Addressable Release Tool
ART-HXX
(inc ART-F, ART-J & ART-T)

Operations And Maintenance Manual
Issue K Rev 8

Edited By:	Iain Maxted
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GUARDIAN GLOBAL TECHNOLOGIES LTD.,
Merlin House, Brunel Court,
Village Farm Industrial Estate,
Pyle, Wales, CF33 7BL, UK.

Tel: +44 (0) 1656 742100
Fax: +44 (0) 1656 742251
E-mail: techsupport@ggtg.net
Website: www.ggtg.net

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IMPORTANT

Read this manual thoroughly, especially the section concerning safety, prior to using any equipment described

This manual is issued on the understanding that it is for use only by persons who have been appropriately trained both in the general use and practice of oilfield well-logging techniques and specifically in the storage, use, operation and maintenance of the equipment described. GUARDIAN GLOBAL TECHNOLOGIES (GGT) accepts no responsibility whatsoever for any damage, injury or death to any equipment or person carrying out any of the instructions or procedures described in this manual. All personnel must satisfy themselves as to the safety of any of the procedures described being mindful of the circumstances in which any work is to be carried out.

No warranty, express or implied, is indicated by any statement in this manual, nor is any guarantee given of conformance to any specification. For details of warranties, conformance and specification, please see the GGT 'General Terms of Sale' together with the appropriate equipment Data Sheets and tool test certificates.

The telemetry system used in the ART has been specifically developed for reliability and safety. It will not interfere with, nor will it be interfered with by any other telemetry system known to GGT. However, no warranty is provided by GGT as to the suitability of the ART for use with any other specific equipment. The user should at all times satisfy him/herself of the suitability of the ART for use with existing equipment by reference to the specifications herein and if appropriate through communication with the Technical Department at GGT.

All information provided in this manual is confidential and must not be distributed to anyone outside the recipients organisation without prior written consent from GGT. The original purchaser of the equipment with which this manual was provided is authorised to make copies for distribution within the purchaser's organisation on condition that recipients are bound by the same conditions of confidentiality. No copies are authorised if this manual has been supplied with equipment on loan or for test and evaluation purposes.

Prior to requesting technical support, please review this manual carefully to ensure that your question is not answered within.

ART-H Use of Manual and Quality Assurance

This manual covers equipment ART-HXX, ART-FXX and ACP-AXX. The ART-F is functionally identical to the ART-H but is fitted with client-specific heads (see Section **Error! Reference source not found.**).

Manual Revisions

Manual Release	Release Date:	Checked By:	Approved By:	Comments:
Provisional (-A)	Oct. 1997	SB	IM	No Updates to be issued. MROD.
A	Mar. 1998	PP	IM	
B				
C	Jul. 1998			
D				
E	Oct. 1999	PP	IM	Issue E tools
F	Aug 2000	PF	IM	Adds ART-F Support
G	May 2001	PF	PF	Minor part change
H	May 2002	AW	IM	New Board Design
H2	Sept 2004	IM	IM	Change to GGT Format
K	Sept 2004	JLR	IM	Fishing head and elec assy mods
K2	March 2005	IM	IM	See details below
K3	May 2005	IM	IM	See details below
K4	Nov 2005	IM	IM	See details below
K5	Mar 2006	IM	IM	See details below
K6		IM	IM	See details below
K7	June 2009	EF	IM	See details below

Table 0.1 – Manual Revisions

Manual Applicability

Manual Issue:	ART-H	ART-F	ART-J	ART-T
A				
B				
C				
D				
E				
F	Issue F Tools	Issue A Tools		
G	Issue G Tools	Issue A Tools		
H	Issue H Tools	Issue B Tools		
H2	Issue H Tools	Issue B Tools	Issue A Tools	
K	Issue K Tools	Issue B Tools	Issue A Tools	Issue D Tools

Table 0.2 – Manual Applicability

Tool Up-Issue Descriptions

ART-H

Issue F to Issue G

- P/N 116-00055 changed to 116-00144.
- P/N 116-00056 changed to 116-00145.

- Release piston is now fully fail-safe in the event of fluid leakage into the tool under all conditions of temperature, pressure, material and manufacturing tolerances.

Issue G to Issue H

- New board layout incorporated – 116-00421 and 116-00105.
- Motor is connectorised.
- Chassis plate changed to 116-00418 to accommodate new boards.

Issue H to Issue K

- Material update on Retaining Sub to 17/4PH; slot width in Retaining Sub reduced. Note: a reduced finger width Wedge is required to keep the fingers open on the 17/4 Retaining Subs because of the narrower grove. This is P/N 301-00041 Iss B.
- Pigtail added.
- Utilises Fishing Head Assembly (116-00086) issue E or above. (Spirol Pins (208-00056) added to retain Mushroom onto Release Piston).
- Utilises Electronics Assembly (116-00244) issue E or above. Issue E reverts to non-welded Motor Housing and Washers are added to electronic assembly.

ART-F

Issue A to Issue B

- New board layout incorporated – 116-00421 and 116-00105.
- Motor is connectorised.
- Chassis plate changed to 116-00418 to accommodate new boards.

- P/N 116-00055 changed to 116-00144.
- P/N 116-00056 changed to 116-00145.

- Release piston is now fully fail-safe in the event of fluid leakage into the tool under all conditions of temperature, pressure, material and manufacturing tolerances.

Panel Up-Issue Descriptions

ACP-A

Issue A to Issue B

- Front Panel PCB added – 116-00402

Issue B to Issue C

- IDC cable upgrade replaces wiring in this tool issue.

Issue D to Issue E

- New IEC Connector added

Issue E to Issue F

- Quick-Start instructions added

Manual Up-issue Descriptions

Issue G to Issue H Rev 0

- Reflects changes to ART-H issue G to issue H.
- Reflects changes to ART-F issue A to issue B.
- Reflects changes to ACP-A issue B to issue C.

- Electronic drawings and parts lists referring to the same part number now co-located.

- Recommended maintenance products table added (Table 7-1 – Recommended Maintenance Products).
- Recommended Torque Settings added (Table 5-1 – Service Torque Settings, Table 5-2 – Fastener Torque Settings).

- Expanded tool test instructions – section 4.1.

- ART-H - Fishing Head o'ring list (116-00247) reincorporated into main o'ring list (116-94003).
- ART-F - Fishing Head o'ring list (116-00269) reincorporated into main o'ring list (116-94011).

- Service types added to o'ring location drawings (see Figure 7-6, **Error! Reference source not found.**).

Issue H Rev 0 to Issue H Rev 1

- Minor text corrections.

Issue H Rev 1 to Issue H Rev 2

- Conversion to Guardian format.

Issue H Rev 2 to Issue K Rev 0

- Reflects changes to ART-H issue H to issue K.

Issue K Rev 0 to Issue K Rev 1

- Section 4.2 - Deployment in Mud added.
- Section 10.1 - Operational Trouble-Shooting added.

Issue K Rev 1 to Issue K Rev 2

- Additional Fishing information provided in section 4.4.
- Maximum recommended release load information improved – section 4.3.
- Maximum release load corrected in Table 3-1 - Mechanical Specifications (Downhole Tool).
- Minimum pressure for release added to Table 3-1 - Mechanical Specifications (Downhole Tool).
- Section number corrected for pre/post job maintenance in section 4.5.
- Lower Head gap measurement added to section 7.3.
- Item 19 added to Table 0.3.
- Quick-Start Release Instructions added – section 4.3.2.

Issue K Rev 2 to Issue K Rev 3

- Section **Error! Reference source not found. Error! Reference source not found.** updated to reflect removal of PAL.
- Figure 6-7 - Tool Address Switch Positions – Board 116-00421 updated.

Issue K Rev 3 to Issue K Rev 4

- Fishing Body elongation check added to TVC Maintenance (Section 7.5.1).

Issue K Rev 4 to Issue K Rev 5

- Surface tool current check added to Section 7.4 (7).
- Tool current trouble shooting added to section 10.2;
- Table 3-4 - Electronic Specifications (Downhole Tool) updated;
- ACP current meter check added to section 7.5.2;
- Supply voltage for ACP in section 2.5 corrected;

Issue K Rev 5 to Issue K Rev 6

- Supply voltage for ACP corrected in Figure 6-1 - System Block Diagram – 116-99403;
- Line voltage corrected in Figure 6-3 - Telemetry And Control Block Diagram - 116-40107;
- Line Isolation Board Schematic issue F added as **Error! Reference source not found.**;
- Line voltages correct, chapter 6;
- Drawings (Figure 7-1, Figure 7-2) added;
- Parity corrected in section **Error! Reference source not found.**;
- Text in sections 6.2.3 and 6.4.2 corrected;
- ART-D support added – Section 12;
- Section **Error! Reference source not found.** updated. Diode D2 changed to D12 and D13. Diode D1 changed to D6. 'exceeding' changed to 'up to';
- 116-00244 Electronics Assembly issue D information added.
- Section 8, ART-H Recommended Spares List up-issued to 116-93003-K, ART-F Recommended Spares List 116-93011 added, ART-J Recommended Spares List 116-93018 added;
- ART-J support added – Section 13;
- Head conversion kits added – Section **Error! Reference source not found.**.

Issue K Rev 6 to Issue K Rev 7

- Arm LED colour corrected, section 4.3.1, ART Operational Sequence.
- ART-T support added – Section **Error! Reference source not found.**.

Issue K Rev 7 to Issue K Rev 8

- Section 3.2, current (motor stall) corrected from <250mA to <160mA, ACP max current output corrected from 300mA to 160mA.
- Resistance checks in section 7.3 - Pre-Job/Post-Job Maintenance updated.

ART-H Use of Manual and Quality Assurance

Upon delivery please check the following items are included in the shipping box -

Item:	Qty:	Part No:	Description:	Reference:
1	1	116-95003	Assembly Drawing. ART-H	
2	1	116-97003	ART-H, Manual	
3	2	116-99003	General Assembly ART- HD	
4	1	210-00003	Ready Box Kit, ART-H	
5	1	213-00003	Grease Nipple Assembly, M6x1/4" UNF	
6	1	213-00004	Spanner, Box, 9/16 AF	
7	1	301-00007	Service Tool, Pressure Isolation	
8	1	301-00032	Removal Tool, ART-H Feedthru	
9	1	301-00033	Installation Tool, ART-H	
10	1	301-00038	Tommy Bar, 4mm	
11	1	301-00041	Wedge, Flaring Tool, ART-H	
12	1	301-00042	Locking Tool, ART-H	
13	1	301-00048	Flaring Tool, ART-H	
14	1	301-00050	Extraction Tool, Release Piston, ART-H	
15	1	301-00053	Pressure Adapter	
16	1	301-00099	Blanking Plug, Pressure Port	
17	1	301-00072	Drive Tool, ART	
18	1	116-99603	Test Certificate	
19	1	301-00707	Feeler Gauge, 0.03”	

Table 0.3 - Shipping List

ART-H Use of Manual and Quality Assurance

Errors and Omissions

Please photocopy this page and use it to notify the Technical Department at the address given below of any errors, omissions or suggestions in connection with this manual.

The Technical Department,
GUARDIAN GLOBAL TECHNOLOGIES LTD,
Merlin House, Brunel Court,
Village Farm Industrial Estate,
Pyle, Bridgend, Wales, CF33 6BL, UK.

Fax: +44 (0) 1656 742251
techsupport@ggtg.net

Document Name/Manual Part Number:	
Manual Version:	

Page # or Section:	Error, Omission or Suggestion

1 Safety

1.1 General Safety Precautions

Standard wireline/electric line safety precautions should be followed in maintenance, operation and use. When dismantling any downhole equipment, if a thread is unusually tight, suspect trapped pressure. Never stand in the 'firing line' of any piece of equipment being disassembled after it has been downhole.

- The thread-protectors supplied with the tool are not intended to be run in the well. For well operations use an appropriate bullnose.
- Ensure sufficient anti-static protection is available when working on the tool electronics. A grounded soldering iron should generally be used.
- Never connect the tool directly to the output of any surface interface panel or power supply - always use a Cable Simulator Unit. (301-00468 - monocable).
- Retention O'rings, if used within the tool, do not provide any pressure seal, but *should* be replaced each time the retained item is removed as minor damage caused to the o'ring may affect the effectiveness of retention. Use only 90 duro o'rings.
- Do not overtighten field or servicing connections. All tools are designed with self-locking pressure seals and joints should be tightened using normal open-ended or 'C' spanners. DO NOT hammer spanners to tighten connections.
- If difficulty is experienced when breaking tool connections after a run in the well, never hammer spanners to separate tools. If necessary use cheater bars with the toolstring well supported. **SUSPECT TRAPPED PRESSURE!**
- When cleaning the tool, ensure thread protectors with o'rings are fitted or fluid can enter the tool and damage the electronics.
- Tools should not be subjected to a temperature gradient greater than 10^{o}C per minute. Do not blow cold air on tools after heat testing but allow the tool to cool naturally with the oven door closed or just ajar. Do not run any tool into a low temperature (injection) well if it has been standing in a hot (desert) environment. Cool the tool gently with hot/warm water. Failure to do so will not only shorten the life of the tool but may caused seal failures due to differential rates of thermal expansion.

1.2 Tool Specific Precautions

- When spring loaded, the fishing grapple can contain substantial energy. Exercise care when assembling or disassembling this item. (See section 5.0)

- Early Retaining Subs were manufactured from Beryllium Copper, a material commonly found in the oilfield. In normal use the material is perfectly safe and presents no health hazard. However, under no circumstances should these Retaining Subs be filed, sanded, ground or undergo any other process which may result in dust or fine particles of the material being inhaled. If such a retaining sub is damaged beyond use it should be returned to GGT for proper disposal. Later Retaining subs were manufactured from high strength stainless steel.

- The telemetry system used in the ART has been specifically developed for reliability and safety. However, no warranty is provided by GGT as to the suitability of the ART for use with any specific item of equipment or system. Should the user require information concerning the compatibility between the ART and any other equipment please contact techsupport@ggtg.net.

- Do not remove the lower pressure housing without using the locking tool. See section 5.4.2 for details.

1.3 Operational Safety

- The ART is one of the very few tools which may be checked for insulation with a Megger meter operating at up to 1000vdc). Ensure no other tools are connected to the ART when performing this test.

- Do not connect the tool directly to the output of any surface interface panel or power supply - always use a Cable Simulator Unit. (301-00468 - monocable).

- All tools are supplied with a default downhole address of 1. **It is vital that no two tools set to the same address (see section** Error! Reference source not found.) **are deployed in a single tool string, as upon activation this may result in the tool string parting in an unexpected manner.** To avoid the possibility of running two tools set to the same address always follow the pre-job checks detailed in section 4.0.

- If running the ART-H between a downhole tractor and heavy perforating string in a highly deviated or horizontal well, it is recommended to place a shock absorber and/or perforating knuckle joint between the ART-H and perforating string to avoid placing the tool under severe side loading from the gun shock.

1.4 Safety and Reliability

The ART-H incorporates a number of safety features which enhance its reliability and operational safety.

- The tool can only be powered by a negative voltage of between 70Vdc and 120Vdc. It is therefore generally inactive during logging and tractor operations.

- A positive indication is provided to the logging engineer of which tools are present and active in the toolstring once the surface panel is connected.

- The release mechanism can only be activated by operating the tool in the correct sequence and by the tool receiving the correctly encoded digital signal.

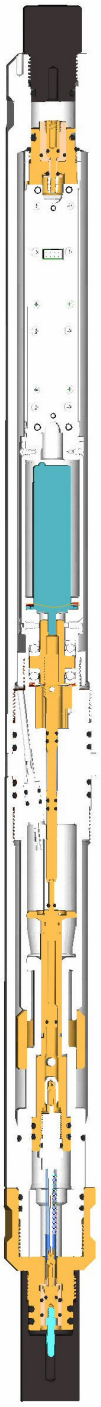
- The tool cannot be activated by a seal failure due to a locking mechanism which is operable only by the motor within the tool. If a seal failure occurs at sufficiently high pressure, the Release Piston will part at a specifically engineered weakpoint and the tool will not release. A new Release Piston will need to be fitted to the tool.

- The fingers of the fishing grapple have to be positively released by the mechanism within the tool and are otherwise retained by a sleeve until activation occurs.

- The tool requires a minimum well pressure to activate the release mechanism and cannot therefore be accidentally activated at surface.

All fasteners used in Guardian tools are stainless-steel (A2 or A4). To maintain the standard of performance of the equipment, only similar corrosion-resistant fasteners should be used as replacements. These can be ordered from Guardian.

2 Introduction



2.1 Description and Application

The ART-H is intended for use in horizontal and highly deviated wells in conjunction with downhole-tractor devices where the controllable release of all or part of a stuck tool-string is required. The tool can replace the cable weakpoint, thereby improving operational safety, or be used to release a specific section of a tool string below a tractor, such as a partially set plug or expanded gun string. The tool is specifically intended for use above a downhole tractor, but can also be deployed below. The tool can also be deployed with electric-line equipped coiled tubing.

The ART-H is designed to withstand the high voltages used to drive downhole tractors and is able to carry a maximum safe working load of three tonnes and a fishing load (post-release) of ten tonnes.

A number of fail-safe mechanisms are incorporated into the device to ensure safe and reliable operation. These include encoded data transmission and validation of user-selectable code, a minimum well pressure for activation and non-operation in the event of a seal failure. Up to seven ART's can be run in a single tool-string, including mixed -H, -A and -B types. Once released, a fishing neck remains to facilitate further recovery operations, with both upper and lower heads being pressure isolated to prevent entry of well fluids. Until released, the entire tool is pressure sealed, thereby minimising maintenance and service time.

The ART-H is available with interfaces to suit most tractor/logging tool combinations in use.

Applications -

- Release of stuck downhole tractors;
- Release of partially set plugs/packers;
- Release of damaged gun strings;
- Release of stuck logging tool.

Figure 2-1 - ART-H Cut-Away

2.2 Physics of Measurement

There are no specific sensors within the ART-H

2.3 Theory of Operation

2.3.1 Electronic Operation

The ART Control Panel, (ACP-A, P/N 116-99002) powers the ART with a negative voltage of 82Vdc. This energises the ART downhole electronics after a delay of approximately 5 seconds. If any voltage outside the range -40 to -140Vdc is applied to the tool the electronics remain isolated. The electronics are disconnected when the line voltage falls below 5Vdc for more than 5 seconds.

With the ACP Selection switch in the safety position, and powered on, the ACP transmits each of the possible seven tool addresses in turn. When interrogating a tool a RED LED is illuminated. Each ART present in the tool string echoes its address back to the ACP. The echoed addresses are received by the ACP and indicated on the front panel by a GREEN LED. This provides the engineer with a positive indication of which tools are available downhole. On Engineer selection of the tool to be released, the addressed tool LED flashes GREEN until tool selection handshaking takes place, after which the addressed tool light is a steady orange.

Actuation of the 'ARM' button sends a coded signal to the selected ART causing it to electronically arm itself. The tool then sends back a confirmation of its 'Armed' status which is indicated by the GREEN 'ARM' LED illuminating. The release button is then actuated causing the selected tool's address and release signal to be sent to the appropriate downhole tool. This command is received by the tool and echoed back to the ACP. Correct reception by both tool and ACP is indicated by the appropriate tool LED turning continuous RED, and the 'MOTOR RUN' LED illuminating. A flashing RED LED indicates a discrepancy between the command transmitted by the ACP and that echoed back from the tool. Once the RELEASE signal has been acknowledged, transmission stops and the downhole signal receiver is disabled to prevent motor current fluctuations being misinterpreted as signals. Further operation is monitored by observing the current meter. Operation of the release motor is indicated by a tool current between 60mA and 120mA dependant on well pressure and temperature.

Operation of the function switch after release causes all address LED's to flash. To reset the panel or to stop operation of the tool it is necessary to turn off the Panel Power.

Release of the tool is generally indicated by the current limit LED showing RED. This is due to the severing of the through-wire in the tool causing a momentary short-circuit.

For a detailed description of the telemetry, see Section 3.

For a full operational sequence, see Section 4.

For a detailed description of the electronic operation of the tool, see Section 6.

2.3.2 Mechanical Operation

Reference: Figure 2-1 - ART-H Cut-Away

On receiving the correct 'Release' instruction from the ACP, the downhole electronics activates the motor. Rotation of the motor turns a drive nut which in turn drives a leadscrew attached to a shuttle valve piston away from the motor (towards the bottom of the tool). Movement of the shuttle valve piston causes two things to occur. Firstly a locking piston is moved towards the bottom of the tool and secondly the shuttle valve is opened, allowing well pressure into a chamber within the tool. The locking piston is a safety feature which inhibits tool operation in the event of a seal failure. Once the locking piston has moved, the release piston is driven towards the bottom of the tool under the influence of well pressure. Movement of the release piston again has two effects. It withdraws a retaining sleeve which otherwise prevents the fingers of a fishing grapple from opening and causes a mushroom attached to the top section of the release piston to spread the fingers of the fishing grapple. Once the fingers of the grapple have been fully spread, the fishing head can be withdrawn from the grapple and the two halves of the tool separated. High pressure feedthrough's prevent the ingress of well fluid after separation.

2.4 Downhole Equipment

The downhole tool consists of upper and lower pressure housings with a double-ended Retaining sub and a lower-sub assembly. Upper and lower head fittings are standard 1 $^{3}/_{16}$" GO with uprated electrical connections. The upper pressure housing contains the electronics and motor assemblies. The lower housing contains the release mechanism. The Retaining sub houses the pressure valve used for tool operation.

The entire downhole assembly is pressure isolated prior to operation, thereby minimising maintenance and cleansing procedures.

2.5 Surface Equipment

The ART Control Panel supplies power to the ART tools and controls operation of all ART devices connected in the toolstring. It may be powered by an ac supply of either 110v or 220v The ACP is connected to the logging cable on surface only after a tool has become stuck and all other power supplies have been disconnected. BNC, UHF and 4mm connections are available for connection to the logging cable.

A recommended spares list and suggested ready box spares are given in Section 8.

3 Specifications

3.1 Mechanical

Make-up Length	27.75 in / 705 mm
Diameter	$2\,^{1}/_{8}$ in / 54 mm
Pressure (Proof.)	15,000 psi
Temperature (Max.)	177°C / 350°F
Weight in air	19 lbs / 8.6 kgs
Measure Point	N/A
Fishing Strength (Min.)	13,200 lbs / 6,000 kgs
Fishing Head	$1\,^{3}/_{16}$ in
Connections	$1^{3}/_{16}$ in GO Type A
Max. Working Load	6,600 lbs / 3,000 kgs
Max. Release Load	400 lbs / 180 kgs *
Min Pressure For Release:	500psi
Shipping Case (LxWxH)	37x17.5x6 in / 94x44.5x15.2 cm

Table 3-1 - Mechanical Specifications (Downhole Tool)

* Maximum recommended load. See Section 4.3.3 for further information.

Upper and lower head connections are available with either standard GO type A or reversed GO type A or client-specific connections. The tool is supplied as standard with GO type A (pin lower, box upper) connections.

Size (LxWxH)	10.7x9.7x7.0 in / 273x247x178 mm
Weight	7 lbs / 3.2 kgs
Sealing	IP65 (Case Closed)

Table 3-2 - Mechanical Specifications (Surface Panel)

3.1.1 Fishing Head

Once the upper section of the ART is removed from the well, a 1 $^{3}/_{16}$" fishing head remains.

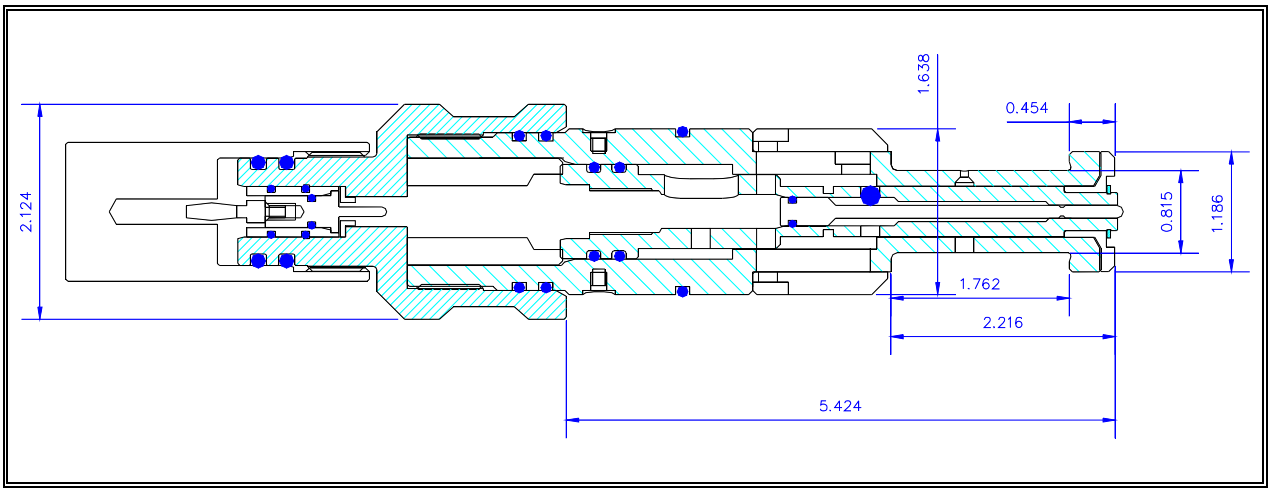


Figure 3-1 - Fishing Head – ART-H

3.2 Electronic

Current (Quiescent):	0mA
Current (Operating):	10-12mA
Current (Motor Running, No Pressure):	40-65mA, Typ. 55mA
Current (Motor Running, at pressure):	60-110mA, Typ. 70-80mA
Current (Motor Stalled):	<160mA Max
Operating Voltage:	-45 to –140Vdc (Nom. –82vdc)
Max. Applied Voltage:	1000vac / 1000vdc
Max. Pass Current:	10 A

Table 3-4 - Electronic Specifications (Downhole Tool)

Supply Voltage:	110 / 220 Vac
Supply Current:	<0.5A
Output Voltage:	-82Vdc Nom.
Max. Output Current:	160mA

Table 3-4 - Electronic Specifications (Surface Panel)

3.2.1 Telemetry Compatibility

The ART does not operate simultaneously with any other tool and therefore employs a stand-alone telemetry system for uphole data and downhole commands. This system has been specifically designed for safety and reliability. The telemetry will not interfere with, nor will it be interfered with by any other telemetry system known to GGT. For advice on deployment of the ART with specific equipment, particularly 'SAFE' perforating systems please contact Guardian Technology's Technical Department.

Each tool has a user selectable address which is used in communication with the surface ACP. The address is set in the tool by means of an internal four way DIP switch**.**

IT IS VITAL THAT NO TWO TOOLS SET TO THE SAME ADDRESS ARE DEPLOYED IN A SINGLE TOOL STRING.

All tools are supplied set to a default address of one. For further details on changing the tool address see section **Error! Reference source not found.**.

4 Operations

4.1 Pre-Job Maintenance and Tool Checks

A pre/post job maintenance check list is provided in Appendix A. It is recommended these checks are carried out before and after every trip in the well.

1. After performing the pre-job maintenance, connect each ART to be run in the toolstring in turn to the ACP via a dummy cable. Select 'Safety' on the ACP selector switch and power the ART. The ART's address will be indicated by a continuous green LED**. CHECK TO SEE THAT NO TWO TOOLS ARE SET TO THE SAME ADDRESS.** See section **Error! Reference source not found.** for details on changing the tool address.

2. Connect each tool in the position that it is to be run in the well, then connect the string to the surface equipment via a logging cable.

Note: The tool must never be connected directly to the output of a surface interface panel - always use a Cable Simulator Unit or real logging cable.

3. Power up the tool-string and run for 1 minute.

4. Disconnect the surface end of the logging cable from the surface equipment and connect to an ART Control Panel (ACP-A, 116-99002).

5. With the ACP selector switch set to safety, switch on the ACP. Check that the user addresses set in the tools connected in the toolstring are reflected in the ACP front panel LED's showing continuous green.

6. Select each ART in turn on the ACP selector switch and press the ARM button. Check to see that each ART arms correctly (see section 2.3.1). Note: it will be necessary to power down the ACP between each tool check to reset the ACP and ART(s).

