LOI THERMPROCESS GMBH

Description

Recipe Station

Heat treatment line

for plates

Version 2.7

October 1st, 2009

LOI THERMPROCESS GMBH

Introduction to the content

This document describes the communication concept, structure and database of the Recipe Station of the Heat Treatment Line.

History

V1.1	2007-10-08	STR	:	Telegram 22 + 24 = 88 Bytes
V1.2	2007-10-09	STR	:	Telegram 51...54 added
V1.3	2007-10-09	jge	:	Handshake quench added
V1.4	2007-10-10	STR	:	Telegram 91...98 added
V1.5	2007-10-15	STR	:	Telegram 23 and 97 added 3 timestamps
V1.6	2007-10-16	STR	:	Telegram 25 and 26 added (same as 13/14)
V1.7	2007-11-20	STR	:	Telegram 27 added
V1.8	2008-04-02	STR	:	HMI added
V1.9	2008-06-23	STR	:	Telegram 23 and 97 added 8 real values and spare
V1.10	2008-08-14	jge	:	Telegram length (all)
V1.11	2008-09-05	STR	:	Telegram 14 and 23 added revision_id
V1.12	2008-09-06	jge	:	Tel 53 added revision_id and Return codes Tel 23

V2.0	2008-09-15	STR	:	All Telegram IDs changed to 3 figures (e.g. 29 -> 209) Telegram 208 and 910 (position and flow) added Telegram 209 and 911 (ack position and flow) added Telegram 210 and 912 (restore position/flow) added Telegram 211 and 913 (ack position/flow) added Telegram 701, 702, 703, 704 added
V2.1	2008-10-28	STR	:	Telegram 203: furnace results from 703 added
V2.2	2008-11-09	STR	:	Tel 503, 104 revision_id position in telegram changed
V2.3	2008-12-17	STR	:	Screen pictures actualized
V2.4	2009-08-29	STR	:	Number of plates in group changed from 7 to 2 Text Length changed from 20 to 32 characters
V2.5	2009-09-03	STR	:	Telegrams 701…704 moved to the document “TelegramsLevel2toPlcE.doc”.
V2.6	2009-09-18	STR	:	Screen pictures actualized
V2.7	2009-10-01	STR	:	chemicals in Tel. 203 Result

List of contents

Data flow chart

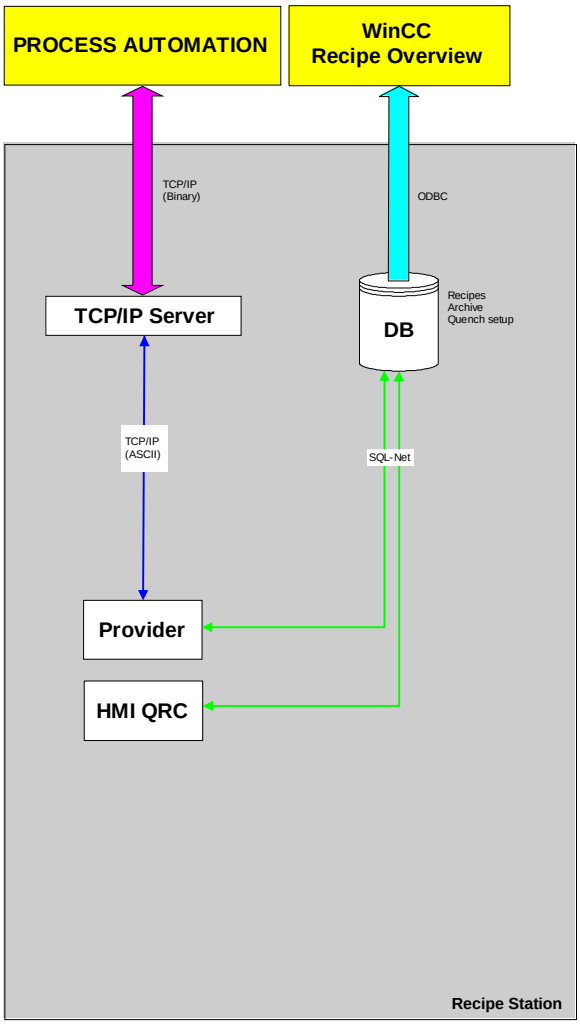
In the following picture above criteria are represented in simple way:

<u>Recipe station components</u>

TCP/IP Server
Provider
Visualization
Oracle™ database

<u>LOI Level 1 process automation</u>

PLC TC (tracking system)
PLC QC (quench control)
PLC BC (burner control)

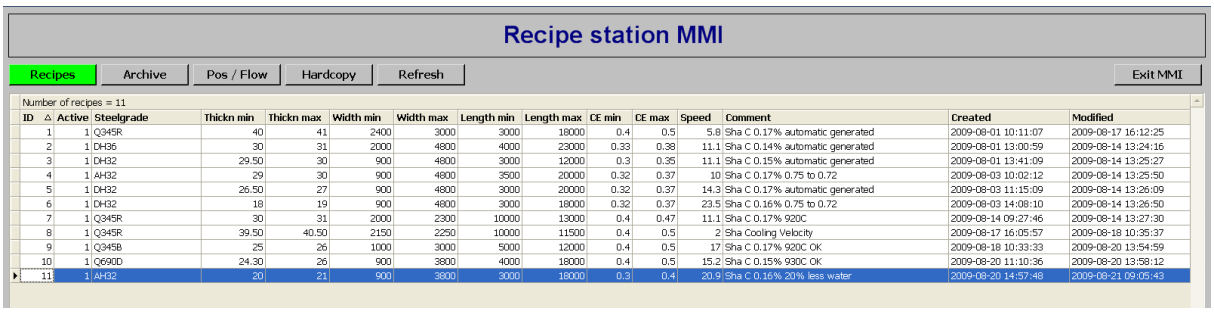


Items of recipe station HMI

The HMI provides the visualization and maintaining of recipes for quenching.
It shows results of quenched plates from the archive with detailed information in tabular view and trend charts of the water flow of each line. A recipe generator is included for an easy startup to find recipes for new steelgrades.

After start the HMI shows the recipe overview picture. From the menu it goes to

- Recipes
- Archive
- Pos/Flow
- Hardcopy
- Refresh
- Exit MMI

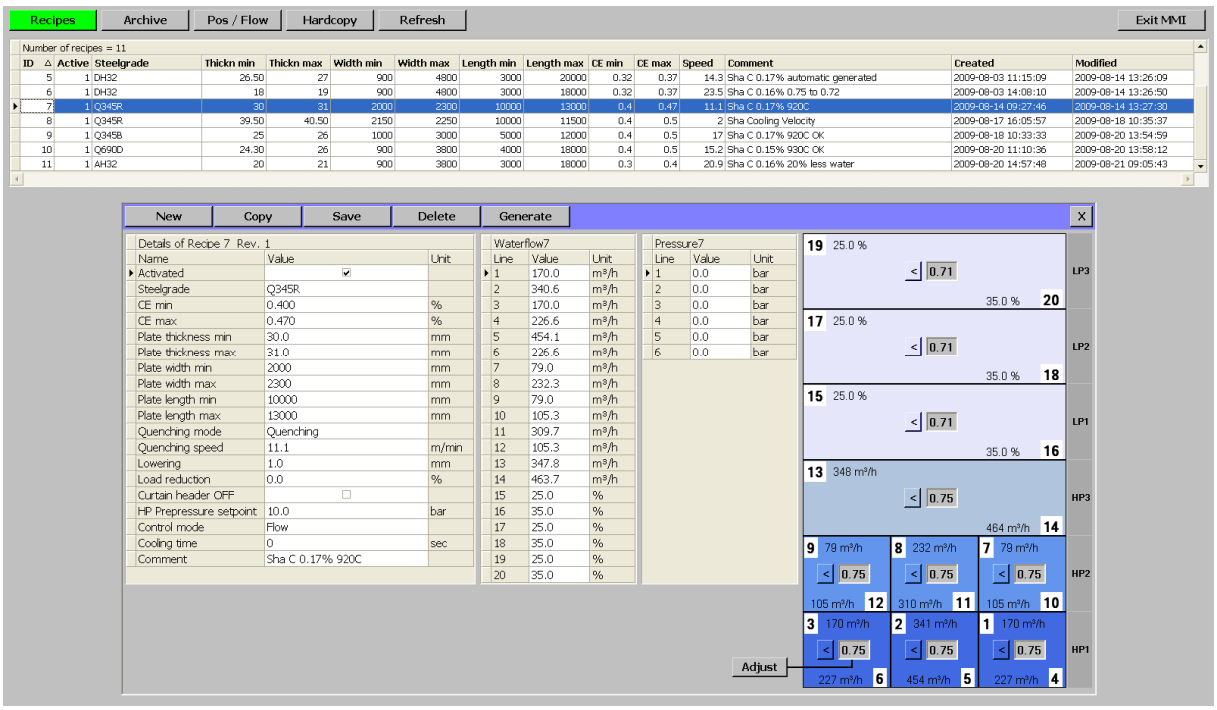


ID	Active	Steelgrade	Thickn min	Thickn max	Width min	Width max	Length min	Length max	CE min	CE max	Speed	Comment	Created	Modified
1	1	Q345R	40	41	2400	3000	3000	18000	0.4	0.5	5.8	Sha C 0.17% automatic generated	2009-08-01 10:11:07	2009-08-17 16:12:25
2	1	DH36	30	31	2000	4800	4000	23000	0.33	0.38	11.1	Sha C 0.14% automatic generated	2009-08-01 13:00:59	2009-08-14 13:24:16
3	1	DH32	29.50	30	900	4800	3000	12000	0.3	0.35	11.1	Sha C 0.15% automatic generated	2009-08-01 13:41:09	2009-08-14 13:25:27
4	1	AH32	29	30	900	4800	3500	20000	0.32	0.37	10	Sha C 0.17% 0.75 to 0.72	2009-08-03 10:02:12	2009-08-14 13:25:50
5	1	DH32	26.50	27	900	4800	3000	20000	0.32	0.37	14.3	Sha C 0.17% automatic generated	2009-08-03 11:15:09	2009-08-14 13:26:09
6	1	DH32	18	19	900	4800	3000	18000	0.32	0.37	23.5	Sha C 0.16% 0.75 to 0.72	2009-08-03 14:08:10	2009-08-14 13:26:50
7	1	Q345R	30	31	2000	2300	10000	13000	0.4	0.47	11.1	Sha C 0.17% 920C	2009-08-14 09:27:46	2009-08-14 13:27:30
8	1	Q345R	39.50	40.50	2150	2250	10000	11500	0.4	0.5	2	Sha Cooling Velocity	2009-08-17 16:05:57	2009-08-18 10:35:37
9	1	Q345B	25	26	1000	3000	5000	12000	0.4	0.5	17	Sha C 0.17% 920C OK	2009-08-18 10:33:33	2009-08-20 13:54:59
10	1	Q690D	24.30	26	900	3800	4000	18000	0.4	0.5	15.2	Sha C 0.15% 930C OK	2009-08-20 11:10:36	2009-08-20 13:58:12
11	1	AH32	20	21	900	3800	3000	18000	0.3	0.4	20.9	Sha C 0.16% 20% less water	2009-08-20 14:57:48	2009-08-21 09:05:43

Recipes

As default it shows a overall recipe grid filling the whole window. A double-click on a row in that grid minimizes the grid and a detailed window with more information appears below. In the top area still all recipes can be selected to switch between detailed recipe information. The recipes can be sorted by pushing a header of a column in the grid.

