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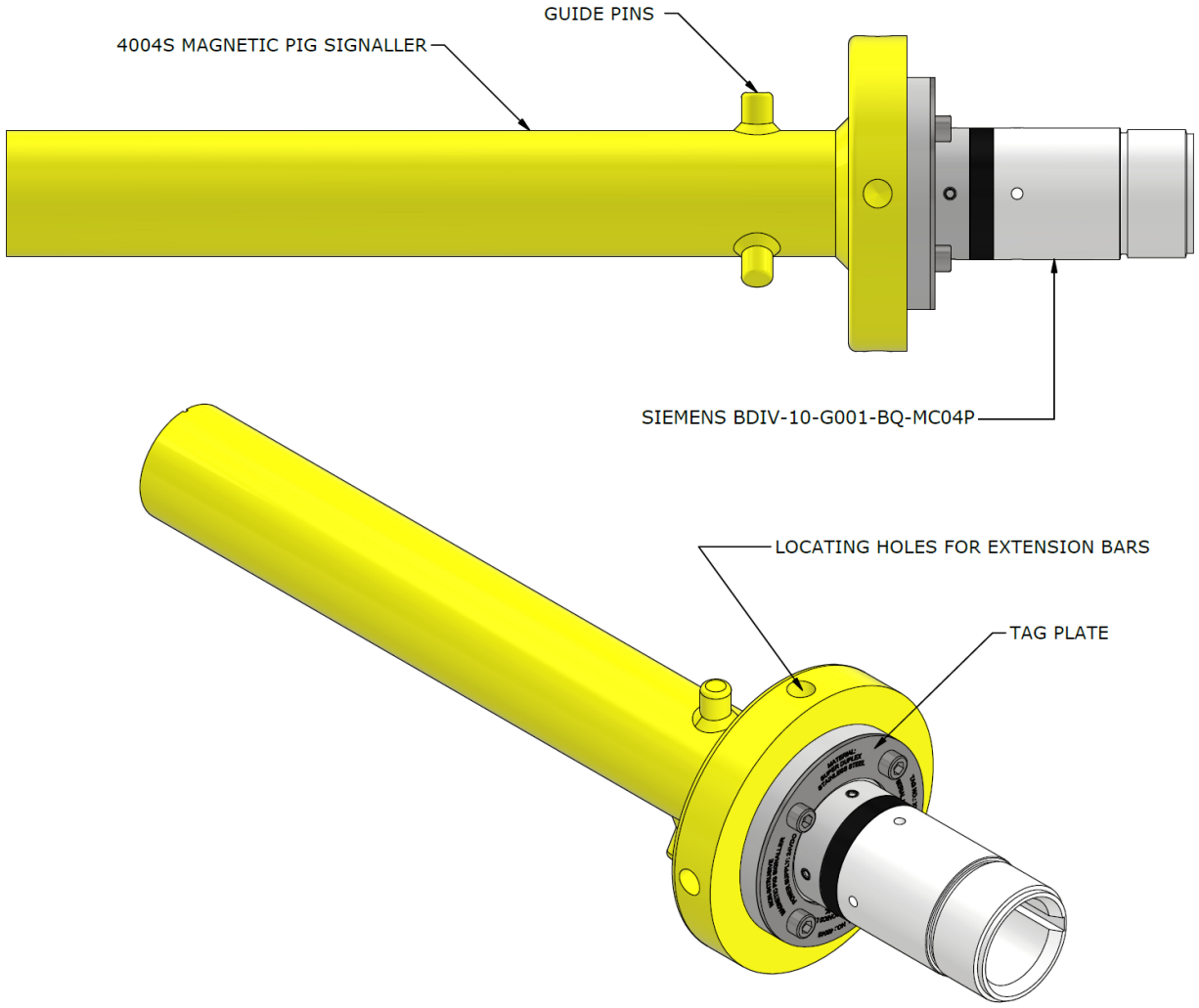
1. GENERAL DESCRIPTION

The 4004S magnetic pig signaller is a compact, self-contained, non-intrusive, magnetic pig signaller suitable for harsh subsea applications. The 4004S detects the passage of magnetic pigs at the point of installation on a pipeline.

