Technical handbook

installation, operation and maintenance of air cooled

Ni-Cd block units type STM 5.180

Contents

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Introduction

The information provided in this manual is intended to help operator and maintenance personnel to obtain the best performance and maximum life from their Saft Ni-Cd STM block batteries.

It describes the main characteristics and operating principles of the blocks and provides general instructions to users and technicians on how to operate, maintain, repair, overhaul and otherwise care for them.

The instructions are of general validity for batteries in Electric Vehicles. Nevertheless, every type of car will have a specific battery assembly and particular operating principles, especially with regards to the various mechanical, electrical, thermal and other interfaces. Specific instructions depending on the type of car can therefore be added to this document.

If you wish to use the battery outside the limits stated herein, please consult us first.

Important recommendations

- Install the battery such as to ensure good ventilation.
- Never allow a flame or fire to come near the battery.
- The electrolyte is harmful to skin and to eyes in particular. In the event of contact with skin or eyes, wash immediately with running water and / or a 10 % solution of boric acid.
- Wear gloves and goggles to manipulate the electrolyte.
- Never use sulfuric acid or acidified water to top-up electrolyte, as acid, even in traces, destroys the battery.
- When batteries are operated in closed premises, room air should be renewed in accordance with applicable safety codes and regulations.

1. Characteristics of STM blocks

1.1. General description

1.1.1. Operation principle of vented Ni-Cd cells

Batteries are electrochemical devices used to supply energy to electrical and electronic products. Chemical energy stored in a battery is converted into electric current when the battery is discharged. This electric current is produced directly by chemical reactions that occur within the battery.

The nickel-cadmium cell is an electrochemical system in which the electrodes containing the active materials undergo changes in oxido-reduction state without any change in physical state. The active materials are highly insoluble in alkaline electrolyte. They remain as solids and do not dissolve while undergoing changes in oxido-reduction state. Because of this, the electrodes are long-lived, since no chemical mechanism exists that would cause the loss of active materials.

During the cell charging and discharging operations, hydroxyl ions are transferred from the positive to the negative plates via the electrolyte. The alkaline solution, KOH, (electrolyte) acts only as the transfer medium.

It does not participate in the electrochemical reaction. Its role in the operations being rather passive, the electrolyte in a nickel-cadmium cell is never affected by the state of charge of the cell itself.

During overcharge, the water contained in the electrolyte is decomposed into O_2 and H_2. A part of these gasses leaves the cells through their vents and the hydraulic system. Consequently, the electrolyte reserve is reduced and topping up of the cells with water becomes necessary after a certain number of cycles.

1.1.2. Description of STM nickel-cadmium blocks

STM blocks consist of 5 nickel-cadmium cells of 1.2 V nominal voltage each. Assembled into a compact unit of 5 cells, the STM monoblock has a nominal voltage of 6 V.

If delivered in single block units (not pre-assembled by Saft into crates or boxes), the blocks are supplied with end plates.

Do not remove those of the STM 5.180 blocks, as they are integrated into the block container.

The blocks will be assembled into a battery by serial (and eventually also parallel) interconnection, in order to achieve the specified battery capacity and voltage. When mounted into a vehicle, the blocks must be installed with sufficient space for ventilation (refer to chapter 3).

■ **Electrodes**

The STM blocks are constituted of sintered positive electrodes and plastic bonded negative electrodes. The sinter positive is obtained by chemical impregnation of nickel hydroxide into a porous nickel structure, which was obtained beforehand by sintering nickel powder onto a thin, perforated and nickel-plated steel strip. Positive and negative electrodes are organised in alternates and separated by a multi-layer separator.

■ **Electrolyte**

The alkaline electrolyte in a nickel-cadmium battery is a solution of potassium hydroxide (KOH), lithium hydroxide (LiOH), sodium hydroxide (NaOH) and distilled or demineralized water. During the electrochemical reaction, its specific gravity remains essentially constant and can thus not be used as an indicator of state of charge. The specific gravity, however, varies due to the normal water consumption during overcharges. The gravity is low when the cells are topped up to their maximum, it is high when the electrolyte reserve is all consumed. The electrolyte used in STM blocks has a specific gravity of 1.21.

■ **Block container**

The block container is made of translucent polypropylene. The block cover, also in polypropylene, is thermowelded to the container after introduction and interconnection of the plate groups ("through-the-wall" interconnection principle).

1.2. Mechanical characteristics of STM 5-180 with end plates

- Length (mm): 260
- Width (mm): 190
- Height (mm): 260
- Weight (kg): 23.2
- Electrolyte reserve (cm^3): 210
- Pole bolts: M 10 x 1.5

See drawings in appendix 1

1.3. Electrical characteristics

- IEC rated capacity C_5 at 0.2 C_5A: 180 Ah
- Nominal voltage Un: 6 V
- Internal resistance R (fully charged) at + 20°C: 2 mΩ

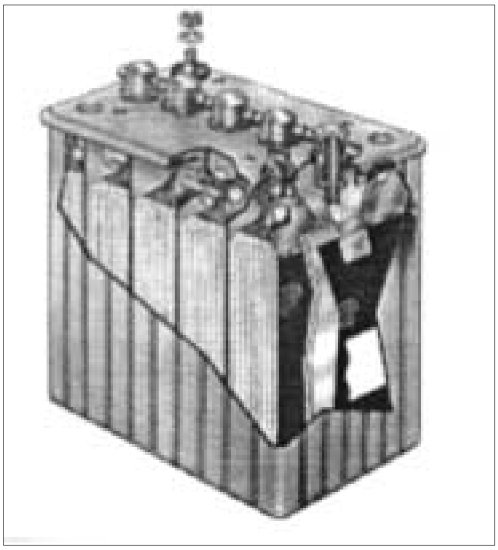


Figure 1 : Monoblock STM

1.4. Water filling system

1.4.1. General description

This chapter describes the working principle of the Saft single point water filling system used on STM blocks.

■ **Assembly instructions**
(see chapter 3.3).

■ **Using instructions (topping-up)**
(see chapter 6.2).

The water filling system links a number of blocks in hydraulic series.

During normal operation of the battery, the gasses produced in the battery are exhausted through this hydraulic system.