7. Switch off and disconnect the ACP.

8. Perform normal logging operations

4.2 Deployment in Mud

If the ART is to be deployed in mud-based fluids or production fluids with a substantial particulates content, it is recommended that the two Filter Screens are removed from the Retaining Sub and the tool is disassembled and very thoroughly cleaned after the operation.

4.3 Tool Operation

Use of the ART to release a stuck toolstring should only be contemplated once all normal tool retrieval techniques have been exhausted.

While attempting to free the toolstring, also attempt to ascertain accurately the stuck point by use of cable tension, working or non-working tools or other appropriate techniques.

Prior to connecting the ACP to the upper end of the cable, attempt to confirm the electrical integrity of the cable by either use of an ohmmeter or by powering a tool(s) below the ART.

4.3.1 ART Operational Sequence

1. Disconnect all surface panels and power supplies from the logging cable. Connect the ACP to the cable using either the BNC, UHF or 4mm sockets.

2. Set ACP selector switch to 'Safety' position and switch on.

3. Check indication on ACP front panel LED's. These will initially sequence RED and after a short delay, will indicate which ART(s) are connected and responding to the panel by a continuous GREEN LED.

4. Slacken off the cable until there is zero tension at the tool head (see section 4.3.3).

5. Select the tool required to be released by means of the ACP selector switch.

6. The selected tool LED will flash GREEN for a short period whilst it is being addressed and will then turn steady ORANGE. At this point the 'ARM' button is enabled.

7. Press the GREEN 'ARM' button on the ACP. After a short delay the 'ARMED' LED will illuminate continuous GREEN indicating acceptance of the arm command.

At this stage it is possible to abort tool release by switching the selector switch back to safety.

8. To release the tool press the RED 'RELEASE' button. After a short delay the 'MOTOR RUN' LED will illuminate and the corresponding tool LED will light continuous RED with all other LED's light GREEN. The current meter will indicate the operating motor current (50< I <100mA).

9. While the motor is running (until the valve opens downhole) a release may be aborted by switching off the ACP. This will reset the downhole tool BUT WILL NOT REVERSE THE MOTOR TO PUT THE VALVE PISTON IN ITS ORIGINAL POSITION.

Indication that the tool has released may be given in a number of ways -

- Current limit LED lights (When released, the tool is likely to short circuit at the lower head).
- Current meter shows a kick.
- Tension on surface kicks.
- Tool can be retrieved from well.

It will be necessary to exert an overpull of a minimum of approximately 100lbs at the ART to free the upper section. This may translate to substantially more at surface in a highly deviated and doglegged well due to cable drag along the well's trajectory.

A total failure of cable insulation at the tool head will prevent operation of the ART. If cable insulation appears to have been lost, (no LED's light green with the ACP connected and powered in the 'Safety' position, and line current is more than 11mA) check line resistance using both polarities of an ohmmeter

4.3.2 Quick-Start ART Release Instructions

QUICK-START ART RELEASE INSTRUCTIONS

1. Disconnect all surface power supplies.
2. Confirm well pressure at ART depth is > 500 psi / 35 bar.
3. Slacken off cable so there is no tension at the cable head.
4. Connect the ACP (ART Panel) to the logging cable.
5. Set ACP rotary switch to 'Safety' and switch on ACP.
6. Confirm ACP current increases by ~11mA after 4-7 seconds.
7. Confirm ACP LED's cycle and appropriate LED's remain lit.
8. Select the tool to be released using the rotary switch.
9. Press the 'ARM' button. Confirm the ARM LED Lights.
10. Press the 'RELEASE' button. Confirm the current increases to between 60 and 150mA.
11. Monitor the current for sharp increase/decrease = Release.
12. Release takes 2-3 minutes. If current drops out < 3 mins, switch off ACP and repeat 5-11.
13. Pull out of hole. Up to 400lbs/200kgs overpull may be required.

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SEE MANUAL S.4.3.1 FOR FURTHER DETAILS

4.3.3 Maximum Recommended Release Load

It is recommended that during a release the cable be slackened off to ensure that there is no tension across the ART. The ART can be released with up to 400lbs/180kgs tension on the head without damage to the Fishing Body, Mushroom or Retaining Sub fingers. The tool will release with greater tension than this but damage may be caused to the above components.

4.4 Fishing Operations

Once the upper section of the ART has been removed from the well, there are no specific restrictions on fishing operations, except that the maximum fishing load should be limited to no more than 10 tonnes. The weakest point in the tool is the fishing neck immediately below the fishing body (Item 12 on Fishing Head Assembly – see Figure 5-25). After any fishing operation, the hole through which the Ball Bearing (3) is dropped (see Figure 4-1 – Fishing Body Stretch Measurement), should be measured axially. If this hole exceeds 6.2mm in the axial dimension, the Fishing Body (12) must be replaced.

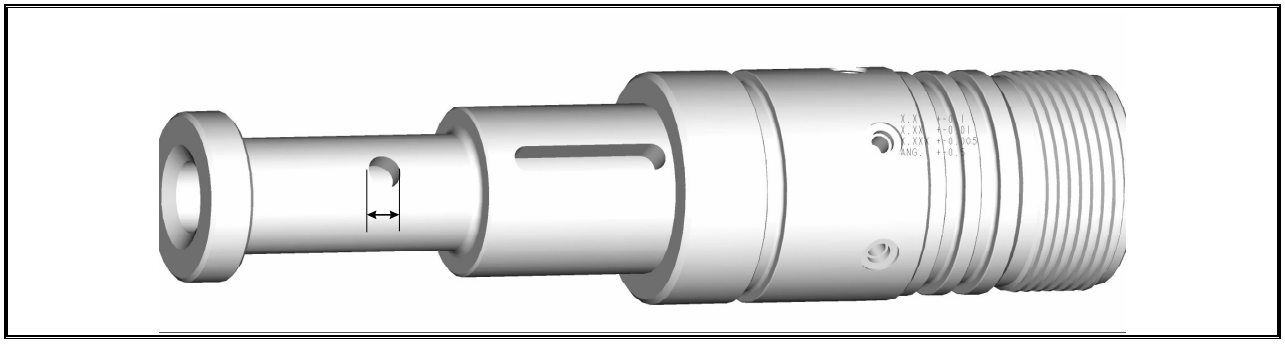

Figure 4-1 – Fishing Body Stretch Measurement

4.5 Post Job Checks

A pre/post job maintenance check list is provided in section 7.3. It is recommended that these checks are carried out before and after every trip in the well.

Perform the test routine as described in 4.1 above.

5 Mechanical Description

5.1 Detailed Mechanical Description

The ART-H consists of the following sub-systems -

- Fishing Head Assembly (designated assembly B)
- Retaining sub and fishing grapple;
- Motor assembly;
- Electronic Sub Assembly (designated assembly E)
- Pressure housings;

An alternative item no. with a prefix letter refers to that actual assembly and reference should be made to the relevant assembly drawing.

i.e E1,E2,E3.....etc. Assembly drawing # 116-50244
Ref: Figure 5-9 – Exploded Assembly Drawing, Electronics, ART-H/F – 116-00244-A (1/2)

B1,B2,B3.....etc. Assembly drawing # 116-50086
Ref: Figure 5-21 – Exploded Assembly Drawing, Fishing Head, ART-H – 116-50086-B

All other item numbers refer to the main ART-H Assembly drawing # 116-95003.
Ref: Figure 5-3 – Exploded Assembly Drawing, ART-H - 116-95003-F

5.1.1 Fishing Head Assembly

The Lower Head (B13) contains a pressure isolation bulkhead which prevents fluid ingress into the ART should a tool below develop a leak. It also houses a high-pressure glass-sealed Feedthrough Assembly (B5) which prevents fluid migration into the lower head once the device has released downhole. A piston (B4), Retaining Sleeve (B8) and Pin (B9) are mounted within the fishing body and move under the influence of well pressure, pushing a Mushroom (B2) against the inner surface of the fishing grapple (part of the Retaining Sub (5)) to open the grapple.

The lower pressure isolation bulkhead is made up as follows. The Lower Head Connector can be either a GO type A connector (B15) fitted with a 4mm male threaded banana pin (B17) or a GO type A reversed connector (B22) excluding the banana pin. The Lower Head Connector (B15 or B22) is insulated by the Lower Head Connector Insulator (B16) and Lower Head Inner Insulator (B14). The complete four part assembly is held in place by a locking 'O'ring which locates in a groove in the Lower Head (B13). The Lower Head Connector/Lower Head Connector Insulator/Banana Pin assembly may be removed as a single unit to facilitate changing of the pressure bulkhead o'rings. (On older tools this assembly may be retained by a circlip)

The Lower Head Connector (B15 or B22) is connected to the Feedthrough Assembly (B5) by a high current, low resistance contact to minimises line resistance and heating during tractor operations.

5.1.2 Retaining Sub and Fishing Grapple

The fishing grapple is integral with the Retaining Sub (5) which houses a shuttle valve mechanism allowing well pressure to operate the Release Piston (B4). The shuttle valve pressure ports are protected from well debris by Safety Screens (49) held in place by Drilled Plugs (50). A Valve Piston (6) is moved by means of a motor and leadscrew and whilst opening the shuttle valve, also moves the Locking Piston (B7). The locking piston prevents activation of the tool should a leak occur across the shuttle valve. A Lower Pressure Housing (12) is screwed onto the Retaining Sub (5) and is anti-rotated with respect to the Lower Head (B13) and Fishing Body (B12) by means of six off Modified M4 x 6 Socket Cap Head screws (B19).

5.1.3 Motor Assembly

A Motor (E7) drives a Leadscrew Nut (4) which in turn moves the Valve Piston (6) which has an integral leadscrew. The Leadscrew Nut (4) is located by a pair of thrust bearings (41). The Motor (E7) is mounted in a Motor Housing (E2) and is secured by the Bearing Housing (3). A pair of wave Spring Washers (E17 & 43) locate the Motor (E7). The Motor (E7) drives the Leadscrew Nut (4) via a key (E8).

5.1.4 Electronic Sub Assembly

The Electronics Chassis Assembly (E9) is secured to the Lower Chassis Mount (E3) at the lower end by two 2mm x 10mm E2 spirol pins (E20) and to the Pressure Isolation Head (E15) by two M3 x 6mm A2 socket cap grub screws (E22). The Lower Chassis Mount (E3) is located within the upper end of the Motor Housing (E2) by four off M3 x 6mm A2 csk head screws (E24).

The upper pressure bulkhead is made up as follows. The Pressure Isolation Head Connector can be either a GO type A connector (E13) or a GO type A reversed connector (E16) fitted with a 4mm male threaded banana pin (E21). The Pressure Isolation Head Connector (E13) or (E16) together with the Pressure Isolation Head Insulator (E14) are mounted in a counter-bore in the upper end of the Pressure Isolation Head (E15). A Pressure Isolation Head Inner Insulator (E23) is inserted into the lower end of the head and the assembly held together by a Contact Assembly (E18) (comprising an M3 x 25mm Brass screw with two Pig-Tails connected to the screw by an brass M3 full nut) and a spring washer (E19).

Printed circuit boards are secured to either side of the chassis (see figure 5.4, Chassis Assembly Drawing. 116-50111). The Chassis Tube (E1) slides over the chassis, electronics and upper pressure bulkhead. It is prevented from rotating relative to the Lower Chassis Mount (E3) by two machined lugs on the chassis. At the upper end, the Chassis Tube (E1) is prevented from rotating relative to the pressure bulkhead by the Chassis Tube Anti-Rotation Collar (E11). The Chassis Tube/Chassis/Anti-Rotation assembly is held in place and slight tension exerted on the Electronics Chassis by the Chassis Tube Retaining Ring (E10). Tightening of this ring holds the chassis assembly firmly and enables the

entire assembly to be inserted into the Upper Housing (1) and rotated to mate the Housing (1) and Retaining Sub (5).

5.2 ART Service Tools

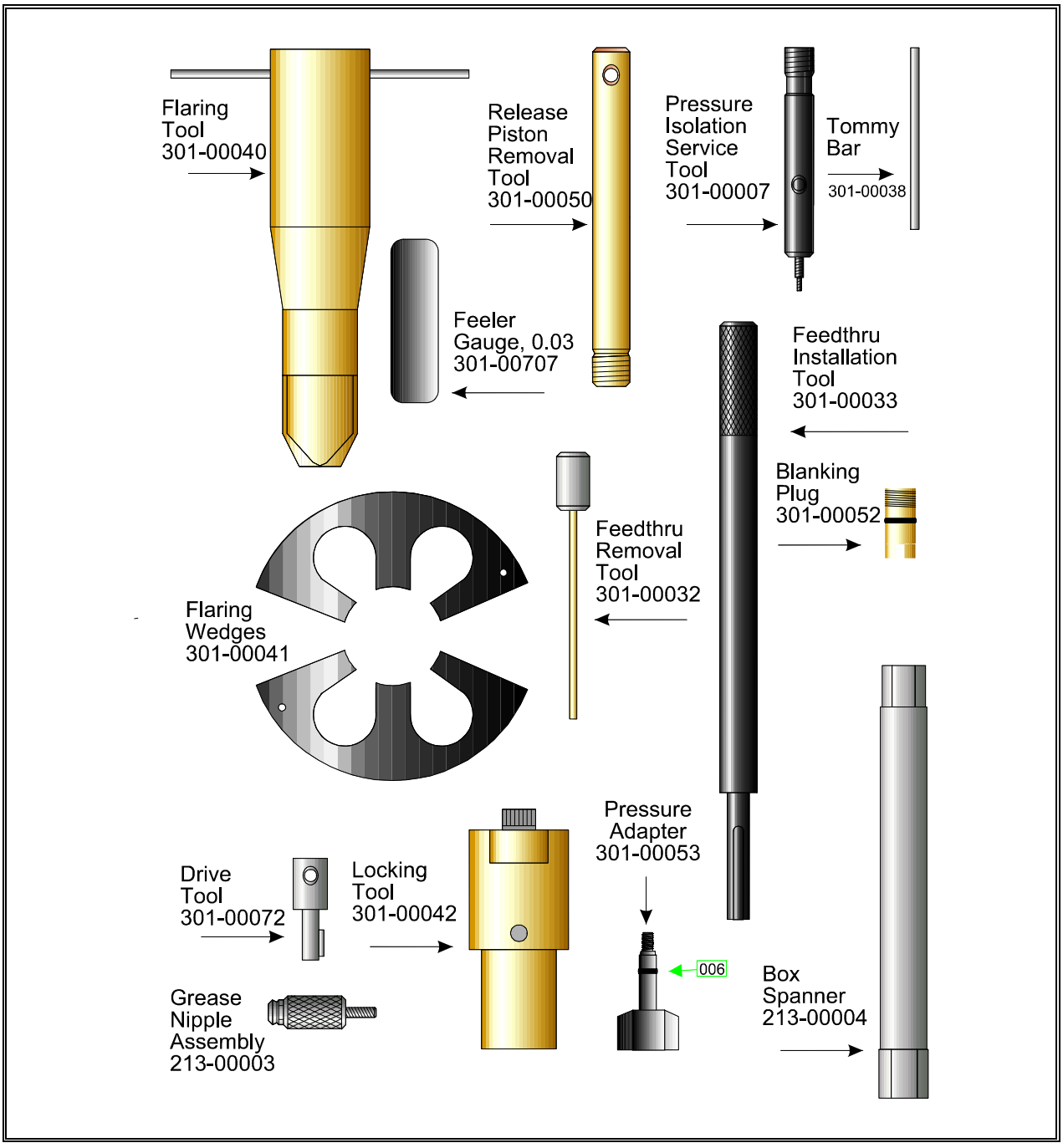

Figure 5-1 - ART-H/F Service Tools

5.3 Tool Disassembly and Assembly

Equipment Required:

- Standard Hand Tools;
- 45mm Spanner;
- Replacement spirol pins and fasteners as required;
- Pressure Isolation Service Tool (301-00007);
- Box Spanner, 9/16" (213-00004);
- Feedthrough Removal Tool (301-00032);
- Feedthrough Insertion Tool (301-00033);
- Flaring Tool (301-00048);
- Wedge Flaring Tool (301-00041);
- Locking Tool (301-00042);
- Release Piston Removal Tool (301-00050);
- Vernier or Digital Calliper/Micrometer;
- C-spanner for 2 $^{1}/_{8}$" housing;
- Grease Nipple Assembly (213-00003);
- Silicone grease/Grease Gun (302-00002);
- Liquid O'ring 101 Grease (302-00030);
- Loctite 242;

5.3.1 Replacement Of Lower Pressure Bulkhead O'rings

1. If the Lower Head Connector is fitted with a 4mm banana pin, grip the pin on the hexagon and carefully pull the Connector (B15) and Lower Head Insulator (B16) from the Lower Head (If a GO reversed Connector (B22) is fitted, insert the PI Service Tool into the threaded socket). The Lower Head Connector Insulator (B16) will be removed with the Connector. Push the Lower Head Connector out of the insulator to reveal the connector o'ring.

2. Remove the connector and insulator o'rings and discard (Note: The inner o'ring on the Lower Head Insulator is for retaining purposes and does not require routine replacement). DO NOT use a sharp instrument or knife for this purpose. If necessary, a soft metallic instrument may be used to assist removal of the o'ring on the connector, but the o'ring on the PEEK insulator MUST be removed by hand to avoid damage to the sealing surfaces. Install new o'rings on the connector and insulator by sliding them over the chamfered end of the components. Use of the O'ring Installation Tool (301-00008) greatly facilitates this procedure.

If the socket contact pulls away from the inner pin of the Lower Head Connector and cannot be retrieved, it will be necessary to remove the lower head to retrieve the contact. See section 5.3.2.

3. Assembly is a reversal of the above procedures. Lubricate o'rings in the pressure bulkheads during reassembly.

5.3.2 Removal Of Lower Head/Pressure Housing

4. Follow items 1 to 3 above.

5. Unscrew the Lower Head (B13) from the Lower Pressure Housing (12). Remove the Spacer (B11).

6. Remove the six off M4x6 screws (B22) at the lower end of the Lower Pressure Housing (12). Install the Locking Tool in the end of the fishing body. Using an adjustable spanner to hold the locking tool, unscrew the lower housing from the Retaining Sub (5) ensuring that the fishing body is prevented from rotating with the pressure housing. (If the fishing body rotates, the through-wire will be damaged). Withdraw the housing over the Fishing Body (B12). If the lower end of the Fishing Body rotates with the Pressure Housing, use a strap wrench around the Fishing Body.

5.3.3 Removal Of Upper Pressure Housing/Chassis Tube

7. Using a C-spanner and 45mm open-ended spanner, unscrew the Upper Pressure Housing (1) from the Retaining Sub (5).

8. Back-off and remove the knurled, bronze-coloured Chassis Tube Retaining Ring (A10). Lift off the bronze-coloured Chassis Tube Anti-Rotation Collar (E11). Slide the Chassis Tube (E1) over the upper Pressure Isolation Head and remove. Access is now available to both electronics circuit boards. Support the tool carefully, as without the Chassis Tube in place, the chassis may be flexed.

5.3.4 Replacement Of Upper Pressure Bulkhead O'rings

9. Remove the two M3 Grubscrews (E22) holding the Pressure Isolation Head (E15) to the electronics chassis. Carefully separate the head and chassis. Unscrew the contact assembly (E18) to separate the pigtails from the head. Use the PI service tool screwed into the connector to remove the Insulator from the head. Retain the Pressure Isolation Head Inner Insulator (E23).

* Some versions of the tool are fitted with M3 studding and a nut.

10. Remove the connector and insulator o'rings and discard. DO NOT use a sharp instrument or knife for this purpose. If necessary, a soft metallic instrument may be used to assist removal of the o'ring on the connector, but the o'ring on the peek insulator MUST be removed by hand to avoid damage to the sealing surfaces. Install new o'rings on the connector and insulator by sliding them over the chamfered end of the components. Use of the Guardian O'ring Installation Tool (301-00008) greatly facilitates this procedure.

11. Assembly is a reversal of the above procedures. Lubricate o'rings in the pressure bulkheads during reassembly.

5.3.5 Removal Of Motor Assembly/Shuttle Valve

12. Remove the four off M3 screws (E24) holding the Lower Chassis Mount (E3) to the Motor Housing (E2). Holding the Motor Housing (E2) unscrew the Motor/Bearing Housing assembly (E2, 3) from the Retaining Sub (5). Gently pull the motor and bearing housing directly away from the main section of the tool. The Valve Piston (6) and Lead Screw Nut (4) may remain in the Retaining Sub (5). Pull the Lead Screw Nut (4), Valve Piston (6) and remaining Bearing (41) straight out of the Retaining Sub (5). Unscrew the Valve Piston (6) from the Leadscrew Nut (4) and remove the Bearing (41).

13. Remove the four off M4 Screws (39) securing the Motor Housing (E2) to the Bearing Housing (3). Separate the two housings. Unsolder the Motor (E7) connections from the PCB and remove the motor (E7) and Wave Spring (E17) from the Motor Housing (E2).

5.3.6 Removal Of Fishing Head/Grapple

14. Using the $^{9}/_{16}$" box spanner, remove the lower Feedthrough Assembly (B6) visible at the lower end of the Fishing Body (11).

15. Identify the through-wire connection to the intermediate Feedthrough Assembly (44) which is visible through the slot in the Fishing Body (B12) and is connected to the through-wire. Remove this connection by pulling gently on the through-wire.

16. Remove one of the two Circlips (B10) from the Retaining Sleeve Pin (B9) and push the pin from the Retaining Sleeve (B8). **These circlips are single use only and should be not be reused**.

17. Pull the Retaining Sleeve (B8) away from the fishing grapple of the Retaining Sub (5). Using a suitable drift or small bladed screwdriver inserted through the fingers of the fishing grapple, push the Locking Piston (B7) approximately $^{1}/_{2}$" into the end of the Release Piston (B4) to release the locking ball (B3). The Locking Piston may drop out of the bottom of the Fishing Body at this point.

18. Insert the Release Piston Removal Tool up through the Fishing Body and screw into the Release Piston. Carefully pull the Removal Tool out of the Fishing Body, thereby closing the Mushroom (B2) to the top of the fishing head and flaring the fishing grapple fingers. Pull the entire Fishing Body (B12) out of the fishing grapple and remove the Release Piston Removal Tool. Remove the Retaining Sleeve (B8) from the Fishing Body (B12).

5.3.7 Replacement of Release Piston/Feedthrough O'rings

19. Remove the Circlip (B1) from the upper end of the Release Piston (B4) and pull away the Mushroom (B2). **This circlip is single use only and should be not be reused**. The Release Piston (B4) can then be pushed out of the Fishing Body (B12) together with the Locking Piston (B7).

20. Push the Locking Piston (B7) completely out of the Release Piston (B4) ensuring the Ball Bearing (B3) is retained for replacement. The o'rings on the Release Piston, Lower Feedthrough and Locking Piston can now be replaced.

Note. The o'ring on the Locking Piston is only to keep the piston in place; it does not act as a pressure seal and therefore does not require replacement unless physically damaged.

21. Remove the Chassis Tube (E1) from the electronics to reveal the through-wire connection (insulated with yellow silicone sleeving). Remove the heat-shrink sleeving and slide the silicone sleeving off the connection. Unsolder the connection.

22. Attach a temporary wire to the through-wire which enters the motor housing and pull the through-wire out of the slot in the Motor Housing (E2). (The temporary wire facilitates reinsertion of the through-wire into the Motor Housing).

23. Using the Feedthrough Removal Tool inserted into the hole at the top of the Retaining Sub through which the through-wire runs, push the Intermediate Feedthrough Assembly (B6) out of the Retaining Sub (5) and pull the temporary wire through the Retaining Sub. Disconnect the temporary wire. The o'rings on the Feedthrough Assembly (B6) can now be replaced.

5.4 Tool Reassembly

During reassembly all o'rings and threads should be lubricated with Liquid O'ring 101 or equivalent. Under no circumstances should silicone grease be used to lubricate threads. Prior to assembly, all parts should be thoroughly degreased, cleaned and dried

During reassembly the torque settings shown below should be adhered to.

Description:	Mating Items:	Torque:
Chassis Tube Retaining Ring	E10 to E15	Hand-tight
Pressure Housings to Retaining Sub	1 & 12 to 5	30lbsft / 40 Nm
Lower Head to Fishing Head	B12 to B13	30lbsft / 40 Nm

Table 5-1 – Service Torque Settings

Thread size (mm)	Nut torque (inlb)	Screw torque (inlb)	Grubscrew torque (inlb)
M2			
M2.5			
M3	20	20	
M4	30	30	20
M5	50	50	30
M6	60	60	50
M8			60
M10			

Table 5-2 – Fastener Torque Settings

5.4.1 Retaining Sub and Motor Assembly

1. Assemble the four o'rings onto the Retaining Sub and wrap threads/o'rings with insulating tape to protect from damage.

2. Insert the Flaring Tool into the fishing grapple and insert the two Flaring Wedges to hold the fishing grapple fingers in a flared position. Remove the Flaring Tool.

3. Install o'rings onto Feedthrough Assembly (B6) and reattach the through-wire to the temporary feeder wire. Pull the temporary wire back through the Retaining Sub (5). Gently pull the through-wire once it protrudes from the outer face of the Retaining Sub (5) until the feedthrough begins to seat in its counter-bore. Using the Feedthrough Installation Tool, and maintaining slight tension on the through-wire, very carefully push the feedthrough into the counter-bore until it seats firmly. Be sure to push only in the direction of the axis of the counter-bore.

4. Grease one Bearing (41) and assemble onto the threaded end of the Drive Nut (4). Install the Wave Spring (43) into the counter bore in the upper end of the Retaining Sub (5).

5. Assemble the o'rings and Anti-Rotation Pin (7) onto the Valve Piston (6) and screw the Valve Piston (6) lightly into the Drive Nut (4). Install a Grease Nipple Assembly into either Retaining Sub pressure port and pump in silicone grease until it is seen issuing from the top and bottom of the Retaining Sub through-hole.

6. Insert the Drive Nut/Valve Piston assembly into the upper end of the Retaining Sub (5).

7. Assembly the second Bearing (41) onto the slotted end of the Drive Nut (4). Ensure that the four off Anti-Rotation Pins (17) do not protrude more than 1/16" from the Bearing Housing (3).

8. Screw the Bearing Housing (3) down onto the Retaining Sub (5) and tighten to a torque of 10 ftlbs

9. Using the Drive Tool (P/N 301-00072), rotate the Drive Nut (4) until the groove in the Valve Piston (6) is aligned with the start of the slots in the Retaining Sub (5).

10. Hold the Retaining Sub vertically with the fishing grapple downwards. Assemble the Motor (E7) to the Bearing Housing (3) by aligning the Anti-Rotation Pins (17) with the holes in the motor flange. Place the second Wave Spring (E17) over the Motor and lower the Motor Housing (E2) over the assembly, taking care that the motor wire passes through the notch in the Motor Housing's internal flange. Align the holes in the Motor Housing (E2) with those in the Bearing Housing (3). Insert and tighten the four off M4 x 8mm Screws (39).

5.4.2 Chassis and Pressure Isolation Head

11. Install the Lower Chassis Mount (E3) (with the Chassis (E9) attached) into the Motor Housing (E7) and secure with four off M3 x 6mm Screws (E24). If the Chassis (E9) has been removed from the Lower Chassis Mount (E3), reinstall using two off new 2mm Spirol Pins (208-00044) before installing the Chassis Mount (E3) into the Motor Housing (E2).

12. Assemble the o'ring onto the Pressure Isolation Head Connector (E13 or E16) and lubricate. If GO type A reversed connector (E16) is fitted install 4mm Banana Pin (E17).

13. Assemble the o'ring onto the Pressure Isolation Head Connector Insulator (E14) and slide the insulator (E14) over the Connector (E13 or E16). Lubricate the outer surface of the insulator and insert this assembly into the Pressure Isolation Head (E15). Assemble the PI Head Inner Insulator (E23) from the reverse side of the PI Head (E15). Insert the contact assembly (E18) with spring washer (E19) and tighten the Connector onto the contact assembly.

14. Slide a 12mm length of high-temperature heatshrink sleeving over both pigtails until it contacts the PI Head Inner Insulator (E23). Shrink the sleeving into place.