The unit is suitable for use on pipelines with wall thickness in excess of 40mm. Detection speed ranges from 0.1 to greater than 20 metres per second. Window of detection is typically 0.5m either side of the unit. The detection capabilities vary depending on the background magnetic noise, pig speed, pipeline diameter, wall thickness and the quality of magnets fitted. It is recommended that pigs are fitted with rare earth magnets (neodymium iron boron) to maximise magnetic signal.



MOUNTING METHOD: The unit will be supplied with a Clamp assembly which can be installed onto the pipeline topside. The clamp assembly has a built-in funnel that will house and secure the 4004S signaller subsea.

2. TYPICAL SPECIFICATIONS

GENERAL:

External supply ..... 24.0 VDC, <5W

Signal outputs..... 4-20mA

Current Loop Listening Level ..... ~8mA

Current Loop Pig Passed Level..... ~17mA

Operating temperature range..... -5°C to +40°C (+23°F to +104°F)

Storage temperature range..... -20°C to +50°C (-4°F to +122°F)

Maximum pipeline surface temperature ..... +150° (+302°F)

Pig Speed Range .....0.01m/s to 20m/s

Max Water Depth 300m (984ft)

Length ..... 452mm (17.8”)

Diameter ..... 121mm (4.8”)

Weight (excluding clamp assembly) 5kg (11lbs)

Weight in water (estimated excluding clamp assembly) 3kg (6.6lbs)

Enclosure Material ..... Super Duplex

Subsea Connector (Bulkhead) .....Siemens BDIV-10-G001-BQ-MC04P

Mating Subsea Connector (Cable Mounted)……..Siemens BDIV-10-A001-BQ-EG10A-MC04S

Protective Coating .....XYLAN 1070 - YELLOW

3. RULES FOR SAFE OPERATION

⚠ **WARNING**: Any operation involving pressure is potentially hazardous. No person should use this equipment unless they are fully aware of the potential hazards of working with pressurised vessels. The purchaser of this equipment is responsible for the training and competence of operators and the manner in which it is used. This manual should be read through and understood before installation and commissioning so that the operator is familiar with the equipment. Contact IK Trax immediately should any difficulty arise in the use of this equipment.

⚠ **WARNING**: Do not expose to aggressive solvents or chemicals which could be harmful to the 4004S signaller or any connectors or any other parts of the equipment.

⚠ **WARNING**: Before Storage, Transportation, operation, installation and any maintenance of the Siemens Wet-Mate Diver connectors please refer to the Siemens Energy DigiTRON Installation, Operations and Maintenance Manual IOM-002 Rev 10 Issue Date: 17/03/23.

4. OPERATION

The 4004S should be electrically connected to the control system as described in Section 5.2 ELECTRICAL & SIGNAL CONNECTION.

4.1. TURNING ON

To turn the unit on, apply 24Vdc power to pins 1 & 2 of the input connector.

When powered, the 4004S will draw 20 – 50mA.

When powered up, the current loop interface will draw ~8mA (if the power supply to the 4004S is not active then the current loop current will be 0mA).

The unit will enter the stabilisation delay state.

4.2. TURNING OFF

Remove power from power input pins 1 & 2.

4.3. STABILISATION

The STABILISATION delay occurs when the unit is initially powered. During STABILISATION the unit will not detect any magnetic event.
The STABILISATION delay is typically 1 minute.

4.4. LISTENING

After STABILISATION the unit enters a 'LISTENING' state where the magnetic flux is continually monitored.

MAGNETIC EVENT – If a DIFFERENCE in magnetic flux greater than the THRESHOLD setting is detected while the unit is LISTENING, then the 4004S will enter PIG PASS MODE state.
THRESHOLD is set to 35 Milligauss (mG).

4.5. PIG PASS MODE

PIG PASS mode is used to confirm pigs have passed the signaller. This is achieved by only signalling PIG PASSED if the flux readings drop by a percentage below the peak reading typically set at 10%.

On detecting a drop in flux readings after a peak reading the 4004 enters the DETECTION DELAY state.

4.6. DETECTION DELAY

The DETECTION DELAY controls how long the unit will signal an event for. It is configured to give the magnetic pig enough time to get out of range of the sensor after it has been detected to avoid re-trigger.
When dealing with pig trains, the expected pig speed and separation is used to configure a suitable value for the DETECTION delay such that the unit will not detect the same pig twice but will enter LISTENING mode in time to detect the next pig.

The DETECTION delay is 1 minute (60 seconds).