When topping-up of the battery is necessary, water will be provided into the system by gravity or by a pump and fill up cell by cell to a predetermined level.

The filling of one hydraulic circuit is terminated when all the cells are filled and the water comes out at the end of the hydraulic circuit.

The main component of the system is the water filling plug (vent) which ensures both, the exhaust of gasses and the automatic regulation of the electrolyte level during topping-up.

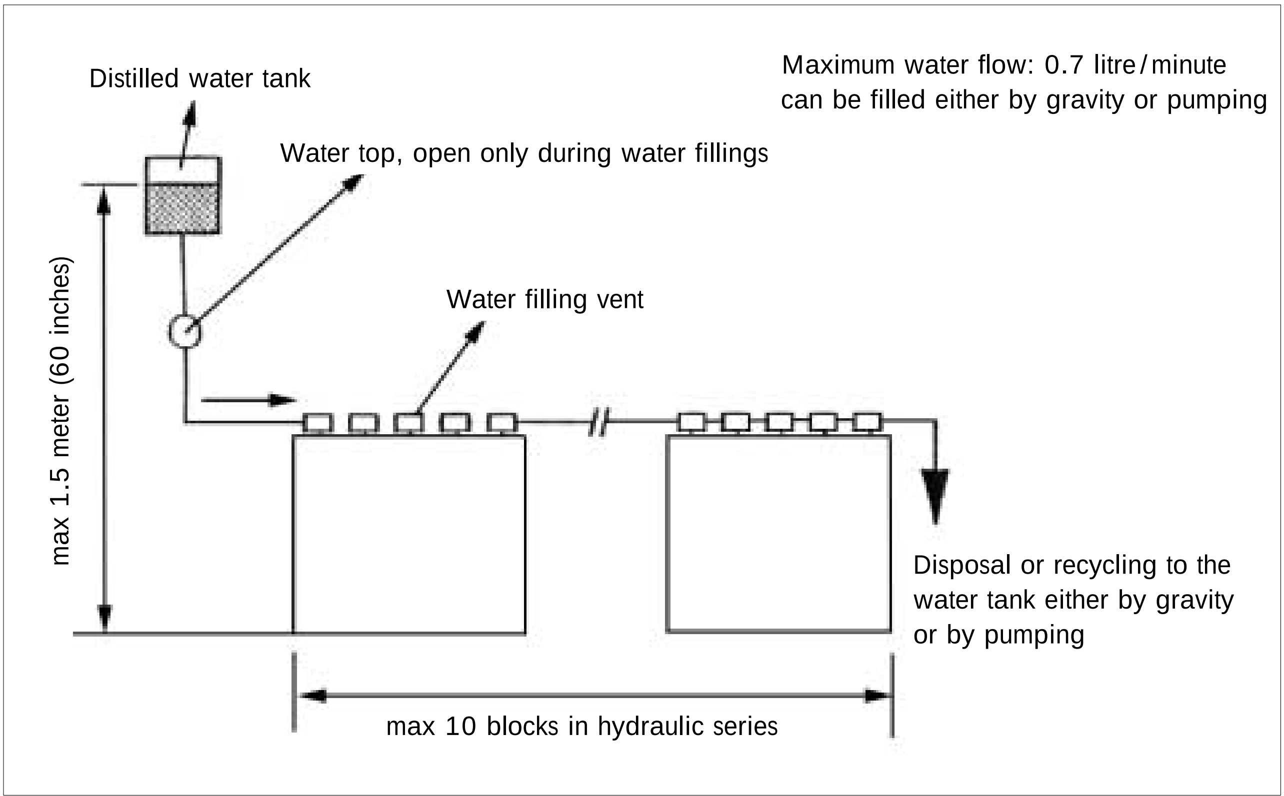


Figure 2: Water filling system skeleton diagram

1.4.2. Working principle of the vent plug

The concept is to fill a cell with water up to a specified level (N) allowing gas which is in the cell to escape. When the specified level is reached, the electrolyte closes the gas exhaust tube and the consequent excess pressure stops the water flow into the cell. The water will now flow to the next cell and so on, to the last cell of the hydraulic circuit.

The vent has a tubular body (1) fitted with a water inlet (2) and outlet (3) in its upper part and with a gas exhaust tube (4) in its lower part.

The water flows across the vent thanks to a plunging siphon (5) and drops into the cell through the water hole (6), while the gas escapes through the exhaust tube (4).

The lower edge of the gas exhaust tube (4) settles the expected electrolyte level of the cell.

When the electrolyte reaches this level, the air located under the cover can not escape through the gas exhaust tube (4) anymore and the water reserve generated by the plunging siphon (5) ensures a safe obstruction of the gas inside the cell. The water filling of the cell is over and the water flows to the next cell through the outlet (3).

The vent has no mobile parts and features a full operation security. Further a relevant chicane system prevents the cell electrolyte to be in contact with the next cell, avoiding any risk of current leakage between several cells in a battery.

❑ **The water flow must be lower than 0.7 liter / minute and the relative internal pressure below 0.15 bars.**