IMPORTANT - DO NOT use Loctite or any other compound on this connection.

15. Attach the assembled PI Head (E15) to the upper end of the Chassis Assembly (E9) by means of two off M3 x 6mm grub screws (E22). Pull the temporary feeder wire back through the slot in the motor housing until the end of the through-wire is adjacent to the end of the contact assembly (E18).

16. Reconnect the through-wire to the pigtail using high-temperature solder. Insulate with silicone sleeving and high-temperature heat-shrink sleeving.

17. Slide the Chassis Tube (E1) over the electronics assembly, aligning it with the two lugs on the lower end of the Chassis (E9). Assemble the Anti-Rotation Collar (E11) and tighten the Retaining Ring (E10) hand tight.

18. Assemble the PI Head o'ring onto the PI Head (E15), grease, and screw the Retaining Sub (5) into the Upper Pressure Housing (1).

5.4.3 Fishing Body/Release Piston

18. Install the o'rings onto the Release Piston (B4), Locking Piston (B7) and Feedthrough Assembly (B5).

19. Push the Release Piston (B4) into the Fishing Body (B12), aligning the slots in the two components. Drop the Ball Bearing (B3) into the upper hole in the Fishing Body ensuring it locates in the internal locating point.

20. Insert the Locking Piston (B7) into the Release Piston (B4), ensuring the Ball Bearing stays in place. Push the Locking Piston (B7) fully home.

21. Place the Mushroom (B2) over the end of the Release Piston (B4) and install the $^{3}/_{8}$" external circlip (B1). Install the o'ring in the groove in the Locking Piston shaft, just visible above the Mushroom. Install the upper o'ring onto the Fishing Body (B12) and slide the Retaining Sleeve (B8) over the upper end of the Fishing Body (B12).

22. Support both upper and lower sections of the tool on Vee-blocks with their corresponding ends together. Feed the socketed end of the wire from Feedthrough Assembly (B6) through the Retaining Sleeve (B8). Feed the through-wire into the stepped cut-out on the Fishing Body (B12) and slide the Retaining Sleeve down onto the shoulder of the Fishing Body (B12).

23. Insert the fishing head into the fishing grapple until the fishing head is aligned with the internal groove in the grapple fingers. Remove the Flaring Wedges and check that the fishing head is correctly engaged in the fishing grapple.

24. Slide the Retaining Sleeve (B8) over the dogs of the fishing grapple, aligning the through-hole with the slots in the Fishing Body (B12).

25. Install one $^{3}/_{16}$" circlip (B10) onto the Retaining Pin (B9) and insert the Pin (B9) through the Retaining Sleeve (B8) and Fishing Body (B12). Install the second circlip.

26. Through the aligned slot in the Release Piston (B4) and Fishing Body (B12) insert the socket contact from the through-wire which connects to the pin contact of Feedthrough Assembly (B5).

27. Ensure that the o'ring installed on the Fishing Body (B12) is well greased and grease the corresponding sealing surface on the inside of the lower end of the Lower Pressure Housing (12). Install the Locking Tool in the lower end of the Fishing Body.

28. Slide the Lower Housing (12) over the Fishing Body. Hold the Retaining Sub with a suitable C-spanner and with a second person holding the Locking Tool with an adjustable spanner, make up the Pressure Housing (12) to the Retaining Sub (5). Align the slots in the lower end of the Lower

Pressure Housing (12) with the holes in the Fishing Body (B12) and install six off M4 x 6mm socket cap head screws (B19).

29. Screw the Feedthrough Assembly (B5) into the Release Piston (B4) using the $^{9}/_{16}$" box spanner supplied (213-00004) to a torque of 25 inlbs.

30. Install the two lower o'rings onto the Fishing Body (B12). Feed the lower end of the through-wire from Feedthrough Assembly (B5) through the Spacer (B11) and insert the Spacer (B11) into the Fishing Body (B12). Feed the through-wire into the Lower Head (B13) and assemble Lower Head (B13) to Fishing Body (B12).

31. Install o'rings onto the Lower Head Connector (B15 or B22) and Lower Head Connector Insulator (B16).

32. Install the 4mm Banana Pin (B17) in the Lower Head Connector (B15) if applicable. Slide the Insulator (B16) over the Connector (B15 or B22).

IMPORTANT - DO NOT use Loctite or any other compound on the connection to the Banana Pin.

33. Slide the Lower Head Inner Insulator (B14) over the smooth pin of the Lower Head Connector. Push entire connector assembly into the Lower Head (B13) until the inner insulator (B14) seats in position and the inner 'o'ring locks in the groove. The connector end pin should engage in the socket contact of the Feedthrough Assembly (B5).

34. Install the o'rings onto the Lower Head (B13) and install thread protectors at both ends.

35. Insert the Grease Nipple Adapter (213-00003) and Grease Nipple (213-00002) into either of the Retaining Sub pressure ports. Pump in silicone grease until it is seen issuing from the second pressure port. Install a Safety Screen (49) (flat side outwards) and Drilled Plug (50) in each of the ports and tighten.

5.4.4 Functional Release Test

It is only recommended this test be performed after the tool has been released in the well. It is not necessary at any other time.

DANGER - On performing this test the lower head may be released from the tool body with considerable force. The tool MUST be placed in a suitable tubular shield, plugged at both ends to prevent damage and/or injury. IF IN DOUBT CONCERNING THE SAFE EXECUTION OF THIS TEST, IT SHOULD NOT BE PERFORMED.

The release test may be carried out by use of the Pressure Adapter (301-00051) and Pressure Port Blanking Plug (301-00052).

The pressure adapter (301-00051) should be screwed into the Retaining Sub only hand tight or the adapter may shear. The spanner flats are to hold the adapter whilst tightening the 1/8 NPT connector.

Prior to performing this test ensure that the Lower Head Connector is removed from the Lower Head and that the through-wire connection from the intermediate Feedthrough Assembly removed from the Release Piston and placed inside the Retaining Sub fingers.

Remove the Filter Screen as described in part 14 of section 5.2.1.

Install the Pressure Port Blanking Plug in one Retaining Sub pressure port and the Pressure Adapter in the other.

Attach a suitable hydraulic pump to the Pressure Adapter install the tool into a suitable safety shield.

Pump the pressure up to between 30 and 50 bar.

Connect an ACP to the ART and perform a release sequence.

The motor will be heard to run for approximately 2 minutes before the valve opens. At this point the pressure will drop to zero.

Continue to pump until the release mechanism is heard to release. This should occur at approximately 20 bar.

Perform a full strip and rebuild of the lower section of the tool.

5.4.5 Redress Post-Release

Once the tool has been recovered from the well, it should be stripped down and thoroughly cleaned. During strip down an examination should be made for any signs of fluid ingress to the upper pressure housing or lower head. If present, the source of the leak should be investigated.

All o'rings should be replaced.

An examination should be made of the internal surfaces of the fishing grapple and the external surfaces of the fishing head. If there is evidence of burring (indicative of release under a high load) then the items should be replaced.

The intermediate Feedthrough Assembly will require replacement as it will have been severed at the point of entry to the Release Piston.

Check for deformation of the lower end of the lower Feedthrough Assembly or the pin of the Lower Head Connector. If either are deformed they should be replaced. No attempt should be made to straighten either as this may affect performance of the equipment.

It is advisable to perform a full pressure and pull test after a downhole release.

5.5 Mechanical Drawings And Parts Lists

5.5.1 General Assembly

The General Assembly schematic and exploded assembly drawings are shown on the following pages.

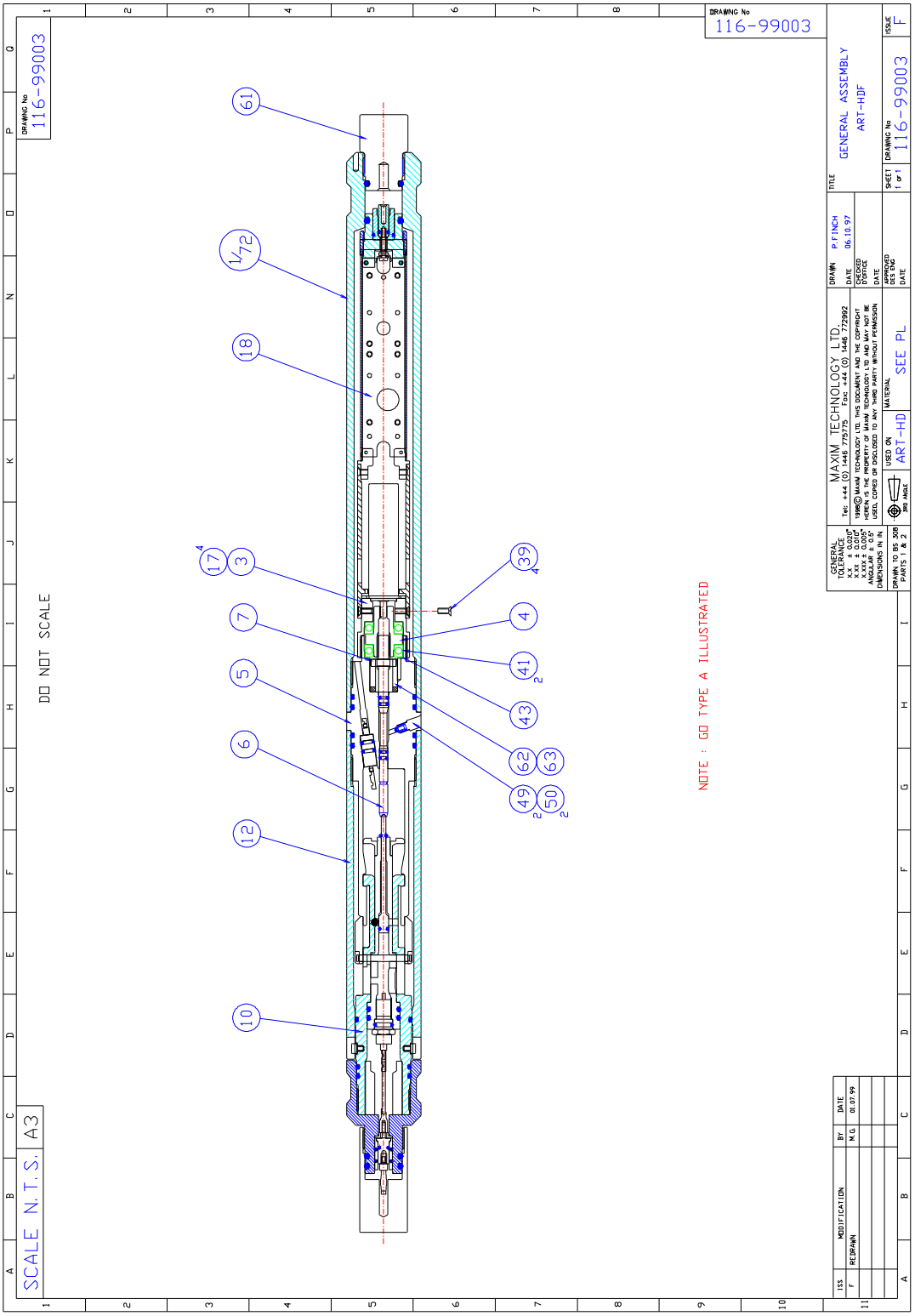

Figure 5-2 - General Assembly Drawing, ART-H - 116-99003-F

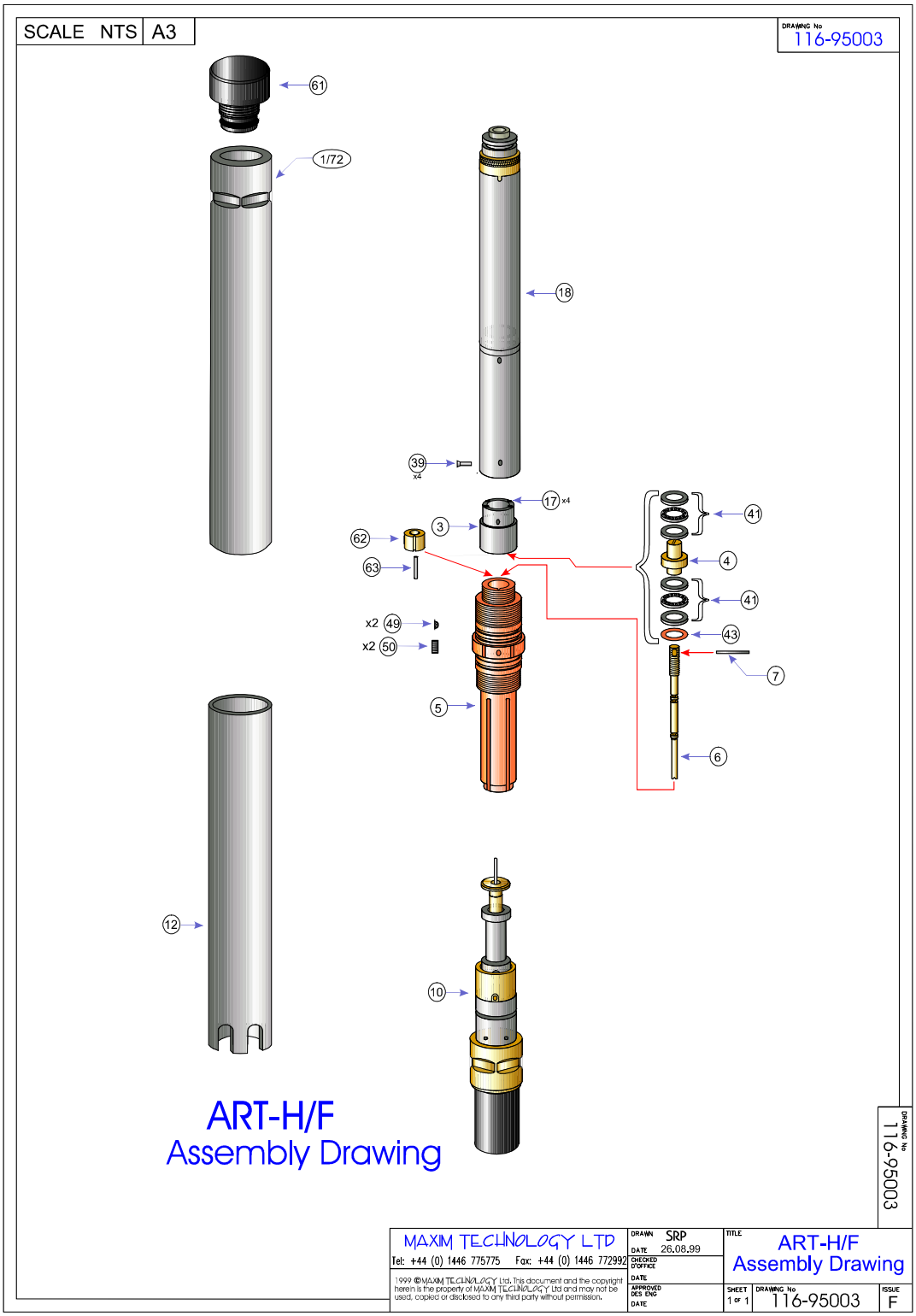

Figure 5-3 – Exploded Assembly Drawing, ART-H - 116-95003-F

5.5.1.1 Parts List, ART-H, 116-99003-F

Item:	Qty:	Part No:	Description:	Reference:
1	1	116-00050	Upper Housing, ART-H, 17/4	
3	1	116-00052	Bearing Housing, ART-H	
4	1	116-00053	Drive Nut, ART-H	
5	1	116-00054	Retaining Sub, ART-H	
6	1	116-00055	Valve Piston, ART-H	
7	1	116-00056	A/R Pin, ART-H	
10	1	116-00086	Fishing Head Ass'y, ART-H	
12	1	116-00061	Lower Housing, ART-H	
17	4	116-00066	A/R Pin, Motor ART-H	
18	1	116-00244	Electronic Sub-Assy, ART-H	
39	4	208-00130	Screw, Csk Skt Hd, M4 x 8mm, S/S	
41	2	212-00002	Thrust Bearing, 28mm OD, 15mm Bore	
43	1	203-00004	Wave Spring, SSB-0110-S17,BRG OD28mm	
49	2	213-00001	Filter Screen, Flange Mounted	
50	2	116-00113	Retaining Plug, 6mm	
56	1	116-94003	O'Ring Build Set, ART-HF	
61	1	201-00022	Thread Protector, Male, 1 3/16" GO	
62	1	116-00082	Insert, Slotted, ART HD	
63	1	116-00121	A/R Pin, Slotted Insert, ART	
69	1	116-91003	B.R.S., ART-H	
70	1	116-92003	A.T.I., ART-H	
71	1	116-95003	Assembly Drawing. ART-H	
72	0	116-00091	Upper Housing, ART-H, K500	

Table 5-3 – Parts List, ART-H – 116-99003-F

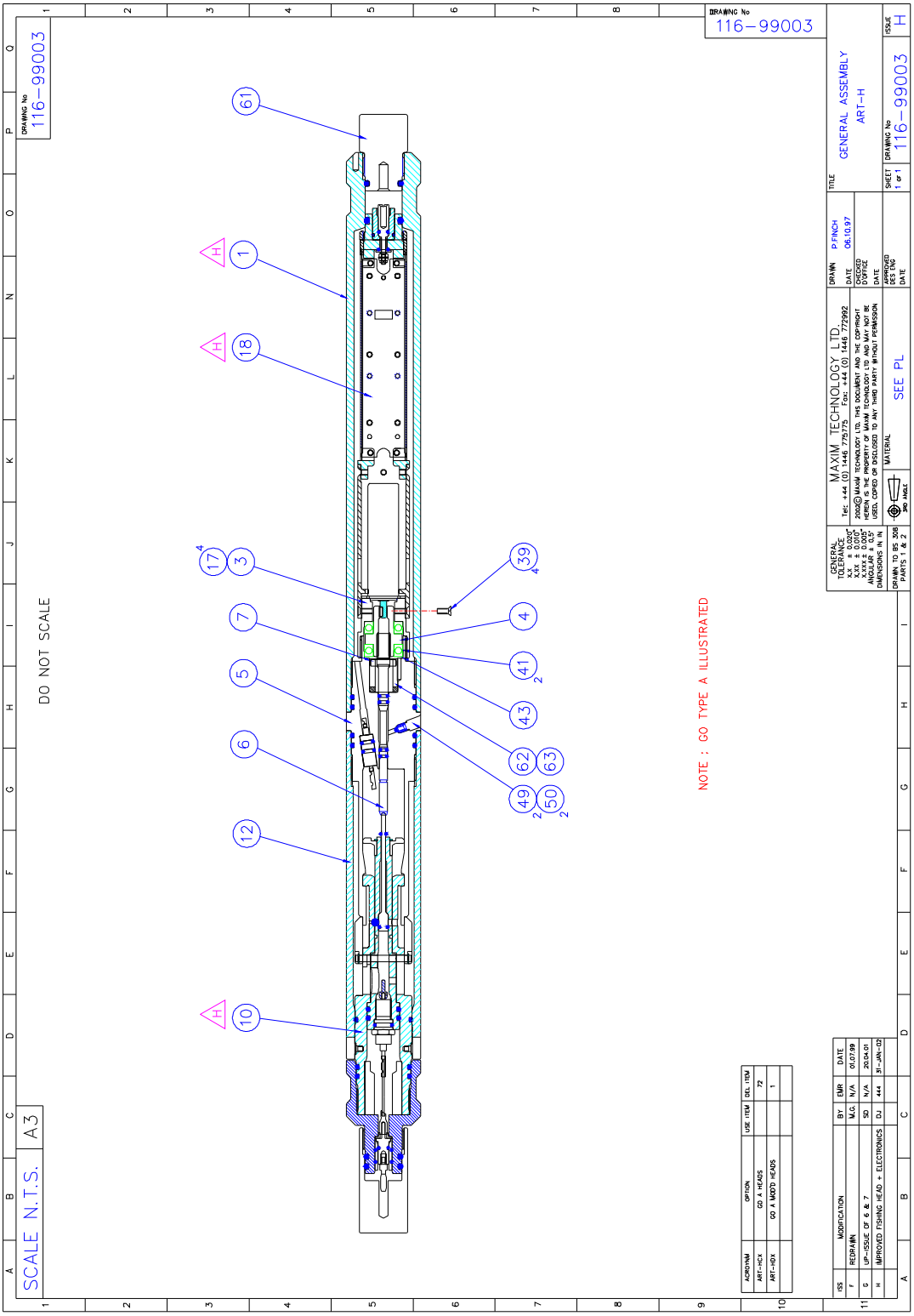

Figure 5-4 - General Assembly Drawing, ART-H - 116-99003-H

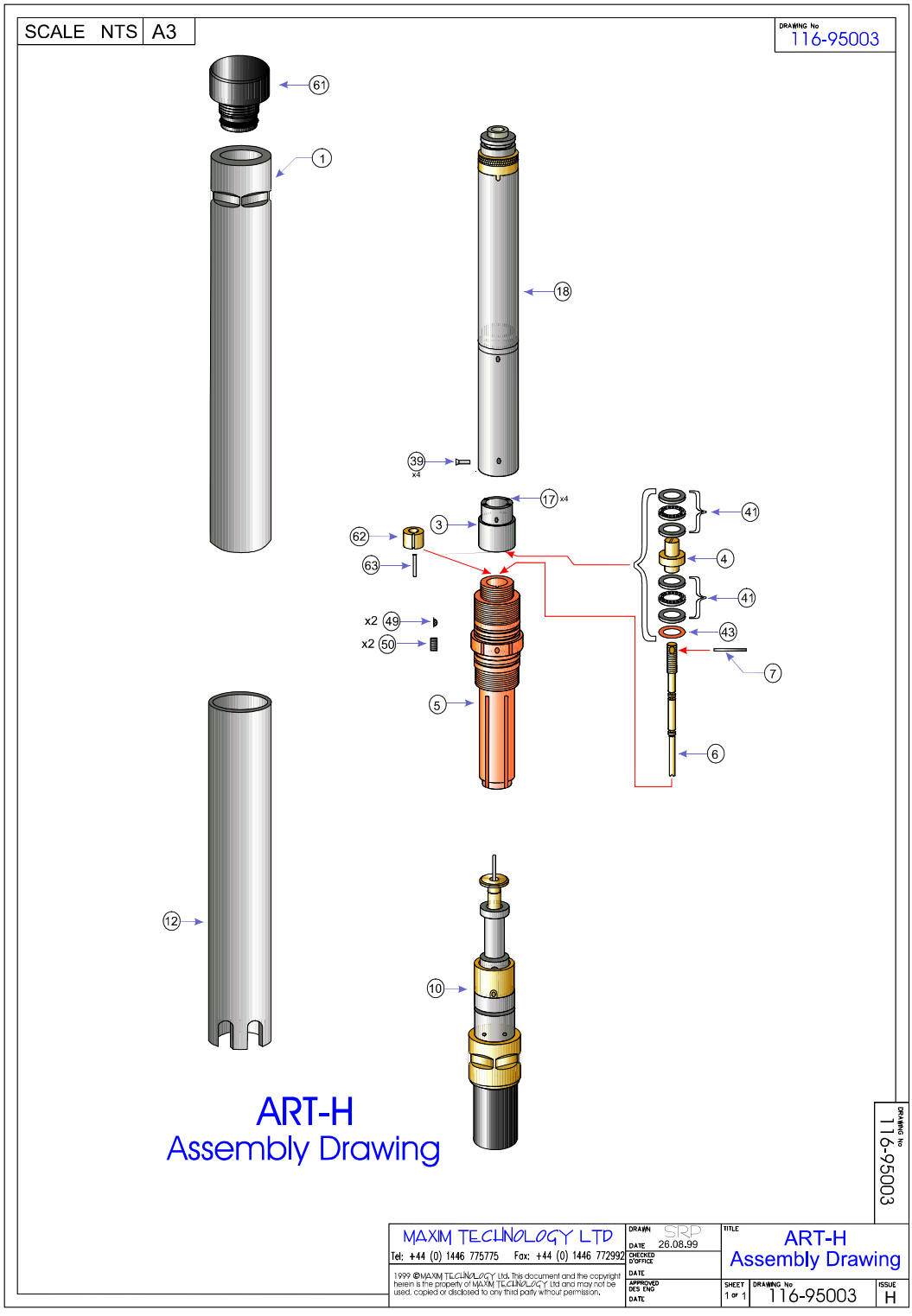

Figure 5-5 – Exploded Assembly Drawing, ART-H - 116-95003-H

Item:	Qty:	Part No:	Description:	Reference:
1	1	116-00091	Upper Housing, ART-H, Monel	
3	1	116-00052	Bearing Housing, ART-H	ISS TN
4	1	116-00053	Drive Nut, ART-H	ISS TN
5	1	116-00054	Retaining Sub, ART-H	ISS TN
6	1	116-00144	Valve Piston	ISS TN
7	1	116-00145	A/R Pin	ISS TN
10	1	116-00086	Fishing Head Ass'y, ART-H	ISS TN
12	1	116-00061	Lower Housing, ART-H	ISS TN
17	4	116-00066	A/R Pin, Motor ART-H	ISS TN
18	1	116-00244	Electronic Sub-Assy, ART-H/F	Note Options
39	4	208-00130	Screw, Csk Skt Hd, M4 x 8mm, S/S	
41	2	212-00002	Thrust Bearing, 28mm OD, 15mm Bore	
43	1	203-00004	Wave Spring, SSB-0110-S17,BRG OD28mm	
49	2	213-00001	Filter Screen, Flange Mounted	
50	2	116-00113	Retaining Plug, 6mm	
56	1	116-94003	O'Ring Build Set, ART-H/F	ISS TN
61	1	201-00022	Thread Protector, Male, 1 3/16" GO	ISS TN
62	1	116-00082	Insert, Slotted, ART HD	ISS TN
63	1	116-00121	A/R Pin, Slotted Insert, ART	ISS TN
69	1	116-91003	B.R/A.T Instruction ART-H/F	
71	1	116-95003	Assembly Drawing. ART-H/F	