During the DETECTION DELAY the current loop interface will draw ~17mA.

On completion of the DETECTION DELAY the signaller returns to LISTENING mode.

5. INSTALLATION

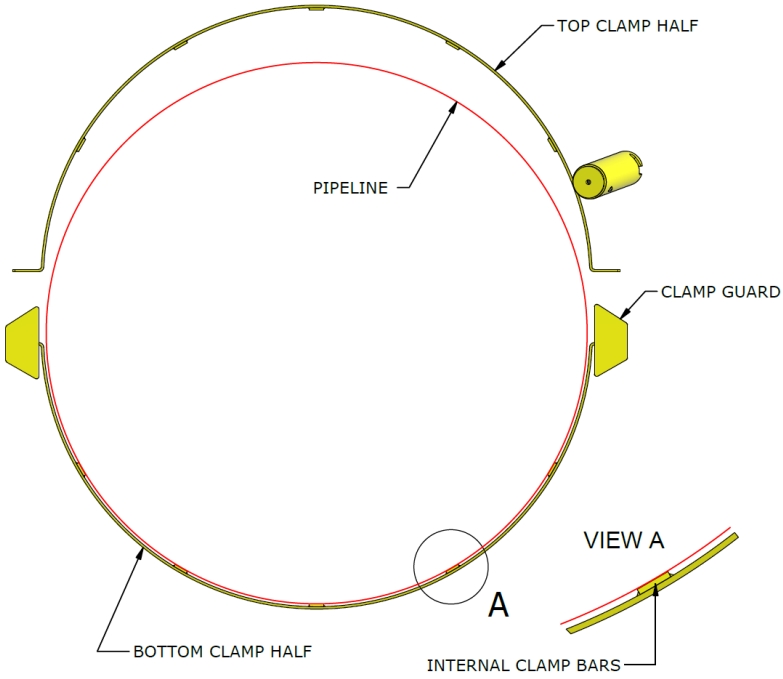
5.1. CLAMP ASSEMBLY INSTALLATION

The 4004S is provided with a clamp assembly that secures the unit to the pipeline. The clamp assembly must be mounted securely. If the unit is allowed to move within the earths' magnetic field, then it will detect this change and cause a DETECTION.

1. Carry out a visual inspection on all the clamp equipment to ensure there is no damage to any of the parts.

2. The bottom clamp half (clamp half with clamp guards) is to be placed under the pipeline and lifted such that the internal bars contact the pipeline, see view A. The clamp guards can be used as lifting / support points to hold the bottom clamp half in place during assembly.

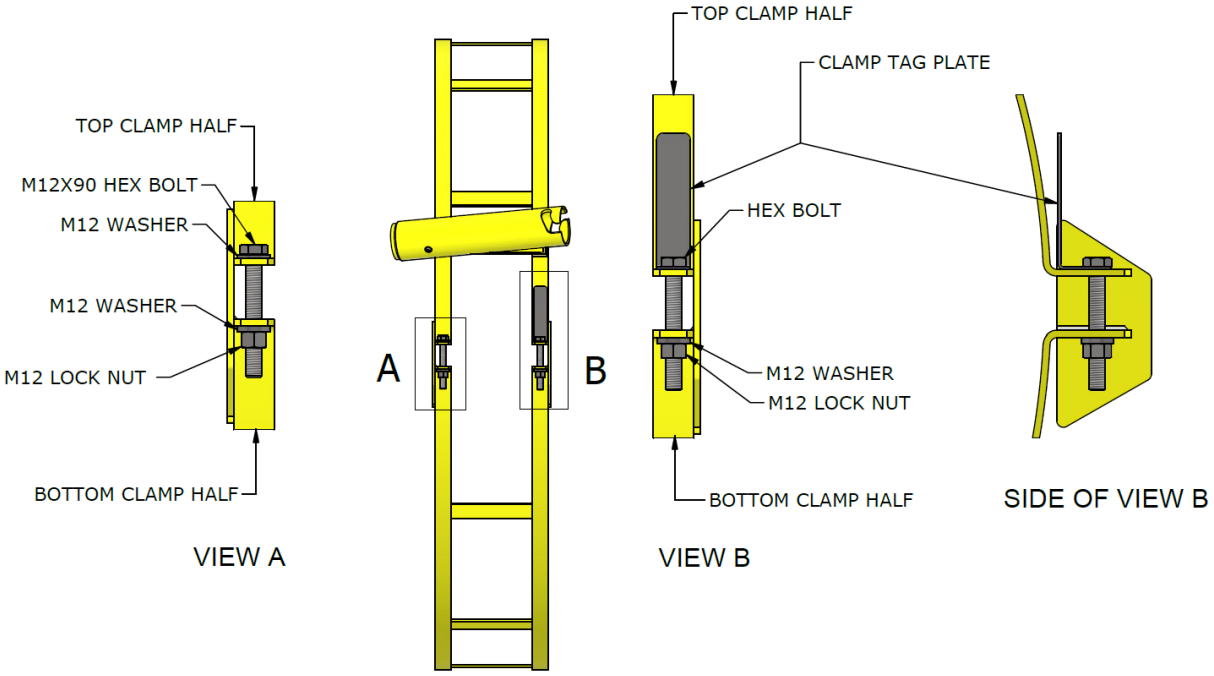
3. The top clamp half (clamp half with funnel attached) is to be lowered onto the top of the pipeline until the internal clamp bars contact the pipeline, see view A.