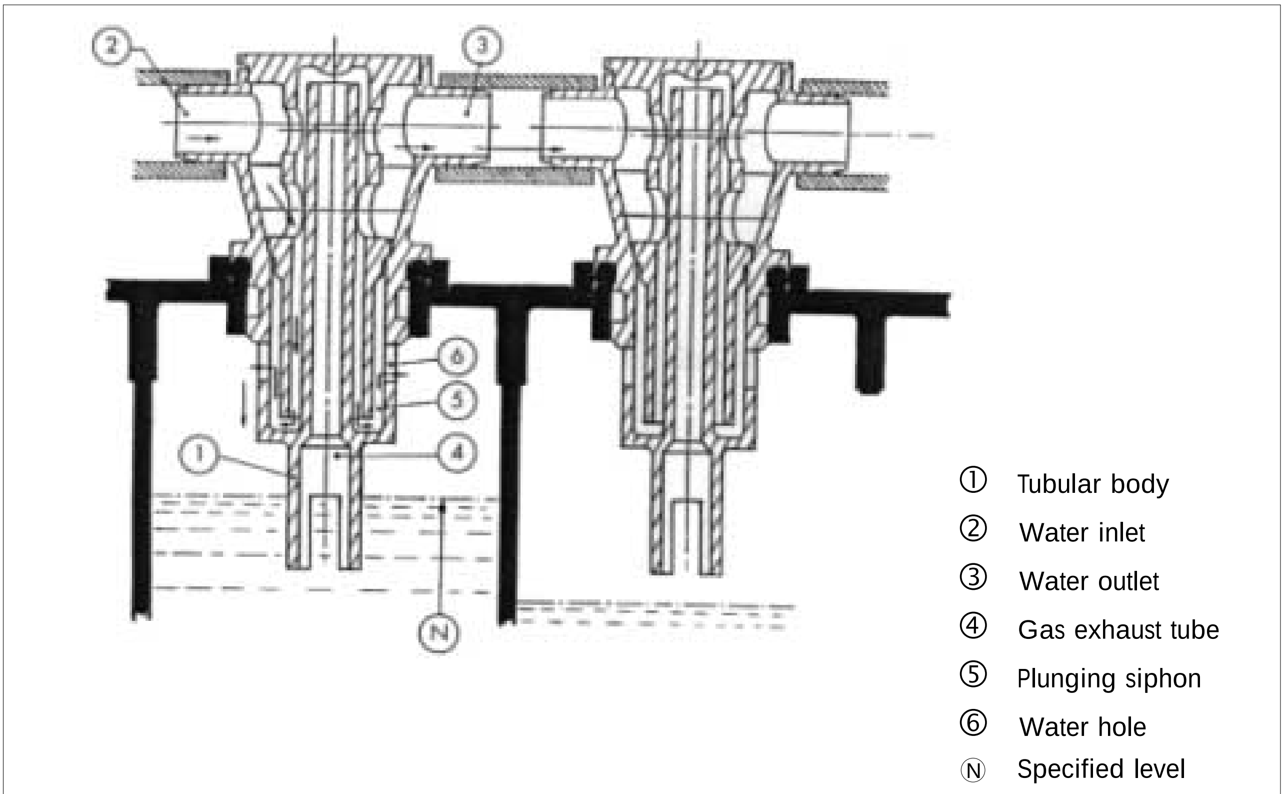


Figure 3: Working principle of the vent plug

2. Precautions and practices

2.1. Transport and storage

STM batteries are delivered filled with electrolyte and discharged (unless otherwise specified). It is normal that the electrolyte level is not visible after a long storage and transport period.
The electrolyte will become visible during charge (refer to chapter 4).

According to customer specification, STM blocks can be delivered completely assembled into batteries, or partly assembled or as a kit of blocks and accessories.
In the latter two cases, in order to avoid any spilling of electrolyte during transport, the blocks are fitted with transport plugs inserted in the vent plugs.

If not placed immediately into service, store batteries in a closed, dry area in their original packaging or otherwise. In the latter case, make sure filler holes are correctly closed, with transport plugs.

❑ **Never drain the cell's electrolyte**

The battery units can be stored in any state of charge. The battery can be stored this way for several years and without any further special precaution.

After a storage period of more than one year, it is necessary to carry out a reconditioning cycle before use.

2.2. Water and electrolyte

The water and electrolyte used in Saft Ni-Cd batteries must be chemically pure.

Under normal operating conditions, STM batteries do not require any charge of, or completement to, their original electrolyte (KOH).

Cells do lose water only when the battery is being overcharged.
Cell electrolyte level is returned to maximum level only by addition of water (see chapter 6.2.).

❑ **If cells have lost their electrolyte by accident** (mishandling, drop, overflow...) it may be necessary to replenish the electrolyte after check of electrolyte density.

This can only be done by Saft authorized personnel.
Please contact us.

❑ **Never measure the electrolyte specific gravity after a topping-up operation.**
The electrolyte above the plate stack will be diluted and you will thus measure wrong values.

Electrolyte is homogeneous again after some charge / discharge cycles.

2.2.1. Water quality

It is absolutely necessary to use chemically pure water (either distilled or demineralized) for topping-up, as ordinary water, even drinking water, contains impurities which will pollute the electrolyte in the long run and adversely affect cell operation. Store water in plastic containers. Keep closed.

2.2.2. Harm caused in using sulfuric acid

Sulfuric acid (as it is used in lead-acid batteries) damages alkaline batteries. Do not put sulfuric acid in a nickel-cadmium battery.

Also prohibit the use of topping-up water recommended for lead-acid batteries since it may contain sulfuric acid.

In case of doubt, make sure with litmus paper (or equivalent) that the water does not exhibit any acid reaction.

❑ **Never check or top up the batteries with instruments used for lead-acid batteries.**

2.3. Electrical shock and burns

Multicell systems attain high voltages. Therefore extreme caution must be exercised during the installation and maintenance of a battery system to prevent serious electrical burns or shock.

❑ **Cut off the AC and DC circuits before working on batteries.**

Assure that personnel understand the risk of working with high voltage batteries and are equipped with insulated tools and other adequate protection equipment.

2.4. Possible dangers through hydrogen

The STM blocks are connected in hydraulic series. The hydraulic system exhausts H_2 and O_2 gasses, which are mainly produced during overcharge.

❑ **Be aware that the hydraulic system can contain highly explosive gasses at any moment.**

When dealing with the battery, special attention must therefore be drawn to the hydraulic system in order to avoid any leakage.
If a leakage is observed, it must be repaired immediately.

Furthermore, general safety rules must be observed very strictly: ensure good ventilation, avoid any flame or heat source to come near to the battery.

3. Installation

A good mechanical installation, ventilation and thermal management of the batteries are crucial to ensure a long life, best performances and user safety.

This manual can only provide general rules of how to assemble STM blocks into batteries.

The final installation will be specific to every vehicle.

Any battery installation must be agreed by Saft in order to engage our product responsibility.

3.1. Assembly into batteries

The electrical connection in series of blocks will be made according to the space available and to minimize the length of the cables.

The connection of the hydraulic system to each of the blocks will follow a path parallel to the electrical circuit so that there is no potential difference between the two ends of a connecting pipe.

