Honeywell

APT2000 Series
2-Wire Toroidal Conductivity Transmitters User Manual

70-82-25-96
MU1I-6251
Revision 1 – 03/00

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Safety Precautions

Be sure to read and observe the following requirements!

Warning

The APT2000TC-0(H)-00 Transmitter is approved for operation in safe areas and hazardous locations DIV 2 (USA/Canada only).
Before connecting the Transmitter to a power supply unit, make sure that this is not capable of outputting more than 40 Vdc (safe areas) / 30 Vdc (DIV 2).

Warning

The APT 2000PH-0(H)-IS Transmitter is approved for operation in hazardous locations DIV 1 (USA/Canada) / Zone 1 (Europe).
Before connecting the Transmitter to a power supply unit, make sure that this is an associated apparatus.

Warning

The measuring inputs of the APT 2000PH-0(H)-IS Transmitter may be led into Zone 0 (Europe).
However, be sure to observe the national regulations concerning Zone 0 applications.
The Transmitter itself is not approved for operation in Zone 0!

Whenever it is likely that the protection has been impaired, the Transmitter shall be made inoperative and secured against unintended operation.
The protection is likely to be impaired if, for example:

- ❏ the Transmitter shows visible damage
- ❏ the Transmitter fails to perform the intended measurements
- ❏ after prolonged storage at temperatures above 70 °C
- ❏ after severe transport stresses

Before recommissioning the Transmitter, a professional routine test must be performed. This test should be carried out at our factory.

The Transmitter shall not be used in a manner not specified by this manual.

Information on this Instruction Manual

ITALICS are used for texts which appear in the APT2000TC Transmitter display.

Bold print is used to represent keys, e.g. **CAL**.

CAL

Keys for which the functions are explained are frequently shown in the left-hand column.

Note

Notes provide important information that should be strictly followed when using the Transmitter.

Warning

Warning means that the instructions given must always be followed for your own safety. Failure to follow these instructions may result in injuries.

Mode Codes

After pressing **CONF** or **CAL** you can enter one of the following codes to access the designated mode:

CONF

CONF, 0000: Error info
CONF, 1200: Configuration
CONF, 5555: Current source

CAL

CAL, 0000: Cal info
CAL, 1001: Zero point calibration
CAL, 1015: Temp probe adjustment
CAL, 1100: Cell factor calibration
CAL, 1125: Input/adjustment of sensor factor
CAL, 2222: Test mode

Contents

1 Assembly

Package Contents and Unpacking

Unpack the unit carefully and check the shipment for transport damage and completeness.
The package contains:

– Front unit of Transmitter

– Lower case

– Short instruction sheet

– This instruction manual

– HART description
(only for Model APT2000TC-H-..)

– Bag containing:

① 2 plastic plugs
② 5 hexagon nuts
③ 3 Pg cable glands
④ 1 rubber reducer
⑤ 1 Pg plug
⑥ 4 set screws
⑦ 1 hinge pin
⑧ 3 cable ties
⑨ 3 filler plugs
⑩ 3 sealing rings
⑪ 1 metal plate for conduit
⑫ 1 jumper

Assembly

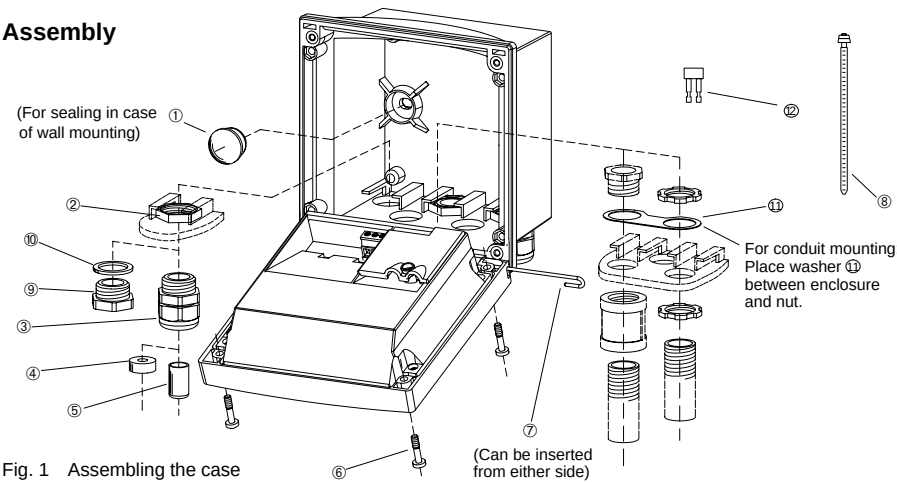


Fig. 1 Assembling the case

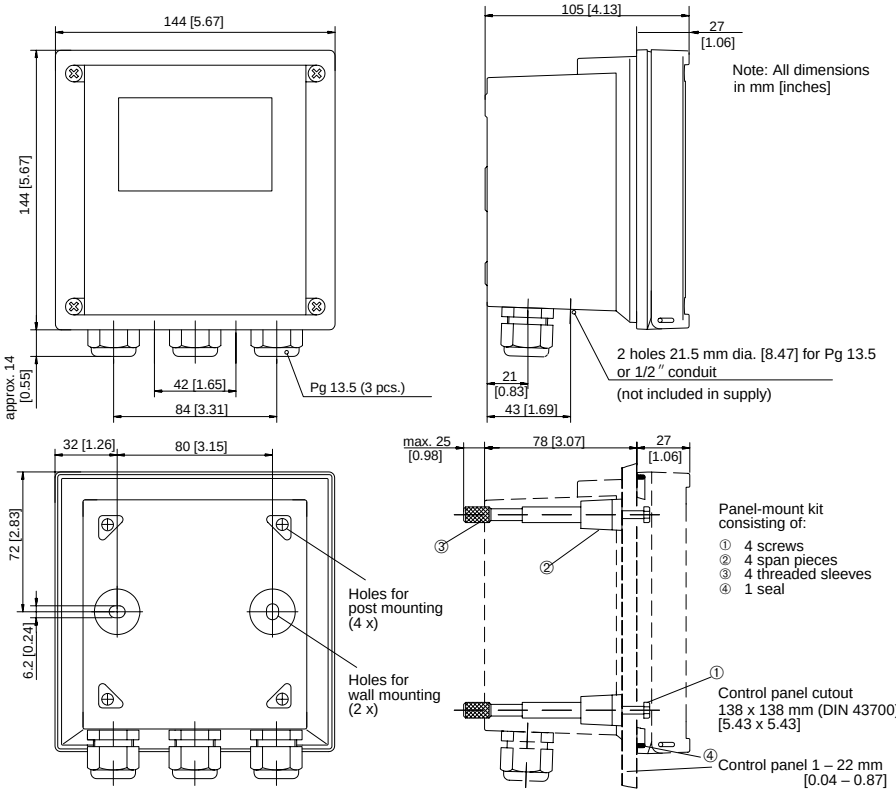


Fig. 2 Dimension drawing for Transmitter, mounting diagram and P/N 51205990-001 panel-mount kit