4. Secure the two clamp halves together with the fitting arrangement shown below.

   The fastener arrangement in view B is as follows. Fit the clamp tag plate to the upper clamp half as shown and slide a M12x90 hex bolt through both clamp halves until the hex bolt has butted against the clamp tag plate. Apply MOLYKOTE G-Rapid plus lubricating paste to the exposed threads of the M12 hex bolt. Slide a M12 washer up the M12x90 hex bolt to the bottom clamp half and secure with a M12 lock nut. Tighten the M12 lock nut until secure.

   The fastener arrangement in view C is as follows. Fit a M12 washer to the upper clamp half as shown and slide a M12x90 Hex bolt through both clamp halves until the hex bolt has butted against the M12 washer. Apply MOLYKOTE G-Rapid plus lubricating paste to the exposed threads of the M12 hex bolt. Slide a M12 washer up the M12x90 hex bolt to the bottom clamp half and secure with a M12 lock nut. Tighten the M12 lock nut until secure. This is to be repeated at the other side of the clamp for both fixing points.



5. Carry out a visual inspection around the clamp to verify the clamp is secure on the pipeline.

6. The 4004S Pig Signaller MUST NOT be inserted into the funnel BEFORE the clamp and funnel assembly is deployed subsea. Only when the clamp and funnel assembly is in its FINAL subsea location and the mating subsea cable is in place ready for diver connection should the 4004S be deployed subsea to be connected by a diver. The 4004S pig signaller should not be exposed to any excessive shock & vibration loads. If this instruction is NOT followed then serious damage may occur to the 4004S pig signaller.

7. The use of suitable Siemens dummy subsea connectors or caps is advised if the pins on receptacles are likely to be exposed to seawater for any significant period. The advised maximum cumulative exposure over the life of the connector is 28 days, although some pin deterioration may occur in a shorter period.

5.2. ELECTRICAL & SIGNAL CONNECTION

PIN/CABLE WIRE No.	DESCRIPTION
1	+24Vdc Supply
2	0Vdc Supply
3	Positive Current Loop Supply
4	Negative Current Loop Supply

Power supply connections to the 4004S subsea via pins 1 & 2 of the subsea cable. The power supply should have a nominal voltage of 24V with a current capacity of at least 1 Ampere.

Current loop interface connections to the 4004S subsea via pins 3 & 4 of the subsea cable. The 4004S is a passive current loop device where the current loop power is supplied to it by the current loop source. The current loop source should have a nominal 24Vdc supply.