The maximum number of blocks connected in hydraulic series is limited to ten on a single circuit. For larger battery units, several totally independent circuits will be provided (for details see 3.3.).

The blocks must be mechanically supported and must not be able to move in any horizontal or vertical direction.

Only the small sides of the blocks must be braced in case of connection of rows of several blocks.

In practice, the blocks will be set up in rows in the axis of the small sides, without any gap.

A supporting structure at the two ends of the row (either bracing or battery box) must withstand a expanding force from the battery of approximately 150 dN per row.

On their longer side, the blocks must be set up with a gap.

A ventilation space of 14 to 20 mm must be foreseen between the rows (refer section 3.2.).

See example of battery assembly in appendix 2.

3.2. Ventilation and cooling

During operation, STM batteries generate heat. When used in daily cycling, a steady heat accumulation must be avoided. The battery therefore needs ventilation (respectively a cooling system) in order to withdraw the accumulated heat in the most efficient way.

Therefore, the blocks must be set up with some space in order to make heat exchange possible. The most efficient heat exchange can be done on the larger side of the blocks.

In practice, 14 to 20 mm space are to be foreseen between the rows of blocks and will serve as ventilation / cooling channels.

In addition to that, ventilation space above and / or underneath the blocks can improve the heat dissipation. In case of air cooling, the cold air is sucked through the battery by fans, either in vertical or horizontal direction. In any case, the cooling system will be designed in order to ensure the most homogenous temperature of the blocks in one battery.

Furthermore, it is recommended to control the battery temperature by sensors or thermostats, which can be supplied by Saft on request.

The optimized solutions for a cooling system must be designed for every battery, depending on the type of car, its use, the type of battery etc.

3.3. Assembly of water filling system

3.3.1. Precautions and general rules

The water filling system links a number of blocks in hydraulic series. The installation of such a system must therefore be carried out very carefully in order to ensure good and safe operation, and to avoid any kind of gas or electrolyte leakages.

• It is very important to ensure that the hydraulic system is sealed, i.e. that no gas and/or water leakages occur. Connecting of pipes, plugs and elbows must be carried out carefully. Whenever a leakage is observed (maybe after some time of operation), this must be repaired immediately.

• The risk of leaking currents through the hydraulic system (which is carrying gases and water !) must be reduced as much as possible.

Therefore we must make sure that:

- the hydraulic connection always follows the electrical one, in order not to create a potential difference more than the voltage of one cell between two hydraulically connected cells.

- not more than 50 cells (i.e. 10 blocks) are connected in one hydraulic series. This limits the voltage on one hydraulic circuit to 60 V nominal.

As a general rule, Saft blocks, if foreseen with a centralized water filling system, are equipped with the water filling plugs.

In order to assemble the battery, we add the necessary accessories, such as pipes, elbows, glue, flame arresting devices, water plugs. Please see detailed description and part numbers in appendix 3.

3.3.2. General instructions for assembly

■ **Levels**

The whole system should be at about the same level. However, if different levels exist, start the hydraulic circuit at the highest point, so that the water can always flow downwards.

■ **Pipes**

For distances less than 200 mm (between two plugs for example), use the flexible, clear pipe diameter 9x12 mm, part number 444 083.

For distances greater than 200 mm (towards the water reservoir, for example) or when forming loops, use the reinforced flexible pipe diameter 10x16 mm, part number 208 859. For angles of 180°, it is preferable to use the polypropylene elbow (part number 444 103).

Avoid all nipping of the flexible pipes when a loop is formed.

Avoid to form vertical loops in which water would stay after the filling operation.

■ **Inlets and outlets**

During normal operation (not topping-up), the hydraulic system must be closed on one side (inlet), so that any gas will escape on the outlet.

• **For the water inlet**, use self closing connecting plugs, Saft part number 208 854 (socket or "female") and 208 855 (plug or "male").

When disconnecting these plugs, both parts will automatically be closed, i.e.

- the inlet to the hydraulic circuit on the battery side is closed,

- the pipe to the water reservoir is closed, and no more water will flow.

• **For the water/gas outlet**, do not use self closing plugs.

You may use free-pass plugs, Saft part number 208 751 (coupling) and 208 752 (nipple).

3.3.3. Fitting the elbow on the plug

It is forbidden to force or push the elbow all the way on to the plug before the application of glue to the elbow (the action of which softens the elbow).

Otherwise, the elbow will break due to the conic shape of the plug nozzle.

To glue an elbow to the plug, use specific cement ("glue") Saft part number 208 793.

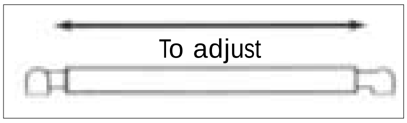
Make sure that the deadline for use (printed on the tube) has not occurred yet (refer figure 5).

Avoid any traces of electrolyte on the plug nozzle or the elbow before glueing.

Working order

1. If not done, assemble first the plug on the block (refer to 7.3.).

2. Before glueing the elbow to the plug, prepare the assembly elbow/pipe.



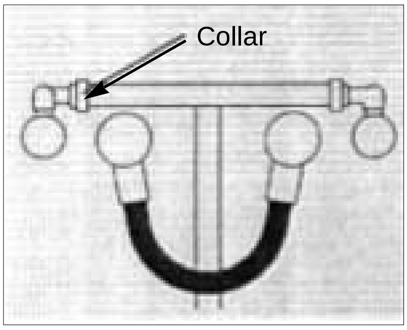
3. Put a continuous layer of glue onto the inner wall of the elbow (see figure 5), using a bent metallic wire (for example a paper clip).

❑ **Attention: the glue contains volatile solvents and so it is important to avoid exposure to the air more than necessary. Do not pour the glue into a receptacle, keep it in the tube.**

4. The glue will soften the plastic material of the elbow rapidly. So it is important to put the elbow on the plug about 5 to 10 seconds after glueing.

5. Fix the pipe on the elbow using the collars part number 208 860. Fix them with care in order not to break the elbows.

6. The elbow, fixed like this on the plug, can stand light mechanical stress after 60 minutes (drying at a temperature higher than + 15°C).