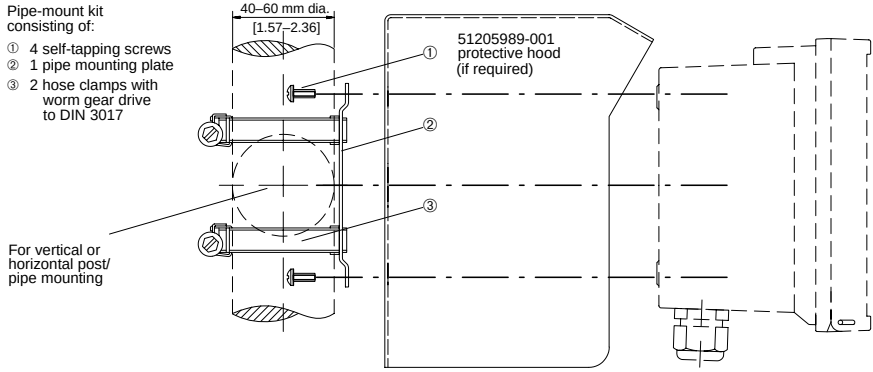


Fig. 3 P/N 51205988-001 pipe-mount kit

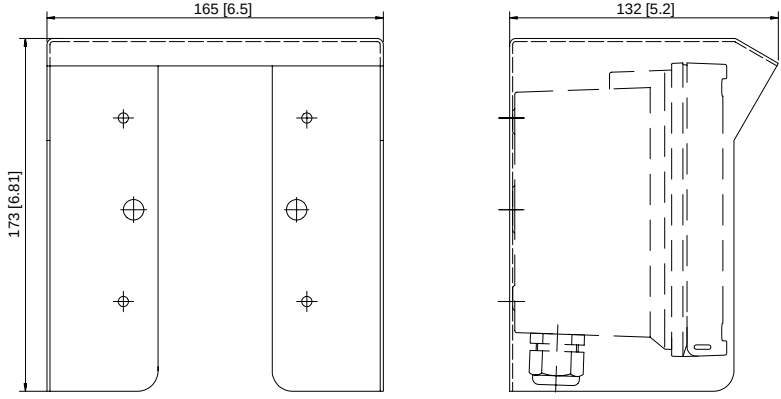
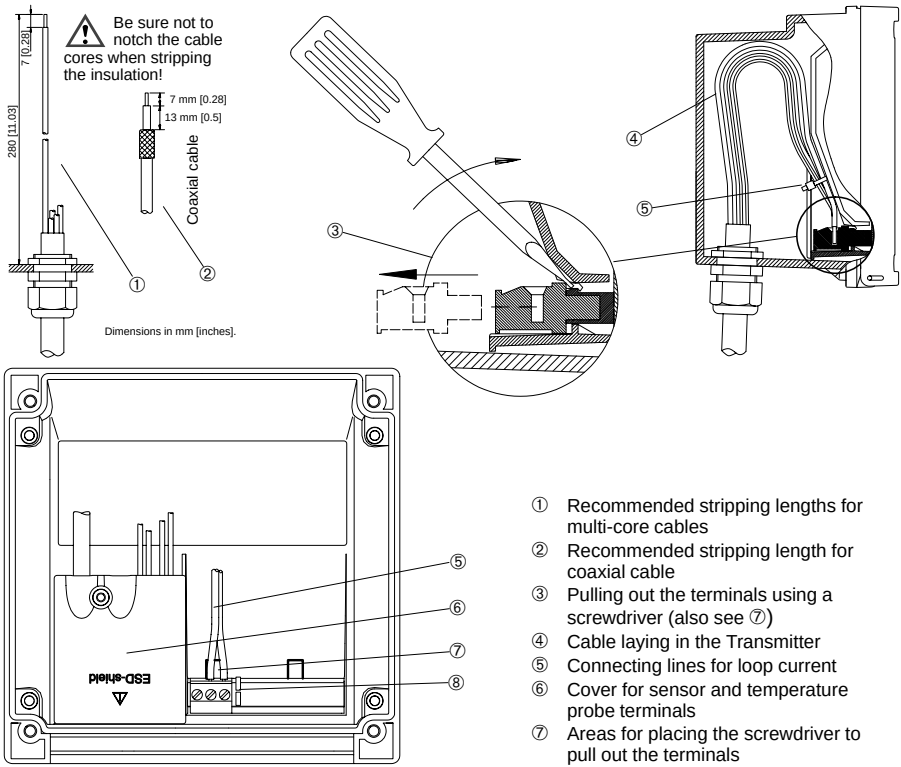


Fig. 4 P/N 51205989-001 protective hood for wall and pipe mounting



① Recommended stripping lengths for multi-core cables
② Recommended stripping length for coaxial cable
③ Pulling out the terminals using a screwdriver (also see ⑦)
④ Cable laying in the Transmitter
⑤ Connecting lines for loop current
⑥ Cover for sensor and temperature probe terminals
⑦ Areas for placing the screwdriver to pull out the terminals
⑧ Connection of handheld terminal

Fig. 5 Installation information

2 Installation, Connection and Commissioning

Proper Use

The APT2000TC Transmitter is used for conductivity and temperature measurement in chemical, pulp and paper, biotechnology, food processing, pharmaceutical, electroplating, and water/wastewater industries. It can either be mounted on site or in a control panel.

Warning

The APT2000TC-0(H)-00 Transmitter is approved for operation in safe areas and hazardous locations DIV 2 (USA/Canada only). Before connecting the Transmitter to a power supply unit, make sure that this is not capable of outputting more than 40 Vdc (safe areas) / 30 Vdc (DIV 2).

Warning

The APT2000TC-0(H)-IS Transmitter is approved for operation in hazardous locations DIV 1 (USA/Canada) / Zone 1 (Europe).
Before connecting the Transmitter to a power supply unit, make sure that this is an associated apparatus.

Warning

The measuring inputs of the APT 2000PH-0(H)-IS Transmitter may be led into Zone 0 (Europe). However, be sure to observe the national regulations concerning Zone 0 applications.
The Transmitter itself is not approved for operation in Zone 0!

Overview of the Conductivity Transmitter

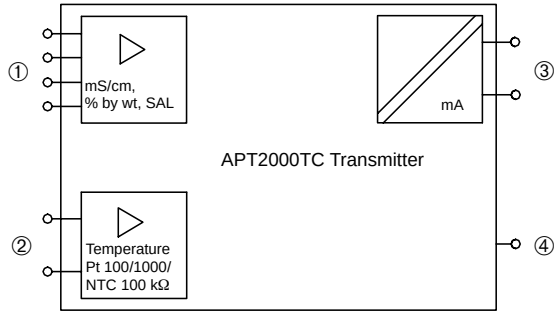


Fig. 6 System functions of APT2000TC Transmitter

① Inputs for toroidal conductivity sensors
② Input for temperature probe
③ Current loop 4 – 20 mA,
transports power to and output signal from the transmitter,
with APT2000TC-H-.. Transmitter also for HART® communication
④ Equipotential bonding (only with APT2000TC-0(H)-IS Transmitter)

Terminal Assignment

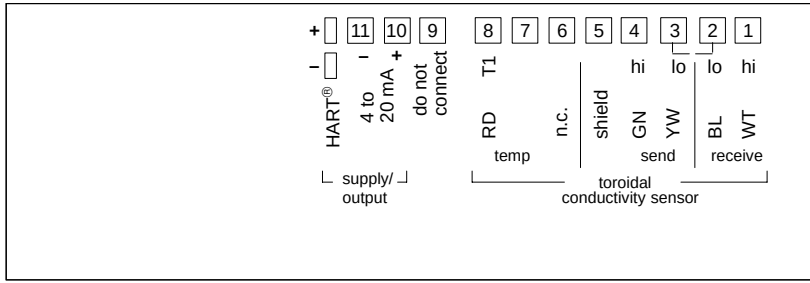


Fig. 7 Terminal assignment of APT2000TC-0(H)-00 Transmitter
NI, Class 1, Div 2, Group A – D, T4

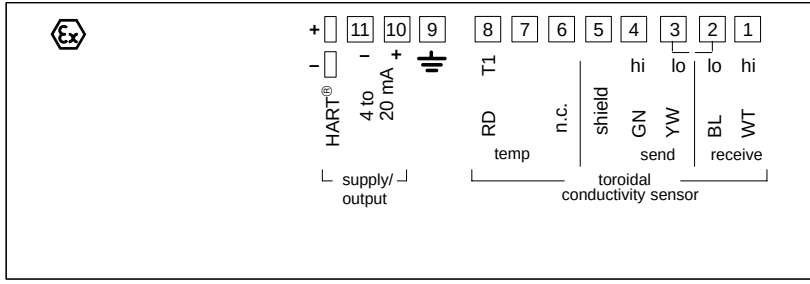


Fig. 8 Terminal assignment of APT2000TC-0(H)-IS Transmitter
IS, Class I, Div 1, Group A – D, T4
II 2(1) G EEx ib [ia] IIC T6

Installation and Commissioning

Warning

Installation and commissioning of the Transmitter may only be carried out in accordance with this instruction manual and per applicable local and national codes. Be sure to observe the technical specifications and input ratings.