Table 5-4 – Parts List, ART-H – 116-99003-H

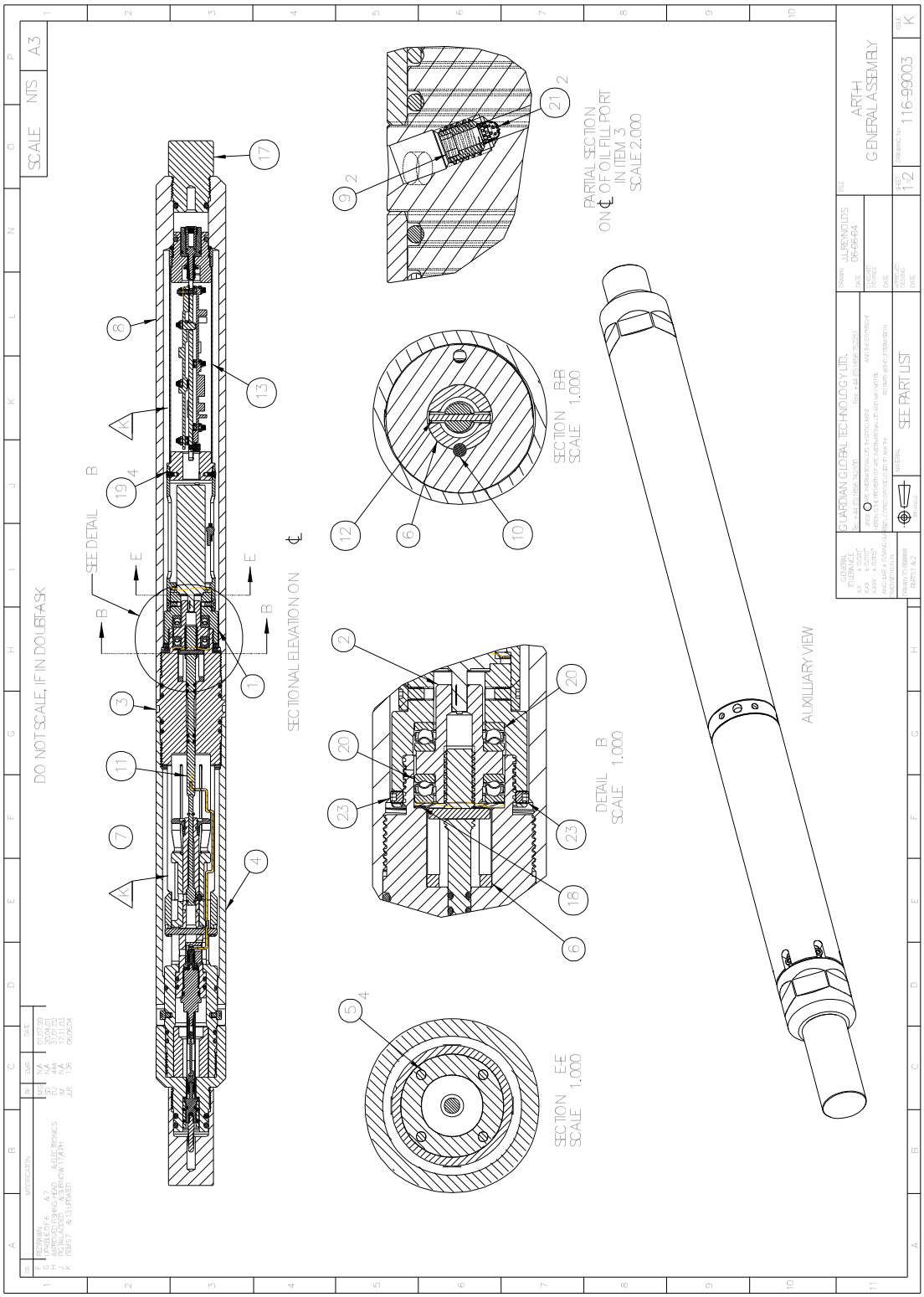

Figure 5-6 - General Assembly Drawing, ART-H - 116-99003-K

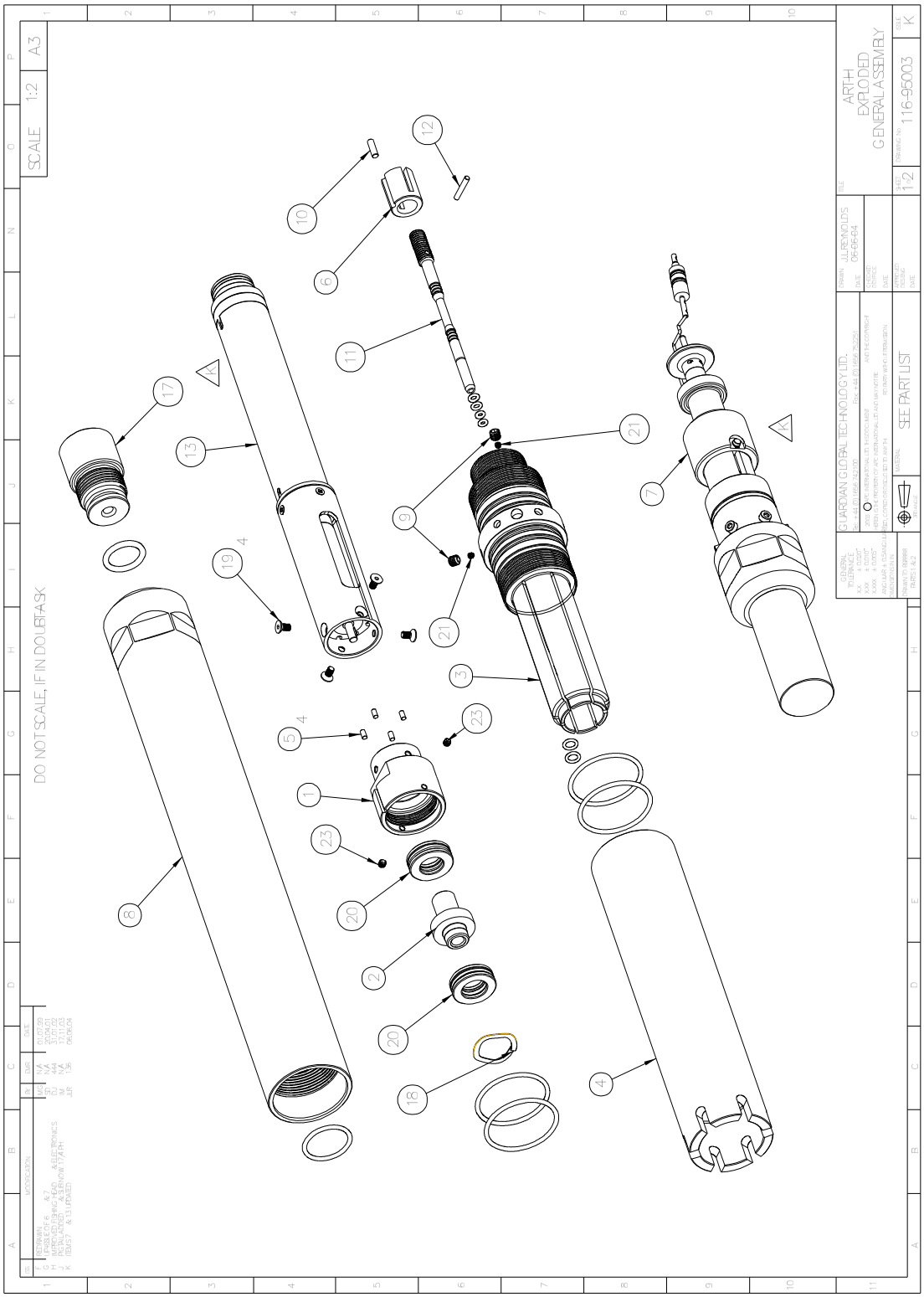

Figure 5-7 - Exploded Assembly Drawing, ART-H - 116-95003-K

Item:	Qty:	Part No:	Description:	Reference:
1	1	116-00052	Bearing Housing, ART-H	ISS TN
2	1	116-00053	Drive Nut, ART-HD	ISS TN
3	1	116-00054	Retaining Sub, ART-H	ISS TN
4	1	116-00061	Lower Housing, ART-HD	ISS TN
5	4	116-00066	A/R Pin, Motor ART-HD	ISS TN
6	1	116-00082	Insert, Slotted, ART HD	ISS TN
7	1	116-00086	Fishing Head Ass'y, ART-H	ISS TN
8	1	116-00091	Upper Housing, ART-H, Monel	OPTION A/B
9	2	116-00113	Retaining Plug, 6mm	
10	1	116-00121	Anti-rotation Pin, Slotted Insert, ART	ISS TN
11	1	116-00144	Valve Piston	ISS TN
12	1	116-00145	A/R Pin	ISS TN
13	1	116-00244	Electronic Sub-Assy, ART-H	Note Options
14	1	116-91003	B.R/A.T Instruction ART-H/F	
15	1	116-94003	O'Ring Build Set, ART-H	ISS TN
16	1	116-95003	Assembly Drawing. ART-H	
17	1	201-00022	Thread Protector, Male, 1 3/16" GO	ISS TN
18	1	203-00004	Wave Spring, SSB-0110-S17,BRG OD28mm	
19	4	208-00130	Screw, Csk Hd Skt , M4 x 8mm, S/S	
20	2	212-00002	Thrust Bearing, 28mm OD, 15mm Bore	
21	2	213-00001	Filter Screen, Flange Mounted	
22	1	303-00199	Pigtail, Dual, Heavy Duty	
23	2	208-00242	Grubscrew, Skt Hd, M4 x 4, A4 S/S	

Table 5-5 – Parts List, ART-H – 116-99003-K

5.5.2 Electronics Assembly Drawings and Parts Lists

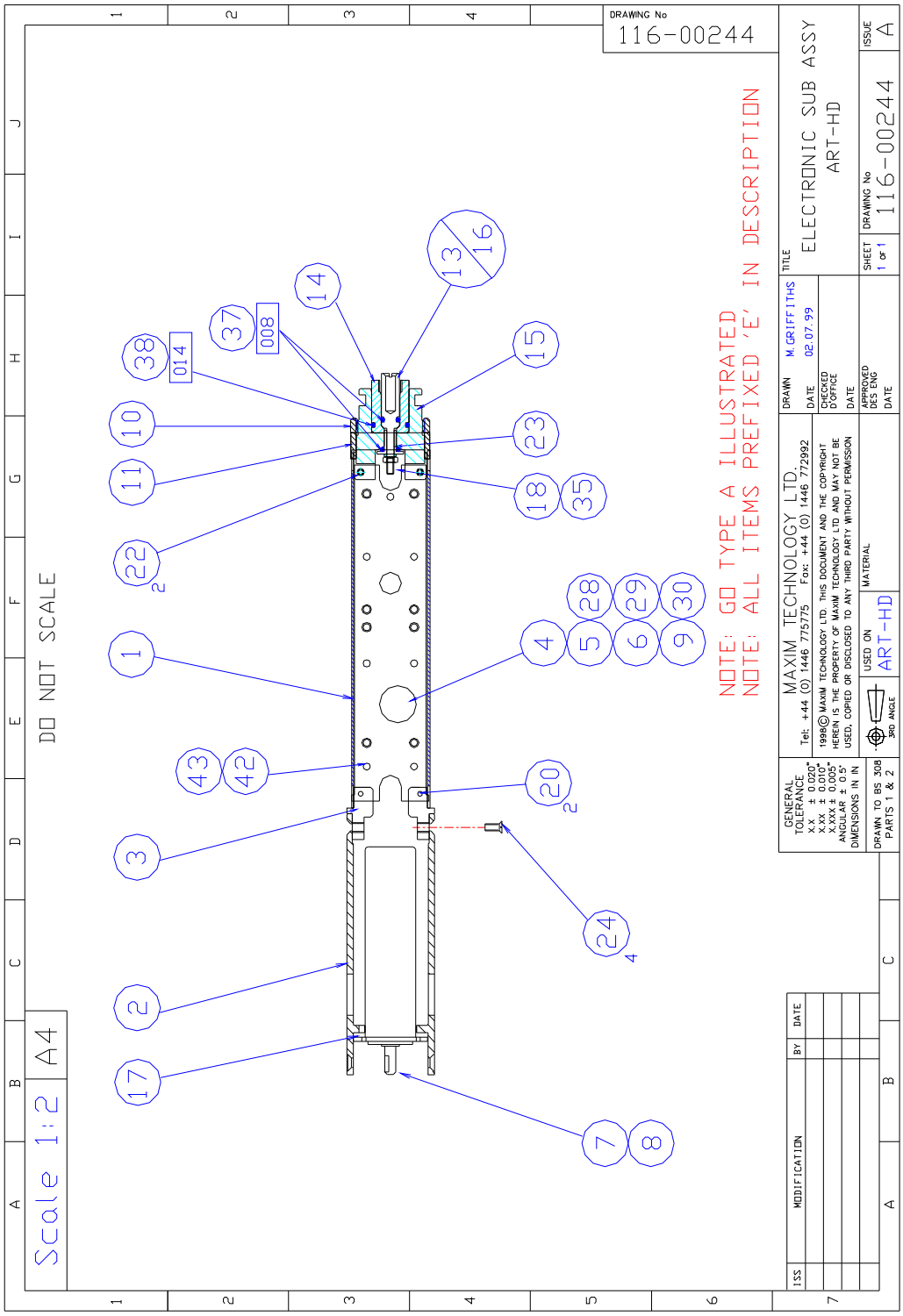

Figure 5-8 –Assembly Drawing, Electronics, ART-H/F – 116-00244-A

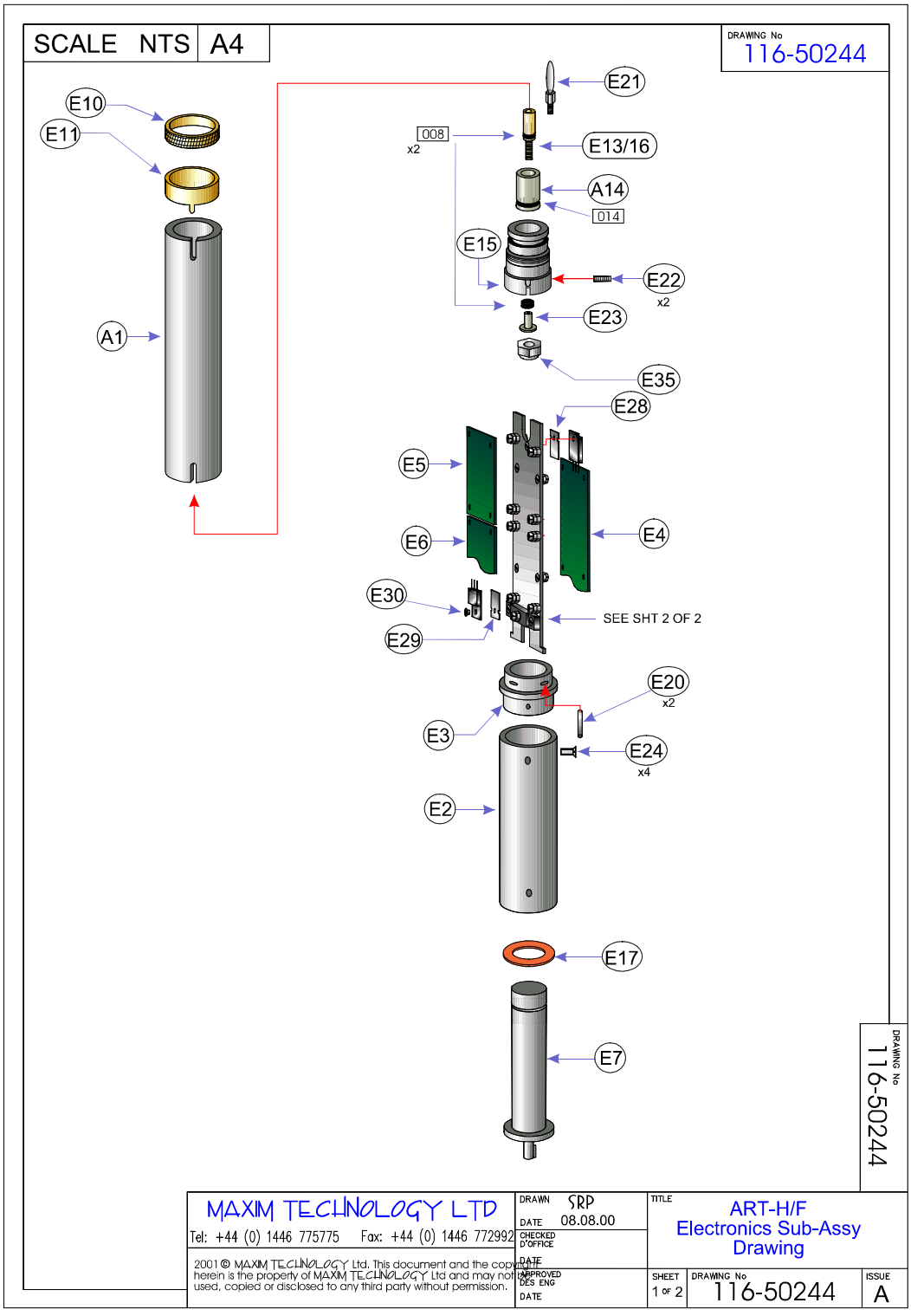

Figure 5-9 – Exploded Assembly Drawing, Electronics, ART-H/F – 116-00244-A (1/2)

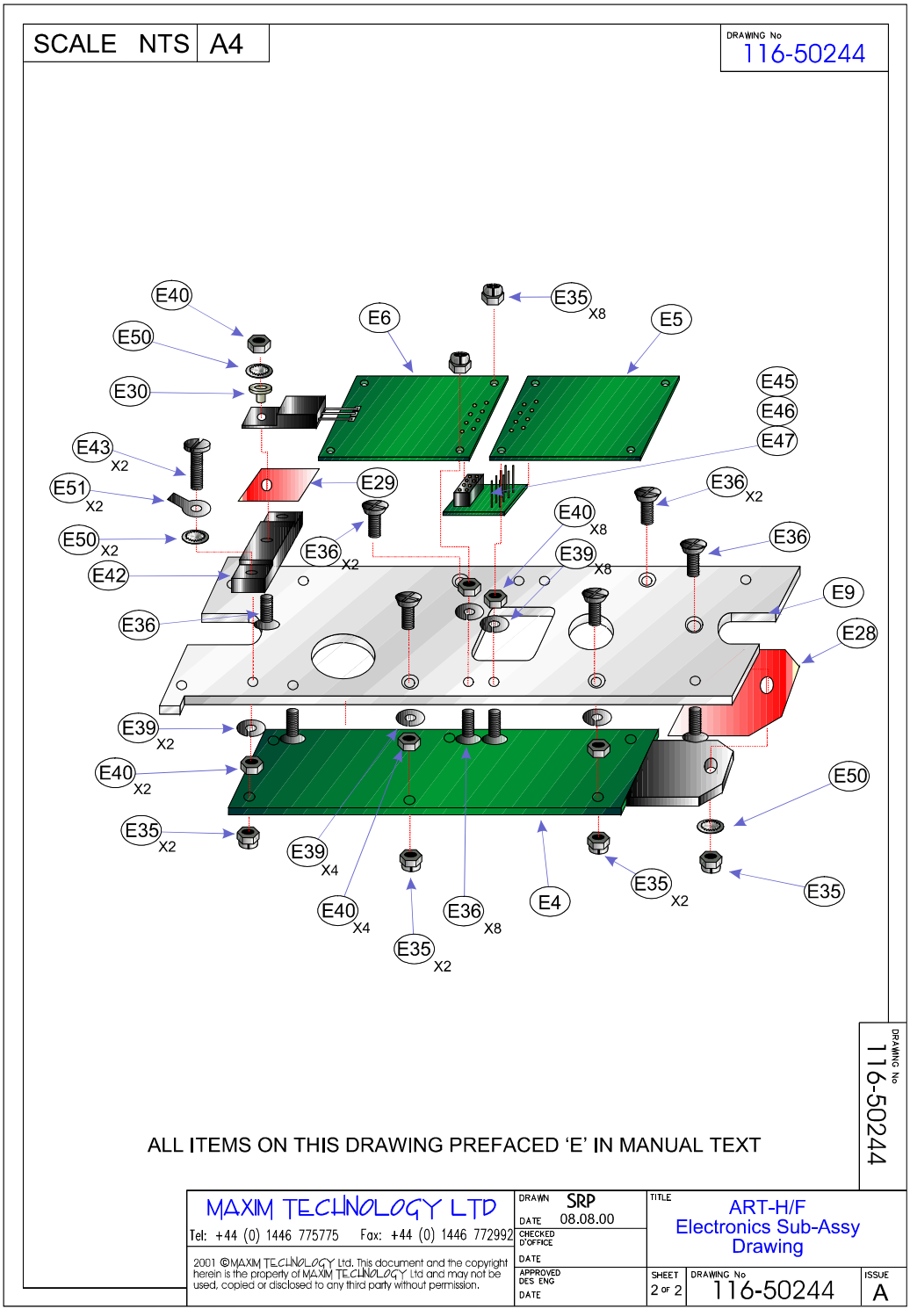

Figure 5-10 – Exploded Assembly Drawing, Electronics, ART-H/F – 116-50244-A (2/2)

5.5.2.1 Parts List, Electronics Assembly – 116-00244-A

Item:	Qty:	Part No:	Description:	Reference:
E1	1	101-00002	Chassis Tube, AVT	
E2	1	116-00051	Motor Housing, ART-H	
E3	1	116-00069	Chassis Mount, Lower, ART-H	
E4	1	116-00105	Line Isolation PCB, Assembled	
E5	1	116-00107	ART Signal PCB 1, Assembled	
E6	1	116-00109	ART Signal PCB 2, Assembled	
E7	1	116-00226	Motor (Keyway shaft)	
E8	1	116-00227	Drive Key, ART	
E9	1	116-00077	Electronic Chassis, ART-H	
E10	1	201-00019	Chassis Tube Retaining Ring	
E11	1	201-00020	Chassis Tube Anti-Rotation Collar	
E13	1	202-00049	Connector, Stud Incl., P I Head, GO Type A	Use for GO Type A
E14	1	202-00003	Cup Insulator, P I Head	
E15	1	202-00069	Head, Pressure Isolation, 1 11/16"	
E16	0	202-00048	Connector, Stud Incl., P I Head, GO Rev'd	Use for GO Type A Rev'd
E17	1	203-00003	Wave Spring, SSR-0125-S17,OD1.25	GIN
E18	1	116-00285	Contact Assembly, ART-H Type	
E20	2	208-00044	Spring Tension Pin, 2mm x 10mm	
E21	0	202-00007	Pin, Banana, 4mm, Male, M3x6mm	Use for GO Type A Rev'd
E22	2	208-00178	Grubscrew, Skt Hd, M3 x 6, S/S	
E23	1	202-00011	Insulator, T Section, Pressure Isolation Head	
E24	4	208-00203	Screw, Csk Hd, Pozi, M3 x 6	
E28	1	404-00205	T03P, MICA Insulator Pad	
E29	1	404-00203	T0220, MICA Insulator Pad	
E30	1	404-00207	Peek Top Hat Insulator, T0220	
E31	1	116-50244	Assembly Drawing, ART-H, Elec Ass'y,	
E32	1	116-00245	A.T.I.,Electronic Sub-Assy, ART-H	Build Instruction
E34	1	116-96003	Wiring Diagram, ART-H/C	
E35	16	208-00180	Nut, M3, Aerotight	Holds TO220
E36	16	208-00125	Screw, Csk Hd Pozi, M3 x 12mm, S/S	Holds TO220
E37	2	204-90008	O'ring, Viton 90, 008	
E38	1	204-90014	O'ring, Viton, 90, 014	
E39	17	208-00009	Washer, 3mm, Spring, S/S	
E40	17	208-00141	Nut, Full, M3, S/S	
E41	1	201-00082	Chassis Assembly Typical	
E42	1	101-00018	Heatsink	
E43	1	208-00096	Screw, Pan Slot Hd, M3 x 16mm, S/S	
E44	1	116-50270	Assembly Drawing, Chassis Assembly ART-H	

Table 5-6 – Parts List, Electronics Assembly, ART-H/F – 116-00244-A

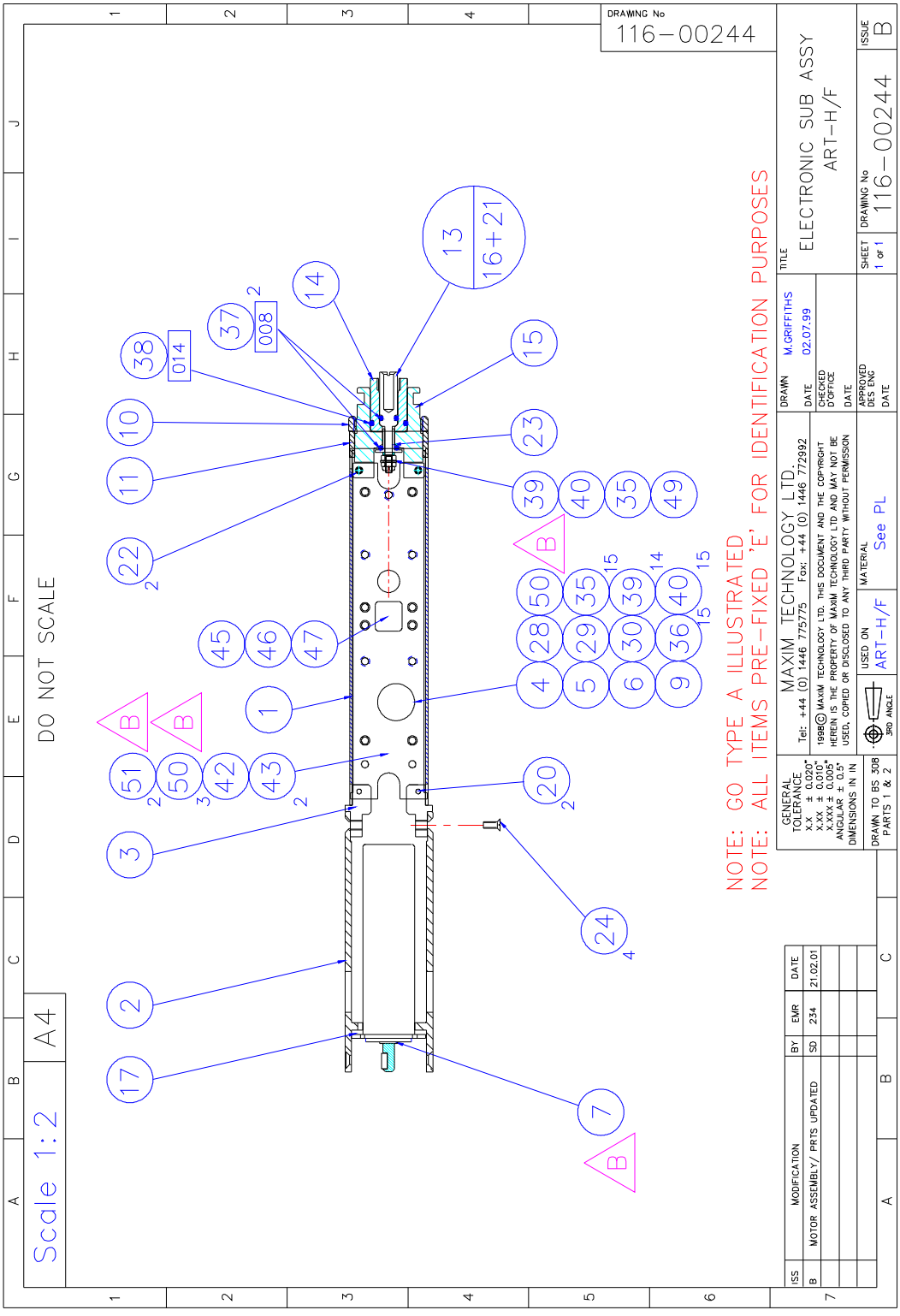

Figure 5-11 –Assembly Drawing, Electronics, ART-H/F – 116-00244-B

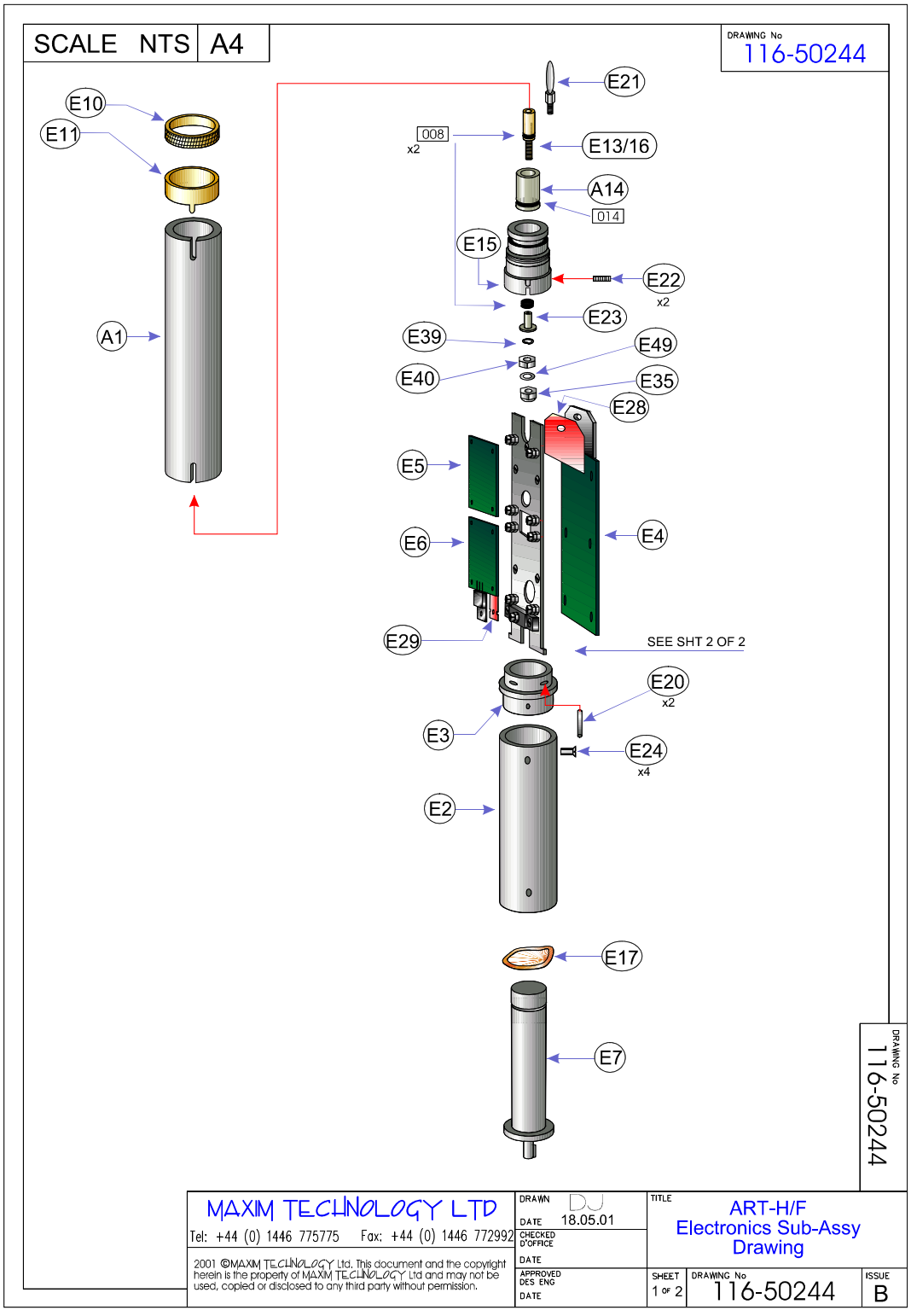

Figure 5-12 – Exploded Assembly Drawing, Electronics, ART-H/F – 116-50244-B (1/2)