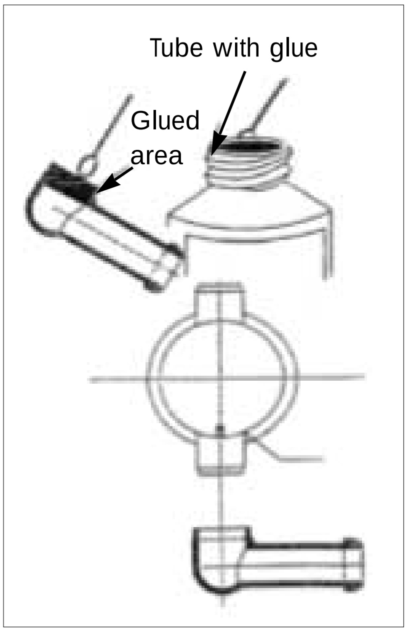


Figure 5

4. Placing blocks into service

STM blocks are delivered filled and uncharged. On reception and/or after a storage period, a commissioning cycle is required.

Do not top up with water or electrolyte prior to the first charge, even if the electrolyte level is underneath the minimum level.
In fact, after longer storage periods, the electrolyte can be totally absorbed by the electrodes.

If delivered in individual units, the blocks are provided with shipping plugs on the vents in order to prevent loose of electrolyte.

4.1. Preparation before use

a) Remove shipping plugs from cells, if any.

b) Ensure correct and tight hydraulic interconnection.

c) Verify that electrical inter-connection of the blocks and the connection of the battery to the load are correct.

d) Check tightness of terminal connecting nuts.

Torque applied should be as follows:

12 ± 2 N.m

4.2. Commissioning cycle

a) Constant current charge at 18 A (0.1 C_5) during 14 hours without voltage limit.

b) Rest period of 1 hour.

c) Topping up with water filling system (see 6.2.).

5. Operation

5.1. Operating temperature

Due to the electrochemical reaction, all Ni-Cd batteries generate heat (calories) to a certain extend during the charge and discharge operation. As STM monoblock batteries are batteries of high energy density, and as they are used in regular cycling, particular attention must be paid to the thermal behaviour of the battery.
In daily cycling applications with currents > 0.1 C_5, a cooling system and temperature control of the battery are recommended, in order to keep the battery temperature within the limits mentioned hereunder.
The temperature measured in a central cell must be less than 45°C in continuous state. This temperature may be exceeded exceptionally (for example when discharged at high rate).
The maximum permissible temperature is 60°C.

■ **Temperature during charging**

For optimum battery performance and life time it is preferable to begin charging at an internal battery temperature of below 35°C. This means in practice that after discharge, if time is sufficient, the battery is cooled down below 35°C before starting the charging operation. This temperature can be exceeded occasionally. In that case the charging process will be done at lower charging efficiency, and the battery will not be fully charged. When charging again at normal temperature, the battery capacity will be restored by a full charge.

5.2. Charging in service

5.2.1. Constant current charge

■ **Normal charge**

In cycling applications, STM batteries are preferably charged in a constant current mode with current rates between 27 A (0.15 C_5) and 36 A (0.2 C_5).

■ **Fast charge**

Possibility of recharging up to 80 percent of the capacity at a charging current of 270 A (1.5 C_5) with a voltage cut-off of 8 V/block.

5.2.2. Recommended charging method

Valid for a temperature range from 0°C (32°F) to + 35°C (95°F).

The charging method described below is supposed to be of general validity for Electric Vehicles equipped with STM batteries. However, specific charging modes, depending on customer specific using conditions, climatic conditions, etc. can be worked out. Please consult Saft.

The preferred charging method for Saft STM batteries is two step constant current charge, as shown in the diagram below.

■ **Principle**

The battery is charged in a first step at constant current, with increasing battery voltage.
As soon as the predetermined charging voltage has been reached, the battery is charged to a lower charge current in order to avoid ineffective battery heating during the necessary overcharge. The change-point, called threshold, is indicated in the diagram by a small circle.

First step: high rate charging at 0.2 C_5 up to predetermined threshold voltage,

Second step: low rate charging at 0.04 C_5 without voltage limitation.

The charging time of the second step is the same as the charging time of the first step. The resulting charge coefficient is 1.2.

Maximum charging time of a fully discharged battery is 10 hours. For new batteries, it could be 11 or 12 hours.

■ **Temperature compensation**

It is essential that the battery definitely reaches the threshold voltage before it is fully charged.

As the voltage level of a Ni-Cd battery is decreasing when temperature increases, it is necessary to have a temperature compensation, adjusting the threshold voltage of the charger with the battery temperature.

The relationship between threshold voltage and temperature is supposed to be a linear one.

It is usual to indicate the threshold voltage for + 20°C. This voltage is adjusted depending on the battery temperature, with a negative temperature coefficient, expressed in millivolts per °C.

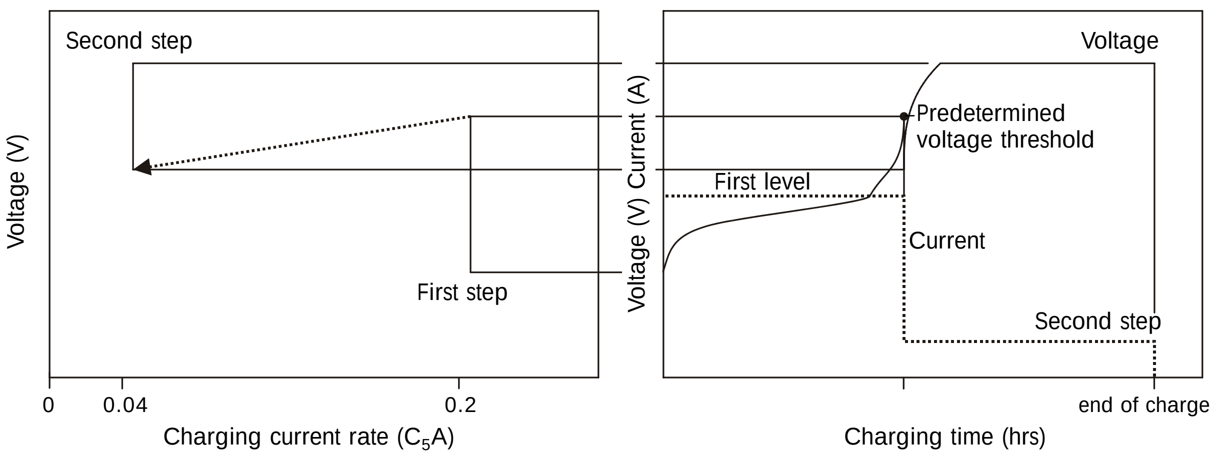
- **Threshold voltage:**

The predetermined threshold voltage at the end of the first charging step is settled at 1.6 V/cell at + 20°C i.e. **8 V/block**.