Warning

Before connecting the APT2000TC-0(H)-00 Transmitter to a power supply unit, make sure that this is not capable of outputting more than 40 Vdc (safe areas) / 30 Vdc (DIV 2).

Warning

Before connecting the APT2000TC-0(H)-IS Transmitter to a power supply unit, make sure that this is an associated apparatus (for input ratings refer to the Control Drawing or the annex of the EC Type Examination Certificate).

Warning

Do not use alternating current or mains power supply!

Warning

When commissioning, a complete configuration must be carried out.

For easier installation, the terminal strips are of a plug-in design. The terminals are suitable for single wires and flexible leads up to 2.5 mm^2 (AWG 14) (see Pg. 9).
A connection example is shown on Pg. 14.

Typical Wiring

Conductivity measurement with Honeywell 5000TC toroidal conductivity sensor

The Honeywell 5000TC toroidal conductivity sensor is used to measure low to highest conductivity values. It can be used for measurements in safe areas.

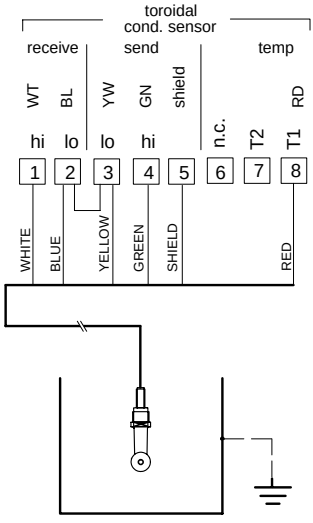


Fig. 9 Conductivity measurement with Honeywell 5000TC toroidal conductivity sensor

Warning

The Honeywell 5000TC toroidal conductivity sensor may only be used in combination with the APT2000TC-0(H)-00 Transmitter.

Note

For special mounting conditions of the sensor, the cell factor can vary between 4.0 and 4.5. Therefore the user should perform a wet calibration of each new sensor to determine the exact cell factor.

Settings for Honeywell 5000TC toroidal conductivity sensor

	Menu		Setting
Temp probe	conf	1200	Pt 1000
Cell factor	cal	1100	4.44

3 Operation

User Interface

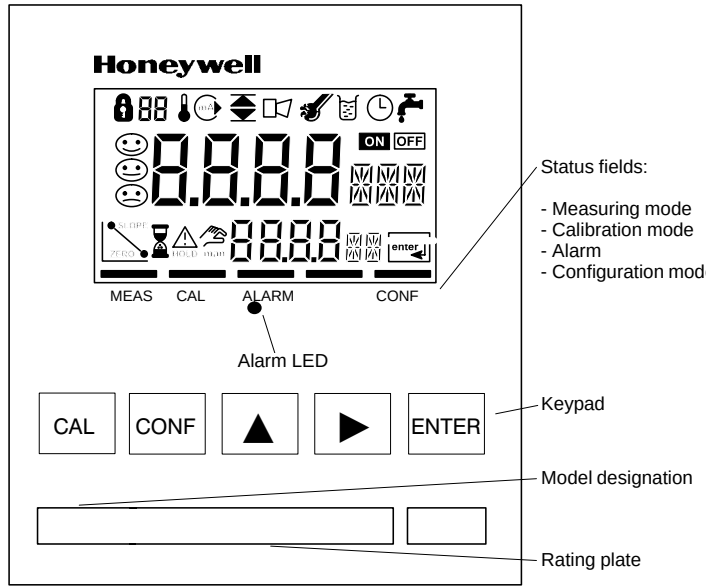


Fig. 10 Front view of Transmitter

Display

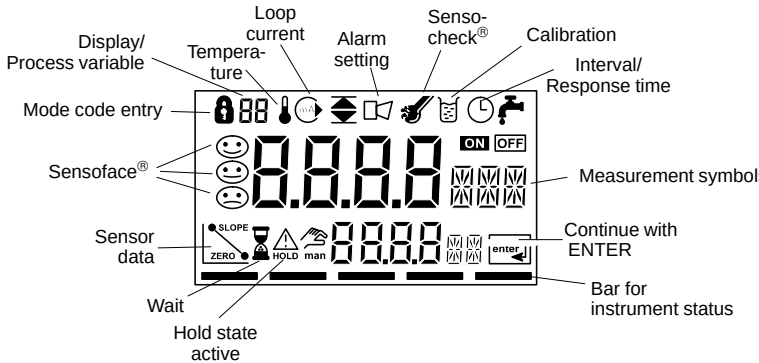


Fig. 11 Display of Transmitter

Keypad

CAL — Start, end calibration

CONF — Start, end configuration

▶ — Select digit position (selected position flashes)

▲ — Change digit

ENTER — Prompt in display: continue in program sequence, Configuration: Confirm entries, next configuration step, Measuring mode: Display loop current

CAL → ENTER — Cal info, display cell factor and zero point (see Pg. 25)

CONF → ENTER — Error info, display last output error message (see Pg. 25)

▲ + ▶ — Start GainCheck® manual instrument self-test (see Pg. 17)

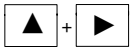
Safety Functions

Sensoface® sensor monitoring

Sensoface® provides information on the sensor condition. A sad “Smiley” indicates that there is a Sensocheck® message.
Sensocheck® signals a short circuit of the primary coil and its lines as well as an interruption at the secondary coil and its lines. Sensocheck® can be switched off. With Sensocheck® switched off, no friendly Smiley appears.

For more detailed information, see chapter “Diagnostic, Maintenance and Cleaning” (Pg. 26).

GainCheck® manual instrument self-test



Simultaneously pressing ▲ and ▶ starts the manual instrument self-test.

A display test is carried out, the software version is displayed and the memory and measured value transmission are checked.

Automatic instrument self-test

The automatic unit self-test checks the memory and the measured-value transmission. It runs automatically in the background at fixed intervals.

Outputs

Current loop (4 to 20 mA)

The current loop transports power to and output signals from the Transmitter. The current is controlled by the process variable selected in the configuration. The current characteristic can be configured as linear or logarithmic curve for conductivity and resistivity.
The current beginning and end can be set to represent any desired value.
If LIN (linear characteristic) is chosen, the minimum span is 5% of the selected process variable / measurement range. If LOG (logarithmic characteristic) is chosen, the minimum span is one decade within the chosen range.
To check connected peripherals (e.g. limit switches, controllers), the loop current can be manually specified (see Pg. 28).

HART® communication

The APT2000TC-H-.. Transmitter can be remote controlled via HART® communication. It can be configured using a handheld terminal or from the control room. Measured values, messages and instrument identification can be downloaded at any time. This allows easy integration also in fully automatic process sequences.