The recipe in the detailed window can be edited and deleted. The operator can create new recipes with the New button or easily with the Copy function of an existing recipe. To save or delete a recipe, a popup window needs to be confirmed.

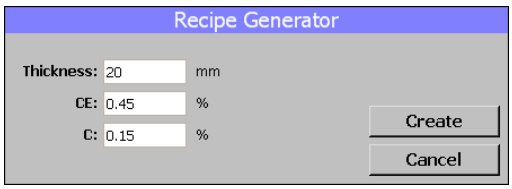


Each set value of the recipe is limit checked, for example it is not possible to create a plate with a thickness of 0 mm. Beside the amount of water flow and pressure is editable. On the right side the HP and LP areas are visualized if the water flow grid contains set values. In this picture the relation between upper and lower zone is calculated. For a quick change of waterflow set values acc. another relation, the Adjust button can be used. The “Arrow” button < 0.75 determines whether the upper or the lower quench line shall be adjusted.

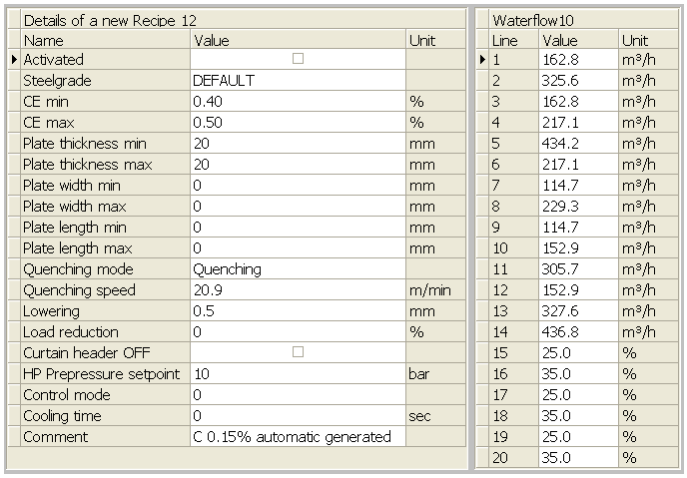
The detailed recipe window can be closed by X to go back to the overall recipe grid.

Recipe generator

The recipe generator opened by the Generate button helps to find a recipe for a new steelgrade.



Just fill in the thickness, CE and amount of carbon in the edit fields of the popup window and push the Create button to execute the generation program.



Details of a new Recipe 12

Name	Value	Unit
Activated	☐	
Steelgrade	DEFAULT	
CE min	0.40	%
CE max	0.50	%
Plate thickness min	20	mm
Plate thickness max	20	mm
Plate width min	0	mm
Plate width max	0	mm
Plate length min	0	mm
Plate length max	0	mm
Quenching mode	Quenching	
Quenching speed	20.9	m/min
Lowering	0.5	mm
Load reduction	0	%
Curtain header OFF	☐	
HP Prepressure setpoint	10	bar
Control mode	0	
Cooling time	0	sec
Comment	C 0.15% automatic generated	

Waterflow10

Line	Value	Unit
1	162.8	m³/h
2	325.6	m³/h
3	162.8	m³/h
4	217.1	m³/h
5	434.2	m³/h
6	217.1	m³/h
7	114.7	m³/h
8	229.3	m³/h
9	114.7	m³/h
10	152.9	m³/h
11	305.7	m³/h
12	152.9	m³/h
13	327.6	m³/h
14	436.8	m³/h
15	25.0	%
16	35.0	%
17	25.0	%
18	35.0	%
19	25.0	%
20	35.0	%

A new recipe is generated with a new recipe ID. The high pressure waterflow set values are determined by a calculation which takes into account the upper-to-lower-line relation, the left/right-to-center-line relation and the amount of carbon. Low pressure areas will be set with default values, but changed for heavy plates if the cooling time is needed. The quenching speed, the quenching mode, lowering is a function of the plate thickness. Further edit fields need to be filled manually:

- Steelgrade
- Plate width max/min
- Plate length max/min
- Comment (if needed)

At least the recipe should be activated (first row of the grid). For the first step this recipe can be used. After some quench trials this recipe can be modified in further steps if the result of shape and hardness is not satisfied.

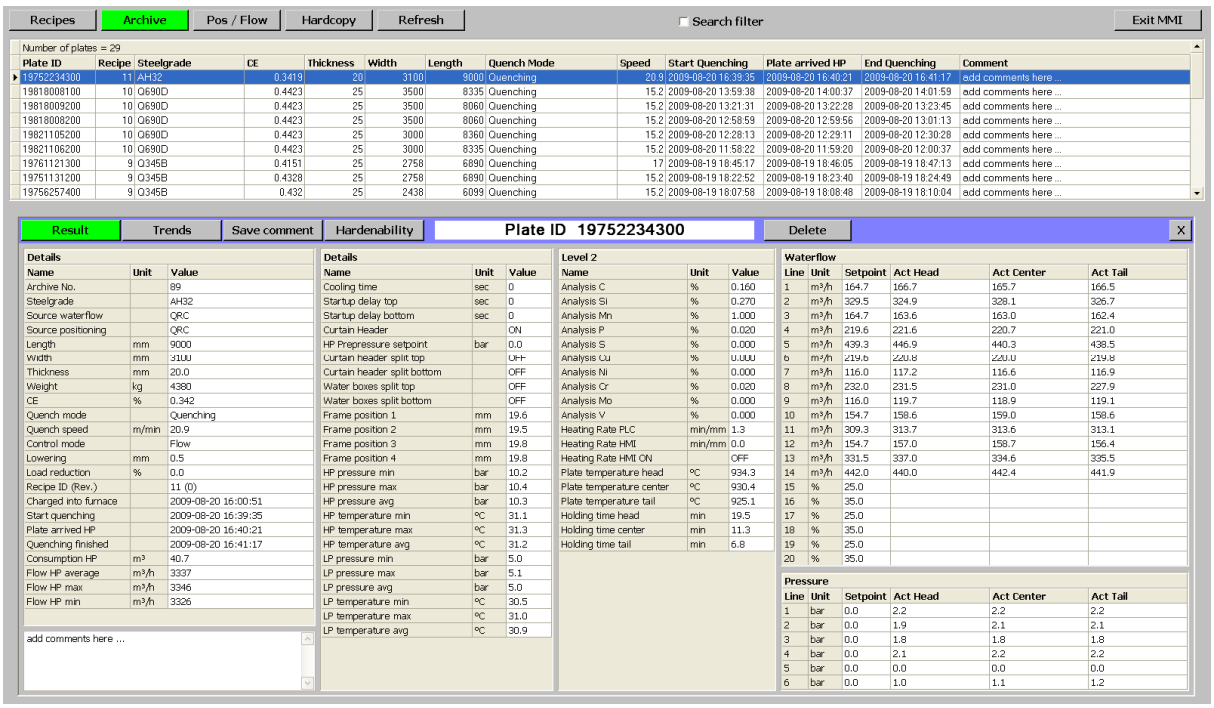
All parameter for limit values, the generation and database access are located in the windows registry.

Archive

In the top area all archived plates available can be selected directly in the overview grid. The number of archived plates are shown in the grid header. Plate results and trends are available. The hardenability program (same as MAC) can be used for the selected plate.

Archive – Result

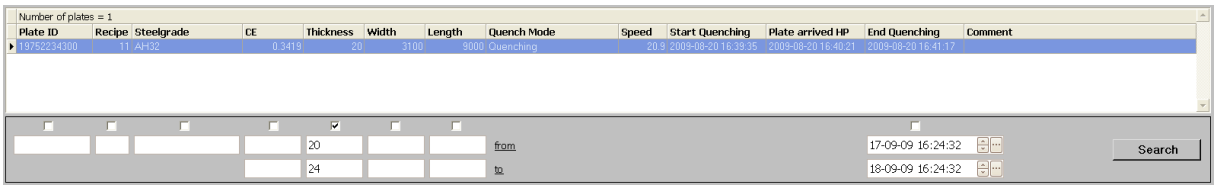
By selecting a plate detailed information of the quench incl. water flow and pressure are visualized. Results from the furnace math model are shown in the Level 2 grid.



Comments can be added by filling the lower-left text box and saved by the Save comment button. The Delete button deletes the selected archived dataset from the database. Each dataset has a unique archive no. The Archive contains also the PDI, the charging/discharging timestamps of heat treatment, waterflow consumption, pressures, cooling time, quench frame position.