- **Temperature coefficient:**

– 0.004 V/°C/cell = **– 0.02 V/°C/block.**

Cut-off can be manual, controlled by a time switch, or an electronic device.



Recommended charging method for STM 5.180 block

- **First step:**

I const. 0.2 C_5: 36 A
Uthresth: 8 V/block
Time t_1: until battery reaches Uthresh

- **Second step:**

I const. 0.04 C_5: 7.2 A
Uthresth: open
Time $t_2 = t_1$

- **Temperature coefficient:**

– 0.02 V/°C/block

- **Overcharge coefficient**: 1.20

Examples of charge voltage at different temperatures:

■ Charging of one STM block at +35°C (95°F):

Threshold voltage at +20°C (68°F) ....8 V
Temperature when charging ....+35°C (95°F)
Temperature difference from +20°C...................................+15°C
Threshold voltage correction ....+15°C x (–0.02) V/°C = –0.3 V
Threshold voltage for charge at 0°C ....8 V – 0.3 V = 7.7 V

■ Charging voltage of two STM block at 0°C (32°F):

Threshold voltage at +20°C (68°F) ....2 x 8 V = 16 V
Temperature when charging..0°C (32°F)
Temperature difference from +20°C ....–20°C
Threshold voltage correction ......–20°C x (–0.02 x 2)V/°C = 0.8 V
Charging voltage for charge at 0°C ....16 V +0.8 V = 16.8 V

Charging time for a 50% discharged batttery:

First step charging time..2.5 hours
Second step charging time ....2.5 hours
Total charging time ....about 5.0 hours

5.3. Discharge

5.3.1. Discharge currents

The maximum continuous discharge current is 360 A (2 C_5). At this current, the battery units must be ventilated in order to limit heating (electrolyte temperature < 60°C).

Peak discharges of short duration, less than or equal to 15 sec, up to a current of 900 A (5 C_5A) are possible.

5.3.2. End voltages in discharge

The voltage level during discharge depends on the current drawn on the battery, and the temperature.

The rated capacity of STM blocks are determined at + 20°C and end voltages of 5 V.

In practice, STM blocks can be discharged down to 0 V.
Even occasional reversal (U < 0 V) will not harm the blocks.

However, it is recommended not to reverse the blocks regularly, and it should be endeavored to comply with the cut-off voltages listed below:

Current 0.2 C_5
Capacity measured at 5.0 V/block
Cut-off voltage: 5.0 V/block

Current 1 C_5
Capacity measured at 4.5 V/block
Cut-off voltage: 4.5 V/block

Current 2 C_5
Capacity measured at 4 V/block
Cut-off voltage: 4 V/block

6. Maintenance

6.1. Periodic maintenance

When the charging equipment is carefully adjusted and functions correctly, STM batteries require, under normal operating conditions, no regular maintenance apart topping-up (refer to 6.2.).

They need to be given brief general inspection, which is usually possible to carry out at the same time as the general inspection of the vehicle. During this inspection, it is sufficient:

- to check tightness of connectors
- to check that the hydraulic system is sealed
- if necessary, to clean the battery with soapy water (do not use any detergents).

Checking of electrolyte density and reconditioning charges are not required systematically, but only when, by accident, this becomes necessary (refer to 7.1. and 7.2.).

6.2. Topping-up operation

■ **Measuring the electrolyte level**

Topping-up with distilled or demineralized water (for water quality refer to 2.2.) is necessary, because Ni-Cd batteries loose water in form of H_2 and O_2 gasses during overcharge.

The electrolyte level can be seen on the blocks from outside through the plastic container. The only reliable moment to measure the electrolyte level is at the end of charge, respectively some minutes after the end of charge (when the electrolyte is at its highest level).

Topping-up becomes necessary, when, at the end of charge, the electrolyte level is at the MIN-mark or below.

In practice, topping-up is done after a number of overcharged amperehours, or, otherwise, after a number of kilometers driven, or a number of cycles, or a number of Ah discharged ; in fact, this is mainly determined by experience.

■ **Frequency of topping-up**

Approximately once every 15 full cycles, or after 3000 cumulated discharged amperehours, ideally every 600 cumulated overcharged amperehours.

■ **Topping-up operation**

❑ **The topping-up operation is carried out one hour (± 15 min) after the end of charge.**

If it is carried out earlier, residual gasses of the charging process may disturb the operation.
If it is carried out later than this, the electrolyte level will fall down and the operator risks to overfill the blocks (overflow during following charge).

Water is entering the hydraulic system by gravity (water reservoir) or by a pump, according to the principles described in chapter 1.4.

The water inlet flow rate must be less than or equal to **0.7 liters per minute**, and the relative pressure must be **below 0.15 bars.**

The water will fill up the battery cell by cell. The end of topping-up of each hydraulic circuit is some seconds after continuous water overflow at the system outlet (inlet then closed manually or by relays).

7. Equipment repair and overhaul

7.1 Electrolyte specific gravity

As described in chapter 2.2., electrolyte specific gravity must only be checked, and electrolyte eventually reconcentrated if the cells have lost electrolyte by accident (overflow), and only if the performances of the battery (after reconditioning) are decreased because of this phenomenon.

In order to measure the electrolyte specific gravity, it is necessary to remove the filling plugs from the blocks. It is important to renew all disassembled connecting pipes and elbows when reassembling the plugs (refer to 7.3.).

Electrolyte specific gravity can be measured earliest 2 full cycles after the last topping-up operation. Otherwise, the electrolyte above the plate stack will be diluted and you will measure wrong values.