For more detailed information, refer to the HART® Command Specification.

Alarm

During an error message the alarm LED flashes. Alarm response time is permanently set to 10 sec.

Error messages can also be signaled with a 22 mA signal via the loop current (see Configuration, Pg. 20).

Configuration

The instrument arrives from the factory configured and ready to operate as a conductivity transmitter. This section provides detailed procedures for changing operation values for specific applications.

CONF

Activate with **CONF**
change parameter with ▲ and ▶,
confirm/continue with **ENTER**,
end with **CONF.**

Mode code “1200”

HOLD

During configuration the Transmitter is in the Hold state, the loop current is frozen.

When the configuration mode is exited, the Transmitter remains in the Hold state for safety reasons. This prevents undesirable reactions of the connected peripherals (e.g. limit switches, controllers) due to incorrect settings. The measured value and *Hold* are displayed alternately. Now you can check whether the measured value is plausible and specifically end the Hold state with **ENTER**. After a relax time of 20 sec (for measured value stabilization) the Transmitter returns to measuring mode.

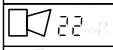
Note

The configuration parameters are checked during the input. In the case of an incorrect input “ERR” is displayed for 3 sec. The parameters cannot be stored with **ENTER** until the input has been repeated.

Configuration parameters

Before attempting any changes refer to the parameter setup list shown below. This table presents the possible options and the factory settings.

Pictograph	Parameter	Choices	Factory setting
88	Process variable / meas. range Selected process variable and measuring range control loop current, limit values and display. Complete configuration required after change.	oo.oo mS / ooo.o mS / oooo mS ooo.o % ooo.o SAL	**ooo.o mS**
Conc	Concentration (only with %)	-01- NaCl (0 – 28 % by wt) -02- HCl (0 – 17 % by wt) -03- NaOH (0 – 22 % by wt) -04- H_2SO_4 (0 – 35 % by wt) -05- HNO_3 (0 – 28 % by wt) -06- H_2SO_4 (95 – 99 % by wt)	**-01-**
	Temperature display	°C °F	**°C**

	Temperature probe	Pt 100 / Pt 1000 / NTC 100 kΩ	**Pt 1000**
	Temperature compensation (not with % and SAL)	OFF LIN NLF (natural waters)	**OFF**
	Temperature coefficient (only with tc LIN)	xx.xx %/K	**02.00 %/K**
	Current characteristic (not with % and SAL)	LIN LOG	**LIN**
	Current beginning (4 mA) (only with LIN)	mS / % / SAL	**000.0 mS**
	Current end (20 mA) (only with LIN)	mS / % / SAL	**100.0 mS**
	Current beginning (4 mA) (only with LOG)	mS *	**0.1 mS**
	Current end (20 mA) (only with LOG)	mS *	**100 mS**
	Hold state	Last: Last current value Fix: Current specified	**Last**
	Hold value (only with Fix)	xx.xx mA	**21.00 mA**
	22 mA signal for error message	ON / OFF	**OFF**
	Sensocheck®	ON / OFF	**OFF**

* 0.1 / 1 / 10 / 100 / 1000 mS

Configuration is cyclical. To stop, press **CONF**.

Calibration

In the calibration mode the cell factor can be modified in two ways. If the cell factor of the sensor in use is known under consideration of the installation conditions, it can be entered directly. Furthermore, the cell factor can be determined with a known calibration solution under consideration of the temperature.

CAL

Activate with **CAL**, confirm/continue with **ENTER**, abort with **CAL → ENTER**

During calibration the Transmitter is in the Hold state. The loop current is frozen.

When the calibration mode is exited, the Transmitter remains in the Hold state for safety reasons. This prevents undesirable reactions of the connected peripherals (e.g. limit switches, controllers) due to incorrect settings. The measured value and *Hold* are displayed alternately. Now you can check whether the measured value is plausible and specifically end the Hold state with **ENTER** or repeat calibration with **CAL.** When you end the Hold state, the Transmitter will return to measuring mode after 20 sec (measured value stabilization).

Calibration by input of cell factor

CAL

Activate calibration by pressing the **CAL** key.
Using the ▲ , ▶ keys enter mode code *"1100"* and then press **ENTER**.

Using the ▲ , ▶ keys enter the cell factor. The lower display shows the conductivity value.

A change in the cell factor also changes the conductivity value.

When there has not been an entry for approx. 6 sec, conductivity and temperature are displayed alternately.

ENTER

Press **ENTER** to confirm the cell factor.

The Transmitter remains in the Hold state. You can end the Hold state with **ENTER**. After 20 sec (measured value stabilization) the Transmitter returns to measuring mode.

Calibration with calibration solution

Note

Be sure to use known calibration solutions and the respective temperature-corrected table values (see Calibration Solutions, Pg. 38).

CAL

Activate calibration by pressing the **CAL** key.
Using the ▲ , ▶ keys enter mode code *"1100"* and then press **ENTER**.

Immerse the sensor in the calibration solution.

After approx. 6 sec the lower display alternately shows the conductivity and temperature values. Read the conductivity value corresponding to the displayed temperature from the table of the used calibration solution (for tables see Pg. 38).

Using the ▲ , ▶ keys change the cell factor until the display shows the conductivity value from the table.

Make sure that the temperature is stable during the calibration procedure.

ENTER

Press **ENTER** to confirm the cell factor.

The Transmitter remains in the Hold state. You can end the Hold state with **ENTER**. After 20 sec (measured value stabilization) the Transmitter returns to measuring mode.

Zero point calibration in air

Note

Zero point calibration is only required when very low conductivity values are to be measured.

Note

Before you start calibration, remove the sensor from the process, clean it and dry it up.

CAL

Activate calibration by pressing the **CAL** key.
Using the ▲ , ▶ keys enter mode code *"1001"* and then press **ENTER**.

Using the ▲ , ▶ keys modify the zero point until the lower display reads 0 µS. If required, change the sign of the zero point!

When there has not been an entry for approx. 6 sec, the lower display alternately shows the zero-corrected conductivity value and the temperature value.

ENTER

Press **ENTER** to confirm the zero point.

The Transmitter remains in the Hold state. You can end the Hold state with **ENTER**. After 20 sec (measured value stabilization) the Transmitter returns to measuring mode.

Input and adjustment of sensor factor

Note

This function should only be used by experts. Incorrectly set parameters may go unnoticed, but change the measuring properties.

The Transmitter comes with a preset sensor factor of 24.6 for the 5000TC sensor. Should you use another sensor, you must enter another sensor factor or determine it using a comparison resistor. After that, you can calibrate the sensor (see Pg. 21).

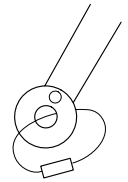
Note

Resistance measurement in test mode can only show the correct value of the test resistor when the sensor factor has been correctly determined.

CAL

Activate calibration by pressing the **CAL** key.
Using the ▲ , ▶ keys enter mode code *"1125"* and then press **ENTER**.

Using the ▲ , ▶ keys enter the sensor factor of the sensor in the main display.



If you do not know the sensor factor, it can be determined using a comparison resistor (recommended resistance value: 100 Ω). The sensor factor must be adjusted until the corresponding resistance value is shown in the lower display.

Press **ENTER** to confirm the sensor factor.

The Transmitter remains in the Hold state. You can end the Hold state with **ENTER**. After 20 sec (measured value stabilization) the Transmitter returns to measuring mode.

Adjustment of temperature probe

Note

This function should only be used by experts. Incorrectly set parameters may go unnoticed, but change the measuring properties. Especially for Pt 100 temperature probe, it is advisable to perform an adjustment.