6. 4004S DEPLOYMENT

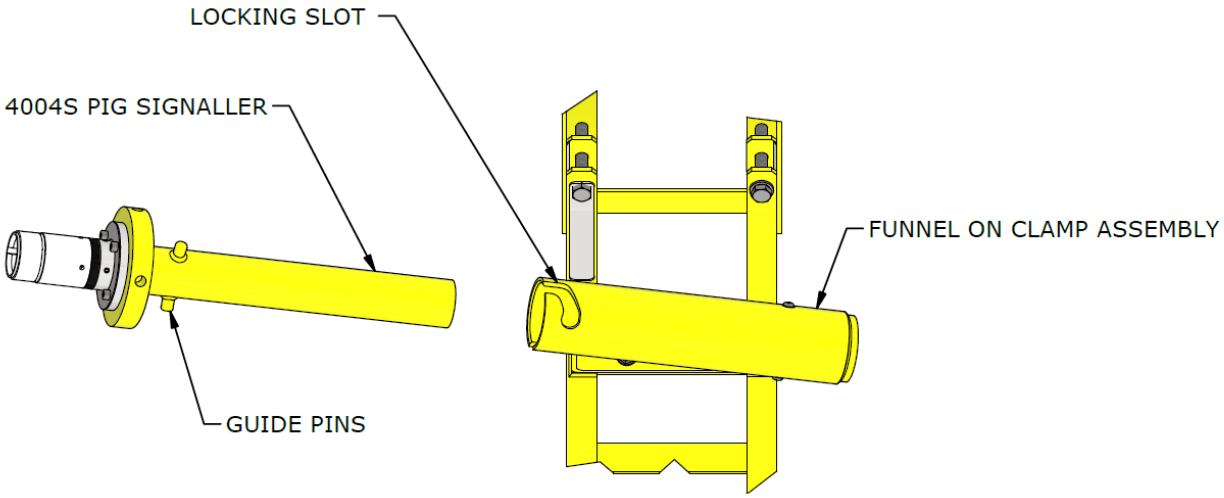
The 4004S pig signaller is to be deployed subsea onto the clamp assembly detailed in section 5.1.

1. The diver will slide the 4004S unit into the clamp assembly funnel as shown in view E with the guide pins engaging in locking slots in the funnel. The 4004S unit should be pushed through the funnel until butted against the funnel base. The locking slots on the funnel are not symmetric so the guide pins can only be installed in one orientation.

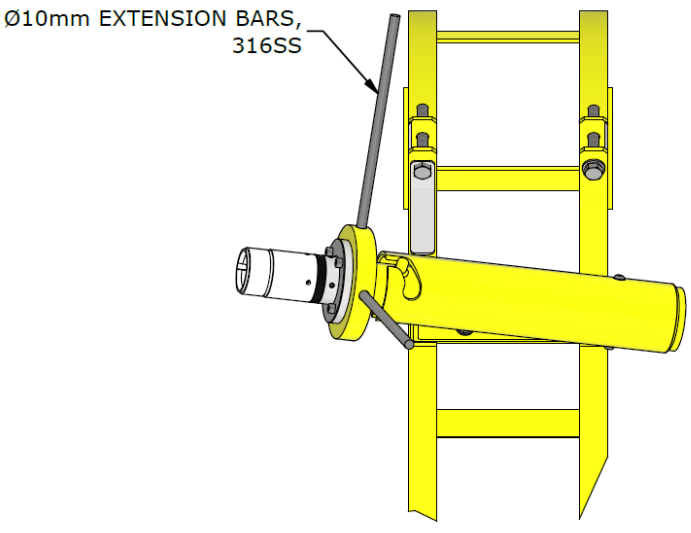
2. Using the provided extension bars, rotate the 4004S unit clockwise until the guide pins are in the locked position, see view F. The locked position is where the guide pins reach the end of the locking slot. Some resistance may be seen to rotate through the slot profile.

3. Remove the extension bars and verify the unit is secure in the funnel.

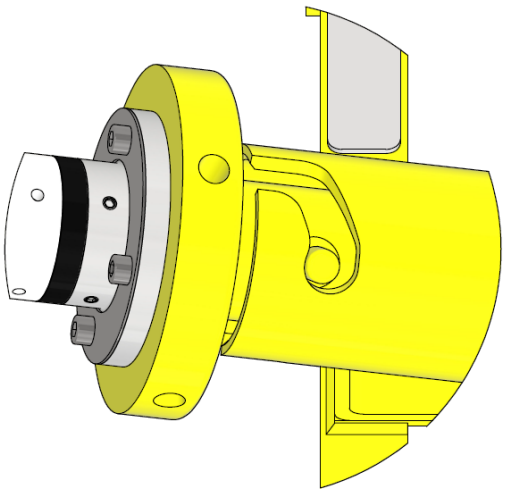
To remove the 4004S signaller repeat step 2. but rotate the 4004S counterclockwise until free.