The nominal specific gravity of electrolyte used in STM blocks at a temperature of + 20°C is:1.21. The specific gravity practically does not vary with the state of charge. The specific gravity varies with the temperature. The specific gravity varies between two topping up operations. Therefore, the lowest acceptable value for specific gravity, when electrolyte level is at "Max" is 1.17. If the specific gravity should be too low, a reconcentration of the electrolyte becomes necessary. This must be done by Saft authorized personnel.
Please contact us.

7.2. Reconditioning

Reconditioning shall be performed when the battery capacity is too low, or when the battery is disbalanced.

Reconditioning shall be done as follows:

a) Residual capacity discharge of the battery.

All the blocks of one battery should be underneath 5 V.

The discharge shall be done at a current of approximately 0.2 C_5 A, 36 A.

b) Constant current charge at the following values:

18 A during 14 hours or 36 A during 7 hours with no voltage limit.

c) Topping-up with water filling system (refer to 6.2.).

d) If necessary, this operation can be repeated.

7.3. Replacing vent plug

New blocks are delivered with their plugs already fitted. Replacement of vent plugs may become necessary after accidental damage, leakages or for other exceptional reasons.

When refitting a vent plug on a block, do always use new connecting pipes and elbows.

Already used components may have traces of electrolyte, which will endeavour the air and electrolyte tightness of the hydraulic system.

■ Fitting a plug on a cell

Before fitting the plug on a block, put a trace of vaseline oil on the O-ring to avoid elastic stress on the O-ring due to adhesion of the contacting surfaces. This will avoid a backward-rotation of the plug, which can mechanically stress the connecting pipes between two plugs.

■ Replacement of several plugs

For better alignment, the water filling plugs have a notch on their upper part (refer figure 6).

When replacing the plugs in one block, it is important to ensure that all the plugs within a block have their notches in the same position, i.e. they all have to show to the right hand or left hand side.

This avoids an accumulation of angular tolerances between the block lid and the plugs, which would stress the connecting pipes between two plugs.

Operations

1. Grease the O-ring as described above

2. Fit connecting pipes on one end of each plug

3. Screw the plugs one by one to the block, using the key 208 999, and fit the connecting pipes between two plugs.

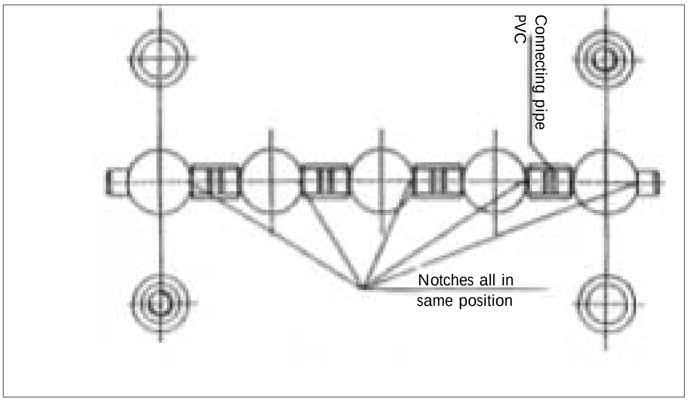
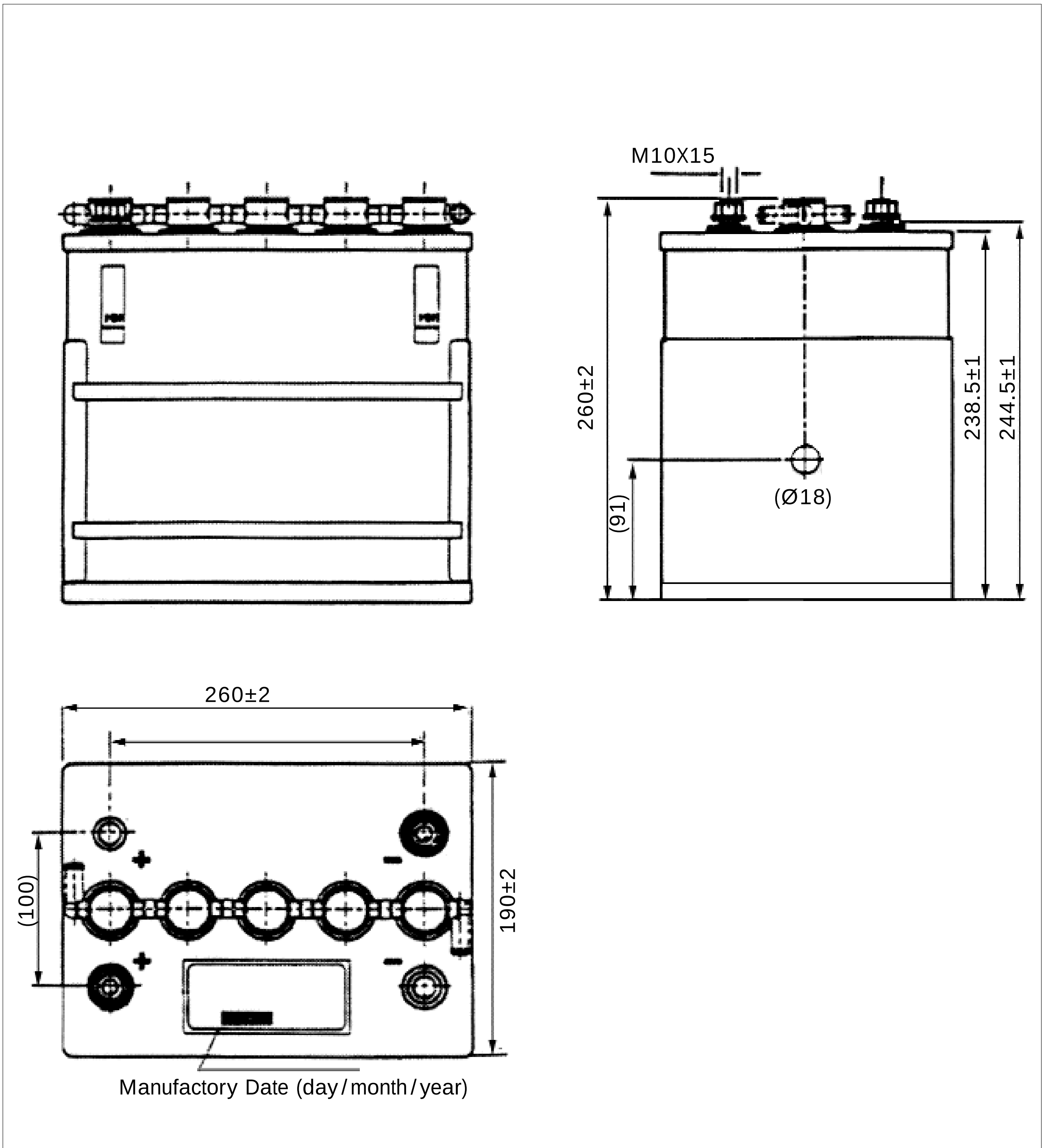