Activate calibration by pressing the **CAL** key.
Using the ▲ , ▶ keys enter mode code *"1015"* and then press **ENTER**.

Measure the temperature of the process medium using an external thermometer.

Using the ▲ , ▶ keys enter the determined temperature value in the main display. If you take over the temperature value shown in the lower display, the correction is without effect.

Press **ENTER** to confirm the temperature value.

The Transmitter remains in the Hold state. You can end the Hold state with **ENTER**. After a relax time of 20 sec (for measured value stabilization) the Transmitter returns to measuring mode.

Measurement

Measuring mode

In the measuring mode the main display shows the configured process variable and the lower display the temperature.

Cal info

With **CAL** and mode code *"0000"* you can activate the cal info. Cal info shows the current calibration data for approx. 20 sec. The 20 sec can be reduced by pressing **ENTER**. During cal info the Transmitter is not in Hold state.

Error info

With **CONF** and mode code *"0000"* you can activate the error info. Error info shows the most recent error message for approx. 20 sec. After that the message will be deleted. The 20 sec can be reduced by pressing **ENTER**. During error info the Transmitter is not in Hold state.

Hold state

The Transmitter will enter the Hold state under the following conditions:

For calibration:	Mode code *1001*
	Mode code *1015*
	Mode code *1100*
	Mode code *1125*
	Mode code *2222*
configuration:	Mode code 1200
	Mode code 5555

The loop current is frozen at *Last* or *Fix* (configuration Pg. 20).
If the calibration or configuration mode is exited, the Transmitter remains in the Hold state for safety reasons. This prevents undesirable reactions of the connected peripherals (e.g. limit switches, controllers) due to incorrect settings. The measured value and *Hold* are displayed alternately. Now you can check whether the measured value is plausible and specifically end the Hold state with **ENTER**. After a relax time of 20 sec (for measured value stabilization) the Transmitter returns to measuring mode.

Note  During error conditions the Hold state will not be active.

4 Diagnostics, Maintenance and Cleaning

Sensoface®, Sensocheck®

Sensoface® provides information on the sensor condition. A sad "Smiley" indicates that there is a Sensocheck® message.

Sensocheck® signals a short circuit of the primary coil and its lines as well as an interruption at the secondary coil and its lines. Sensocheck® can be switched off. With Sensocheck® switched off, no friendly Smiley appears.

Error Messages

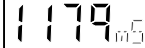
When one of the following error messages is output, the Transmitter can no longer correctly determine the process variable or output it via the loop current.

During an error message the alarm LED flashes. The alarm response time is permanently set to 10 sec.

Error messages can also be signaled with a 22 mA signal via the loop current (see Configuration, Pg. 20).

Error info

With **CONF** and mode code *"0000"* you can activate the error info. Error info shows the most recent error message for approx. 20 sec. After that the message will be deleted. The 20 sec can be reduced by pressing **ENTER**. During error info the Transmitter is not in Hold state.

Error number	Display (flashing)	Problem	Possible causes
Err 01		Sensor	- Wrong cell factor - Outside measurement range - SAL > 45 ‰ - Sensor connection or cable defective
Err 02		Sensor	- Unsuitable sensor
Err 03		Temperature probe	- Outside temp range - Outside temp range for TC - Outside temp range for SAL - Outside temp range for concentration
Err 21		Loop current	- Meas. value below configured current beginning - Wrong configuration for current beginning (see Pg. 20)

Error number	Display (flashing)	Problem	Possible causes
Err 22		Loop current	- Meas. value above configured current end - Wrong configuration for current end (see Pg. 20)
Err 23		Loop current	- Configured current span too small (Difference between current beginning and end)
Err 33		Sensocheck®	- Short circuit in primary coil - Short circuit of cable
Err 34		Sensocheck®	- Open circuit in secondary coil - Cable interrupted
Err 98		System error	- Configuration or calibration data defective; completely reconfigure and recalibrate the Transmitter - Measured value transmission defective - Memory error in Transmitter program (PROM defective)
Err 99		Factory settings	- EEPROM or RAM defective - Error in factory settings This error message normally should not occur, as the data are protected from loss by multiple safety functions. Should this error message nevertheless occur, there is no remedy. The Transmitter must be repaired and recalibrated at the factory.

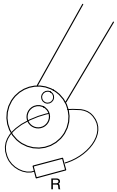
Diagnostics Functions

Cal info

Pressing **CAL** and entering mode code *"0000"* is going to activate the cal info. Cal info shows the current calibration data for approx. 20 sec. During cal info the Transmitter is not in Hold state.

Test mode

Pressing **CAL** and entering mode code *"2222"* is going to activate the test mode. In the test mode you can check the measuring equipment with a resistor. Sensoface® is disabled.



To do so, a comparison resistor is looped through the sensor. The comparison resistance value is indicated in the main display in kΩ. When the resistance value exceeds 2 kΩ, the display shows "– – – –".

R: e.g. 100 Ω

Pressing **ENTER** ends the test mode. The Transmitter goes to Hold state.

Error info

Pressing **CONF** and entering mode code *"0000"* is going to activate the error info. Error info shows the most recent error message for approx. 20 sec. After that the message will be deleted. During error info the Transmitter is not in Hold state.

Display loop current

Pressing **ENTER** in measuring mode displays the loop current for a few seconds.

Current source

To check the connected peripherals (e.g. limit switches, controllers), the loop current can be manually specified.

Warning

In the current source mode the loop current no longer follows the measured value! It is manually specified.
Therefore, it must be ensured that the connected devices (control room, controllers, indicators) do not interpret the current value as a measured value!

Pressing **CONF** and entering mode code *"5555"* is going to activate the current source mode. Specify the loop current using ▶, ▲ and **ENTER**. The actually flowing loop current is shown in the lower display.
Pressing **CONF** exits the current source mode again.

GainCheck® manual instrument self-test

The manual instrument self-test is started by simultaneously pressing ▲ and ▶.

A display test is carried out, the software version is displayed and the memory and measured-value transmission are checked.

Automatic self-test

The automatic self-test checks the memory and the measured-value transmission. It runs automatically in the background at fixed intervals.

Maintenance and Cleaning

Maintenance

The Transmitter contains no user repairable components. If problems persist even after reviewing section 4, please contact the factory.

Cleaning

To remove dust, dirt and spots, the external surfaces of the Transmitter may be wiped with a damp, lint-free cloth. A mild household cleaner may also be used if necessary.

5 Appendix

Product Line

Units

	Ref. No.
Toroidal Conductivity Transmitter for application in safe areas or hazardous locations DIV 2 (USA/Canada only)	APT2000TC-0-00
Toroidal Conductivity IS Transmitter for application in hazardous locations DIV 1 (USA/Canada) / Zone 1 (Europe)	APT2000TC-0-IS
Toroidal Conductivity Transmitter with HART® communication for application in safe areas or hazardous locations DIV 2 (USA/Canada only)	APT2000TC-H-00
Toroidal Conductivity IS Transmitter with HART® communication, for application in hazardous locations DIV 1 (USA/Canada) / Zone 1 (Europe)	APT2000TC-H-IS

Mounting Accessories

	Ref. No.
Pipe-mount kit	51205988-001
Panel-mount kit	51205990-001
Protective hood	51205989-001

Further Accessories

	Ref. No.
HART® test socket, integrated in Pg cable gland (for APT2000TC-H-.. Transmitter only)	51205991-001