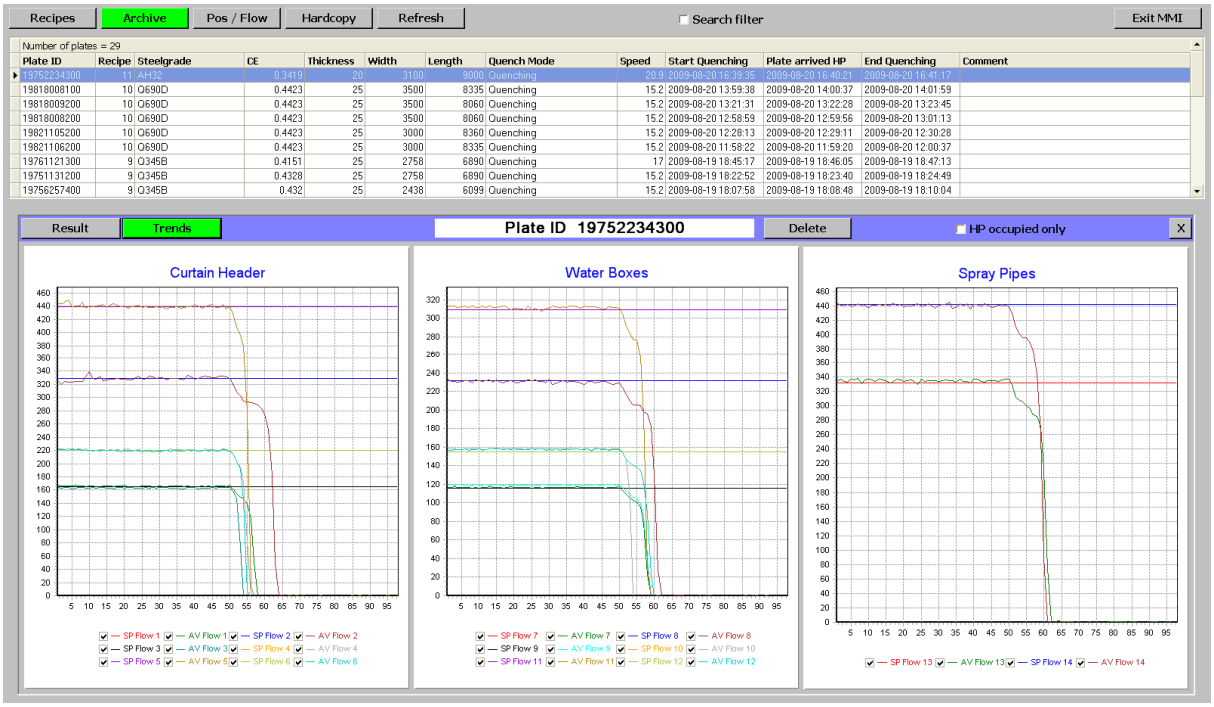
The hardenability program are opened by the Hardenability button.

With the Search filter check box the search grid appears below the top located overview grid. It helps to find plates by limiting thickness, length, … properties.



Archive – Trends

The selected plate gives also information by trend views, which is separated in trends charts of curtain header, water boxes and spray pipes.



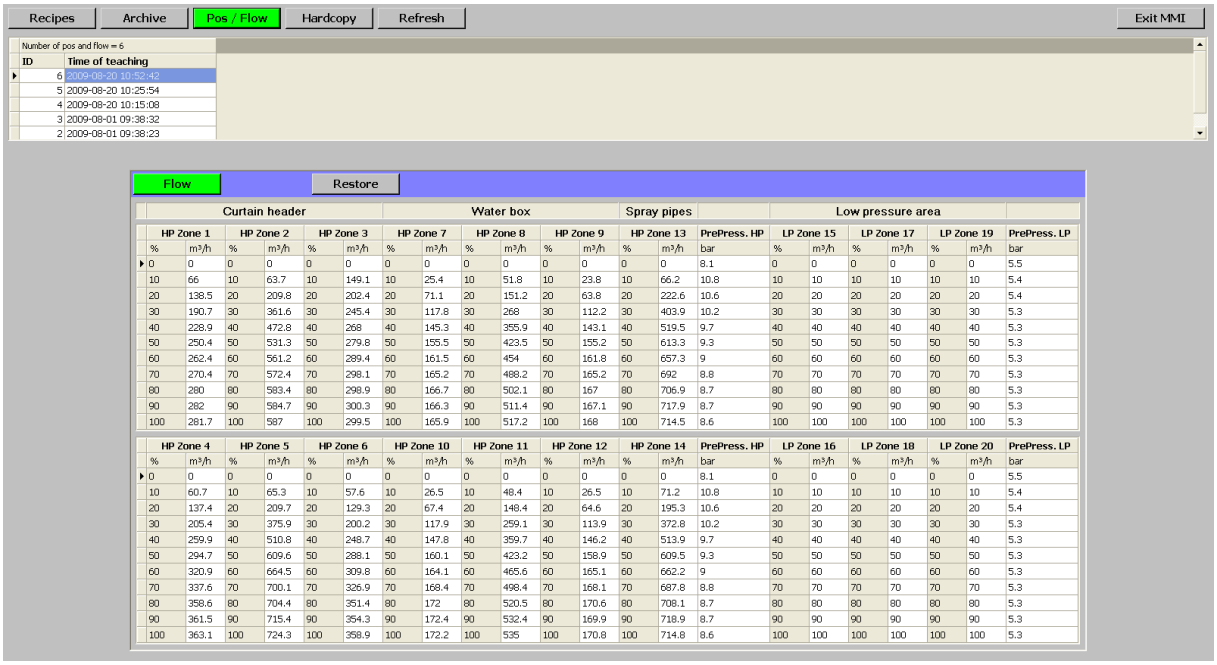
Each water line is shown with set and act values, which can be switched off the chart by clicking the corresponding check box below the charts. With HP occupied only only the trends shown when the plate occupied the high pressure areas during quenching.

The detailed archive window can be closed by X to go back to the overall archive grid.

Position and Flow

The Position and Flow table shows the relation between position of flow valves [0..100%] and the amount of waterflow [m³/h]. After “teaching” or generating of position and flow during each setup of the quench, the result will be sent from the quench control unit to the Recipe Station and saved there in the local database.

Later these values are needed to preset the waterflow lines of the quench in advance of each quench cycle, accordingly the waterflow setpoints of the recipe.



With Restore the archived pos/flow values can be sent back to the quench control unit.

Definition of telegrams

Items of communication

Communication is differentiated dependent on the existing communication partners into different kinds of telegram:

Telegrams: Data transfer between LOI components
Database access: Read/Write operations to the Oracle™ database which delivers recipes to setup the quench and archived process data

Telegrams between Recipe station (RS Server) and PLC

On Recipe station site the program “RSServer.exe” provides the communication to each PLC:

- PLC-TC (tracking control) for material tracking
- PLC-QC (quench control) for the quench facilities

The transport protocol of the telegrams between Recipe station and each PLC is TCP/IP. All data exchange between two partners is ensured over one connection means PLC is SERVER and Recipe station is CLIENT. The telegram is coded in binary format and has a fixed length.

Structure of telegram Type-A

The Type-A telegram is divided into 2 parts as follows:

Message Header	20 Bytes	Binary
Data Body	n Bytes	

Structure of telegram Type-B

The Type-B telegram is divided into 3 parts as follows:

Message Header	20 Bytes	Binary
Data Header	86 Bytes	
Data Body	n Bytes	

Kinds of telegram

The system uses 2 kind of telegrams:

- Watchdog telegram
- Data telegram

Overview of telegrams

ID	Sender	Receiver	Telegram Length	Timing	Aim
101	**TC**	**RS**	**20**	**Cyclically**	**Watchdog**
102	**RS**	**TC**	**20**	**Cyclically**	**Watchdog**
103	**TC**	**RS**	**114**	**Event**	**Recipe Request by tracking plc**
104	**RS**	**TC**	**474**	**Event**	**Answer with recipe by recipe station**
201	**QC**	**RS**	**20**	**Cyclically**	**Watchdog**
202	**RS**	**QC**	**20**	**Cyclically**	**Watchdog**
203	**QC**	**RS**	**1708**	**Event**	**Quench result (after discharging)**
204	**RS**	**QC**	**108**	**Event**	**Acknowledge quench result**
205	QC	RS	114	Event	Recipe Request by tracking plc (optional)
206	RS	QC	474 (*)	Event	Answer with recipe by recipe station (optional)
207	**QC**	**RS**	**620**	**Event/Cyclically**	**Cyclic quench result**
208	**QC**	**RS**	**3120**	**Event**	**Position and flow**
209	**RS**	**QC**	**22**	**Event**	**Acknowledge position and flow**
210	**RS**	**QC**	**3120**	**Event**	**Restore position and flow**
211	**QC**	**RS**	**22**	**Event**	**Acknowledge restore position and flow**
501	**TC**	**QC**	**20**	**Cyclically**	**Watchdog**
502	**QC**	**TC**	**20**	**Cyclically**	**Watchdog**
503	**TC**	**QC**	**618**	**Event**	**Control set Quench (2 min. before exit)**
504	**QC**	**TC**	**108**	**Event**	**Acknowledge control set quench**
701	**QC**	**L2**	**20**	**Cyclically**	**Watchdog QC -> L2**
702	**L2**	**QC**	**20**	**Cyclically**	**Watchdog L2 -> QC**
703	**L2**	**QC**	**140**	**Event**	**Furnace result L2-> QC**
704	**QC**	**L2**	**22**	**Event**	**Acknowledge Furnace result QC -> L2**

The telegrams 501 … 504 and 701 … 704 are used between TC, QC and L2 uses the same kind of telegram specification.

Telegrams between TCPIP-Server and Provider

The inner interface of the program “TCPIP-Server.exe” (RS) are connected to the program “Provider.exe” (PR), which provides the quench recipes and archives quench results with a connection to the local oracle database.

The transport protocol of the telegrams between the RS and PR is TCP/IP. All data exchange between these two partners is ensured over one connection means RS is SERVER and PR is CLIENT. The telegram is coded in ASCII format with dynamic length.

Structure of telegram

Telegram types

ID	Sender	Receiver	Telegram Length	Timing	Aim
901	**RS**	**PR**		**Cyclically**	**Watchdog RS Server to RS Provider (TC)**
902	**PR**	**RS**		**Cyclically**	**Watchdog RS Provider to RS Server**
903	**RS**	**PR**		**Event**	**Recipe Request**
904	**PR**	**RS**		**Event**	**Answer with recipe**
905	**RS**	**PR**		**Cyclically**	**Watchdog RS Server to RS Provider (QC)**
906	PR	RS			Not used (spare watchdog)
907	**RS**	**PR**		**Event**	**Quench result (after discharging)**
908	**PR**	**RS**		**Event**	**Acknowledge quench result**
909	**RS**	**PR**		**Event**	**Quench act values (during quenching)**
910	**RS**	**PR**		**Event**	**Position and flow**
911	**PR**	**RS**		**Event**	**Acknowledge position and flow**
912	**RS**	**PR**		**Event**	**Restore position and flow**
913	**PR**	**RS**		**Event**	**Acknowledge restore position and flow**

Message Header

A telegram begins always with the Message Header and has a fixed length of 20 Bytes.