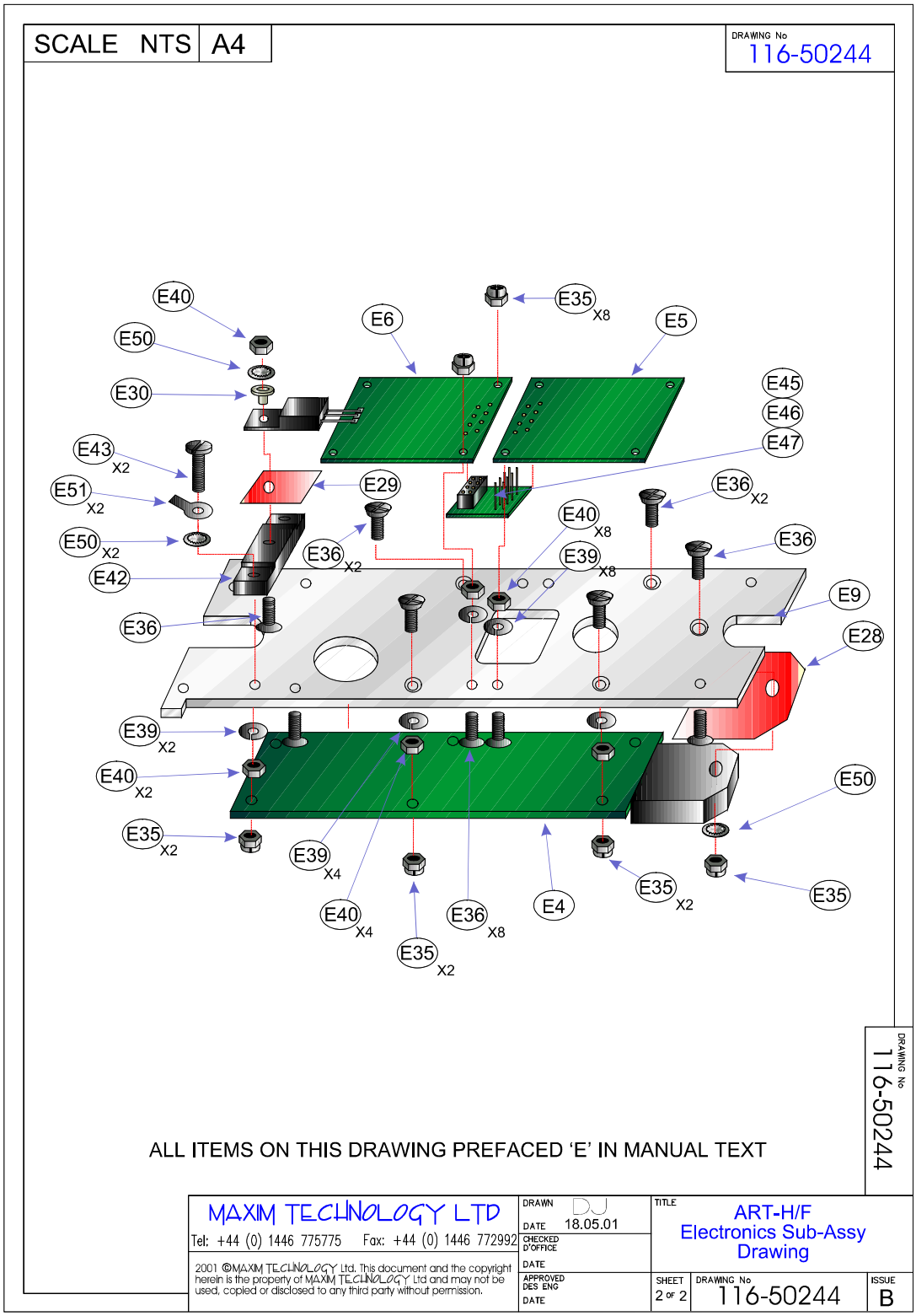

Figure 5-13 – Exploded Assembly Drawing, Electronics, ART-H/F – 116-50244-B (2/2)

Item:	Qty:	Part No:	Description:	Reference:
E1	1	101-00002	Chassis Tube, AVT	Iss TN
E2	1	116-00051	Motor Housing, ART-H	Iss TN
E3	1	116-00069	Chassis Mount, Lower, ART-H	Iss TN
E4	1	116-00105	Line Isolation PCB, Assembled	Iss TN
E5	1	116-00107	ART Signal PCB 1, Assembled	Iss TN
E6	1	116-00109	ART Signal PCB 2, Assembled	Iss TN
E7	1	406-00004	Motor, Assembed (With Key)	Iss TN
E9	1	116-00077	Electronic Chassis, ART	Iss TN
E10	1	201-00019	Chassis Tube Retaining Ring	Iss TN
E11	1	201-00020	Chassis Tube Anti-Rotation Collar	Iss TN
E13	1	202-00049	Connector, Stud Int'l., P I Head, GO Type A	Use for GO Type A
E14	1	202-00003	Cup Insulator, P I Head	Iss TN
E15	1	202-00069	Head, Pressure Isolation, 1 11/16"	Iss TN
E16	0	202-00048	Connector, Stud Int'l., P I Head, GO Rev'd	Use for GO Type A Rev'd
E17	1	203-00003	Wave Spring, SSR-0125-S17,OD1.25	GIN
E20	2	208-00044	Spring Tension Pin, 2mm x 10mm	
E21	0	202-00007	Pin, Banana, 4mm, Male, M3x6mm	Use for GO Type A Rev'd
E22	2	208-00178	Grubscrew, Skt Hd, M3 x 6, S/S	
E23	1	202-00011	Insulator, T Section, Pressure Isolation Head	Iss TN
E24	4	208-00203	Screw, Csk Hd, Pozi, M3 x 6	
E28	1	404-00205	T03P, MICA Insulator Pad	
E29	1	404-00203	TO220, MICA Insulator Pad	
E30	1	404-00207	Peek Top Hat Insulator, TO220	
E31	1	116-50244	Assembly Drawing, ART-H/F, Elec Ass'y,	Iss
E32	1	116-00245	B.R./A.T.I.,Electronic Sub-Assy, 116-00244/281	Build Instruction
E34	1	116-96003	Wiring Diagram, ART-H/C/F	Iss
E35	16	208-00180	Nut, M3, Aerotight	Holds TO220
E36	14	208-00125	Screw, Csk Hd Pozi, M3 x 12mm, S/S	Holds TO220
E37	2	204-90008	O'ring, Viton, 90, 008	TN
E38	1	204-90014	O'ring, Viton, 90, 014	TN
E39	15	208-00009	Washer, 3mm, Spring, S/S Square Section.	
E40	16	208-00141	Nut, Full, M3, S/S	
E42	1	101-00018	Heatsink	Iss TN
E43	2	208-00096	Screw, Pan Slot Hd, M3 x 16mm, S/S	
E45	1	404-00099	8 Way High Density Connector Socket	
E46	1	404-00100	8 Way High Density Pin Carrier	
E47	1	116-00288	ART Control Interconnect PCB, Bare	
E49	1	208-00008	Washer, 3mm, Plain, S/S	
E50	4	208-00010	Washer, 3mm, Shakeproof, S/S	
E51	2	208-00110	Solder Tag, M3	

Table 5-7 – Parts List, Electronics Assembly, ART-H/F – 116-00244-B

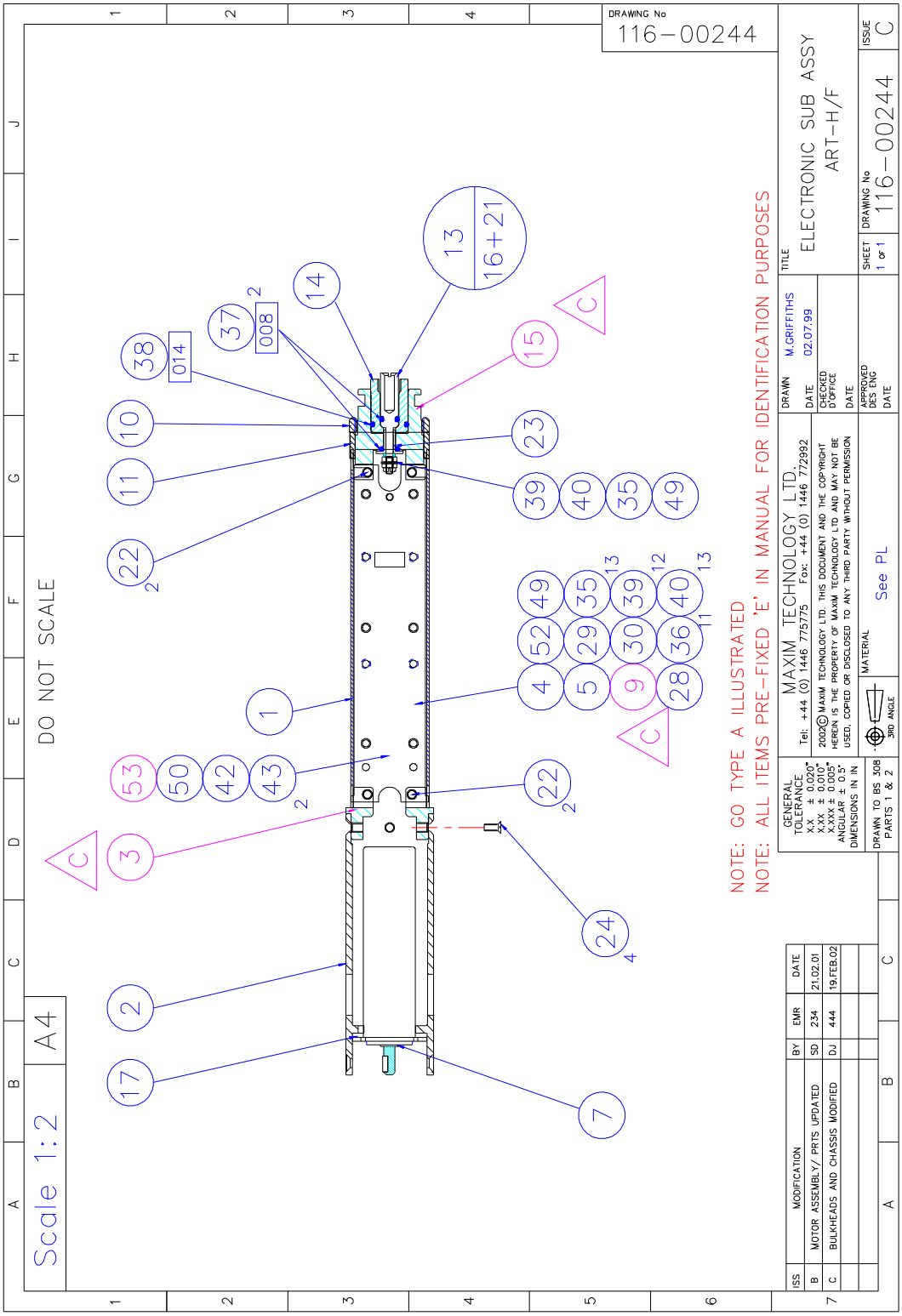

Figure 5-14 –Assembly Drawing, Electronics, ART-H/F – 116-00244-C

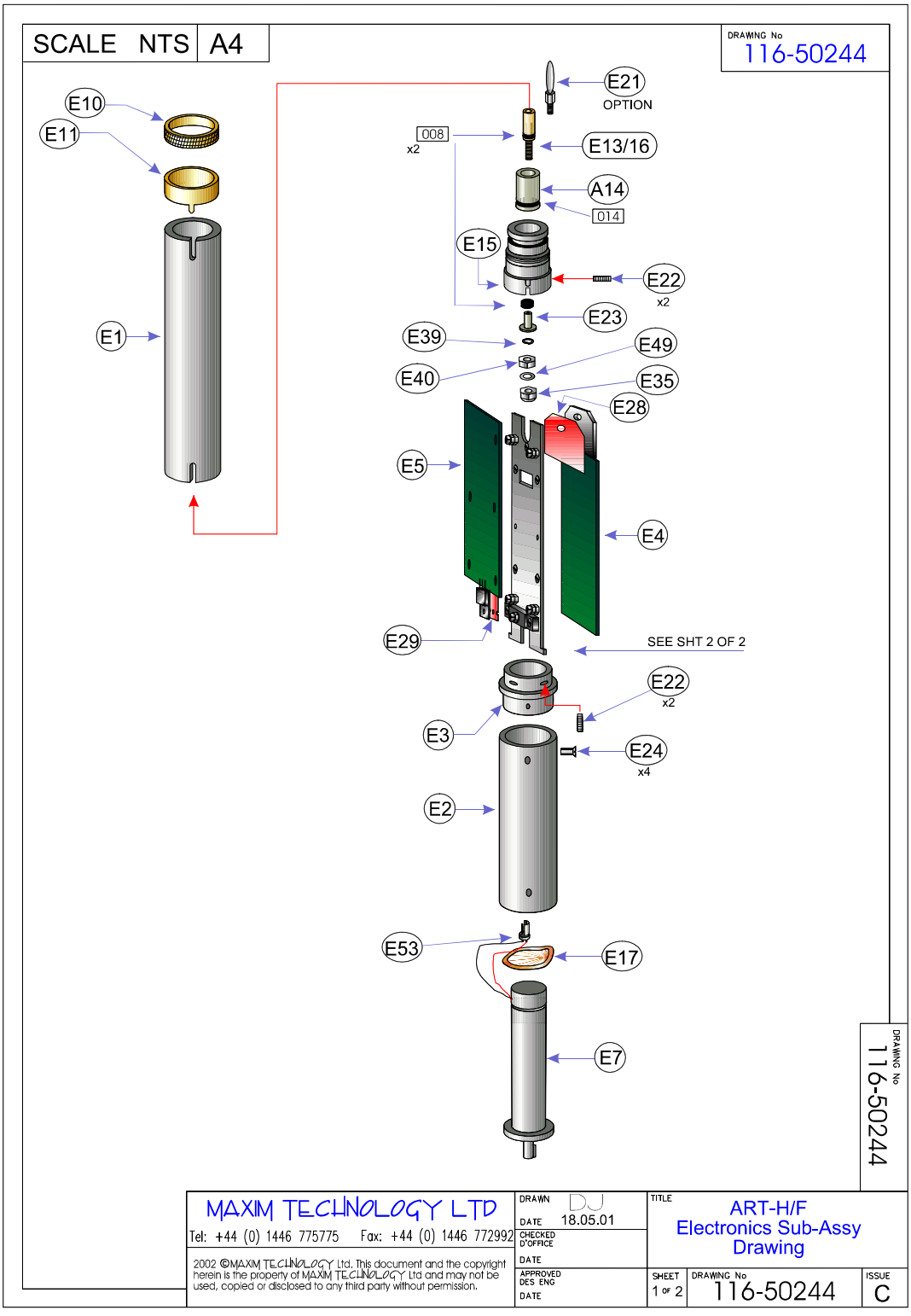

Figure 5-15 – Exploded Assembly Drawing, Electronics, ART-H/F – 116-50244-C (1/2)

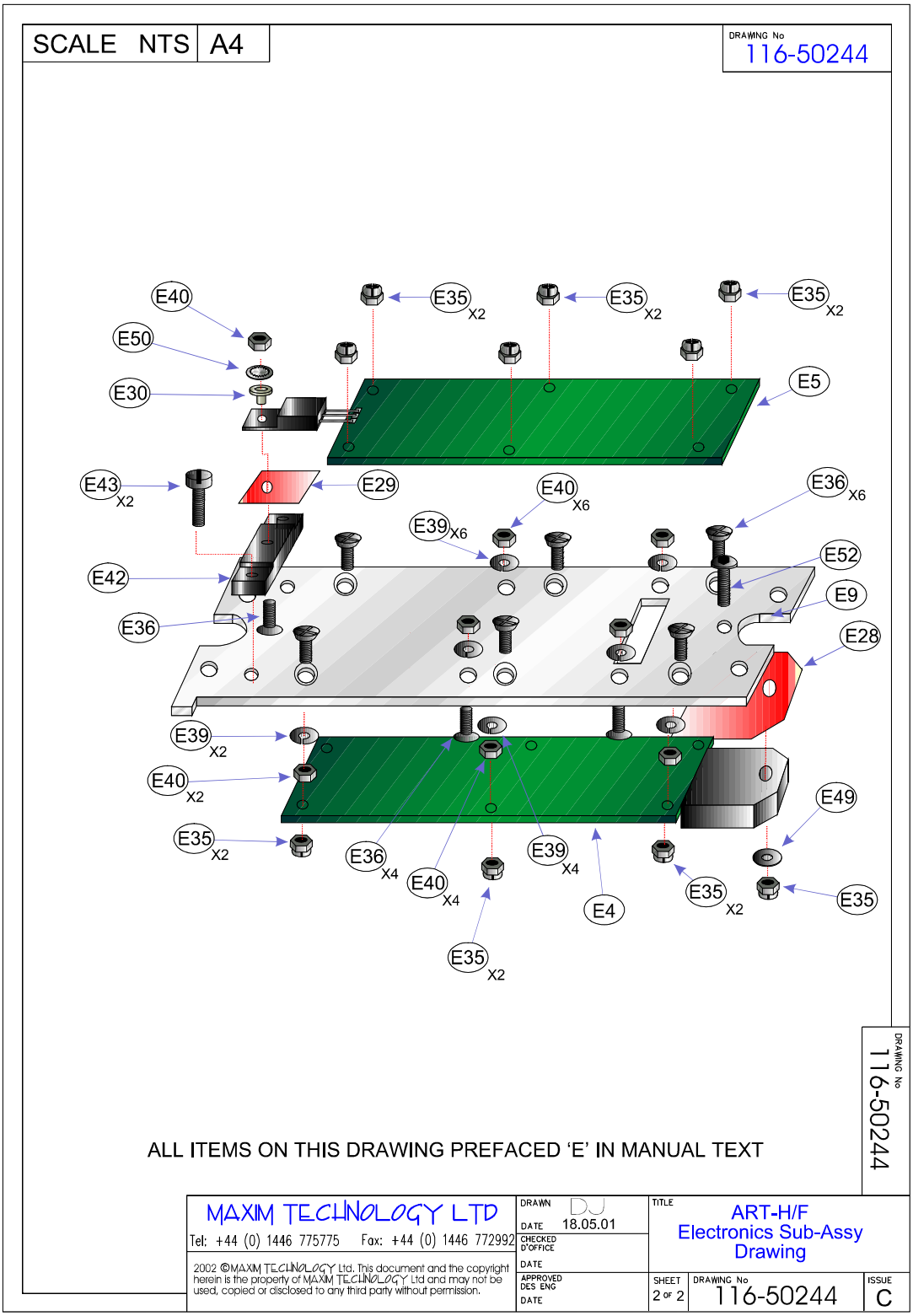

Figure 5-16 – Exploded Assembly Drawing, Electronics, ART-H/F – 116-50244-C (2/2)

Item:	Qty:	Part No:	Description:	Reference:
1	1	101-00002	Chassis Tube, AVT	Iss TN
2	1	116-00051	Motor Housing, ART-HD	Iss TN
3	1	116-00419	Chassis Mount, Lower, ART-H	Iss TN
4	1	116-00105	Line Isolation PCB, Assembled	Iss TN
5	1	116-00421	ART Power Supply/Signal PCB Assembly	Iss TN
7	1	406-00004	Motor, Assembed (With Key)	Iss TN
9	1	116-00418	Electronic Chassis, ART-H	Iss TN
10	1	201-00019	Chassis Tube Retaining Ring	Iss TN
11	1	201-00020	Chassis Tube Anti-Rotation Collar	Iss TN
13	1	202-00049	Connector, Stud Int'l., P I Head, GO Type A	Use for GO Type A
14	1	202-00003	Cup Insulator, P I Head	Iss TN
15	1	202-00224	Head, Pressure Isolation, (4mm)	Iss TN
16	0	202-00048	Connector, Stud Int'l., P I Head, GO Rev'd	Use for GO Type A Rev'd
17	1	203-00003	Wave Spring, SSR-0125-S17,OD1.25	GIN
21	0	202-00007	Pin, Banana, 4mm, Male, M3x6mm	Use for GO Type A Rev'd
22	4	208-00101	Grubscrew, Skt Hd, M4 x 10	
23	1	202-00011	Insulator, T Section, Pressure Isolation Head	Iss TN
24	4	208-00203	Screw, Csk Hd, Pozi, M3 x 6	
28	1	404-00205	T03P, MICA Insulator Pad	
29	1	404-00203	TO220, MICA Insulator Pad	
30	1	404-00207	Peek Top Hat Insulator, TO220	
31	1	116-50244	Assembly Drawing, ART-H/F, Elec Ass'y,	Iss
32	1	116-00245	B.R./A.T.I.,Electronic Sub-Assy, 116-00244/281	Build Instruction
34	1	116-96003	Wiring Diagram, ART-H/C/F	Iss
35	14	208-00180	Nut, M3, Aerotight	Holds TO220
36	11	208-00125	Screw, Csk Hd Pozi, M3 x 12mm, S/S	Holds TO220
37	2	204-90008	O'ring, Viton, 90, 008	TN
38	1	204-90014	O'ring, Viton, 90, 014	TN
39	13	208-00009	Washer, 3mm, Spring, S/S Square Section.	
40	14	208-00141	Nut, Full, M3, S/S	
42	1	101-00018	Heatsink	Iss TN
43	2	208-00096	Screw, Pan Slot Hd, M3 x 16mm, S/S	
49	2	208-00008	Washer, 3mm, Plain, S/S	
50	1	208-00010	Washer, 3mm, Shakeproof, S/S	
52	1	208-00200	Screw, Button Hd, Skt., M3 x 12mm, Blk	For Q1 (116-00105)
53	1	404-00189	Connector Insert, 4 Pin	