Specifications

APT2000TC-0(H)-00 Transmitter

Cond input	Input for Series 5000 toroidal conductivity sensor
Process variable/ranges**	00.00 to 99.99 mS/cm 000.0 to 999.9 mS/cm 0000 to 9999 mS/cm
Concentration	0.0 to 100.0 % by wt.
Salinity	0.0 to 45.0 ‰ (0 to 35 °C)
Accuracy***	< 1 % of meas. value ± 0.02 mS/cm
Sensor monitoring	Sensocheck®: monitoring of primary and lines for short circuit and monitoring of secondary for open circuit (can be switched off)
Sensor standardization*	– Entry of cell factor with display of conductivity and temperature – Zero point adjustment – Temperature probe adjustment – Input of sensor factor
Permissible cell factor	0.100 to 19.999
Permissible sensor factor	1.00 to 99.99
Permissible offset	± 0.5 mS/cm

APT2000TC-0(H)-IS Transmitter

Cond input	Input for Series 5000 toroidal conductivity sensor
Process variable/ranges**	00.00 to 99.99 mS/cm 000.0 to 999.9 mS/cm 0000 to 9999 mS/cm
Concentration	0.0 to 100.0 % by wt.
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Permissible cell factor	0.100 to 19.999
Permissible sensor factor	1.00 to 99.99
Permissible offset	± 0.5 mS/cm

APT2000TC-0(H)-00 Transmitter

Temp input	Pt 100 / Pt 1000 / NTC 100 kΩ	
Ranges	– NTC	–10.0 to +130.0 °C +14 to +266 °F
	– Pt	–20.0 to +150.0 °C –4 to +302 °F
Resolution	0.1 °C / 1 °F	
Accuracy	< 0.5 K****	
Temp compensation* (Ref. temp 25 °C)	LIN NLF	00.00 to 19.99 %/K Natural waters to EN 27888 (0 to 36 °C)
Concentration determination	-01- NaCl	0-26.3 % by wt (0 °C) ... 0-28.1 % by wt (100 °C)
	-02- HCl	0-17 % by wt (-20 °C) ... 0-17 % by wt (50 °C)
	-03- NaOH	0-12 % by wt (0 °C) ... 0-22 % by wt (100 °C)
	-04- H_2SO_4	0-25 % by wt (-17 °C) ... 0-35 % by wt (110 °C)
	-05- HNO_3	0-28 % by wt (-20 °C) ... 0-28 % by wt (50 °C)
	-06- H_2SO_4	95-99 % by wt (-10 °C) ... 95-99 % by wt (110 °C)
Display	LC display, alarm LED	
Loop current	4 to 20 mA, floating 22 mA for error message* supply voltage 14 to 40 V	
Characteristic*	Linear or logarithmic	
Current error	< 0.3 % of current value ± 0.05 mA	

APT2000TC-0(H)-IS Transmitter

Temp input	Pt 100 / Pt 1000 / NTC 100 kΩ	
Ranges	– NTC	–10.0 to +130.0 °C +14 to +266 °F
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	-04- H_2SO_4	0-25 % by wt (-17 °C) ... 0-35 % by wt (110 °C)
	-05- HNO_3	0-28 % by wt (-20 °C) ... 0-28 % by wt (50 °C)
	-06- H_2SO_4	95-99 % by wt (-10 °C) ... 95-99 % by wt (110 °C)
Display	LC display, alarm LED	
Loop current EEx ib IIC	4 to 20 mA, floating 22 mA for error message* supply voltage 14 to 30 V, I_{max} = 100 mA, P_{max} = 0.8 W	
Characteristic*	Linear or logarithmic	
Current error	< 0.3 % of current value ± 0.05 mA	

APT2000TC-0(H)-00 Transmitter

Start/End of scale*	As desired within ranges for mS, %, SAL
Min. span	LIN 5 % of selected range LOG 1 decade
Current source	3.8 mA to 22.00 mA
HART® communication (HART transmitter only)	Digital communication via FSK modulation of loop current, reading of device identification, measured values, status and messages reading and writing of parameters
Explosion protection	USA/Canada: NI, Class I, Div 2, Group A – D, T4
Data retention	> 10 years (EEPROM)
RFI suppression	To EN 50 081-1 and EN 50 081-2
Immunity to interference	To EN 50 082-1 and EN 50 082-2
Temperature	Operating/ambient temp –20 to +55 °C Transport and storage temp –20 to +70 °C
Enclosure	Material: thermoplastic polyester, reinforced (polybutylene terephthalate) Protection: IP 65 Color: bluish gray RAL 7031
Cable glands	3 breakthroughs for Pg 13.5 2 breakthroughs for NPT 1/2 “ or Rigid Metallic Conduit

APT2000TC-0(H)-IS Transmitter

Start/End of scale*	As desired within ranges for mS, %, SAL
Min. span	LIN 5 % of selected range LOG 1 decade
Current source	3.8 mA to 22.00 mA
HART® communication (HART transmitter only)	Digital communication via FSK modulation of loop current, reading of device identification, measured values, status and messages reading and writing of parameters
Explosion protection	USA/Canada: IS, Class I, Div 1, Group A – D, T4 Europe: II 2G EEx ib [ia] IIC T6 CE 0032 TÜV 99 ATEX 1430
Data retention	> 10 years (EEPROM)
RFI suppression	To EN 50 081-1 and EN 50 081-2
Immunity to interference	To EN 50 082-1 and EN 50 082-2
Temperature	Operating/ambient temp –20 to +55 °C Transport and storage temp –20 to +70 °C
Enclosure	Material: thermoplastic polyester, reinforced (polybutylene terephthalate) Protection: IP 65 Color: bluish gray RAL 7031
Cable glands	3 breakthroughs for Pg 13.5 2 breakthroughs for NPT 1/2 “ or Rigid Metallic Conduit

APT2000TC-0(H)-00 Transmitter

Dimensions	See Dimension drawings, Pg. 7 ff
Weight	approx. 1 kg

* user defined
** displayed with 3 1/2 digits
*** ± 1 count
**** with Pt 100 < 1K, with NTC > 100 °C < 1 K

APT2000TC-0(H)-IS Transmitter

Dimensions	See Dimension drawings, Pg. 7 ff
Weight	approx. 1 kg

* user defined
** displayed with 3 1/2 digits
*** ± 1 count
**** with Pt 100 < 1K, with NTC > 100 °C < 1 K

Type Examination Certificate

Translation

(1) **EC-TYPE EXAMINATION CERTIFICATE**

(2) Equipment or Protective System intended for use in potentially explosive atmospheres - **Directive 94/9/EC**

(3) EC-Type Examination Certificate Number

TÜV 99 ATEX 1501

(4) Equipment or Protective System: Analytical process transmitter Typ APT2000TC-*-IS

(5) Manufacturer: Honeywell Inc.

(6) Address: USA - Fort Washington PA 19034, 1100 Virginia Drive

(7) This equipment or protective system and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.

(8) The TÜV Hannover/Sachsen-Anhalt e.V., TÜV Certification Body N° 0032 in accordance with Article 9 of the Council Directive 94/9/EC of March 23, 1994, certifies that this equipment or protective system has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II to the Directive.

The examination and test results are recorded in confidential report N° 99/PX25991.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 50 014:1997 **EN 50 020:1994**

(10) If the sign "X" is placed after the certification number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-TYPE EXAMINATION CERTIFICATE relates only to the design and construction of the specified equipment or protective system. If applicable, further requirements of this Directive apply to the manufacture and supply of this equipment or protective system.

