhythm.
Inhalation causes shortness of breath.
Gases have a suffocating effect.
Inhalation causes narcotic effect/intoxication.

Additional information

The product has not been tested. The information is derived from the properties of the individual components.

! SECTION 12: Ecological information

12.1. Toxicity

Ecotoxicological effects

	Value	Species	Method	Validation
Fish	LC50 > 40 mg/l (96 h)	Oncorhynchus mykiss		R-143a
Daphnia	EC50 300 mg/l (48 h)	Daphnia magna	OECD 202	R-143a
Algae	NOEC > 44 mg/l (96 h)	Selenastrum capricornutum		R-143a

12.2. Persistence and degradability

Physico-chemical

degradability At normal temperature very highly volatile or gaseous product that can be released to atmosphere.
Elimination test cannot be employed.

**Biological
degradability**

3 - 5 % (28 d) OECD 301 D not readily degradable

12.3. Bioaccumulative potential

No high bioaccumulation potential.

Because of the n-octanol/water distribution coefficient (log K o/w) accumulation in organisms is not expected.

12.4. Mobility in soil

high mobility

Adsorption in the soil is not likely.

12.5. Results of PBT and vPvB assessment

The substances in this mixture do not meet the PBT/vPvB criteria of REACH, annex XIII.

12.6. Other adverse effects

GWP: 3300

ODP: 0

! General regulation

Avoid release to the environment.

SECTION 13: Disposal considerations

13.1. Waste treatment methods

Waste code No.

14 06 01*

Name of waste

chlorofluorocarbons, HCFC, HFC

Wastes marked with an asterisk are considered to be hazardous waste pursuant to Directive 91/689/EEC on hazardous waste.

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Recommendations for the product

Dispose of as hazardous waste.
Return to manufacturer.

Recommendations for packaging

Transportable pressure equipment (empty, residual pressure): Return to supplier / manufacturer.

General information

Operators of stationary equipment shall be responsible for putting in place arrangements for the proper recovery.

I SECTION 14: Transport information

Land and inland navigation transport ADR/RID

UN 1078 REFRIGERANT GAS, N.O.S. (Pentafluorethan (R 125), 1,1,1-Trifluorethan (R 143a)), 2.2, (C/E), Classification code: 2A

Marine transport IMDG

UN 1078 REFRIGERANT GAS, N.O.S. (Pentafluorethan (R 125), 1,1,1-Trifluoroethane (R 143a)), 2.2

EmS: F-C, S-V

Air transport ICAO/IATA-DGR

UN 1078 Refrigerant gas, n.o.s. (Pentafluorethan (R 125), 1,1,1-Trifluoroethane (R143a)), 2.2

Special precautions for user

The protective measures listed in Sections 6, 7 and 8 of the Safety Data Sheet have to be considered.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

not applicable

No transport as bulk according IBC - Code.

I SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

Other regulations (EU)

Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases.

Regulation (EC) No 303/2008 establishing minimum requirements and the conditions for mutual recognition for the certification of companies and personnel as regards stationary refrigeration, air conditioning and heat pump equipment containing certain fluor

Regulation (EC) No 1494/2007 establishing, pursuant to Regulation (EC) No 842/2006, the form of labels and additional labelling requirements as regards products and equipment containing certain fluorinated greenhouse gases.

VOC standard

VOC content >=99 % 21,1 °C 10611 hPa

15.2. Chemical Safety Assessment

The protective measures listed in Sections 6, 7 and 8 of the Safety Data Sheet have to be considered.

An exposure scenario is not required.

Chemical safety assessments for substances in this mixture were carried out.

SECTION 16: Other information

Recommended uses and restrictions

Use in accordance with regulation (EC) No 842/2006 on certain fluorinated greenhouse gases.

National and local regulations concerning chemicals shall be observed.

Further information

The information contained herein is based on the state of our knowledge. It characterizes the product with regard to the appropriate safety precautions. It does not represent a guarantee of the properties of the product.
Indication of changes: "!" = Data changed compared with the previous version.

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Wording of the R/H-phrases specified in chapter 3 (not the classification of the mixture!)

R 12 Extremely flammable.

H220 Extremely flammable gas.

H280 Contains gas under pressure; may explode if heated.