Table 5-8 – Parts List, Electronics Assembly, ART-H/F – 116-00244-C

Figure 5-17 –Assembly Drawing, Electronics, ART-H/F – 116-00244-D

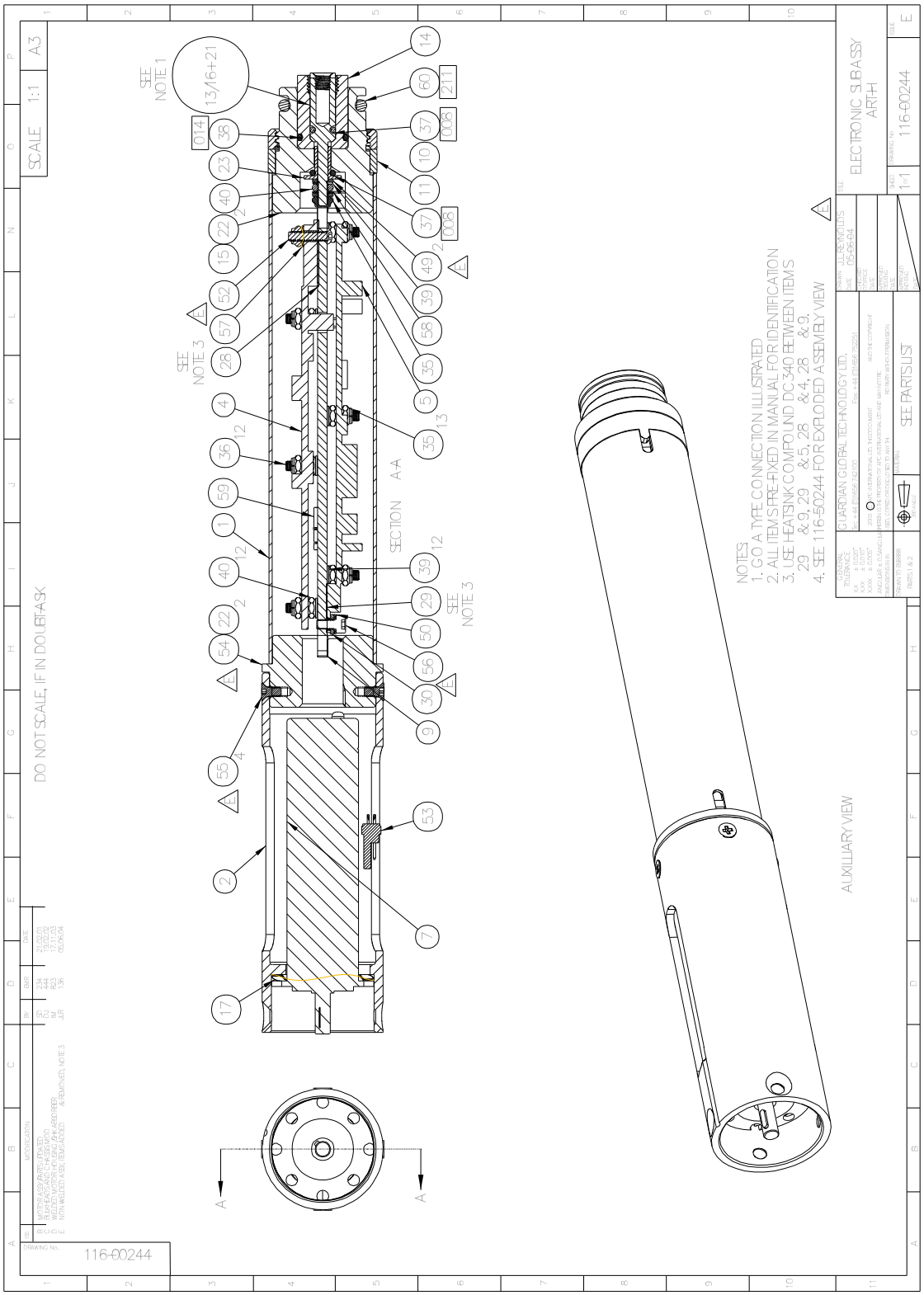

Figure 5-18 –Assembly Drawing, Electronics, ART-H/F – 116-00244-E

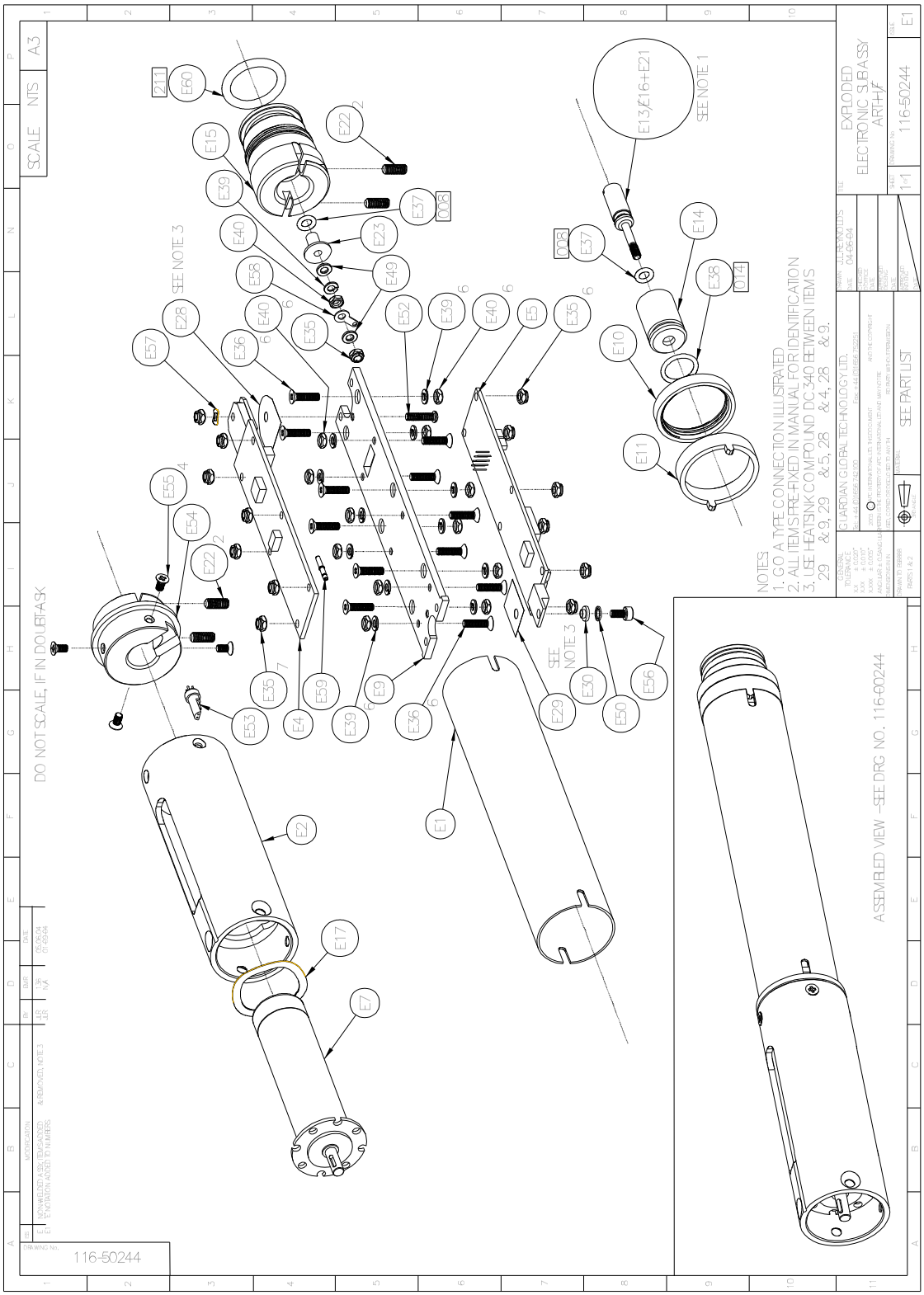

Figure 5-19 –Assembly Drawing, Electronics, ART-H/F – 116-00244-E1

Item:	Qty:	Part No:	Description:	Reference:
1	1	101-00002	Chassis Tube, AVT	Iss TN
2	1	116-00051	Motor Housing, ART-HD	ART-I type
4	1	116-00105	Line Isolation PCB, Assembled	Iss TN
5	1	116-00421	ART Power Supply/Signal PCB Assembly	Iss TN
7	1	406-00004	Motor, Assembled (With Key)	SS Cap type
9	1	116-00418	Electronic Chassis, ART-H	Iss TN
10	1	201-00019	Chassis Tube Retaining Ring	Iss TN
11	1	201-00020	Chassis Tube Anti-Rotation Collar	Iss TN
13	0	202-00049	Connector, Stud Int'l., P I Head, GO Type A	Use for GO Type A
14	1	202-00003	Cup Insulator, P I Head	Iss TN
15	1	202-00224	Head, Pressure Isolation, (4mm)	Iss TN
16	1	202-00048	Connector, Stud Int'l., P I Head, GO Mod'd	Use for GO Type A Rev'd
17	1	203-00003	Wave Spring, SSR-0125-S17,OD1.25	
21	0	202-00007	Pin, Banana, 4mm, Male, M3x6mm	Use for GO Type A Rev'd
22	4	208-00101	Grubscrew,Skt Hd, M4 x10	
23	1	202-00011	Insulator, T Section, Pressure Isolation Head	Iss TN
28	1	404-00205	T03P, MICA Insulator Pad	
29	1	404-00203	TO220, MICA Insulator Pad	
30	1	404-00344	Peek Top Hat Insulator	
31	1	116-50244	Assembly Drawing, ART-H/F, Elec Ass'y,	Iss
32	1	116-00245	B.R./A.T.I.,Electronic Sub-Assy, 116-00244/281	Build Instruction
34	1	116-96003	Wiring Diagram, ART-H/C/F	Iss
35	14	208-00180	Nut, M3, Aerotight	Holds TO220
36	12	208-00125	Screw, Csk Hd Pozi, M3 x 12mm, S/S	Holds TO220
37	2	204-90008	O'ring, Viton, 90, 008	TNDO NOT KIT IF BUILDING COMPLETE TOOL
38	1	204-90014	O'ring, Viton, 90, 014	TNDO NOT KIT IF BUILDING COMPLETE TOOL
39	13	208-00009	Washer, 3mm, Spring, S/S Square Section.	
40	13	208-00141	Nut, Full, M3, S/S	
49	2	208-00008	Washer, 3mm, Plain, S/S	
50	1	208-00010	Washer, 3mm, Shakeproof, S/S	
52	1	208-00200	Screw, Button Hd, Skt., M3 x 12mm, Blk	For Q1 (116-00105)
53	1	404-00189	Connector Insert, 4 Pin	
54	1	116-00419	Chassis Mount, Lower, ART-H	
55	4	208-00203	Screw, Csk Hd Pozi, M3 x 6mm	
56	1	208-00066	Screw, Skt Cap Hd, M3 x 6mm, S/S A2	
57	1	208-00172	Washer, 3mm, Crinkle, S/S	
58	1	208-00110	Solder Tag, M3	
59	1	404-00183	Socket Contact, Crimp 20 AWG	
60	1	204-90211	O'ring, Viton, 90, 211	DO NOT KIT IF BUILDING COMPLETE TOOL

Table 5-9 – Parts List, Electronics Assembly, ART-H/F – 116-00244-E

5.5.3 Fishing Head, Drawings and Parts Lists

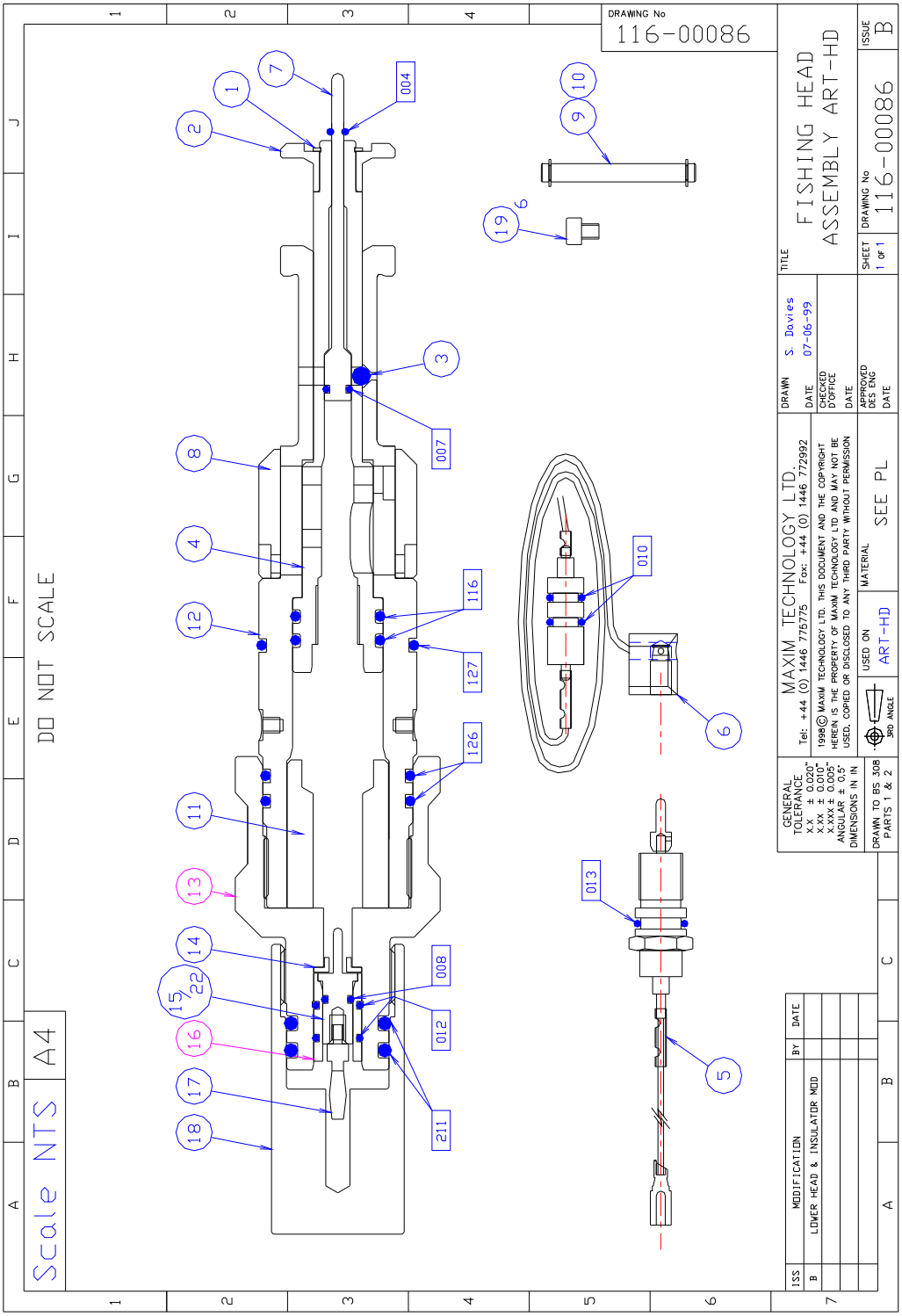

Figure 5-20 – Assembly Drawing, Fishing Head, ART-H - 116-00086-B

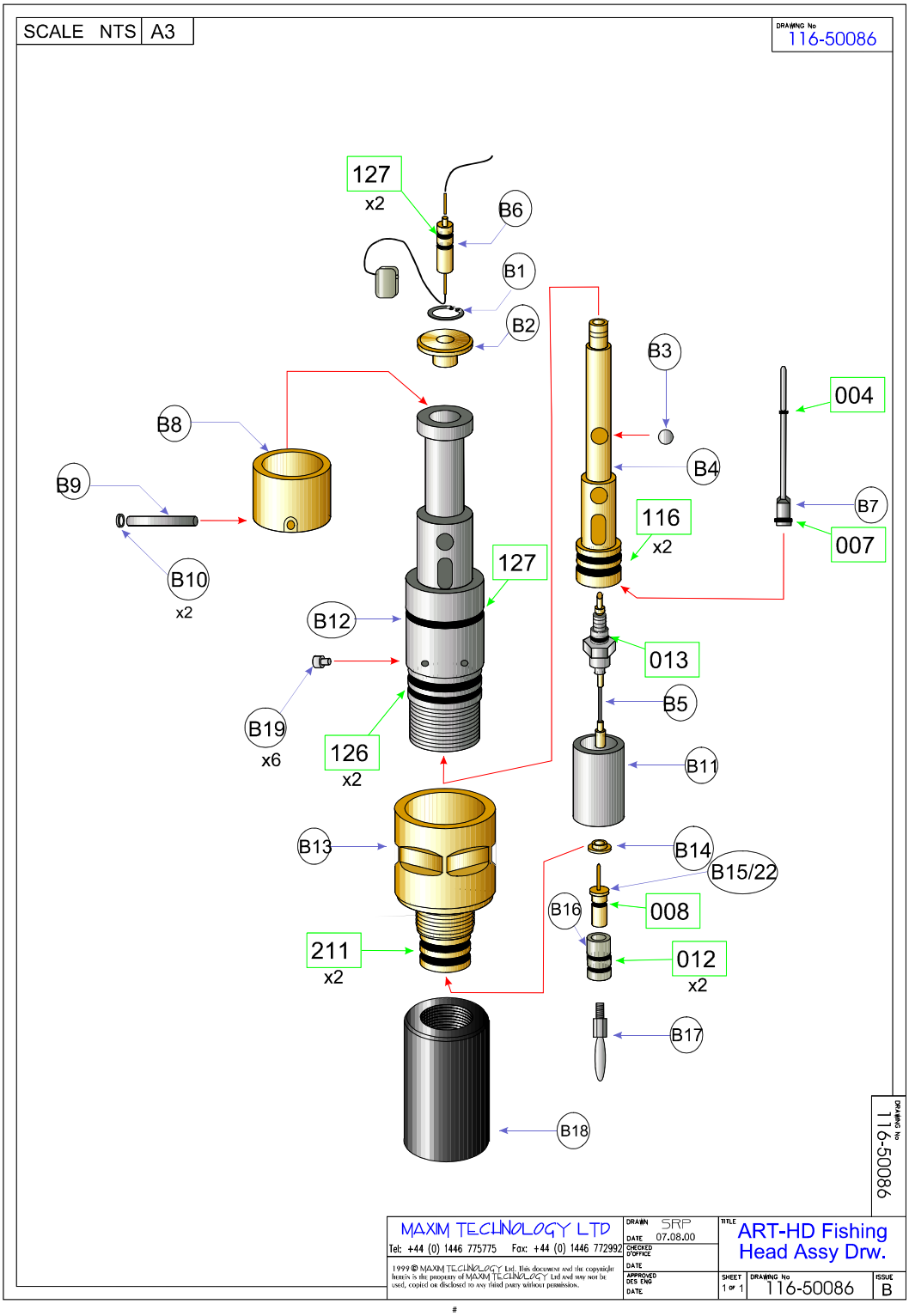

Figure 5-21 – Exploded Assembly Drawing, Fishing Head, ART-H – 116-50086-B

5.5.3.1 Fishing Head Assembly Parts List, By Item – 116-00086

Item:	Qty:	Part No:	Description:	Reference:
B1	1	208-00040	Circlip, 3/8", External, S/S	
B2	1	116-00057	Mushroom, ART-H	
B3	1	212-00003	Ball Bearing, A4 S/S, 3/16" Dia.	
B4	1	116-00058	Release Piston, ART-H	
B5	1	303-00057	Cable Assembly, Lower, ART-H	
B6	1	303-00056	Cable Assembly, Intermediate, ART-H	
B7	1	116-00059	Locking Piston, ART-H	
B8	1	116-00062	Retaining Sleeve, ART-H	
B9	1	116-00063	Pin, Retaining Sleeve, ART-H	
B10	2	208-00182	Circlip, 3/16", External, BeCu	
B11	1	116-00065	Spacer, ART-H	
B12	1	116-00060	Fishing Body, ART-H	
B13	1	116-00064	Lower Head, ART-H	
B14	1	202-00026	Insulator, Lower Head, Inner (Short)	
B15	0	202-00041	Connector, Lower Head, GO Type A	Use for GO Type A
B16	1	202-00040	Insulator, Lower Head, PPL Type.	
B17	0	202-00007	Pin, Banana, 4mm, Male, M3x6mm	Use for GO Type A
B18	1	201-00021	Thread Protector, Female, 1 3/16" GO	
B19	6	116-00071	Screw, Modified M4 x 6	
B20	1	116-91086	B.R.S., 116-00086, Fishing Head Assy	
B21	1	116-92086	A.T.I., 116-00086, Fishing Head Assy, ART- HD	
B22	1	202-00047	Connector, Lower Head, GO Rev'd	Use for GO Type A Rev'd
B23	1	116-00247	O'Ring Build Set, Fishing Head Assy., ART-H	
B24	1	116-50086	Assembly Drawing, Fishing Head Assembly ART-H	

Table 5-10 – Parts List, Fishing Head Assembly, ART-H – 116-00086-B

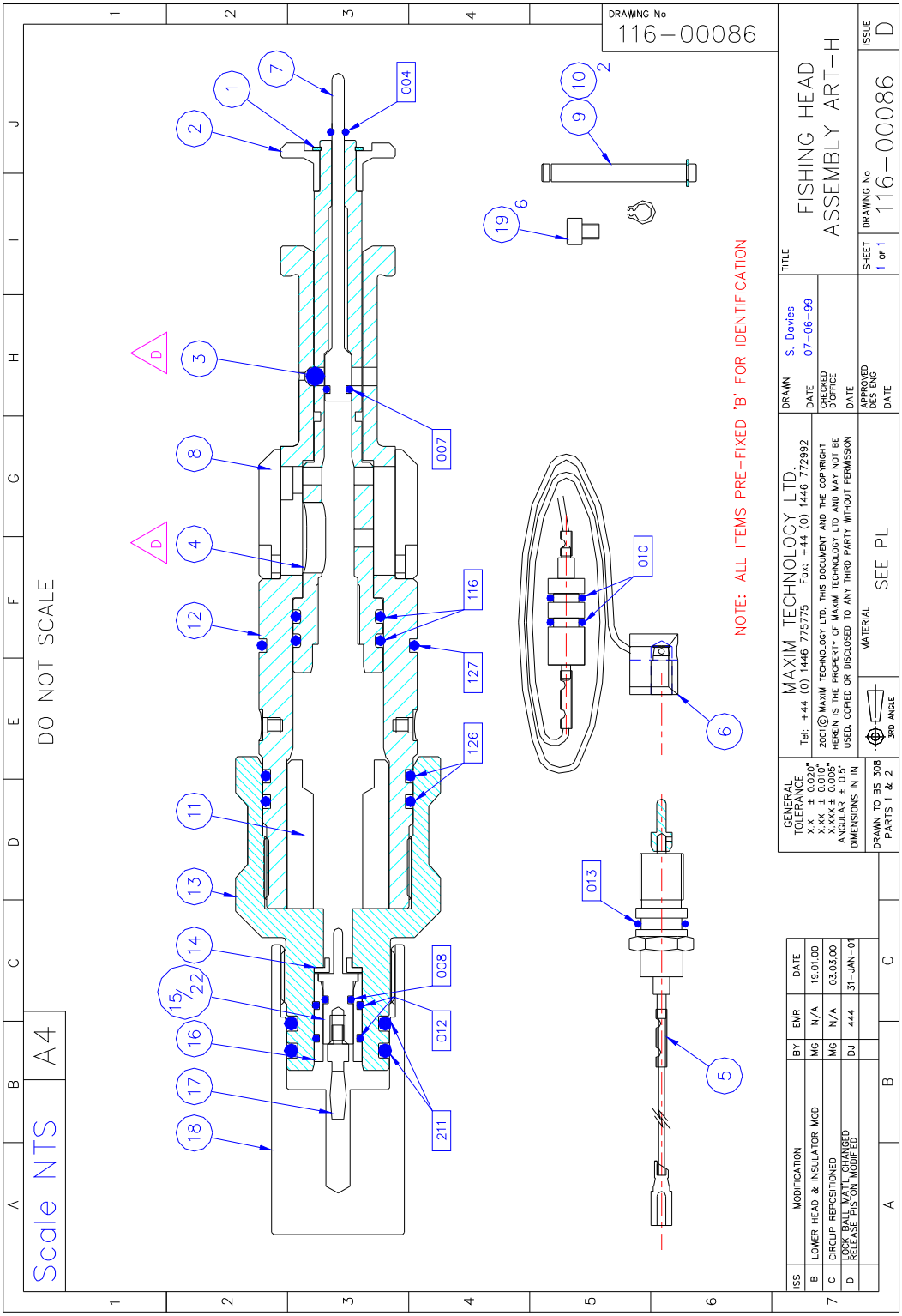

Figure 5-22 – Assembly Drawing, Fishing Head, ART-H - 116-00086-D

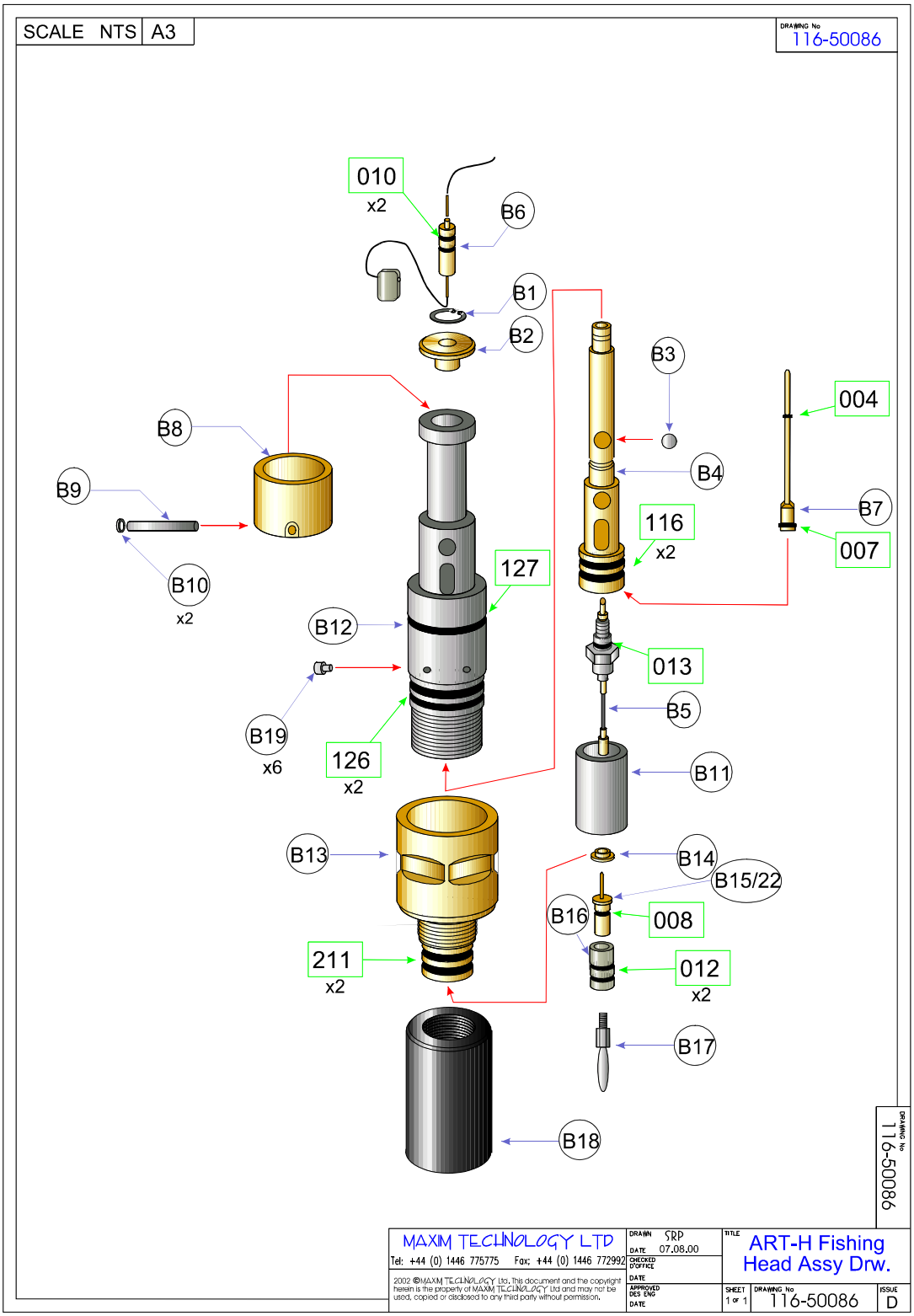

Figure 5-23 – Exploded Assembly Drawing, Fishing Head, ART-H – 116-00086-D

Item:	Qty:	Part No:	Description:	Reference:
B1	1	208-00040	Circlip, 3/8", External, S/S	
B2	1	116-00057	Mushroom, ART-H	Iss TN
B3	1	212-00028	Ball Bearing, Tungsten Carbide, D3/16"	
B4	1	116-00058	Release Piston	Iss TN
B5	1	303-00057	Cable Assembly, Lower, ART-H	Iss TN
B6	1	303-00056	Cable Assembly, Intermediate, ART-H	Iss TN
B7	1	116-00059	Locking Piston, ART-H	Iss TN
B8	1	116-00062	Retaining Sleeve, ART-H	Iss TN
B9	1	116-00063	Pin, Retaining Sleeve, ART-H	Iss TN
B10	2	208-00182	Circlip, 3/16", External, BeCu	
B11	1	116-00065	Spacer, ART-H	Iss TN
B12	1	116-00060	Fishing Body, ART-H	Iss TN
B13	1	116-00064	Lower Head, ART-H	Iss TN
B14	1	202-00026	Insulator, Lower Head, Inner (Short)	Iss TN
B15	1	202-00041	Connector, Lower Head, GO Type A	Iss TN Use for GO Type A
B16	1	202-00040	Insulator, Lower Head, PPL Type.	Iss TN
B17	1	202-00007	Pin, Banana, 4mm, Male, M3x6mm	Use for GO Type A
B18	1	201-00021	Thread Protector, Female, 1 3/16" GO	Iss TN
B19	6	116-00071	Screw, Modified M4 x 6	Iss TN
B20	1	116-91086	B.R/A.T. 116-00086, Fishing Head Assy ART HD/F	Iss
B22	0	202-00047	Connector, Lower Head, GO Modified	Iss TN Use for GO Type A Rev'd
B23	1	116-00247	O'Ring Build Set, Fishing Head Assy., ART-H/F	Iss
B24	1	116-50086	Assembly Drawing, Fishing Head Assembly ART-H	Iss