(12) The marking of the equipment or protective system shall include the following:

II 2 (1) G EEx ib [ia] IIC T6

TÜV Hannover/Sachsen-Anhalt e.V.
TÜV CERT-Zertifizierungsstelle
Am TÜV 1
D-30519 Hannover

Hannover, 1999-11-17

Head of the Certification Body

(13) **SCHEDULE**

(14) **EC-TYPE EXAMINATION CERTIFICATE N° TÜV 99 ATEX 1501**

(15) Description of equipment or protective system

The Analytical process transmitter Typ APT2000TC-*-IS is used for the recognition and processing of electrochemical quantities.

The maximum permissible ambient temperature is 55°C.

Electrical data

Current loop .... in type of protection "Intrinsic Safety" EEx ib IIC
(terminals 10, 11) only for the connection to a certified intrinsically safe circuit with the following maximum values:

U_i = 30 V
I_i = 100 mA
P_i = 0.8 W

effective internal capacitance C_i = 20 nF
effective internal inductance L_i = 0.2 mH

Conductivity measuring loop ..... in type of protection "Intrinsic Safety" EEx ia IIC
(terminals 1, 2, 3, 4, 5) Maximum values:

U_O = 7.5 V
I_O = 63 mA
P_O = 80 mW
R_i = 80 Ω
Characteristic: linear
effective internal capacitance C_i = 3 nF
The effective internal inductance is negligibly small.

max. permissible external capacitance C_o = 11.1 µF
max. permissible external inductance L_o = 9 mH

Temperature measuring loop .... in type of protection "Intrinsic Safety" EEx ia IIC
(terminals 7, 8) Maximum values:

U_O = 5 V
I_O = 3.5 mA
P_O = 5 mW
R_i = 1590 Ω
Characteristic: linear
effective internal capacitance C_i = 250 nF
The effective internal inductance is negligibly small.

max. permissible external capacitance C_o = 100 µF
max. permissible external inductance L_o = 1 H

Schedule EC-type examination certificate N° TÜV 99 ATEX 1501

EP (Terminal 9) for the connection to the equipotential bonding system

The current loop is safely separated from the conductivity measuring loop and the temperature measuring loop up to a voltage of 60 V. The conductivity measuring loop and the temperature measuring loop are galvanically connected.

(16) Test documents are listed in the test report No. 99/PX25991.

(17) Special condition for safe use

none.

(18) Essential Health and Safety Requirements

no additional ones

BA 07 1 99 1 1003/00

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Calibration Solutions

Potassium Chloride Solutions
Electrical Conductivity in mS/cm

Temperature [°C]	Concentration 0.01 mol/l	0.1 mol/l	1 mol/l
0	0.776	7.15	65.41
5	0.896	8.22	74.14
10	1.020	9.33	83.19
15	1.147	10.48	92.52
16	1.173	10.72	94.41
17	1.199	10.95	96.31
18	1.225	11.19	98.22
19	1.251	11.43	100.14
20	1.278	11.67	102.07
21	1.305	11.91	104.00
22	1.332	12.15	105.94
23	1.359	12.39	107.89
24	1.386	12.64	109.84
25	1.413	12.88	111.80
26	1.441	13.13	113.77
27	1.468	13.37	115.74
28	1.496	13.62	
29	1.524	13.87	
30	1.552	14.12	
31	1.581	14.37	
32	1.609	14.62	
33	1.638	14.88	
34	1.667	15.13	
35	1.696	15.39	
36		15.64	

Data source: K. H. Hellwege (Editor), H. Landolt, R. Börnstein: Zahlenwerte und Funktionen .... Volume 2, Part. Volume 6

Sodium Chloride Solutions
Electrical Conductivity in mS/cm

Temperature [°C]	Concentration saturated*	0.1 mol/l**	0.01 mol/l**
0	134.5	5.786	0.631
1	138.6	5.965	0.651
2	142.7	6.145	0.671
3	146.9	6.327	0.692
4	151.2	6.510	0.712
5	155.5	6.695	0.733
6	159.9	6.881	0.754
7	164.3	7.068	0.775
8	168.8	7.257	0.796
9	173.4	7.447	0.818
10	177.9	7.638	0.839
11	182.6	7.831	0.861
12	187.2	8.025	0.883
13	191.9	8.221	0.905
14	196.7	8.418	0.927
15	201.5	8.617	0.950
16	206.3	8.816	0.972
17	211.2	9.018	0.995
18	216.1	9.221	1.018
19	221.0	9.425	1.041
20	226.0	9.631	1.064
21	231.0	9.838	1.087
22	236.1	10.047	1.111
23	241.1	10.258	1.135
24	246.2	10.469	1.159
25	251.3	10.683	1.183
26	256.5	10.898	1.207
27	261.6	11.114	1.232
28	266.9	11.332	1.256
29	272.1	11.552	1.281
30	277.4	11.773	1.306
31	282.7	11.995	1.331
32	288.0	12.220	1.357
33	293.3	12.445	1.382
34	298.7	12.673	1.408
35	304.1	12.902	1.434
36	309.5	13.132	1.460

Data source: * K. H. Hellwege (Editor), H. Landolt, R. Börnstein: Zahlenwerte und Funktionen .... Volume 2, Part. Volume 6
** Test solutions calculated according to IEC 746-3

Concentration Curves

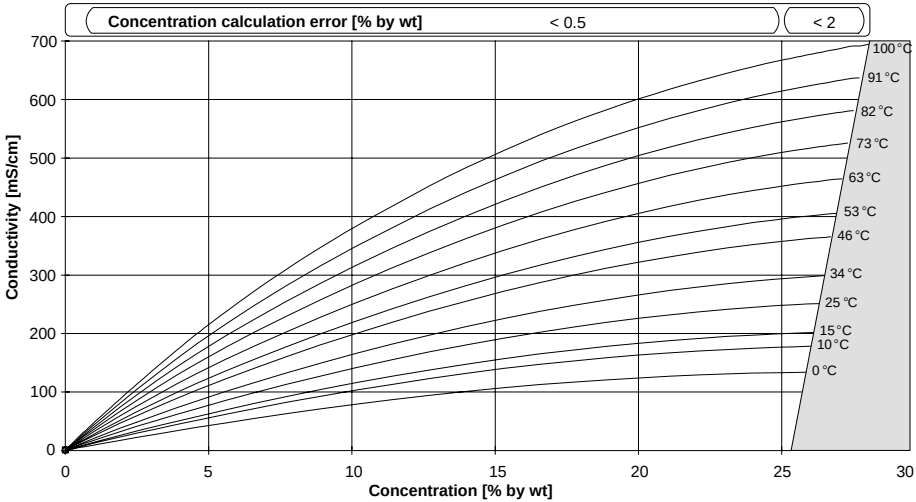

Fig. 12 Concentration curves NaCl (configuration: concentration -01-)

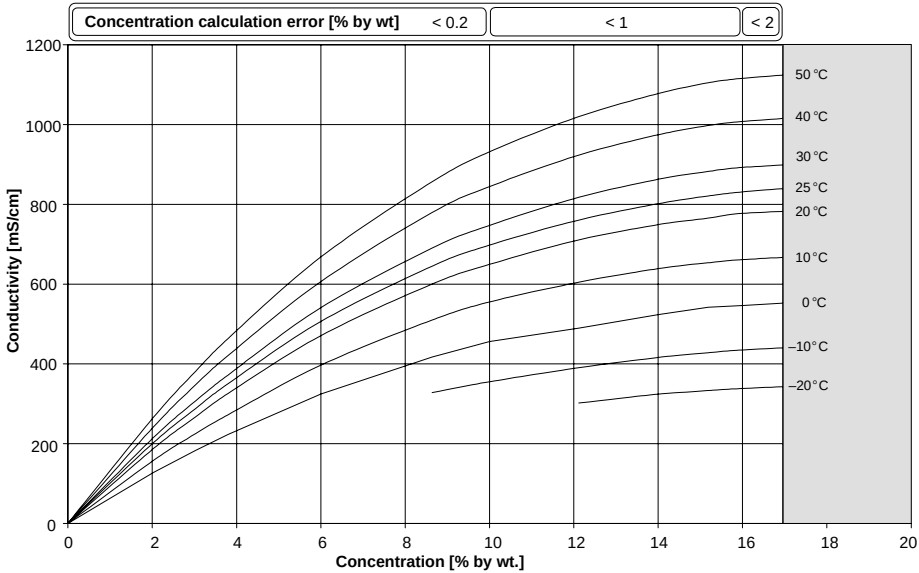

Fig. 13 Concentration curves HCl (configuration: concentration -02-)