Message Header	Message Id	Indicates the identification of the message	2 Bytes	Integer
	Message Length	Indicates the whole length of the message	2 Bytes	Integer
	Sender	Indicates the sending device	2 Bytes	Character
	Receiver	Indicates the receiver device	2 Bytes	Character
	Timestamp	Indicates the year, month, day, hour, minute, second when sending the message	8 Bytes	S7- Format
	Life counter	No limitation, but each telegram gets a new number	2 Bytes	Integer
	SPARE		2 Bytes	Integer

Data Header

Some data telegrams have a common Data Header, which contains specific plate set values and information. The Data Header has always the same structure and a fixed length of 86 Bytes.

Data Header	num_plates	Number of plates in group (1..2)	2 Bytes	Integer	
	group_type	Type of group: 1. Single Plate 2. One beside one 3. One behind one (not supported)	2 Bytes	Integer	
	plate length	Length of plate group	4 Bytes	Real	m
	plate width	Width of plate group	4 Bytes	Real	m
	plate_thickness	Thickness of plate group	4 Bytes	Real	m
	CE	Carbon Equivalent	4 Bytes	Real	%
	Product_code_1	Primary production code to identify a plate specific recipe, e.g. steel grade, material class,....	32 Bytes	32 x Character	
	Product_code_2 (optional)	Secondary production code to identify a plate specific recipe, e.g. steel grade, material class,....	32 Bytes	32 x Character	
	Handling code (optional)	Extends the identification for plate specific recipe, if product code is not unique to handle the plate, e.g. 1. Quenching 2. Quenching and oscillating 3. Cooling 4. ...	2 Bytes	Integer	
			86 Bytes		

Data Body

According to the type of a data telegram, an additional Data Body is appended, which includes for example the requested recipe or quench results.

Telegram number: 101 Watchdog TC -> RS

Sender:	PLC Tracking Control	TC
Receiver:	Recipe station	RS
Type:	A	
Total length:	20 Bytes	

Timing and general description:

The telegram is triggered cyclically by PLC-TC to ensure the alive functionality, where are 2 reasons to disconnect and reestablish the connection:

- The Watchdog telegram is not received after a fixed time
- The Life Counter is not changed between two Watchdog telegrams

Message Header	Message_Id	101	2 Bytes	Integer
	Message_length	20	2 Bytes	Integer
	Sender	TC	2 Bytes	Character
	Receiver	RS	2 Bytes	Character
	Timestamp	Indicates the year, month, day, hour, minute, second when sending the message	8 Bytes	S7- Format
	Life_counter	No limitation, but each telegram gets a new number	2 Bytes	Integer
	SPARE		2 Bytes	Integer
Additional spare			X Bytes	byte

Telegram number: 102 Watchdog RS -> TC

Sender:	Recipe station	RS
Receiver:	PLC Tracking Control	TC
Type:	A	
Total length:	20 Bytes	

Telegram number: 201 Watchdog QC -> RS

Sender:	PLC Quench Control	QC
Receiver:	Recipe station	RS
Type:	A	
Total length:	20 Bytes	

Telegram number: 202 Watchdog RS -> QC

Sender:	Recipe station	RS
Receiver:	PLC Quench Control	QC
Type:	A	
Total length:	22 Bytes	

Telegram number: 103 Request Recipe TC -> RS

Sender: PLC Tracking Control TC
Receiver: Recipe station RS
Type: B
Total length: 114 Bytes

Timing and general description:

The telegram is triggered by PLC-TC to request a valid recipe (with set values) for a plate before charging into furnace.

Message Header			20 Bytes		
Data Header	num_plates	Number of plates in group (1..2)	2 Bytes	Integer	
	group_type	Type of group: 1. Single Plate 2. One beside one 3. One behind one	2 Bytes	Integer	
	plate_length	Length of plate group	4 Bytes	Real	m
	plate_width	Width of plate group	4 Bytes	Real	m
	plate_thickness	Thickness of plate group	4 Bytes	Real	m
	CE	Carbon Equivalent	4 Bytes	Real	%
	Productcode_1	Customer production code to identify a plate specific recipe, e.g. steel grade, material class,	32 Bytes	Character	
	Productcode_2	Customer production code to identify a plate specific recipe, e.g. steel grade, material class,	32 Bytes	Character	
	Handlingcode (optional)	Extends the identification for plate specific recipe, if product code is not unique to handle the plate, e.g. 1. Quenching 2. Quenching and oscillating 3. Cooling 4. ...	2 Bytes	Integer	
Data Body	C	Amount of carbon	4 Bytes	Real	
	SPARE		4 Bytes	Byte	

Telegram number: 104 Recipe answer RS -> TC

Sender: Recipe station RS
Receiver: PLC Tracking Control TC
Type: B
Total length: 474 Bytes

Timing and general description:

The telegram is triggered by Recipe station after request of telegram 103, to send a valid recipe (with set values) for a plate before charging into furnace. In case of non existing recipe, the answer is a fault value (<0) in Recipe_ID.

Message Header			20 Bytes		
Data Header			86 Bytes		
Data Body	recipe_id	1..31.000: valid recipe < 0: Error code: **-99: No recipe found (in general)** **-98: Product code 1 doesn't exist** **-97: CE doesn't exist** **-96: plate thickness doesn't exist** **-95: plate width doesn't exist** **-94: plate length doesn't exist** **-93: recipe found, but not activated**	2 Bytes	Integer	
	quench_mode	1. Quenching 2. Quenching and oscillating 3. Cooling	2 Bytes	Integer	
	quench_speed	Speed of plate during quenching	4 Bytes	Real	m/min
	water_flow_1 ... 20	water flow values for each line	80 Bytes	20 x Real	m³/h
	cooling_time	oscillation time quench mode 2, 3	2 Bytes	Integer	sec
	startup_delay_top	delay of start up quench mode 3 top	2 Bytes	Integer	1/10 sec
	startup_delay_bottom	delay of start up quench mode 3 bottom	2 Bytes	Integer	1/10 sec
	Lowering	0,0..10,0 mm	4 Bytes	Real	mm
	Load_reduction	0..60 %	4 Bytes	Real	%
	curtainheader_off	Shut off water flow for curtain header 0 = ON 1 = OFF	2 Bytes	Integer	
	HP_prepressure_set	Pressure before quench	4 Bytes	Real	bar
	Control_mode	Control mode for curtain header, controlled by 0 = Flow 1 = Pressure	2 Bytes	Integer	
	Pressure_1 ... 14	(optional) pressure control set values for each line of curtain header and water boxes (line 1..12)	56 Bytes	Real	
	Ramp_water	Ramp water on/ off 0 = OFF 1 = ON	2 Bytes	Integer	
	Ramp_water_type	Ramp water static/dynamic 0 = STATIC 1 = DYNAMIC	2 Bytes	Integer	
	Ramp_switchpoint	DYNAMIC ramp: switch point	4 Bytes	Real	m
	Ramp_start_short	DYNAMIC ramp: starting point of the ramp for short plate	4 Bytes	Real	m

Data Body	Ramp_start_long	DYNAMIC ramp: starting point of the ramp for long plate	4 Bytes	Real	m
	CH_split_top	STATIC ramp: splitting the top curtain header 0 = no splitting	2 Bytes	Integer	
	CH_start_1_top	STATIC ramp:	4 Bytes	Real	m
	CH_modify_1_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_start_2_top	STATIC ramp:	4 Bytes	Real	m
	CH_modify_2_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_start_3_top	STATIC ramp:	4 Bytes	Real	m
	CH_modify_3_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_split_bottom	STATIC ramp: splitting the bottom curtain header 0 = no splitting	2 Bytes	Integer	
	CH_start_1_bottom	STATIC ramp:	4 Bytes	Real	m
	CH_modify_1_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_start_2_bottom	STATIC ramp:	4 Bytes	Real	m
	CH_modify_2_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_start_3_bottom	STATIC ramp:	4 Bytes	Real	m
	CH_modify_3_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_split_top	STATIC ramp: splitting the top water boxes 0 = no splitting	2 Bytes	Integer	
	WB_start_1_top	STATIC ramp:	4 Bytes	Real	m
	WB_modify_1_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_start_2_top	STATIC ramp:	4 Bytes	Real	m
	WB_modify_2_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_start_3_top	STATIC ramp:	4 Bytes	Real	m
	WB_modify_3_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_split_bottom	STATIC ramp: splitting the bottom water boxes 0 = no splitting	2 Bytes	Integer	
	WB_start_1_bottom	STATIC ramp:	4 Bytes	Real	m

Data Body	WB_modify_1_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_start_2_bottom	STATIC ramp:	4 Bytes	Real	m
	WB_modify_2_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_start_3_bottom	STATIC ramp:	4 Bytes	Real	m
	WB_modify_3_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	SP_start_top	STATIC ramp:	4 Bytes	Real	m
	SP_modify_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	SP_start_bottom	STATIC ramp:	4 Bytes	Real	m
	SP_modify_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	Ramp_speed	Ramp speed on/off 0 = OFF 1 = ON	2 Bytes	Integer	
	Ramp_speed_target	Target speed ramp	4 Bytes	Real	m/min
	Ramp_speed_start	Start point ramp behind plate head	4 Bytes	Real	mm
	Ramp_speed_end	End point ramp before plate tail	4 Bytes	Real	mm
	SPARE	chemicals	40 Bytes	Byte	
	Revision_id	**Represents the last version number of requested recipe** 1..65.535	**2 Bytes**	**Integer**	
	SPARE		10 Bytes	Byte	

Telegram number: 203 Quench result QC -> RS

Sender: PLC Quench Control QC
Receiver: Recipe station RS
Type: B
Total length: 1756 Bytes