VIEW D



VIEW E



VIEW F

7. DEPLOYMENT

The following section does not provide a comprehensive deployment procedure as every deployment is different however it does outline the minimum checks which should be carried out before deployment. Repeating these checks before deployment will pick up most problems before the unit is deployed and can save significant costs and avoid unnecessary delays. If the results of any of these checks are not as expected, then please contact IK Trax immediately.

1. At least 24 hours prior to deployment any personnel who will be involved with the operation of the 4004S should review this entire manual to familiarise themselves with the unit.

2. Visually inspect all cables and connectors for any signs of damage. Confirm that all connectors are securely mated.

3. Referring to section 5.1 CLAMP ASSEMBLY INSTALLATION to confirm that the 4004S clamp assembly is suitably and securely mounted.

4. Gradually bring a magnetic object (most hand tools, such as screw drivers, have sufficient magnetism) near to the sensor, the sensor is positioned as shown in section 1 GENERAL DESCRIPTION.

5. Detection should be confirmed either at the control station or on test equipment connected topside.

7.1. SUBSEA CABLE CONNECTOR & CABLE

The 4004S has a diver wet mate bulkhead connector (Siemens BDIV-10-G001-BQ-MC04P) fitted on its top flange. This connector can withstand the full water pressure (30bar, 300m wd) when not connected (Open Face).

A compatible diver wet mate cable connector (Siemens BDIV-10-A001-BQ-EG10A-MC04S) must be used to connect to it. The subsea flying lead on the cable MUST be independently secured to the structure to ensure there is **no load on the 4004S subsea connector** from subsea cable connector and cable assembly. Securing it to the subsea structure will also ensure no movement is transmitted to the 4004S due to currents/wave motion influences subsea.

The use of suitable Siemens dummy subsea connectors or caps is advised if the pins on receptacles are likely to be exposed to seawater for any significant period. The advised maximum cumulative exposure over the life of the connector is 28 days, although some pin deterioration may occur in a shorter period.

8. RECOMMENDED MAGNET ARRANGEMENT

It is recommended that pigs be fitted with 4x, or more rare earth magnets (neodymium iron boron) spaced equally around the pig body with the same poles facing outwards e.g. all north poles facing outwards (as shown) or all south poles facing outwards. It is critical that the magnets are not oriented with a mixture of north and south poles facing outwards as this may result in 'dead-spots' in the magnetic field around the pig. Magnets may be embedded in foam pigs in a similar fashion. The cost of quality magnets is insignificant compared to the potential cost of a lost pig if unsuitable, cheaper magnets are used. Contact IK Trax for a quote for suitable magnets. Effective pig detection is dependent on several factors including:

PIPE WALL THICKNESS – The thinner the pipe wall, the stronger the magnetic signal.

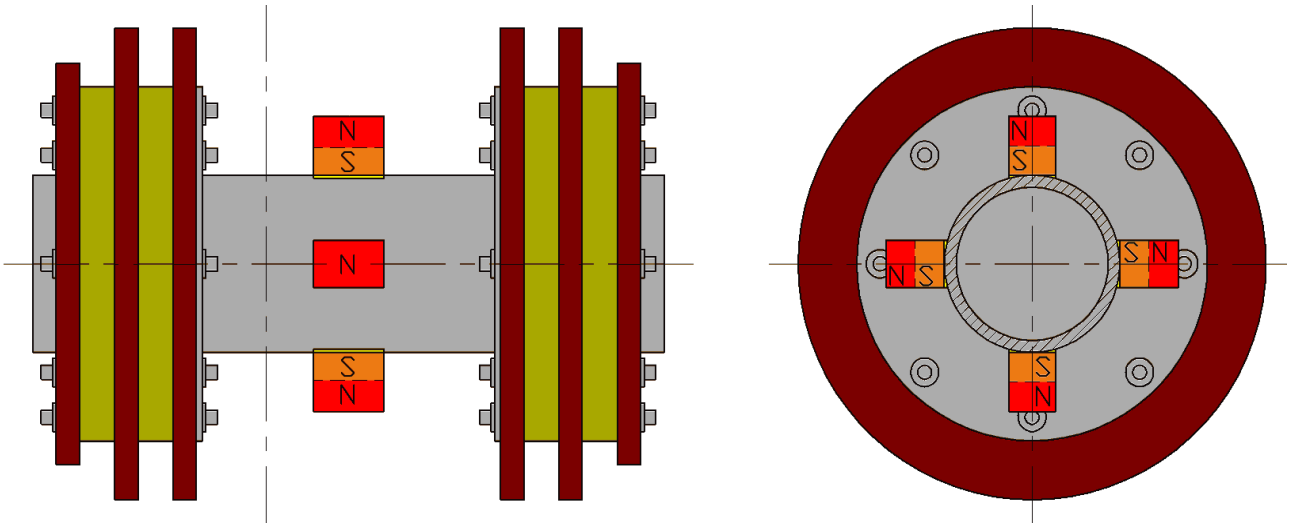
PIPELINE MATERIAL – Different materials cause different attenuations to the magnetic signals. For example, 50mm of concrete will affect the signal considerably less than 50mm of mild steel.