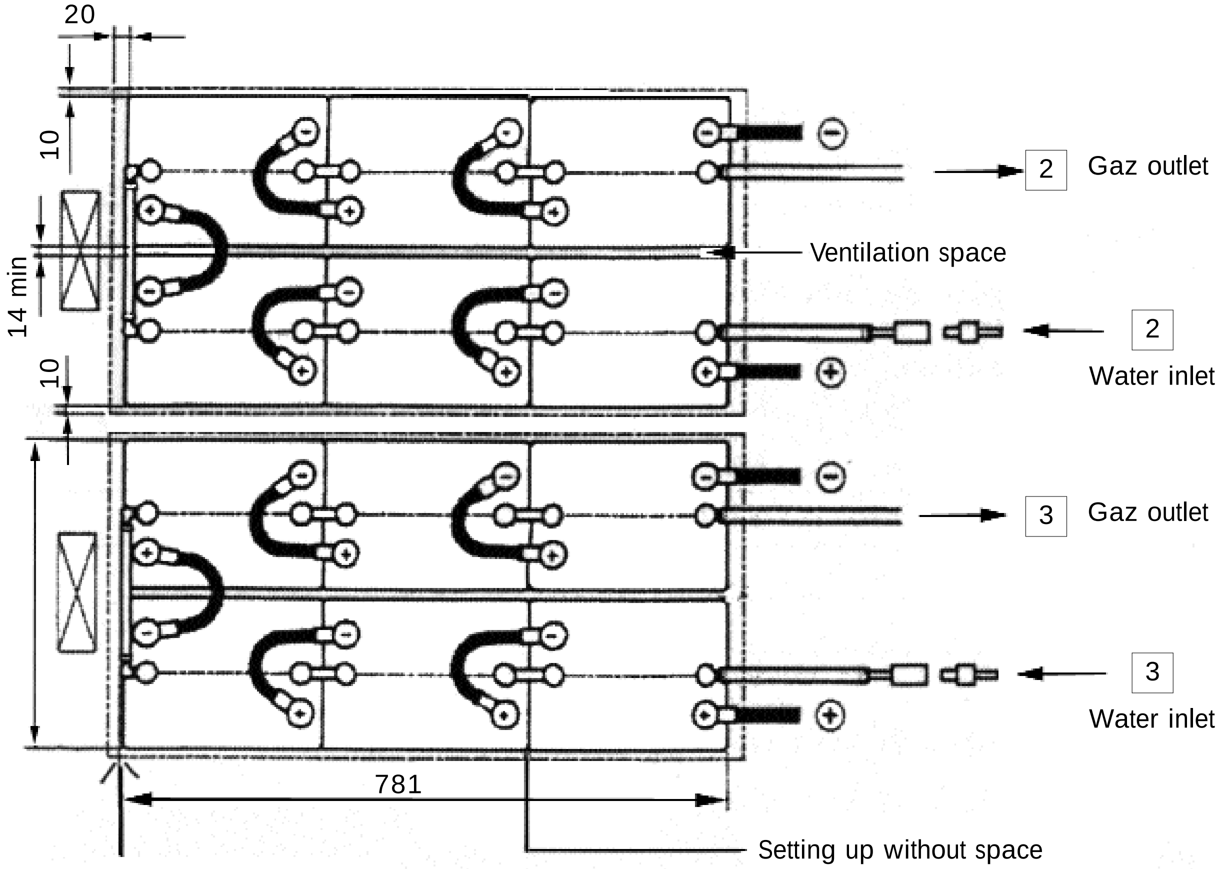
Figure 6: Replacement of several plugs

Appendix 1



Monoblock STM 5.180 - 6 V - 180 Ah
(dimensions in mm - Right hand)

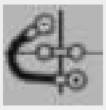
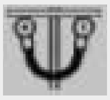
Appendix 2



Assembly into batteries

Appendix 3

Spare parts

Block type	Block P/N			End lug 35 mm²	End lug 50 mm²	Pole protect	Vent plug
STM 5.180 RH	210190	E 230 35 mm²	E 230 35 mm²	209456	210290	210080	208790
STM 5.180 LH	210191	210288	210288	209456	210290	210080	208790

Connectors and end cables for STM 5.180

Connector				End cable			
Length	Cable section	Pole bolt	P/N	Length	Cable section	Pole bolt	P/N
E 230	50 mm²	M 10	210525	L 500	50 mm²	M 10	210594
E 400	50 mm²	M 10	210591	L 1000	50 mm²	M 10	210595
E 800	50 mm²	M 10	210592	L 1500	50 mm²	M 10	210524
E 1600	50 mm²	M 10	210593	L 2000	50 mm²	M 10	210289

Accessories of the water filling system

Elbow ABS	208 740	orange, glued before fitting to plug
Adaptor ABS	209 635	orange, glued before fitting to plug
Glue	208 793	Tube Tensol n°12
Pipe 9 x 12	444 083	for small connections
Pipe 10 x 16	208 859	for connections > 200 mm
Collar	208 860	connecting pipe to elbow
Elbow polypro.	444 103	connecting pipe to pipe
Key	208 999	for all water filling plugs
Water coupling	208 854	(female) self closing
Water nipple	208 855	(male) self closing
Water coupling	208 751	(female) free pass
Water nipple	208 752	(male) free pass

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