Timing and general description:

The telegram is triggered by PLC-QC after discharging of a single plate or group of plates from the quench:

Message Header					20 Bytes		
Data Header					86 Bytes		
Data Body	2x	plate_id	primary plate identification	32 Bytes	144 Bytes	Char	
		plan_no	secondary plate identification	32 Bytes		Char	
		plate_length	length of plate	4 Bytes		Real	m
		plate_width	width of plate	4 Bytes		Real	m
	src_water_flow		Quench water flow set values given by 0 = HMI 1 = QRC		2 Bytes	Integer	
	src_positioning		Quench positioning set values given by 0 = HMI 1 = QRC		2 Bytes	Integer	
	recipe_id		1..31.000		2 Bytes	Integer	
	quench_mode		1. Quenching 2. Quenching and oscillating 3. Cooling		2 Bytes	Integer	
	quench_speed		Speed of plate during quenching		4 Bytes	Real	m/min
	water_flow_1 ... 20		water flow values for each line		80 Bytes	20 x Real	m3/h
	cooling_time		oscillation time quench mode 2, 3		2 Bytes	Integer	sec
	startup_delay_top		delay of start up quench mode 3 top		2 Bytes	Integer	1/10 sec
	startup_delay_bottom		delay of start up quench mode 3 bottom		2 Bytes	Integer	1/10 sec
	Lowering		1..10 mm		4 Bytes	Real	m
	Load_reduction		0..60 %		4 Bytes	Real	%
	curtainheader_off		Shut off water flow for curtain header 0 = ON 1 = OFF		2 Bytes	Integer	
	HP_prepressure_set		Pressure before quench		4 Bytes	Real	bar
	Control_mode		Control mode for curtain header, controlled by 0 = Flow 1 = Pressure		2 Bytes	Integer	
	Pressure_1 ... 14		(optional) pressure control set values for each line of curtain header and water boxes (line 1..12)		56 Bytes	14 x Real	bar
	Ramp_water		Ramp water on/off 0 = OFF 1 = ON		2 Bytes	Integer	

	Ramp_water_type	Ramp water static/dynamic 0 = STATIC 1 = DYNAMIC	2 Bytes	Integer	
	Ramp_switchpoint	DYNAMIC ramp: Switch point	4 Bytes	Real	m
	Ramp_start_short	DYNAMIC ramp: starting point of the ramp for short plate	4 Bytes	Real	m
	Ramp_start_long	DYNAMIC ramp: starting point of the ramp for long plate	4 Bytes	Real	m
	CH_split_top	STATIC ramp: splitting the top curtain header 0 = no splitting	2 Bytes	Integer	
	CH_start_1_top	STATIC ramp: start point after head	4 Bytes	Real	m
	CH_modify_1_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_start_2_top	STATIC ramp: start point after head	4 Bytes	Real	m
	CH_modify_2_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_start_3_top	STATIC ramp: start point after head	4 Bytes	Real	m
	CH_modify_3_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_split_bottom	STATIC ramp: splitting the bottom curtain header 0 = no splitting	2 Bytes	Integer	
	CH_start_1_bottom	STATIC ramp: start point after head	4 Bytes	Real	m
	CH_modify_1_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_start_2_bottom	STATIC ramp: start point after head	4 Bytes	Real	m
	CH_modify_2_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_start_3_bottom	STATIC ramp: start point after head	4 Bytes	Real	m
	CH_modify_3_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_split_top	STATIC ramp: splitting the top water boxes 0 = no splitting	2 Bytes	Integer	
	WB_start_1_top	STATIC ramp: start point after head	4 Bytes	Real	m
	WB_modify_1_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_start_2_top	STATIC ramp: start point after head	4 Bytes	Real	m
	WB_modify_2_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_start_3_top	STATIC ramp: start point after head	4 Bytes	Real	m
	WB_modify_3_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_split_bottom	STATIC ramp: splitting the bottom water boxes 0 = no splitting	2 Bytes	Integer	
	WB_start_1_bottom	STATIC ramp: start point after head	4 Bytes	Real	m
	WB_modify_1_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_start_2_bottom	STATIC ramp: start point after head	4 Bytes	Real	m
	WB_modify_2_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_start_3_bottom	STATIC ramp: start point after head	4 Bytes	Real	m
	WB_modify_3_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	SP_start_top	STATIC ramp: start point after head	4 Bytes	Real	m
	SP_modify_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	SP_start_bottom	STATIC ramp: start point after head	4 Bytes	Real	m

SP_modify_bottom		STATIC ramp: +/- 30%	4 Bytes		Real	%
Ramp_speed		Ramp speed on/off 0 = OFF 1 = ON	2 Bytes		Integer	
Ramp_speed_target		Target speed ramp	4 Bytes		Real	m/min
Ramp_speed_start			4 Bytes		Real	mm
Ramp_speed_end			4 Bytes		Real	mm
Chemicals			40 Bytes		10 x Real	%
4x		frame_pos	16 Bytes		Real	m
HP_pressure_min		Pressure min. value of High pressure area	4 Bytes		Real	bar
HP_pressure_max		Pressure max. value of High pressure area	4 Bytes		Real	bar
HP_pressure_avg		Pressure avg. value of High pressure area	4 Bytes		Real	bar
HP_temp_min		Temperature min. value of High pressure area	4 Bytes		Real	°C
HP_temp_max		Temperature max. value of High pressure area	4 Bytes		Real	°C
HP_temp_avg		Temperature avg. value of High pressure area	4 Bytes		Real	°C
LP_pressure_min		Pressure min. value of Low pressure area	4 Bytes		Real	bar
LP_pressure_max		Pressure max. value of Low pressure area	4 Bytes		Real	bar
LP_pressure_avg		Pressure avg. value of Low pressure area	4 Bytes		Real	bar
LP_temp_min		Temperature min. value of Low pressure area	4 Bytes		Real	°C
LP_temp_max		Temperature max. value of Low pressure area	4 Bytes		Real	°C
LP_temp_avg		Temperature avg. value of Low pressure area	4 Bytes		Real	°C
20x	Flow_plate_set	Water flow set value for a line, if plate head arrived	4 Bytes	480 Bytes	Real	m³/h
	Flow_ramp_set	Water flow set value for a line, if ramp starts	4 Bytes		Real	m³/h
	Flow_end_set	Water flow set value for a line, if plate tail arrived	4 Bytes		Real	m³/h
	Flow_plate_act	Water flow act value for a line, if plate head arrived	4 Bytes		Real	m³/h
	Flow_ramp_act	Water flow act value for a line, if ramp starts	4 Bytes		Real	m³/h
	Flow_end_act	Water flow act value for a line, if plate tail arrived	4 Bytes		Real	m³/h
14x	Pressure_plate_set	Pressure set value for a line, if plate head arrived	4 Bytes	336 Bytes	Real	bar
	Pressure_ramp_set	Pressure set value for a line, if ramp starts	4 Bytes		Real	bar
	Pressure_end_set	Pressure set value for a line, if plate tail arrived	4 Bytes		Real	bar
	Pressure_plate_act	Pressure act value for a line, if plate head arrived	4 Bytes		Real	bar
	Pressure_ramp_act	Pressure act value for a line, if ramp starts	4 Bytes		Real	bar
	Pressure_end_act	Pressure act value for a line, if plate tail arrived	4 Bytes		Real	bar
Speed_plate_set		Speed set value, if plate head passed the slit nozzle	4 Bytes		Real	m/min
Speed_ramp_set		Speed set value, if ramp starts	4 Bytes		Real	m/min
Speed_end_set		Speed set value, if plate tail passed the slit nozzle	4 Bytes		Real	m/min
Speed_plate_act		Speed act value, if plate head passed the slit nozzle	4 Bytes		Real	m/min

	Speed_ramp_act	Speed act value, if ramp starts	4 Bytes	Real	m/min
	Speed_end_act	Speed act value, if plate tail passed the slit nozzle	4 Bytes	Real	m/min
	Time_start_quench,	Indicates the year, month, day, hour, minute, second when head arrives quench	32 Bytes	Char	
	Time_start_hp	Indicates the year, month, day, hour, minute, second when tail leaves high pressure area	32 Bytes	Char	
	Time_end_quench	Indicates the year, month, day, hour, minute, second when tail leaves	32 Bytes	Char	
	Flow_hp_avg	Average water flow High pressure area during quenching	4 Bytes	Real	m³/h
	Flow_hp_max	Maximum water flow High pressure area during quenching	4 Bytes	Real	m³/h
	Flow_hp_min	Minimum water flow High pressure area during quenching	4 Bytes	Real	m³/h
	Flow_lp_avg	Average water flow Low pressure area during quenching	4 Bytes	Real	m³/h
	Flow_lp_max	Maximum water flow Low pressure area during quenching	4 Bytes	Real	m³/h
	Flow_lp_min	Minimum water flow Low pressure area during quenching	4 Bytes	Real	m³/h
	Cons_hp	Water flow consumption High pressure area during quenching	4 Bytes	Real	m³
	Cons_lp	Water flow consumption Low pressure area during quenching	4 Bytes	Real	m³
	Revision_id	**Represents the last version number of requested recipe** 1..65.535	**2 Bytes**	**Integer**	
	alloy_C	Carbon	4 Bytes	Real	%
	alloy_Si		4 Bytes	Real	%
	alloy_Mn		4 Bytes	Real	%
	alloy_P		4 Bytes	Real	%
	alloy_S		4 Bytes	Real	%
	alloy_Cu		4 Bytes	Real	%
	alloy_Ni		4 Bytes	Real	%
	alloy_Cr		4 Bytes	Real	%
	alloy_Mo		4 Bytes	Real	%
	alloy_V		4 Bytes	Real	%
	Time_charge_furnace	Indicates the year, month, day, hour, minute, second when head entereds the furnace	32 Bytes	Char	%
	Heatrate_PLC	Specific heatrate given by PLC formula	4 Bytes	Real	min/mm
	Heatrate_HMI	Specific heatrate given by HMI of Level1	4 Bytes	Real	min/mm
	Heatrate_HMI_on	HMI heatrate ON	2 Bytes	Integer	0: OFF 1: ON
	Platetemp_head	Calculated plate core temperature of the head during discharging	4 Bytes	Real	°C
	Platetemp_center	Calculated plate core temperature of the center during discharging	4 Bytes	Real	°C
	Platetemp_tail	Calculated plate core temperature of the tail during discharging	4 Bytes	Real	°C
	Holdingtime_head	Calculated holding time of the plate head	2 Bytes	Integer	sec
	Holdingtime_center	Calculated holding time of the plate center	2 Bytes	Integer	sec
	Holdingtime_tail	Calculated holding time of the plate tail	2 Bytes	Integer	sec
	Spare	Spare	28 Bytes	Byte	

Telegram number: 204 Acknowledge quench result RS -> QC

Sender: Recipe station RS
Receiver: PLC Quench Control QC
Type: B
Total length: 108 Bytes

Timing and general description:

The telegram is triggered by event after receiving of the quench result.