DISTANCE BETWEEN MAGNET AND SENSOR – The closer the magnets are to the magnetic sensor, the stronger the magnetic signal.

NUMBER OF MAGNETS FITTED TO PIG – The more magnets which are placed around the pig, the more uniform and effective the overall magnetic field is.

STRENGTH OF MAGNETS – The stronger the magnets, the stronger the magnetic signal.

BACKGROUND MAGNETIC NOISE – The more magnetically quiet the surrounding area is, the more sensitive the 4004S can be set without the risk of false triggers. Large magnetic objects (such as vehicles or tools) moving nearby can cause large magnetic signals, the magnetic signal from the pig must be significantly larger than these to allow reliable detection.



10. MAINTENANCE AND STORAGE

All IK Trax products are designed to require minimum maintenance. The 4004S should be cleaned using fresh water and cleaning agents as necessary. Do not use chemicals which could be damaging to the housing or connector.

Periodically inspect all connectors and cables for any signs of damage.

Siemens DigiTRON Diver connector products require zero maintenance for their 30 year subsea lifetime and up to 250 subsea mate and de-mate cycles.
There are no user serviceable parts in the connectors. Disassembly of the product should not be attempted. If there are any problems developed with the product then the user should contact Siemens Energy Technical Support for advice.

⚠ **CAUTION**: Risk of material damage, corrosion of the exposed male pin in the receptacle connector.
28 days is the maximum cumulative allowable exposure of unprotected receptacle pins to seawater over the lifetime of the connector
Always immediately fit a Subsea Environment Cap or Dummy Plug to the receptacle in order to protect the pins from corrosion.

⚠ **CAUTION**: Risk of material damage. Under no circumstances must the contact pins in the receptacle connector be exposed to seawater with power on.
If this situation does occur the electrical connector could be destroyed (depending on electrical energy available). At a minimum, the contact surfaces of the pins will very rapidly degrade by electrolytic action. If these damaged pins are subsequently mated into a socketinsert there is a **very high risk** of damage to the insulation and seals within the plug connector.

11. SUBSEA CABLES / CONNECTORS

Before every deployment all All connector products should be thoroughly inspected before use. Connectors can be safely cleaned using Isopropyl Alcohol (IPA) and lint-free cloth, but do not soak the product in IPA. Allow time for IPA to evaporate before mating the connector together. Be careful not to leave any cloth fibres on the front-face of the plug or on the receptacle pins. Other cleaning fluids should not be used as they may not be compatible with the rubbers or plastics used in the product.
Under no circumstances should a foreign object be used to depress the shuttle pins of the plug connector.

11.1 CONNECTOR MATING AND DEMATING

1. **Live Mate / De-mate :** The connectors are not designed to be mated or de-mated while electrically energised. Depending on the type of electrical load, the following advice should be followed..

   ⚠ **CAUTION**: Risk of material damage. The maximum number of live mate / de-mate operations under any of these conditions is ONE only. There is a high risk of damage to both plug and receptacle connector that would render it unusable.

2. **Checks before mating the product** : Transport and topside protection caps must be removed before subsea deployment.