Table 5-11 – Parts List, Fishing Head Assembly, ART-H – 116-00086-D

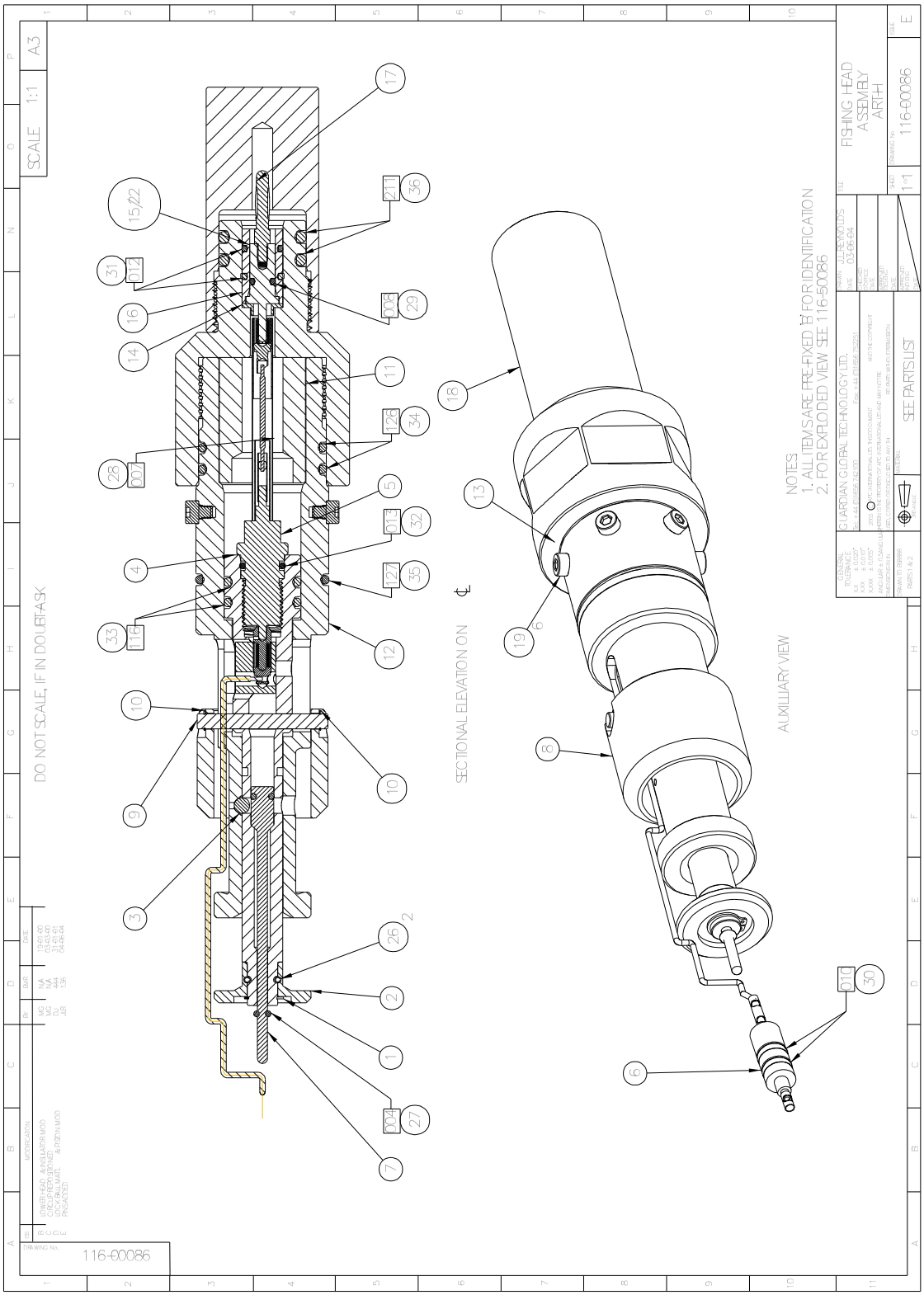

Figure 5-24 – Assembly Drawing, Fishing Head, ART-H - 116-00086-E

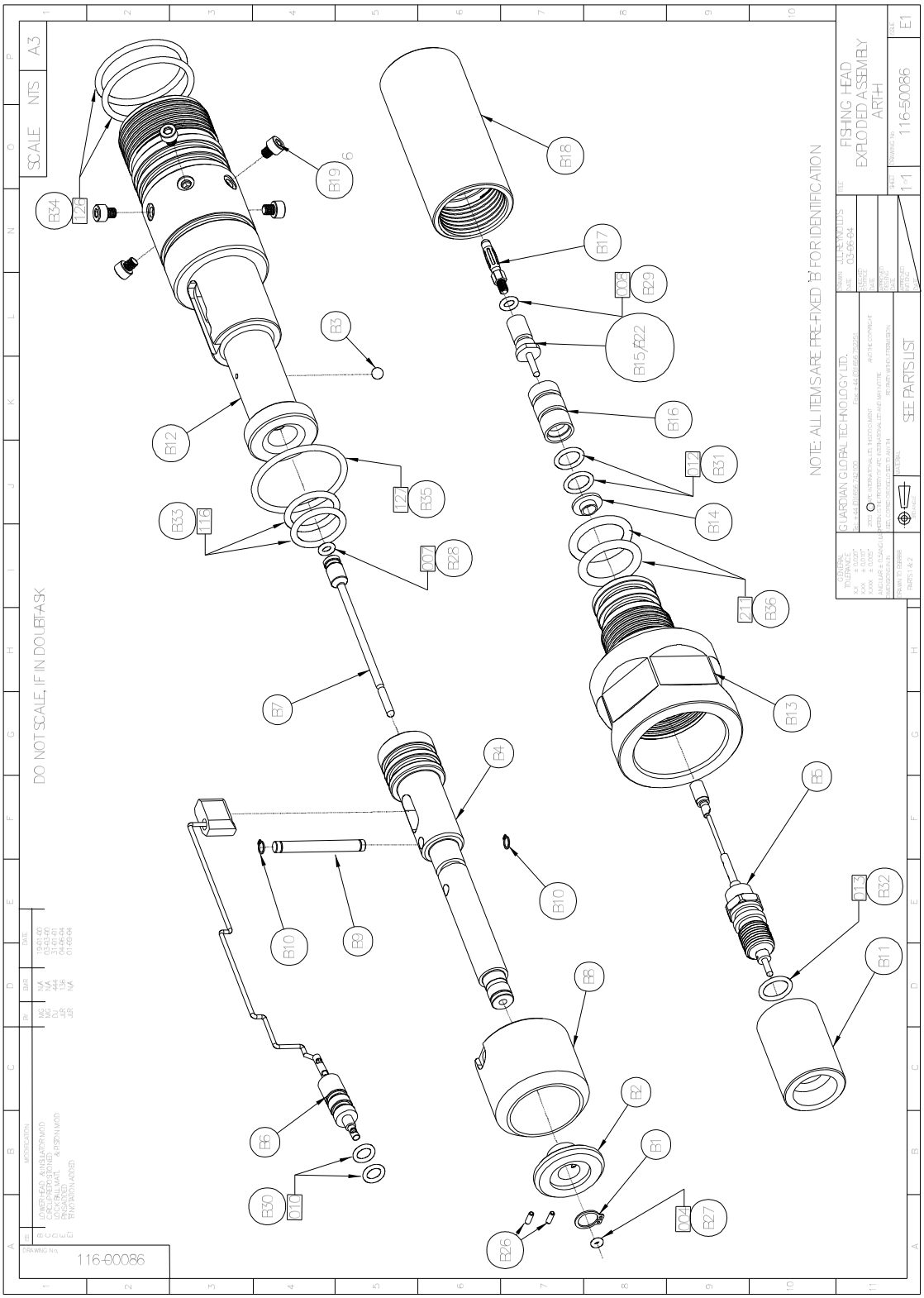

Figure 5-25 – Exploded Assembly Drawing, Fishing Head, ART-H – 116-00086-E

Item:	Qty:	Part No:	Description:	Reference:
1	1	208-00040	Circlip, 3/8", External, S/S	
2	1	116-00057	Mushroom, ART-HD	Iss TN
3	1	212-00028	Ball Bearing, Tungsten Carbide, D3/16"	
4	1	116-00058	Release Piston	Iss TN
5	1	303-00057	Cable Assembly, Lower, ART-HD	Iss TN
6	1	303-00056	Cable Assembly, Intermediate, ART-HD	Iss TN
7	1	116-00059	Locking Piston, ART-H	Iss TN
8	1	116-00062	Retaining Sleeve, ART-H	Iss TN
9	1	116-00063	Pin, Retaining Sleeve, ART-HD	Iss TN
10	2	208-00182	Circlip, 3/16", External, BeCu	
11	1	116-00065	Spacer, ART-H	Iss TN
12	1	116-00060	Fishing Body, ART-H	Iss TN
13	1	116-00064	Lower Head, ART-H	Iss TN Option with 25 Non perferating Head
14	1	202-00026	Insulator, Lower Head, Inner (Short)	Iss TN
15	1	202-00041	Connector, Lower Head, GO Type A	Iss TN Use for GO Type A
16	1	202-00040	Insulator, Lower Head, PPL Type.	Iss TN
17	1	202-00007	Pin, Banana, 4mm, Male, M3x6mm	Use for GO Type A
18	1	201-00021	Thread Protector, Female, 1 3/16" GO	Iss TN
19	6	116-00071	Screw, Modified M4 x 6	Iss TN
20	1	116-91086	B.R/A.T. 116-00086, Fishing Head Assy ART HD/F	Iss
22	0	202-00047	Connector, GO A type, 4mm socket	Iss TN Use for GO Type A Rev'd
24	1	116-50086	Assembly Drawing, Fishing Head Assembly ART-H	Iss
26	2	208-00056	Spring Tension Pin, 2mm x 6mm	
27	1	204-90004	O'ring, Viton, 90, 004	DO NOT KIT IF BUILDING COMPLETE TOOL
28	1	204-90007	O'ring, Viton, 90, 007	DO NOT KIT IF BUILDING COMPLETE TOOL
29	1	204-90008	O'ring, Viton, 90, 008	DO NOT KIT IF BUILDING COMPLETE TOOL
30	2	204-90010	O'ring, Viton, 90, 010	DO NOT KIT IF BUILDING COMPLETE TOOL
31	1	204-90012	O'ring, Viton, 90, 012	DO NOT KIT IF BUILDING COMPLETE TOOL
32	1	204-90013	O'ring, Viton, 90, 013	DO NOT KIT IF BUILDING COMPLETE TOOL

33	2	204-90116	O'ring, Viton, 90, 116	DO NOT KIT IF BUILDING COMPLETE TOOL
34	2	204-90126	O'ring, Viton, 90, 126	DO NOT KIT IF BUILDING COMPLETE TOOL
35	1	204-90127	O'ring, Viton, 90, 127	DO NOT KIT IF BUILDING COMPLETE TOOL
36	2	204-90211	O'ring, Viton, 90, 211	DO NOT KIT IF BUILDING COMPLETE TOOL

Table 5-12– Parts List, Fishing Head Assembly, ART-H – 116-00086-E

6 Electronics Description

6.1 System Block Diagram

The system block diagram is shown below.

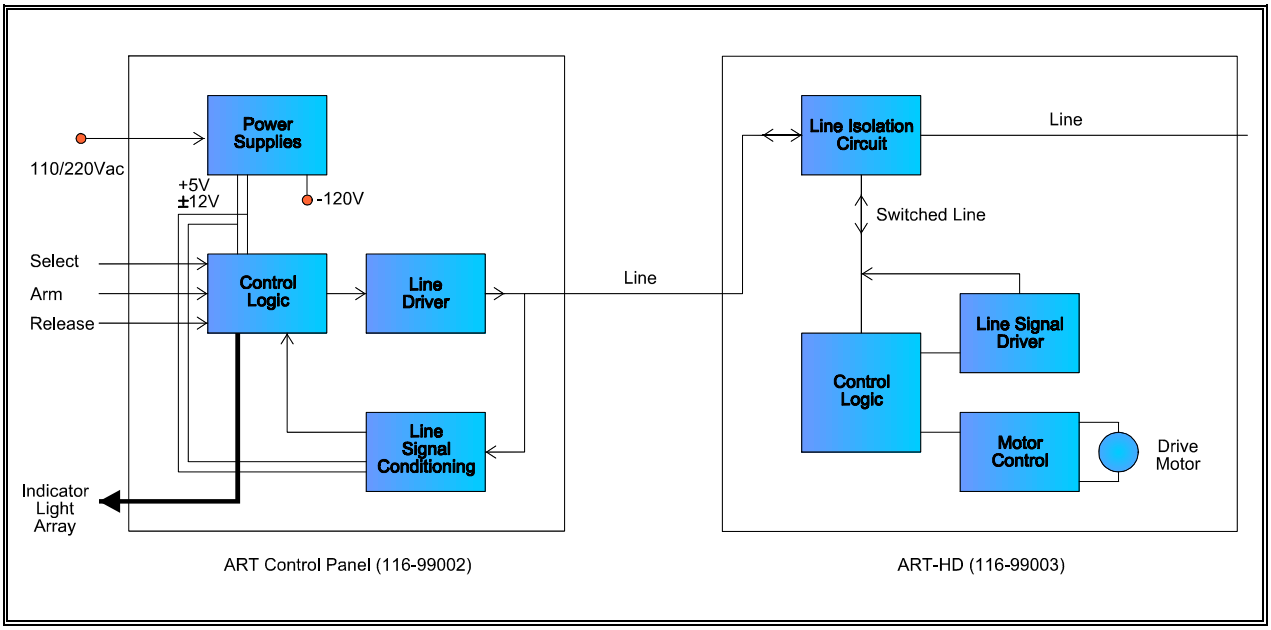

Figure 6-1 - System Block Diagram – 116-99403

6.2 Downhole Block Diagram Description

The downhole electronics are constructed on two circuit boards, numbers 116-00107 and 116-00109, which contain telemetry and control circuitry together with a third line isolation board, 116-00105, which disconnects the internal electronics from the line unless the line voltage is within predetermined limits.

6.2.1 Line Isolation Block Diagram

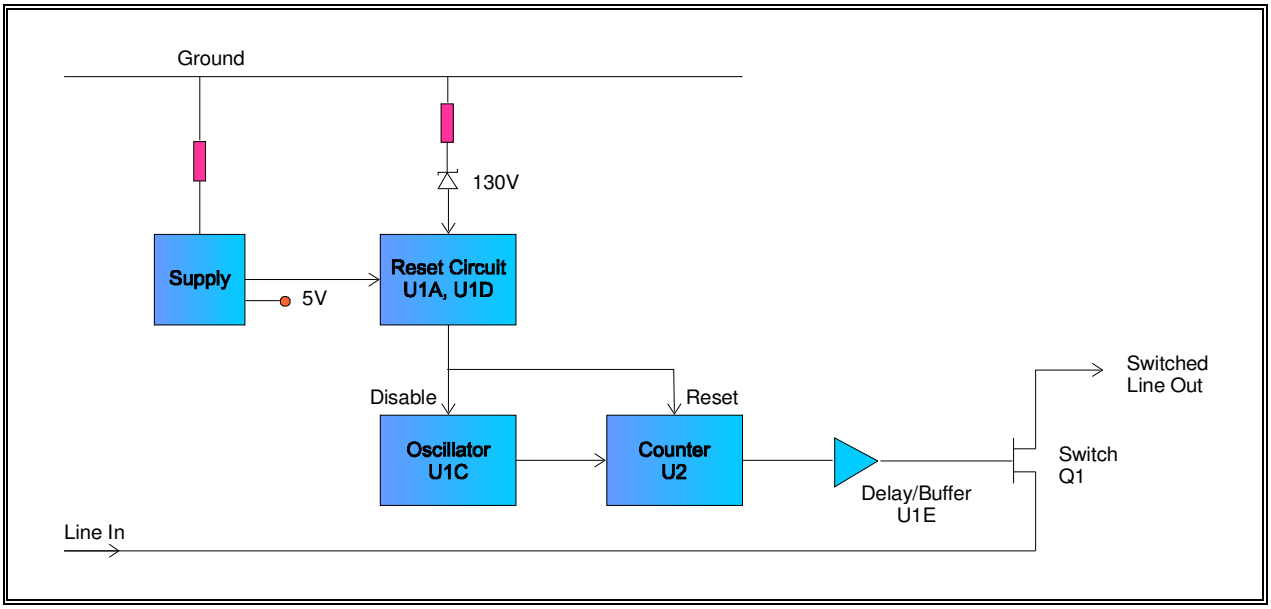

Figure 6-2 - Line Isolation Block Diagram - 116-40105

Line voltage powers the micro-power switching circuit through a high resistance. Application of power resets a counter (U2) to zero. An oscillator (U1C) causes the counter to count up until the counter state operates the switch Q1 after about 5 seconds, and disables the oscillator. If the line voltage exceeds 130V, the counter is reset switching the 'Line Out' off.

6.2.2 Telemetry and Control Block Diagram

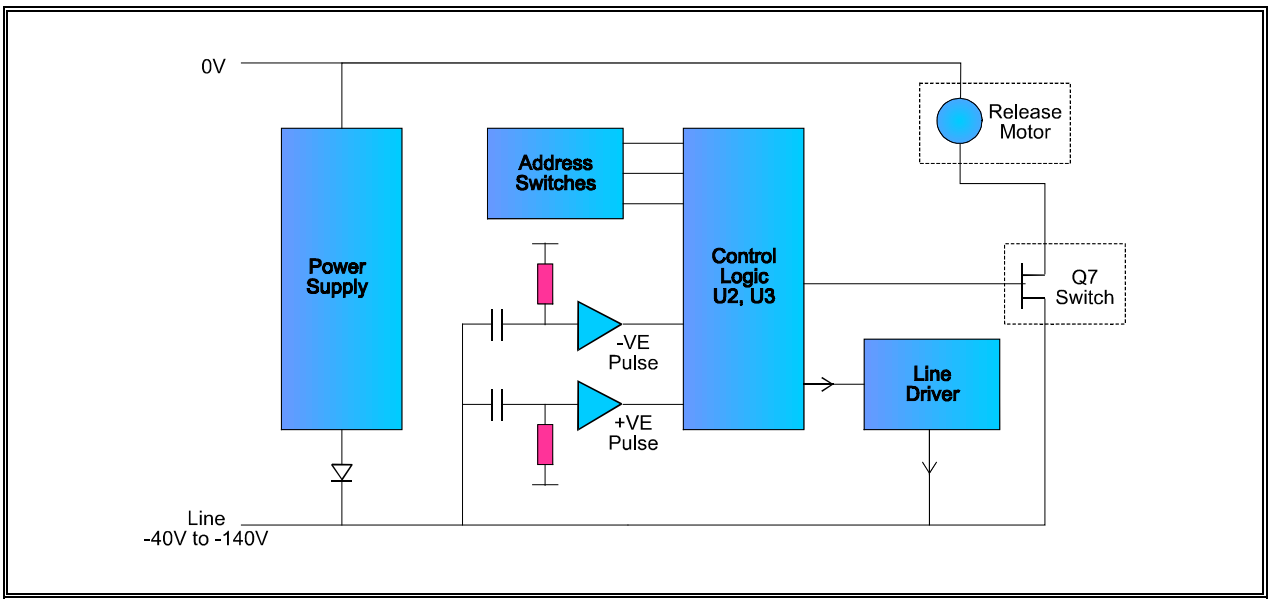

Figure 6-3 - Telemetry And Control Block Diagram - 116-40107

The ART Control circuitry discriminate, shape and convert the line pulses to logic level for input to the Control Logic. The Control Logic block receives the signals from surface, and steps a logic state machine through seven states in response to signals sent to an address set by DIP switches on the board. See section 6.4.2 for details of the switch setting. Signals to other addresses are ignored. If any signal received is not a repeat of the present state, or the next state, the system steps back one stage. If a further non-valid signal is received the logic returns to state 1. On reaching state 7 (the release operating state), the motor switch (Q7) is turned on and further input signals are disabled.

6.2.3 Surface Block Diagram Description

The ACP electronics are constructed on two boards. Board number 116-00103 contains the processor and associated electronics while board number 116-00116 contains the power and signal control circuitry. A linear PSU (409-00016) provides the line voltage and local low voltage supplies. This PSU is either switchable between 110 and 220vac or set at one ac voltage.

6.2.4 Processor Block Diagram

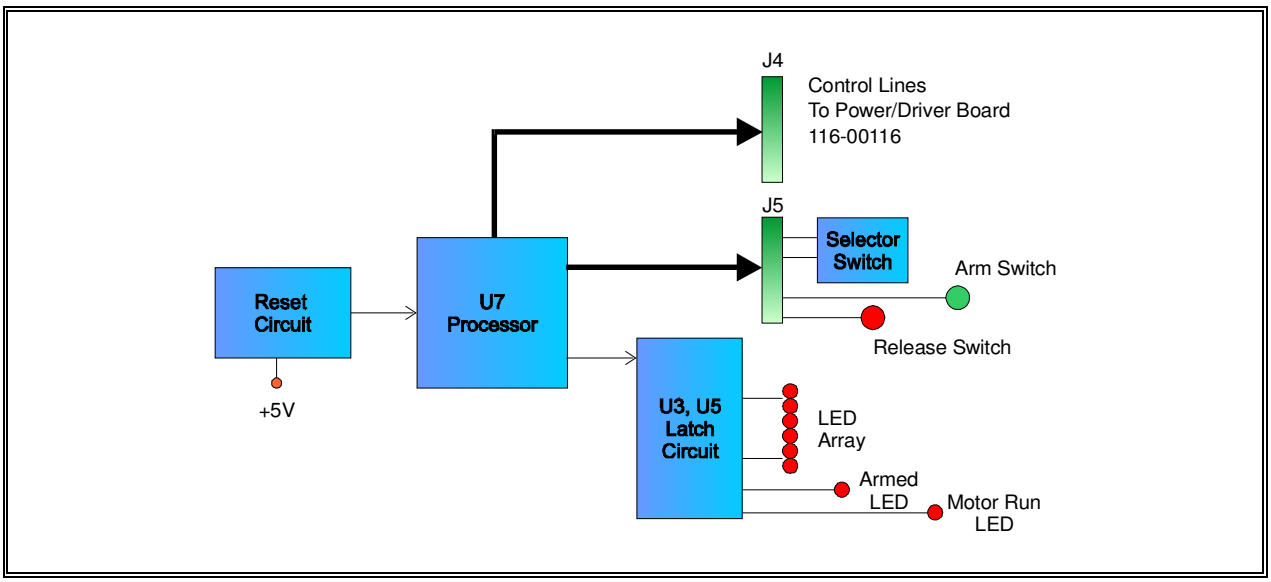

Figure 6-4 - Processor Block Diagram - 116-40103

The ART control program is stored in microcontroller U7. Under control of the address switches, the controller outputs signals to control the line pulse driver, and receives the signals returned by the downhole tools after they are amplified by the Power and Signal Board. The output states for the indicator LED's are latched by U3, U5 and indicate the status of the ACP and attached tool(s).

6.2.5 Signal And Power Block Diagram

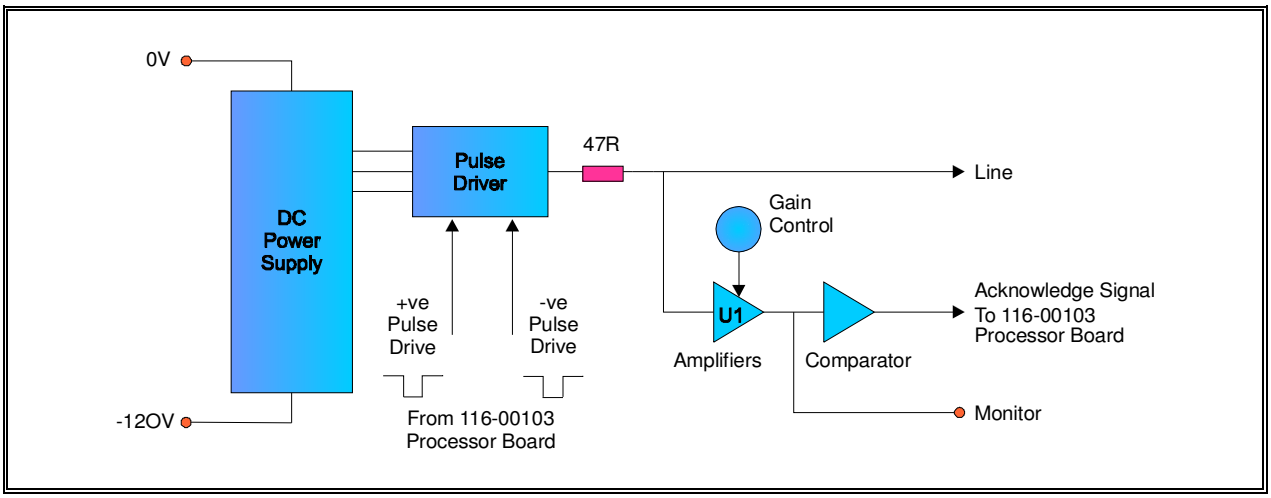

Figure 6-5 - Power And Signal Block Diagram - 116-40116

The -120V power supply generates a voltage chain with steps of -90V, -72V and -108V. The mid-point voltage (-90V) is used to create the base line voltage via a power buffer in the line driver. To generate positive pulses the line is switched to the -72V level, and for negative pulses to the -108V level. The line current is monitored and indicated on a front panel current meter.

Signals returned from the tool are developed across the 47R resistor, amplified and converted to logic levels for input to the processor board. An output to monitor the line signal is provided and the gain control may be altered to adjust amplification for specific cables. In all but extreme cases, however, the system will operate correctly with the gain control set at any position.

6.3 Detailed Downhole Circuit Descriptions

6.3.1.1 Tool Addresses Settings

The tool address is controlled by S1 on both types of telemetry and control board. An address between 1 and 7 is set by the three high order switches on board 116-00109.

Address	SW1 - 1	SW1 - 2	SW1 - 3	SW1 - 4
Binary	X	4	2	1
1	N/A	OFF	OFF	ON
2	N/A	OFF	ON	OFF
3	N/A	OFF	ON	ON
4	N/A	ON	OFF	OFF
5	N/A	ON	OFF	ON
6	N/A	ON	ON	OFF
7	N/A	ON	ON	ON

Table 6-1 - Tool Address Switch Settings – Board 116-00109

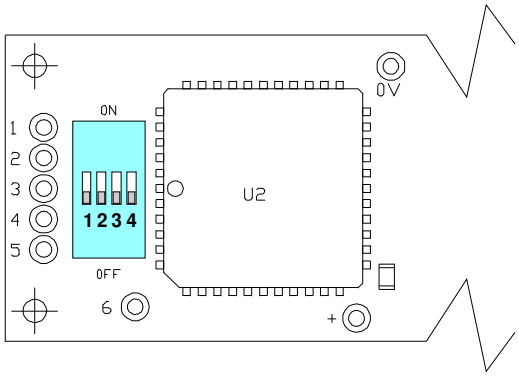

Figure 6-6 - Tool Address Switch Positions – Board 116-00109

On board 116-00421 the address is set by the three low-order switches representing binary 1, 2 and 4.

Address	SW1 - 1	SW1 - 2	SW1 - 3	SW1 - 4
Binary	1	2	4	X
1	ON	OFF	OFF	N/A
2	OFF	ON	OFF	N/A
3	ON	ON	OFF	N/A
4	OFF	OFF	ON	N/A
5	ON	OFF	ON	N/A
6	OFF	ON	ON	N/A
7	ON	ON	ON	N/A

Table 6-2 - Tool Address Switch Settings – Board 116-00421

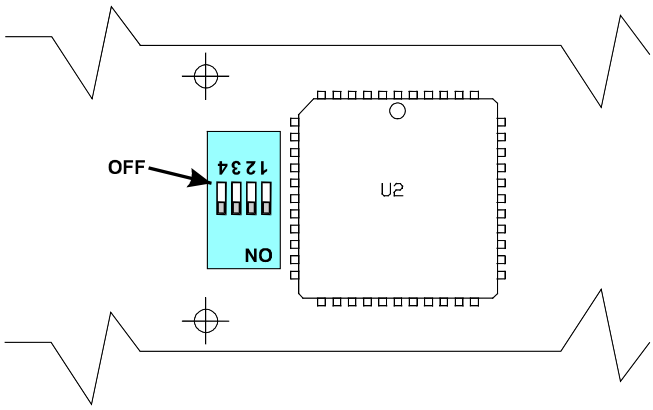

Figure 6-7 - Tool Address Switch Positions – Board 116-00421

Note: The correct address can be checked by connecting the tool to an ACP and allowing the ACP to scroll through and locate active tools.

7 Maintenance (Mechanical & Electrical)

7.1 Introduction

All threads should be lubricated with Liquid O'ring 101 or equivalent during reassembly. O'rings can be lubricated with silicone grease or Liquid O'ring 101. Under no circumstances should silicone grease be used on, or be allowed to come into contact with mating threads as it will act as a thread locking compound making disassembly extremely difficult.

The preventative maintenance scheme suggested for use with all GUARDIAN equipment is divided into three phases. These are -

7.1.1 Pre/Post-Job Maintenance

The pre/post-job maintenance covers tool operational checks, wellsite calibrations, primary pressure seal maintenance and general condition.

7.1.2 Routine Tool maintenance (RTM)

Routine Tool Maintenance procedures are designed to be carried out every 6 jobs or two months if the equipment has been used infrequently. More frequent maintenance is recommended if the equipment is used in hot or high pressure environments. This should be scheduled according to maintenance policy. RTM is divided into electrical and mechanical tasks - RTM(E) and RTM(M). It covers all seal maintenance and the correct operation of sensors.

7.1.3 Tool Verification Check (TVC)

The Tool Verification Check is a set of in-depth tests and measurements designed to ensure that the tool is operating correctly within specification. The TVC should be carried out every 12 - 15 jobs or 6 months as appropriate.

7.2 Recommended Products

The following products are recommended for use with Guardian products. Use of other products or the use of these products in other than the approved application during tool maintenance may degrade performance and/or void warranty.