Message Header			20 Bytes	
Data Header	Match the data header of quench result from PLC-QC		86 Bytes	
Data Body	Life_counter_QC	Match the life counter from quench result 1..30.000: valid lifecounter < 0: Error code: **-99: negative ack. (wrong plate_id)**	2 Bytes	Integer

Telegram number: 205 Request Recipe QC -> RS (optional)

Sender:	PLC Quench Control	QC
Receiver:	Recipe station	RS
Type:	B	
Total length:	114 Bytes	

Timing and general description:

The telegram is triggered by PLC-QC to request a valid recipe (with set values) for a plate before start sequence quench (2 minutes before discharging into quench). Not for mode 4.

Message Header			20 Bytes		
Data Header	num_plates	Number of plates in group (1..2)	2 Bytes	Integer	
	group_type	Type of group: 1. Single Plate 2. One beside one 3. One behind one	2 Bytes	Integer	
	plate_length	Length of plate group	4 Bytes	Real	m
	plate_width	Width of plate group	4 Bytes	Real	m
	plate_thickness	Thickness of plate group	4 Bytes	Real	m
	CE	Carbon Equivalent	4 Bytes	Real	%
	Productcode_1	Customer production code to identify a plate specific recipe, e.g. steel grade, material class,	32 Bytes	Character	
	Productcode_2	Customer production code to identify a plate specific recipe, e.g. steel grade, material class,	32 Bytes	Character	
	Handlingcode (optional)	Extends the identification for plate specific recipe, if product code is not unique to handle the plate, e.g. 1. Quenching 2. Quenching and oscillating 3. Cooling 4. ...	2 Bytes	Integer	
Data Body	C	Amount of carbon	4 Bytes	Real	
	SPARE		4 Bytes	Byte	

Telegram number: 206 Recipe answer RS -> QC (optional)

Sender: Recipe station RS
Receiver: PLC Quench Control QC
Type: B
Total length: 474 Bytes

Timing and general description:

The telegram is triggered by Recipe station after request of telegram 205, to send a valid recipe (with set values) for a plate before charging into quench. In case of non existing recipe, the answer is a fault value (<0) in Recipe_ID.

Message Header			20 Bytes		
Data Header			86 Bytes		
Data Body	recipe_id	1..31.000: valid recipe < 0: Error code: **-99: No recipe found (in general)** **-98: Product code 1 doesn't exist** **-97: CE doesn't exist** **-96: plate thickness doesn't exist** **-95: plate width doesn't exist** **-94: plate length doesn't exist** **-93: recipe found, but not activated**	2 Bytes	Integer	
	quench_mode	1. Quenching 2. Quenching and oscillating 3. Cooling	2 Bytes	Integer	
	quench_speed	Speed of plate during quenching	4 Bytes	Real	m/min
	water_flow_1 ... 20	water flow values for each line	80 Bytes	20 x Real	m³/h
	cooling_time	oscillation time quench mode 2, 3	2 Bytes	Integer	sec
	startup_delay_top	delay of start up quench mode 3 top	2 Bytes	Integer	1/10 sec
	startup_delay_bottom	delay of start up quench mode 3 bottom	2 Bytes	Integer	1/10 sec
	Lowering	0,0..10,0 mm	4 Bytes	Real	mm
	Load_reduction	0..60 %	4 Bytes	Real	%
	curtainheader_off	Shut off water flow for curtain header 0 = ON 1 = OFF	2 Bytes	Integer	
	HP_prepressure_set	Pressure before quench	4 Bytes	Real	bar
	Control_mode	Control mode for curtain header, controlled by 0 = Flow 1 = Pressure	2 Bytes	Integer	
	Pressure_1 ... 14	(optional) pressure control set values for each line of curtain header and waterboxes (line 1..12)	56 Bytes	Real	
	Ramp_water	Ramp water on/off 0 = OFF 1 = ON	2 Bytes	Integer	
	Ramp_water_type	Ramp water static/dynamic 0 = STATIC 1 = DYNAMIC	2 Bytes	Integer	
	Ramp_switchpoint	DYNAMIC ramp: switch point	4 Bytes	Real	m

Data Body	Ramp_start_short	DYNAMIC ramp: starting point of the ramp for short plate	4 Bytes	Real	m
	Ramp_start_long	DYNAMIC ramp: starting point of the ramp for long plate	4 Bytes	Real	m
	CH_split_top	STATIC ramp: splitting the top curtain header 0 = no splitting	2 Bytes	Integer	
	CH_start_1_top	STATIC ramp:	4 Bytes	Real	m
	CH_modify_1_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_start_2_top	STATIC ramp:	4 Bytes	Real	m
	CH_modify_2_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_start_3_top	STATIC ramp:	4 Bytes	Real	m
	CH_modify_3_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_split_bottom	STATIC ramp: splitting the bottom curtain header 0 = no splitting	2 Bytes	Integer	
	CH_start_1_bottom	STATIC ramp:	4 Bytes	Real	m
	CH_modify_1_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_start_2_bottom	STATIC ramp:	4 Bytes	Real	m
	CH_modify_2_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_start_3_bottom	STATIC ramp:	4 Bytes	Real	m
	CH_modify_3_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_split_top	STATIC ramp: splitting the top water boxes 0 = no splitting	2 Bytes	Integer	
	WB_start_1_top	STATIC ramp:	4 Bytes	Real	m
	WB_modify_1_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_start_2_top	STATIC ramp:	4 Bytes	Real	m
	WB_modify_2_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_start_3_top	STATIC ramp:	4 Bytes	Real	m
	WB_modify_3_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_split_bottom	STATIC ramp: splitting the bottom water boxes 0 = no splitting	2 Bytes	Integer	
	WB_start_1_bottom	STATIC ramp:	4 Bytes	Real	m
	WB_modify_1_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_start_2_bottom	STATIC ramp:	4 Bytes	Real	m
	WB_modify_2_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_start_3_bottom	STATIC ramp:	4 Bytes	Real	m
	WB_modify_3_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	SP_start_top	STATIC ramp:	4 Bytes	Real	m

Data Body	SP_modify_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	SP_start_bottom	STATIC ramp:	4 Bytes	Real	m
	SP_modify_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	Ramp_speed	Ramp speed on/off 0 = OFF 1 = ON	2 Bytes	Integer	
	Ramp_speed_target	Target speed ramp	4 Bytes	Real	m/min
	Ramp_speed_start	Start point ramp behind plate head	4 Bytes	Real	mm
	Ramp_speed_end	End point ramp before plate tail	4 Bytes	Real	mm
	SPARE		40 Bytes	Byte	
	Revision_id	**Represents the last version number of requested recipe** 1..65.535	**2 Bytes**	**Integer**	
	SPARE		10 Bytes	Byte	

Telegram number: 207 Quench act values QC-> RS (1 sec)

Sender: PLC Quench Control QC
Receiver: Recipe station RS
Type: B
Total length: 620 Bytes

Timing and general description:

The telegram is triggered by PLC-QC during quenching of a single plate or group of plates.

Message Header					20 Bytes		
Data Header					86 Bytes		
Data body	2x	plate_id	primary plate identification	32 Bytes	144 Bytes	Character	
		plan_no	secondary plate identification	32 Bytes		Character	
		plate_length	length of plate	4 Bytes		Real	m
		plate_width	width of plate	4 Bytes		Real	m
	src_water_flow		Quench water flow set values given by 0 = HMI 1 = EMS		2 Bytes	Integer	
	src_positioning		Quench positioning set values given by 0 = HMI 1 = EMS		2 Bytes	Integer	
	4 x Frame_pos		Frame position actual value		16 Bytes	Real	mm
	Quench_occ		Quench area occupied		2 Bytes	Integer	1 = occ
	HP_occ		HP area occupied		2 Bytes	Integer	1 = occ
	quench_speed_set		Set point speed during quenching		4 Bytes	Real	m/min
	quench_speed_act		Actual speed during quenching		4 Bytes	Real	m/min
	HP_Pressure		HP Prepressure		4 Bytes	Real	bar
	HP_Temp		HP Pretemperature		4 Bytes	Real	°C
	LP_Pressure		LP Prepressure		4 Bytes	Real	bar
	LP_Temp		LP Pretemperature		4 Bytes	Real	°C
	20 x Flow_set		Water flow set value for a line		80 Bytes	20 x Real	m3/h
	20 x Flow_act		Water flow act value for a line		80 Bytes	20 x Real	m3/h
	20 x Pressure_set		Pressure set value for a line		80 Bytes	20 x Real	bar
	20 x Pressure_act		Pressure act value for a line		80 Bytes	20 x Real	bar
	Count		Count telegrams per session		2 Bytes	Integer	

Telegram number: 208 Position and flow QC -> RS

Sender: PLC Quench Control QC
Receiver: Recipe station RS
Type: A
Total length: 3120 Bytes

Timing and general description:

The telegram is triggered by PLC-QC after successful result of the position and flow teaching function:

Message Header				20 Bytes			
Data body	Line 1	Max_waterflow_pos_0	Max. water flow value at valve position 0 for line 1	4 Bytes	44 Bytes	Real	m³/h
		Max_waterflow_pos_1	Max. water flow value at valve position 1 for line 1	4 Bytes			
		Max_waterflow_pos_2	Max. water flow value at valve position 2 for line 1	4 Bytes			
		…					
		Max_waterflow_pos_10	Max. water flow value at valve position 10 for line 1	4 Bytes			
	Line 1	Valve_pos_0_flow	Valve position 0 for line 1 for flow	4 Bytes	44 Bytes	Real	%
		Valve_pos_1_flow	Valve position 1 for line 1 for flow	4 Bytes			
		Valve_pos_2_flow	Valve position 2 for line 1 for flow	4 Bytes			
		…					
		Valve_pos_10_flow	Valve position 10 for line 1 for flow	4 Bytes			
	Line 2 to 20	19 x 11 x Max_waterflow_pos_x	Same definition of water flow values for Line 2 …. 20	44 Bytes	19 x 88 Bytes	Real	m³/h
		19 x 11 x Valve_pos_x_flow	Same definition of valve positions for Line 2 …. 20	44 Bytes		Real	%
	Line 1	Max_pressure_pos_0	Max. pressure value at valve position 0 for line 1	4 Bytes	44 Bytes	Real	m³/h
		Max_pressure_pos_1	Max. pressure value at valve position 1 for line 1	4 Bytes			
		Max_pressure_pos_2	Max. pressure value at valve position 2 for line 1	4 Bytes			
		…					
		Max_pressure_pos_10	Max. pressure value at valve position 10 for line 1	4 Bytes			
	Line 1	Valve_pos_0_pressure	Valve position 0 for line 1 for pressure	4 Bytes	44 Bytes	Real	%
		Valve_pos_1_pressure	Valve position 1 for line 1 for pressure	4 Bytes			
		Valve_pos_2_pressure	Valve position 2 for line 1 for pressure	4 Bytes			
		…					

		Valve_pos_10_pressure	Valve position 10 for line 1 for pressure	4 Bytes			
	Line 2 to 14	13 x 11 x Max_pressure_pos_x	Same definition of pressure values for line 2 …. 14	44 Bytes	13 x 88 Bytes	Real	bar
		13 x 11 x Valve_pos_x_pressure	Same definition of valve positions for line 2 …. 14	44 Bytes		Real	%
	HP	Prepressure at valve pos 0	Prepressure value at valve position 0 for high pressure area	4 Bytes	44 Bytes	Real	bar
		Prepressure at valve pos 1	Prepressure value at valve position 1 for high pressure area	4 Bytes			
		Prepressure at valve pos 2	Prepressure value at valve position 2 for high pressure area	4 Bytes			
		…					
		Prepressure at valve pos 10	Prepressure value at valve position 10 for high pressure area	4 Bytes			
	LP	Prepressure at valve pos 0	Prepressure value at valve position 0 for low pressure area	4 Bytes	44 Bytes	Real	bar
		Prepressure at valve pos 1	Prepressure value at valve position 1 for low pressure area	4 Bytes			
		Prepressure at valve pos 2	Prepressure value at valve position 2 for low pressure area	4 Bytes			
		…					
		Prepressure at valve pos 10	Prepressure value at valve position 10 for low pressure area	4 Bytes			
	Timestamp teaching		Timestamp of successful teaching of the tables	20 Bytes		Char	

Telegram number: 209 Acknowledge position and flow RS -> QC

Sender:	Recipe station	RS
Receiver:	PLC Quench Control	QC
Type:	A	
Total length:	22 Bytes	

Timing and general description:

The telegram is triggered by event after receiving of the position and flow result.

Message Header			20 Bytes	
Data Body	Life_counter_QC	Match the life counter from position and flow result	2 Bytes	Integer

Telegram number: 210 Restore old position/flow RS -> QC

Sender: Recipe station RS
Receiver: PLC Quench Control QC
Type: A
Total length: 3120 Bytes

Timing and general description:

The telegram is triggered after pressing a push button in the HMI system menu of the Recipe station, to restore a stored position and flow table for the Quench PLC.

Message Header				20 Bytes			
Data body	Line 1	Max_waterflow_pos_0	Max. water flow value at valve position 0 for line 1	4 Bytes	44 Bytes	Real	m³/h
		Max_waterflow_pos_1	Max. water flow value at valve position 1 for line 1	4 Bytes			
		Max_waterflow_pos_2	Max. water flow value at valve position 2 for line 1	4 Bytes			
		…					
		Max_waterflow_pos_10	Max. water flow value at valve position 10 for line 1	4 Bytes			
	Line 1	Valve_pos_0_flow	Valve position 0 for line 1 for flow	4 Bytes	44 Bytes	Real	%
		Valve_pos_1_flow	Valve position 1 for line 1 for flow	4 Bytes			
		Valve_pos_2_flow	Valve position 2 for line 1 for flow	4 Bytes			
		…					
		Valve_pos_10_flow	Valve position 10 for line 1 for flow	4 Bytes			
	Line 2 to 20	19 x 11 x Max_waterflow_pos_x	Same definition of water flow values for Line 2 …. 20	44 Bytes	19 x 88 Bytes	Real	m³/h
		19 x 11 x Valve_pos_x_flow	Same definition of valve positions for Line 2 …. 20	44 Bytes		Real	%
	Line 1	Max_pressure_pos_0	Max. pressure value at valve position 0 for line 1	4 Bytes	44 Bytes	Real	m³/h
		Max_pressure_pos_1	Max. pressure value at valve position 1 for line 1	4 Bytes			
		Max_pressure_pos_2	Max. pressure value at valve position 2 for line 1	4 Bytes			
		…					
		Max_pressure_pos_10	Max. pressure value at valve position 10 for line 1	4 Bytes			
	Line 1	Valve_pos_0_pressure	Valve position 0 for line 1 for pressure	4 Bytes	44 Bytes	Real	%
		Valve_pos_1_pressure	Valve position 1 for line 1 for pressure	4 Bytes			
		Valve_pos_2_pressure	Valve position 2 for line 1 for pressure	4 Bytes			
		…					

		Valve_pos_10_pressure	Valve position 10 for line 1 for pressure	4 Bytes			
	Line 2 to 14	13 x 11 x Max_pressure_pos_x	Same definition of pressure values for line 2 …. 14	44 Bytes	13 x 88 Bytes	Real	bar
		13 x 11 x Valve_pos_x_pressure	Same definition of valve positions for line 2 …. 14	44 Bytes		Real	%
	HP	Prepressure at valve pos 0	Prepressure value at valve position 0 for high pressure area	4 Bytes	44 Bytes	Real	bar
		Prepressure at valve pos 1	Prepressure value at valve position 1 for high pressure area	4 Bytes			
		Prepressure at valve pos 2	Prepressure value at valve position 2 for high pressure area	4 Bytes			
		…					
		Prepressure at valve pos 10	Prepressure value at valve position 10 for high pressure area	4 Bytes			
	LP	Prepressure at valve pos 0	Prepressure value at valve position 0 for low pressure area	4 Bytes	44 Bytes	Real	bar
		Prepressure at valve pos 1	Prepressure value at valve position 1 for low pressure area	4 Bytes			
		Prepressure at valve pos 2	Prepressure value at valve position 2 for low pressure area	4 Bytes			
		…					
		Prepressure at valve pos 10	Prepressure value at valve position 10 for low pressure area	4 Bytes			
	Timestamp		Timestamp of successful teaching of the tables	32 Bytes		Char	

Telegram number: 211 Ackn. restore old position/flow QC -> RS

Sender:	PLC Quench Control	QC
Receiver:	Recipe station	RS
Type:	A	
Total length:	22 Bytes	

Timing and general description:

The telegram is triggered by event from PLC-QC after receiving of the restored position and flow table from the Recipe station.

Message Header			20 Bytes	
Data Body	Life_counter_RS	Match the life counter from position and flow result	2 Bytes	Integer

Telegram number: 501 Watchdog TC -> QC

Sender:	PLC Tracking Control	TC
Receiver:	PLC Quench Control	QC
Type:	A	
Total length:	20 Bytes	

Telegram number: 502 Watchdog QC -> TC

Sender:	PLC Quench Control	QC
Receiver:	PLC Tracking Control	TC
Type:	A	
Total length:	20 Bytes	

Telegram number: 503 Control set Quench TC -> QC

Sender: PLC Tracking Control TC
Receiver: PLC Quench Control QC
Type: B
Total length: 618 Bytes

Timing and general description:

The telegram is triggered by PLC-TC (2 minutes before discharging from furnace) of a single plate or group of plates

Message Header					20 Bytes		
Data Header					86 Bytes		
Data Body	2x	plate_id	primary plate identification	32 Bytes	144 Bytes	Character	
		plan_no	secondary plate identification	32 Bytes		Character	
		plate_length	length of plate	4 Bytes		Real	m
		plate_width	width of plate	4 Bytes		Real	m
	recipe_id		1..31.000: valid recipe < 0: no recipe		2 Bytes	Integer	
	quench_mode		1. Quenching 2. Quenching and oscillating 3. Cooling		2 Bytes	Integer	
	quench_speed		Speed of plate during quenching		4 Bytes	Real	m/min
	waterflow_set_1 ... 20		water flow values for each line		80 Bytes	20 x Real	m3/h
	cooling_time		oscillation time quench mode 2, 3		2 Bytes	Integer	sec
	startup_delay_top		delay of start up quench mode 3 top		2 Bytes	Integer	1/10 sec
	startup_delay_bottom		delay of start up quench mode 3 bottom		2 Bytes	Integer	1/10 sec
	Lowering		1..10 mm		4 Bytes	Real	m
	Load_reduction		0..60 %		4 Bytes	Real	%
	curtainheader_off		Shut off water flow for curtain header 0 = ON 1 = OFF		2 Bytes	Integer	
	HP_prepressure_set		Pressure before quench		4 Bytes	Real	bar
	Control_mode		Control mode for curtain header, controlled by 0 = Flow 1 = Pressure		2 Bytes	Integer	
	Pressure_1 ... 14		(optional) pressure control set values for each line of curtain header and waterboxes (line 1..12)		56 Bytes	14 x Real	bar
	Ramp_water		Ramp water on/off 0 = OFF 1 = ON		2 Bytes	Integer	
	Ramp_water_type		Ramp water static/dynamic 0 = STATIC 1 = DYNAMIC		2 Bytes	Integer	
	Ramp_switchpoint		DYNAMIC ramp: Switch point		4 Bytes	Real	m
	Ramp_start_short		DYNAMIC ramp: starting point of the ramp for short plate		4 Bytes	Real	m
	Ramp_start_long		DYNAMIC ramp: starting point of the ramp for long plate		4 Bytes	Real	m
	CH_split_top		STATIC ramp: splitting the top curtain header 0 = no splitting		2 Bytes	Integer	