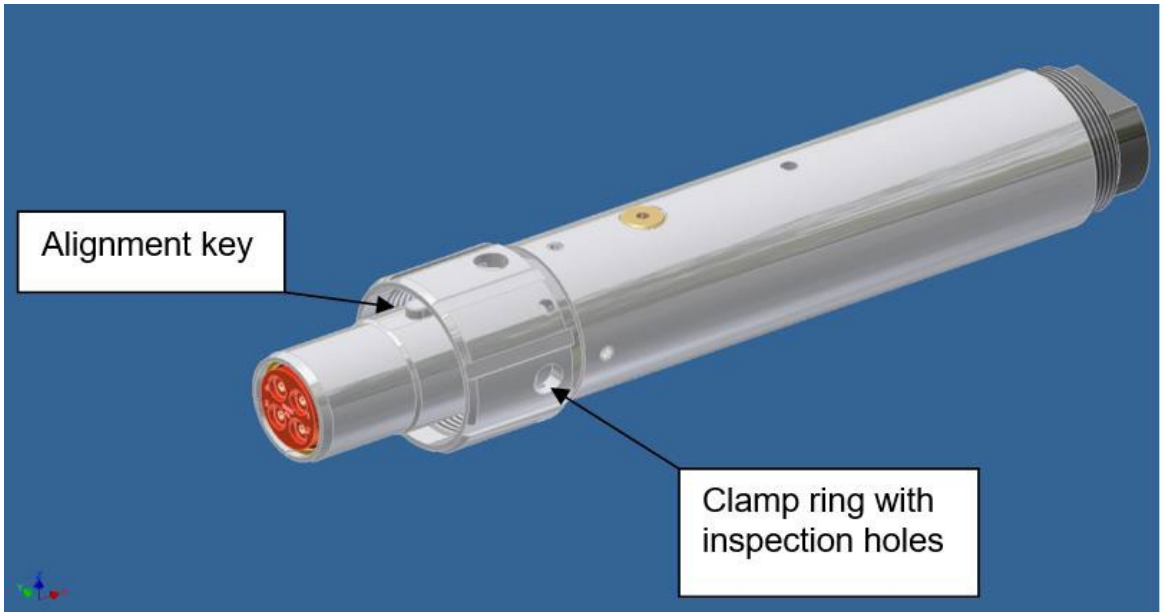
Before mating, the receptacle connector (male pins) should be checked for debris and damage. The connectors have been designed to accommodate sand and silt contamination; however large pieces of debris should be removed. Use a water jet if subsea, but do not direct the water jet at the front face (seals) of the plug connector.
Inspect the receptacle pins for any signs of damage, such as bent pins, blackening due to electrical faults, or corrosion of the pins (green colour).
Check the front-face of the plug connector (red-coloured rubber sealing element). There should be no tears to the rubber or any darkening of colour.
If evidence of such faults exists, do not use the connector. Please contact IK Trax Technical support.

3. **Diver operated Mating:** The clamp ring should be rotated clockwise by hand until tight. The connectors are designed to remain clamped together with only firm hand tightness on the clamp ring. If a clamping torque is used, this MUST NOT exceed 20Nm (15 lbf.ft). A 2-3" C-spanner can be used for this operation.

   De-mating is simply a reverse of this process.

4. **Connector Alignment:** These connectors have been designed to self-align during mating. All that is required is to ensure that the alignment pin on the plug connector is engaged in the alignment groove within the receptacle connector before screwing the clamp ring up.

5. **Post Mating Checks:** Full engagement of the connectors can be checked through the viewing hole in the clamp ring. If the connectors are fully mated, then no gap should be visible between the plug and receptacle, refer to Figure below.



12. DISPOSAL OF UNIT

IK Trax takes its responsibilities under the WEEE Regulations extremely seriously and has taken steps to be compliant in line with our corporate and social responsibilities. In the UK, IK Trax has joined a registered compliance scheme WeeeCare (registration number **WEE/MP3538PZ/SCH**).

Electrical and electronic equipment should never be disposed of with general waste but must be separately collected for the proper treatment and recovery.

When buying a new product you will have the possibility to return, free of charge, another end of life product of equivalent type that has fulfilled the same functions as the supplied equipment. These items may be deposited at:

IK Trax
Online House
Woodburn Road
Blackburn Business Park
Blackburn
Aberdeen
AB21 0PS
UK

Alternatively, to arrange a collection of any waste electrical equipment, obligated to IK Trax please telephone WeeeCare on **0844 800 2004**

13. WARRANTY

IK Trax products are guaranteed for one year from the date of purchase. Goods should be returned transportation prepaid to IK Trax.

There is no charge for parts or labour should any product require repair due to a manufacturing deficiency during the guarantee period.

In the event of a manufacturing deficiency the inward transportation costs will be repaid to the client.