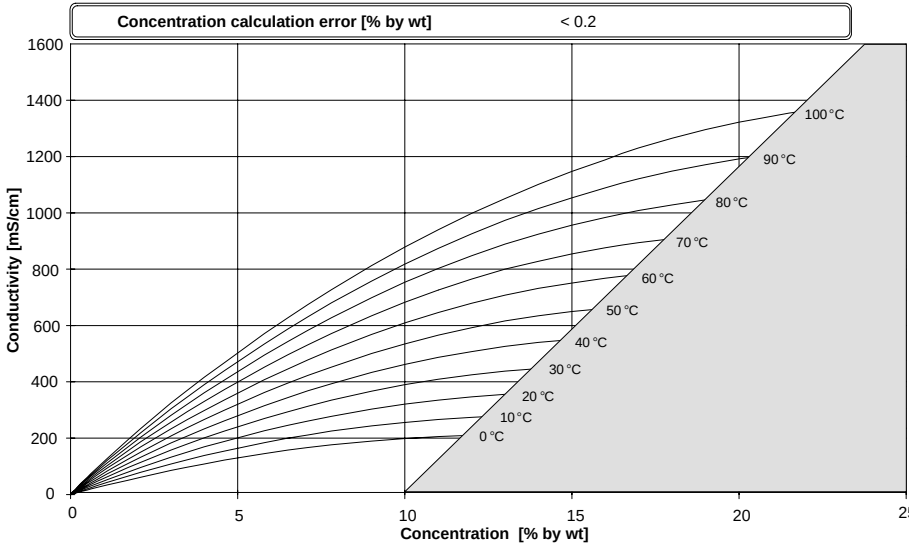

Fig. 14 Concentration curves NaOH (configuration: concentration -03-)

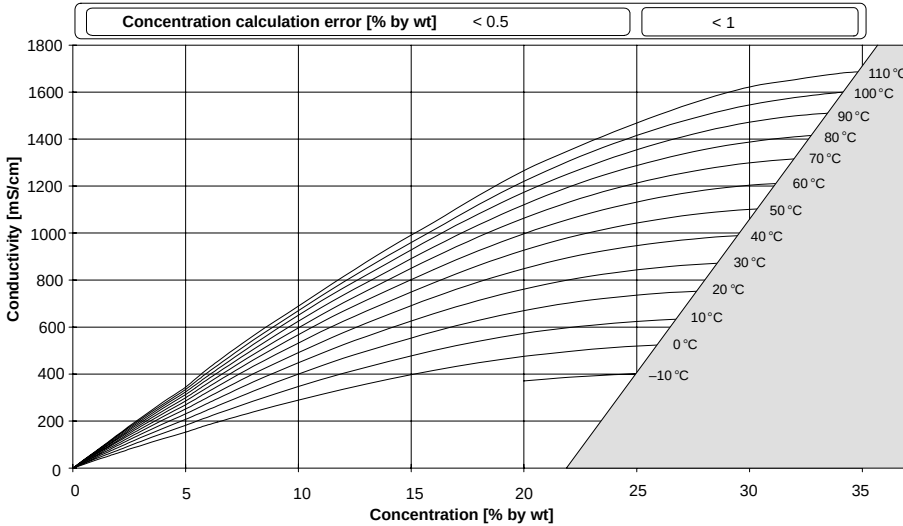

Fig. 15 Concentration curves H_2SO_4 (configuration: concentration -04-)

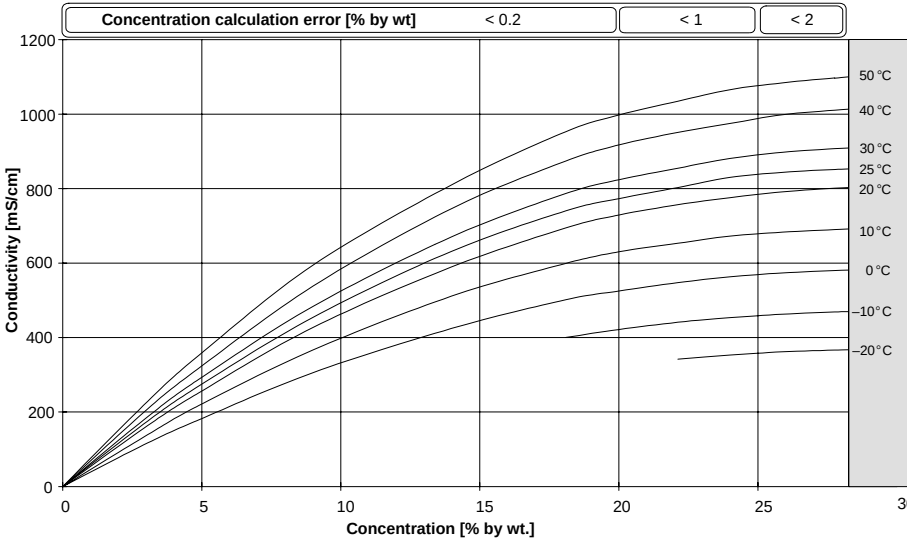

Fig. 16 Concentration curves HNO_3 (configuration: concentration -05-)

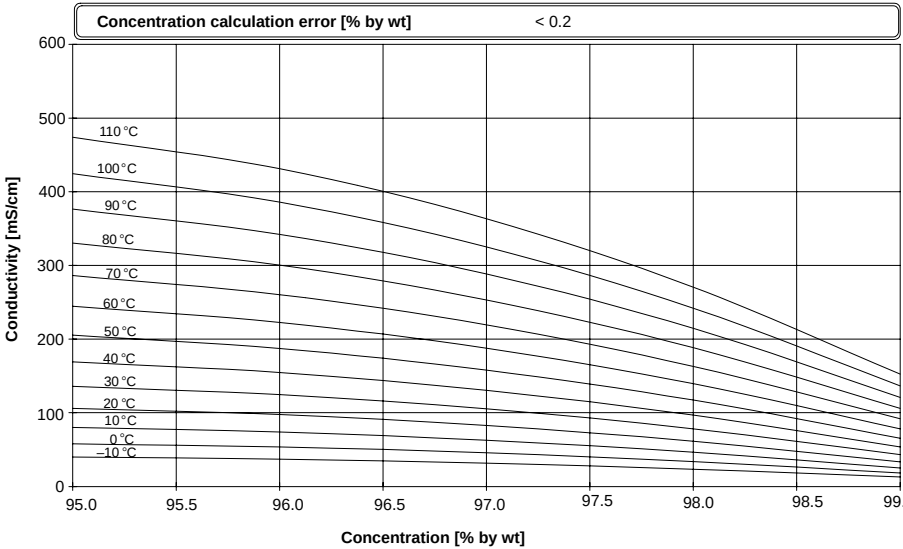

Fig. 17 Concentration curves H_2SO_4 (range 95 to 99 % by wt), (configuration: concentration -06-)

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