	CH_start_1_top	STATIC ramp: start point after head	4 Bytes	Real	m
	CH_modify_1_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_start_2_top	STATIC ramp: start point after head	4 Bytes	Real	m
	CH_modify_2_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_start_3_top	STATIC ramp: start point after head	4 Bytes	Real	m
	CH_modify_3_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_split_bottom	STATIC ramp: splitting the bottom curtain header 0 = no splitting	2 Bytes	Integer	
	CH_start_1_bottom	STATIC ramp: start point after head	4 Bytes	Real	m
	CH_modify_1_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_start_2_bottom	STATIC ramp: start point after head	4 Bytes	Real	m
	CH_modify_2_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	CH_start_3_bottom	STATIC ramp: start point after head	4 Bytes	Real	m
	CH_modify_3_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_split_top	STATIC ramp: splitting the top water boxes 0 = no splitting	2 Bytes	Integer	
	WB_start_1_top	STATIC ramp: start point after head	4 Bytes	Real	m
	WB_modify_1_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_start_2_top	STATIC ramp: start point after head	4 Bytes	Real	m
	WB_modify_2_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_start_3_top	STATIC ramp: start point after head	4 Bytes	Real	m
	WB_modify_3_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_split_bottom	STATIC ramp: splitting the bottom water boxes 0 = no splitting	2 Bytes	Integer	
	WB_start_1_bottom	STATIC ramp: start point after head	4 Bytes	Real	m
	WB_modify_1_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_start_2_bottom	STATIC ramp: start point after head	4 Bytes	Real	m
	WB_modify_2_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	WB_start_3_bottom	STATIC ramp: start point after head	4 Bytes	Real	m
	WB_modify_3_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	SP_start_topm	STATIC ramp: start point after head	4 Bytes	Real	m
	SP_modify_top	STATIC ramp: +/- 30%	4 Bytes	Real	%
	SP_start_bottom	STATIC ramp: start point after head	4 Bytes	Real	m
	SP_modify_bottom	STATIC ramp: +/- 30%	4 Bytes	Real	%
	Ramp_speed	Ramp speed on/off 0 = OFF 1 = ON	2 Bytes	Integer	
	Ramp_speed_target	Target speed ramp	4 Bytes	Real	m/min
	Ramp_speed_start		4 Bytes	Real	mm

Data Body	Ramp_speed_end		4 Bytes	Real	mm
	Recipe Spare	chemicals	40 Bytes	Byte	
	Revision_id	Represents the last version number of requested recipe 1..65.535	2 Bytes	Integer	
	spare		10 Bytes		

Telegram number: 504 Acknowledge control Set quench QC -> TC

Sender:	PLC Quench control	QC
Receiver:	PLC Tracking Control	TC
Type:	B	
Total length:	108 Bytes	

Timing and general description:

The telegram is triggered by event after receiving of the control set quench (503).

Message Header			20 Bytes	
Data Header	Match the data header of control set quench from PLC-TC (503)		86 Bytes	
Data Body	Life_counter_TC	Match the life counter from control set quench	2 Bytes	Integer

Setup connection at plc

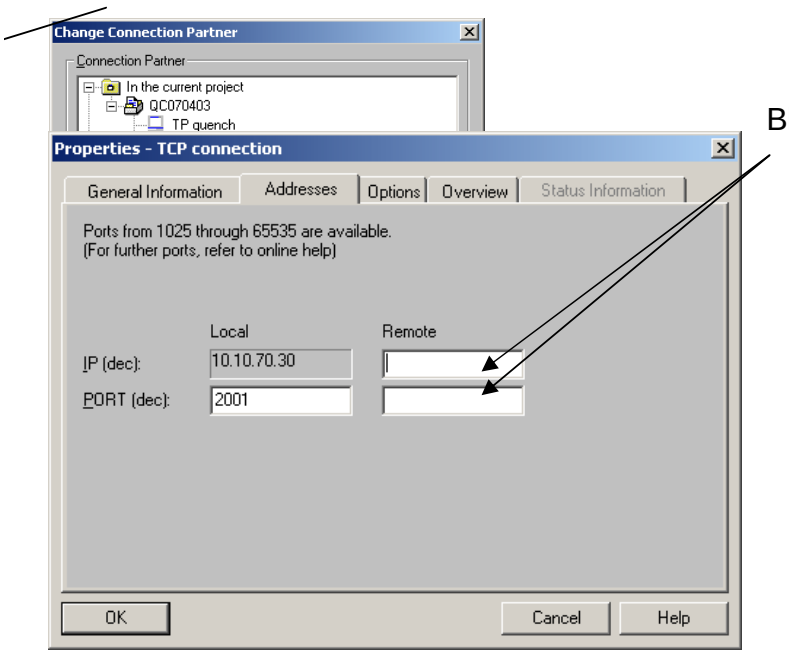
Partner 1	Port	Active connection	Partner 2	Port	Connection type
TC	2000	No	L2	auto	unspecified
TC	2001	No	RS	auto	unspecified
TC	2002		BC	2002	specified
TC	2003		QC	2003	specified
BC	2000	No	L2	auto	unspecified
QC	2000	No	L2	auto	unspecified
QC	2001	No	RS	auto	unspecified

Connection type: unspecified connection
Port for PLC to Level 2 2000
Port for PLC (Recipe Station) 2001
Active connection PLC: no

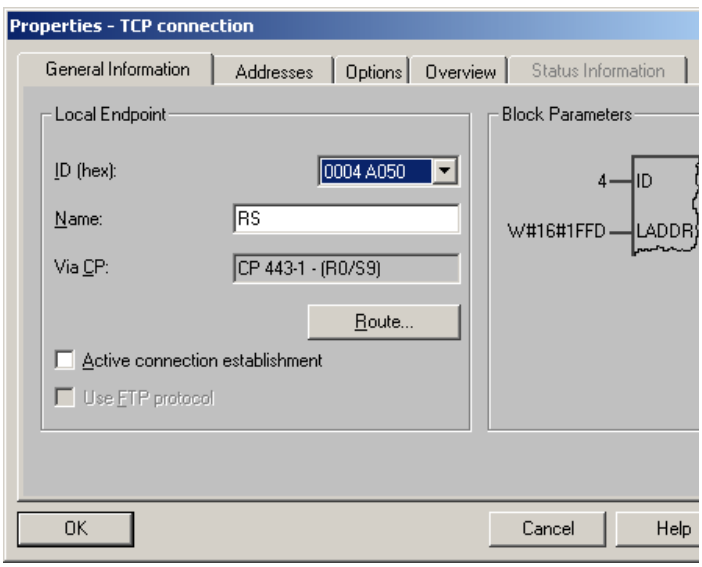
Local ID	Partner ID	Partner	Type	Active connection partner	Subnet
0001 A050		Tracking PLC	TCP connection	No	Ethernet [IE]
0002 A050		Level 2	TCP connection	No	Ethernet [IE]
0003 A050		RS	TCP connection	No	Ethernet [IE]

Example for connection

Manager at Step 7



Blank at unspecified connections



Handshake tracking quench

Slot	DP...	Order Number / Designation	I Address	Q Address
1	32DE	4 Bytes Input	0... 3	
2	32DA	4 Bytes Output		0... 3
3	64	64 Bytes Input consistent	4... 7	
4	128	64 Bytes Output consistent		4... 7

Configuration DP/ DP Coupler seen from quench (all other seen from quench)

Symbol	abs.	type	comment
Ready 4	Q +0.0	BOOL	ready for start mode 4 running, spraying
Ready 1+2	Q +0.1	BOOL	ready for start mode 1+ 2, quenching
Ready 3	Q +0.2	BOOL	ready for start mode 3 cooling
Presets ok	Q +0.3	BOOL	presets taken over to AC PLC
Come on 1+2	Q +0.4	BOOL	water running 1+2 com on plate
Come on 3	Q +0.5	BOOL	allowed plate out of furnace mode 3
Come on 4	Q +0.6	BOOL	allowed plate drive true the quench mode 4
QC watchdog	Q +3.7	BOOL	Watchdog from tracking PLC
Mode to tracking	QW +10	INT	to tracking mode number
Start	I +0.0	BOOL	prepare quench
Go mode 1+2	I +0.1	BOOL	water start mode 1+2
Go mode 3	I +0.2	BOOL	start cooling mode 3
go mode 4	I +0.3	BOOL	start spraying from tracking
quench drive ok	I +1.0	BOOL	quench drive ok
tail out of quench	I +1.1	BOOL	plate tail is out of HP area
mat in quench	I +1.2	BOOL	material in quenching area
mat not in quench	I +1.3	BOOL	material not in quenching area
TC watchdog	I +3.7	BOOL	Watchdog to tracking PLC
mode from tracking	IW +10	INT	from tracking mode number
Thick track	ID +24	REAL	thickness [mm]
QC speed	ID +32	REAL	quench speed [m/ min]
QC length	ID +36	REAL	plate length [mm]

quench no operation ready to run:
allowed modes are on: ready 4, ready 1+2 , ready 3 (only active if sequence is on)

- Start send Telegram 53, acknowledge with Telegram 54.
- Send mode number via DP/ DP
- Confirm with start
- if no faults quench will start with preparations, all ready messages will switch off and the actual mode will be replayed via DP/DP
- Signal presets ok are given when preparations are finished. The actual mode will be displayed via DP/DP and via signal ready…
- to start the water/ quench process send the message go mode… After this signal the valves will be open (ready and presets ok will be switched off)

- if quench is ready with preparations for material come out signals ready mode.. , presets ok and come on... will be given.
- If material enter the quench signal material in quench switch on and signal mat not in quench switch off.
- After leaving the material high pressure area signal tail out of quench will switch on.
- HP area will switch off
- After leaving of the material, the signal material in quench will witch off and also the signal out of HP area. The signal no material in quench will switch on
- quench will stop now complete
- all signals from the quench are off
- quench will shut down and prepare for receiving next job
- quench ready with shut down mode signals will be switch on again.