Product	Part Number	Size	Application
Lubriplate 930AA	302-00001	14oz Tin	Lubrication of mechanical parts only or where lubricant will not be in close proximity to electronics boards or components. Should not be used where gasses given off at temperature could come into contact with electronics systems.
Lubriplate 930AA	302-00001	100ml Tube	
Lubriplate 1444	302-00031	14oz Tube	Lubrication of threads and seals – general application.
Liquid O'ring 101	302-00030	1 lb. Tin	Lubrication of threads and seals – general application (Preferred).
Silicone Grease	302-00002	100gr Tube	Pressure and fluid inlet ports where high retention under temperature is required. e.g. PWH Pressure Inlet Port, ART Pressure Balance Port. Do not use on threads. May be used on o'ring seals.
Loctite 242	302-00004	10ml Tube	Used to lock fasteners (> M4 Thread) which may require future release. Not recommended for use on any fastener < M4 thread. Do not use on plastic components.
Loctite 601	302-00005	10ml Tube	Used to lock small metallic components permanently in place. Not normally used during maintenance. Do not use on plastic components.
DC200/50	302-00035	1 l. Tub	Oil filling of pressure tool buffer tubes and pressure balanced tools. e.g. PWH buffer tube.
Paratherm NF	302-00036	1 l. Tub	Oil filling of pressure tool buffer tubes and pressure balanced tools. e.g. PWH buffer tube. (Preferred)
RTV	302-00016	100ml Tube	Used to secure massive components against vibration & shock.

Table 7-1 – Recommended Maintenance Products

Note: During RTM/TVC maintenance or after repair, the nuts securing the electronics boards to the chassis studding should be hand-tightened with a 5mm A/F nut spinner (~5-7inlbs), and then backed-off $^{1}/_{8}$ turn. This is to allow for board expansion and contraction.

7.3 Pre-Job/Post-Job Maintenance

See Appendix A

A pre/post job maintenance check list is provided in Appendix A. It is recommended that the checks as described below are carried out before and after every trip in the well. For assembly/disassembly instructions see Section 5.3.

The following equipment will be required to perform the pre/post job maintenance:

- Standard Hand Tools;
- Single Service O'ring Kit (206-00003);
- 2 x C-spanner for 2 $^{1}/_{8}$" housing;
- Grease Nipple/Adapter (213-00002/213-00003);
- Silicone grease/Grease Gun (302-00002);
- Liquid O'ring 101 Grease (302-00030);
- ART-H Service Tool Kit;
- 0.030" Feeler Gauge (301-00707);

1. Thoroughly clean outer surface of tool.

2. Check tool outer body and c-spanner holes for excessive damage or wear.

3. Clean thread protectors and check for damage.

4. Clean all threads and check for damage.

5. Remove lower head, lower pressure housing and upper pressure housings. Check all visible o'rings for nicks, other damage or heat set - replace as appropriate and lubricate with Liquid O'ring 101. (Ref: PPJ in o'ring location drawings).

6. Check all o'ring sealing surfaces in the upper and lower ends of the pressure housings and the lower head for damage or scoring.

7. Remove the Chassis Tube from the electronics assembly and visually check for loose, damaged or burnt components.

8. Check all fasteners for security.

9. Check for bent, damaged, loose or corroded contacts.

10. Check position of groove in Valve Piston. See Figure 7-1 – Valve Piston Alignment. The Groove (1) should be aligned with the end of slot (2) when viewed through one of the six slots forming the fingers of the Retaining Sub.

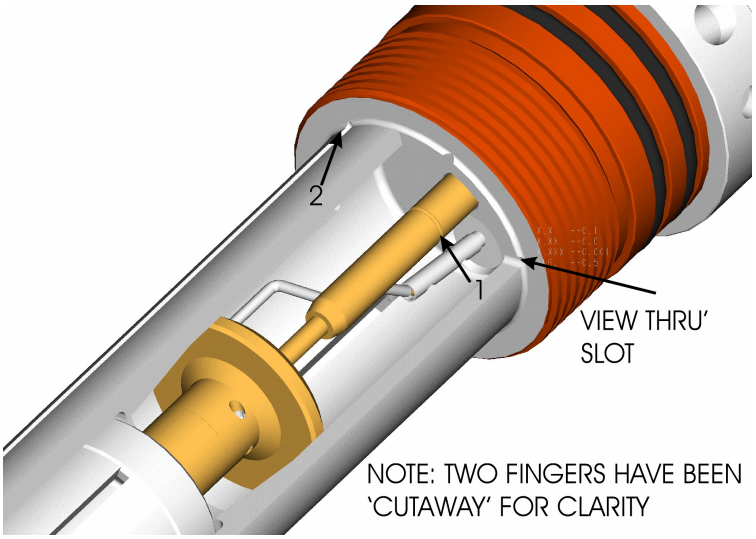

Figure 7-1 – Valve Piston Alignment

11. Check position of locking piston. (See Figure 7-2 – Locking Piston Alignment). The end of the Locking Piston (1) should butt against (or be very close to) the bottom of the Valve Piston (2) at point (3).

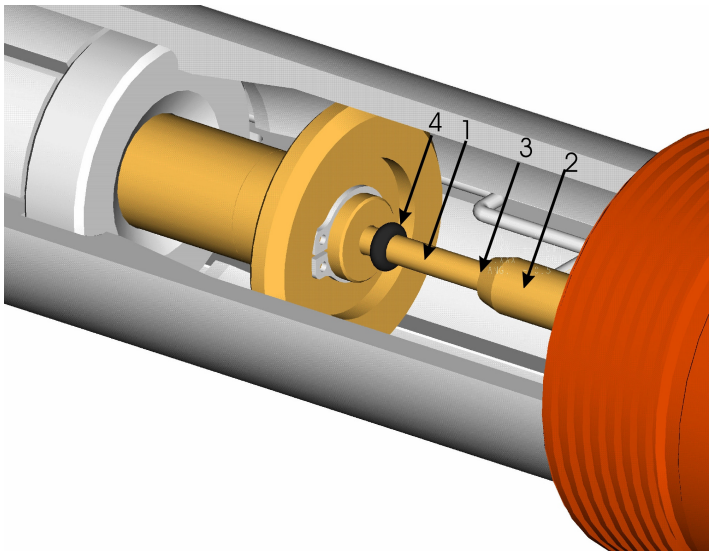

Figure 7-2 – Locking Piston Alignment

12. Check 004 o'ring is seated in groove in Locking Piston. See Figure 7-2 – Locking Piston Alignment (4).

13. Replace the upper and lower housings and lower head lubricating all threads with approved lubricant.

14. Using a 'Megger' meter set to 1000v, check the insulation between upper head and ground with +ve probe on the upper head contact. Result should show a resistance of not less than 999MΩ.

15. Reverse the probes – result should be 550kΩ.

16. Using a low-voltage multimeter, check continuity between upper head and lower head. Result should be <1Ω.

17. Check that the gap as shown in Figure 7-3 is less than 0.03" / 0.75mm. Use Feeler Gauge (301-00707).

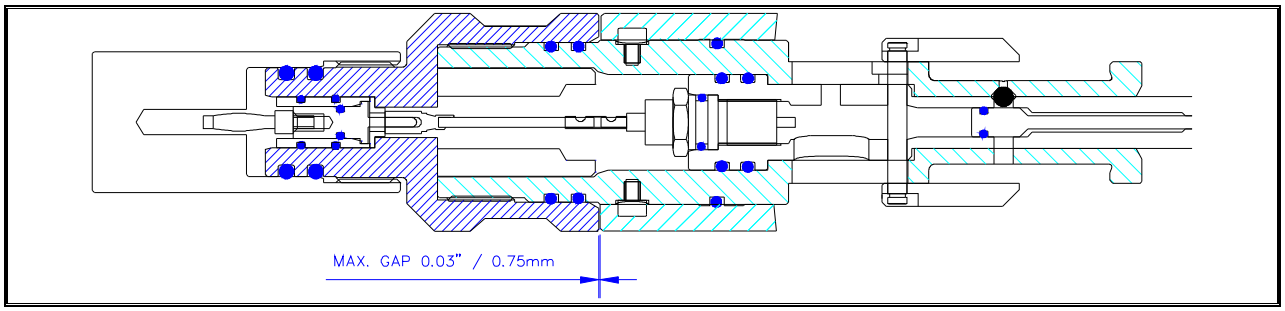

Figure 7-3 – Lower Head Gap Measurement

18. Remove both retaining plugs from the shuttle valve pressure ports. If an air-line is available blow air in one port to remove silicone grease and any well fluid. Note. The Safety Screen (49) on the downstream side of the airflow will be removed with the silicone grease - ensure that this screen is preserved for replacement. Blow air in the opposing hole to remove the second screen. Continue to blow air through the connecting ports until no further fluid is seen to exit. Screw the grease nipple and grease nipple adapter into either port and inject silicone grease until it is seen issuing from the second port. Check both Safety Screens (49) for integrity and replace in each pressure port or renew as appropriate. Replace the Retaining Plugs (50).

19. Perform operational check (See Section 4) and check address setting.

20. Lubricate end threads and replace thread protectors.

7.4 Routine Tool Maintenance (M & E)

See Appendix B for RTM checksheet

The following equipment will be required to perform the RTM:

- Standard Hand Tools;
- O'rings as required;
- Replacement spirol pins and fasteners as required;
- Pressure Isolation Service Tool (301-00007);
- O'ring Installation Tool, Size 008 (301-00008);
- 2 x C-spanner for 2 $^{1}/_{8}$" housing;
- Grease Nipple/Adapter (213-00002/213-00003);
- Silicone grease/Grease Gun (302-00002);
- Liquid O'ring 101 Grease (302-00030);
- Loctite 242;
- ART-H Service Tool Kit;
- Cable simulator (301-00468);
- ART Control Panel;

1. Perform all maintenance procedures given in the pre/post job maintenance schedule.

In addition to these procedures, perform the following:

Remove lower head, lower pressure housing and upper pressure housings. Remove the Chassis Tube (E1 in Electronics Assembly drawings).

2. Clean circuit boards of and dirt, grease or other deposits.

3. Inspect all fasteners and large components for security. Replace RTV/Silicone Compound (302-00006) or Loctite 242 (302-00004) as appropriate.

4. Remove chassis from Pressure Isolation Head and check for security of brass screw in lower side of PI Head (Applies only to early issue tools. On all later tools the PI Head connection is secured with an Aerotight nut).

5. Check for excess play between the Electronics Chassis (E9 in Electronics Assembly drawings) and the Lower Chassis Mount (E3 in Electronics Assembly drawings). If excess play is present, remove the two spirol pins (E20) securing the Chassis and renew. Item 5 applies only to tools fitted with spirol pins to the chassis/lower mount. Later tools have grubscrews fitted – these should be tightened as required.

6. Replace all o'rings referenced **RTM** in o'ring location drawings.

7. Perform functional check. Set the ACP Function Switch to 'SAFETY'. Switch on the ACP and check that the current meter reads approximately 11mA, and that the light sequence cycles through all tools showing a red light while interrogating each tool and leaving a green light on the address of the tool under test.

   Set the Function Switch to the tool address and check that the ACP flashes while handshaking with the tool and then stops cycling. Press the 'ARM' button and check that the 'ARMED' LED illuminates. Press the 'RELEASE' button and check that the 'MOTOR RUN' LED illuminates. Note the tool current which should be between 40 and 65mA. Switching the Panel Power off immediately will prevent the motor advancing the release mechanism. Reset the Function Switch to 'SAFETY'.

7.5 Tool Verification Check

7.5.1 Mechanical – TVC-M

See Appendix C for TVC checksheet

The following equipment will be required to perform the TVC(M):

- Standard Hand Tools;
- O'rings as required;
- Replacement spirol pins and fasteners as required;
- Pressure Isolation Service Tool (301-00007);
- Box Spanner, 9/16" (213-00004);
- Feedthrough Removal Tool (301-00032);
- Feedthrough Insertion Tool (301-00033);
- Flaring Tool (301-00048);
- Wedge Flaring Tool (301-00041);
- Locking Tool (301-00042);
- Release Piston Removal Tool (301-00050);
- Vernier or Digital Calliper/Micrometer;
- 2 x C-spanner for 2 $^{1}/_{8}$" housing;
- Grease Nipple/Adapter (213-00002/213-00003);
- Silicone grease/Grease Gun (302-00002);
- Liquid O'ring 101 Grease (302-00030);
- Loctite 242;

1. Perform all maintenance procedures given in the pre/post job maintenance schedule.

2. Perform all maintenance procedures given in the RTM maintenance schedule.

In addition to these procedures, perform the following:

3. Replace all o'rings referenced TVC in o'ring location drawings.

4. Remove and service the two Thrust Bearings. (Ref: 41 in General Assembly / Exploded Drawings).

5. Replace the two Wave Springs. (Ref: E17 in Electronics Assembly Drawings and 43 in General Assembly / Exploded Drawings).

6. Examine the pressure housing for signs of wear. If wear is apparent, measure four diameters at the positions shown on the diagram below on both upper and lower pressure housings.

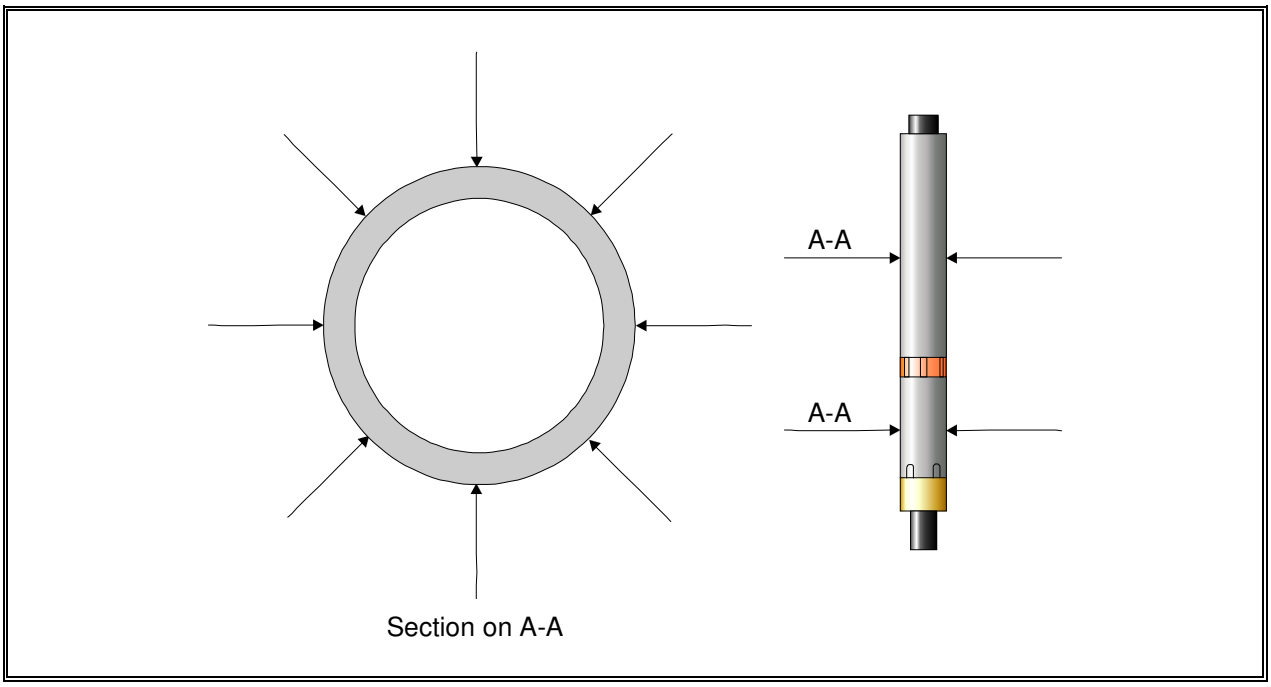

Figure 7-4 - Pressure Housing Wear Measurement

If any of the diameters are 2.105" (53.47mm) or less, the pressure housing(s) should be replaced.

7. Examine the Locking Ball hole in the Fishing Body (see section 4.4) for elongation. If the hole exceeds the specified length, replace the Fishing Body (116-00060).

7.5.2 Electrical – TVC-E

The tool verification check is a set of in-depth tests and measurements designed to ensure that the tool is operating correctly within specification. The TVC should be carried out every 6 months or 12-15 jobs as appropriate. A TVC check sheet is provided in Appendix C.

The following equipment will be required to perform the TVC(E):

- Tektronix 2235A oscilloscope, or equivalent 100Mhz oscilloscope;
- x1/x10 Scope Probe;
- Fluke Digital Multimeter (or similar);
- Cable Simulator Unit - Monocable (Guardian P/N 301-00468);

Remove the ACP cover, and connect a mains power lead to the power socket.

CAUTION - MAINS A.C. AND 120V DC ARE PRESENT IN THE UNIT. REFER TO CIRCUIT AND LAYOUT DIAGRAMS WHEN CARRYING OUT CHECKS.

Switch on the ACP with no tool or cable connected.

8. Check the supply rails for correct voltages.

		Tolerance:
• -120V	Power/signal Board TB1	+/- 4.0V
• +12V	Power/signal Board TB2	+/- 0.75V
• +5V	Power/signal Board TB2	+/- 0.75V
• -12V	Power/signal Board TB2	+/- 0.75V
• -90V	Power/signal Board Z2Anode	+/- 2.5V
• -72V	Power/signal Board Z3Anode	+/- 2.5V
• -54V	Power/signal Board Z4Anode	+/- 2.5V

Switch off the ACP, replace and secure the front panel. Connect the ACP to a tool via a Cable Simulator Unit. Set the function switch to SAFETY. Switch on the ACP.

9. Check the input Line Voltage is 120V +/- 4.0V.

10. Inspect the signal level on the line with the Oscilloscope set to AC input, 5V/cm sensitivity. The ACP should transmit a signal burst at 1Hz repetition, of +ve and -ve pulses 18V amplitude, in the format shown in section 3.3, fig. 3.1.

11. Inspect the signal level on the 'MONITOR' output, with the oscilloscope sensitivity set to 2V/cm. The ACP signal train should be seen, limited to +/- 3V amplitude, followed by the return signal from the tool.

12. Carry out the functional checks detailed in the RTM(E), section 6.6.2. above.

13. Connect a power resistor of 1k5 value and at least 5w rating in series with a calibrated digital multimeter on mA range to the output of the ACP. Switch on the ACP. The ACP front panel current meter and the DMM should read within 5mA of each other.

If any of the above checks fail, see Sections 6.3 (Detailed Circuit Description) or 10.2 (Electronic Trouble-Shooting)

7.6 Non-Routine Maintenance Procedures

7.6.1 Change Of Tool Address

Changing of the tool's address is accomplished by means of the DIP switches mounted on board 116-00107 (116-00421 in issue H and later tools).

See Section **Error! Reference source not found.** for a description of the DIP switch settings.

7.6.2 Change of Head Type

The ART-H is supplied as standard with GO Type A upper (box) and lower (pin) heads. Conversion kits are available to convert these to reversed type A (upper - pin / lower - box). Order the following P/N and follow the instructions supplied.

202-00022	PI Head Conversion, GO Type A to GO Type A (Rev)
202-00031	LH Conversion, ART-H, GO to GO Type A (Rev)

7.6.3 Redress After Seal Failure

Should the internal cavity of the lower housing of the tool be subject to well pressure of 2000psi or greater (seal failure or other mechanism) during operations, it is recommended that a new Release Piston – 116-00058 be fitted if an issue F or above Piston is in use. (This Piston has a circumferential groove 2.8" / 71mm from its larger end).

This procedure is not necessary if the tool has executed a normal motorised release cycle.

Issue F Release Pistons are fitted to ART-H, issue H and above and to ART-F, issue B and above.

7.7 O'ring Specifications

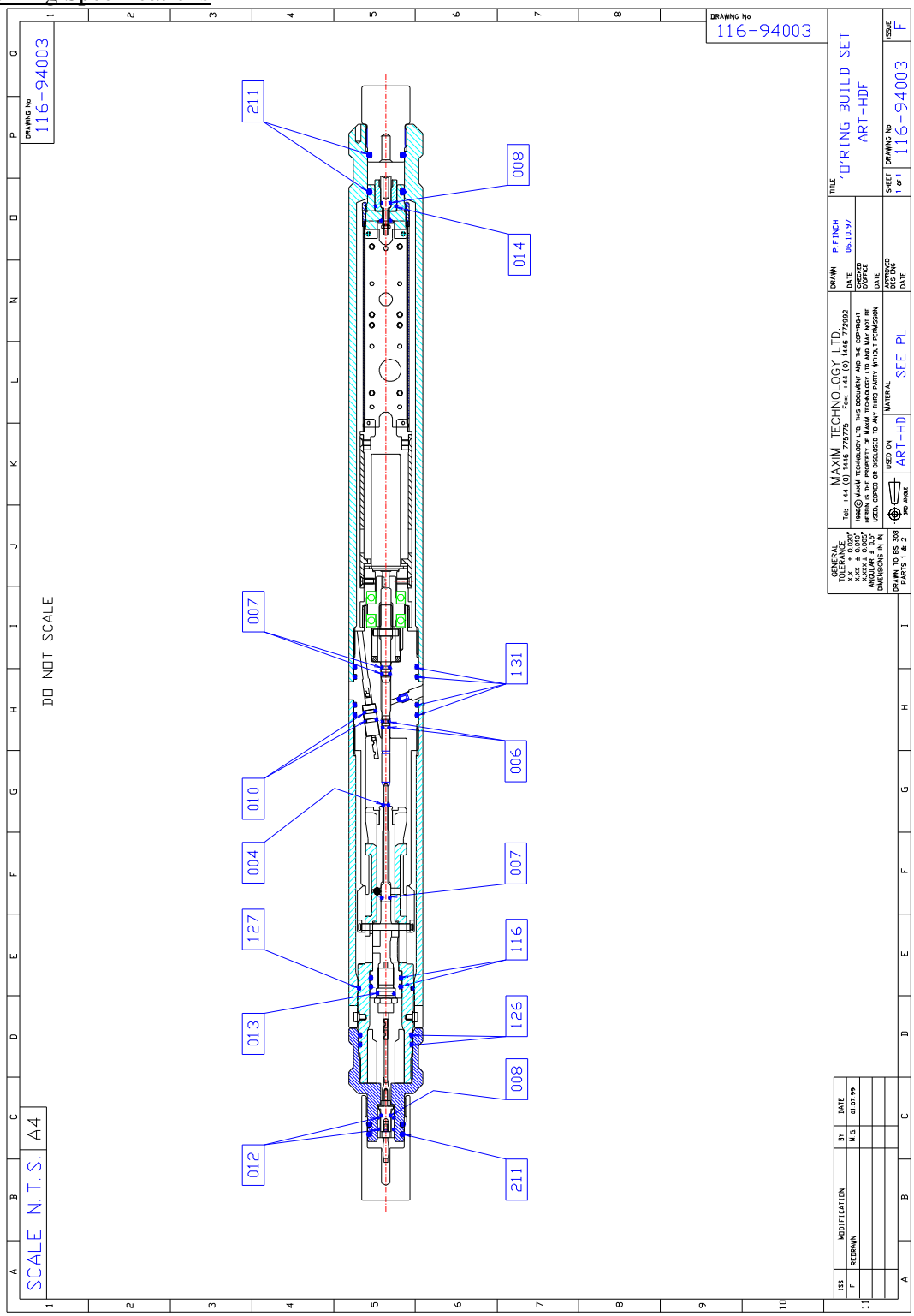

Figure 7-5 - O'ring Location Drawing - 116-94003-F

Item:	Qty:	Part No:	Description:	Reference:
1	2	204-90006	O'ring, Viton, 90, 006	
2	2	204-90007	O'ring, Viton, 90, 007	
3	1	204-90008	O'ring, Viton 90, 008	
4	1	204-90014	O'ring, Viton, 90, 014	
5	4	204-90131	O'ring, Viton, 90, 131	
6	2	204-90211	O'ring, Viton, 90, 211	
7	1	116-00247	O'Ring Build Set, Fishing Head Assy., ART-H	Not reqd. where pre-build Fishing Head Assy is used

Table 7-2 - O'Ring Listing, ART-H Main Assembly - 116-94003-F

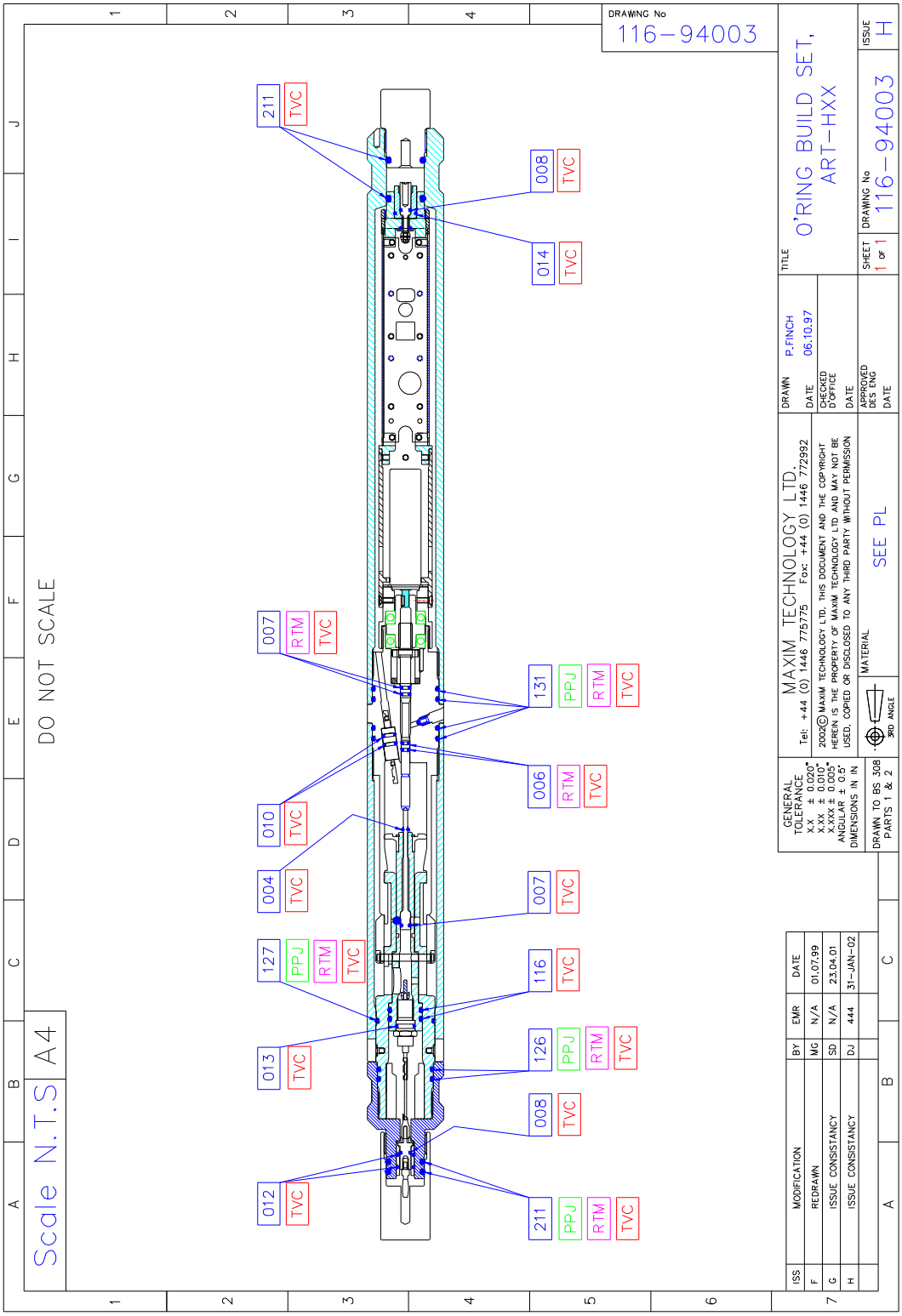

Figure 7-6 - O'ring Location Drawing - 116-94003-H

Item:	Qty:	Part No:	Description:	Reference:
1	1	204-90004	O'ring, Viton, 90, 004	
2	2	204-90006	O'ring, Viton, 90, 006	
3	3	204-90007	O'ring, Viton, 90, 007	
4	2	204-90008	O'ring, Viton, 90, 008	
5	2	204-90010	O'ring, Viton, 90, 010	
6	2	204-90012	O'ring, Viton, 90, 012	
7	1	204-90013	O'ring, Viton, 90, 013	
8	1	204-90014	O'ring, Viton, 90, 014	
9	2	204-90116	O'ring, Viton, 90, 116	
10	2	204-90126	O'ring, Viton, 90, 126	
11	1	204-90127	O'ring, Viton, 90, 127	
12	4	204-90131	O'ring, Viton, 90, 131	
13	4	204-90211	O'ring, Viton, 90, 211	

Table 7-3 - O'Ring Listing, ART-H Main Assembly - 116-94003-H

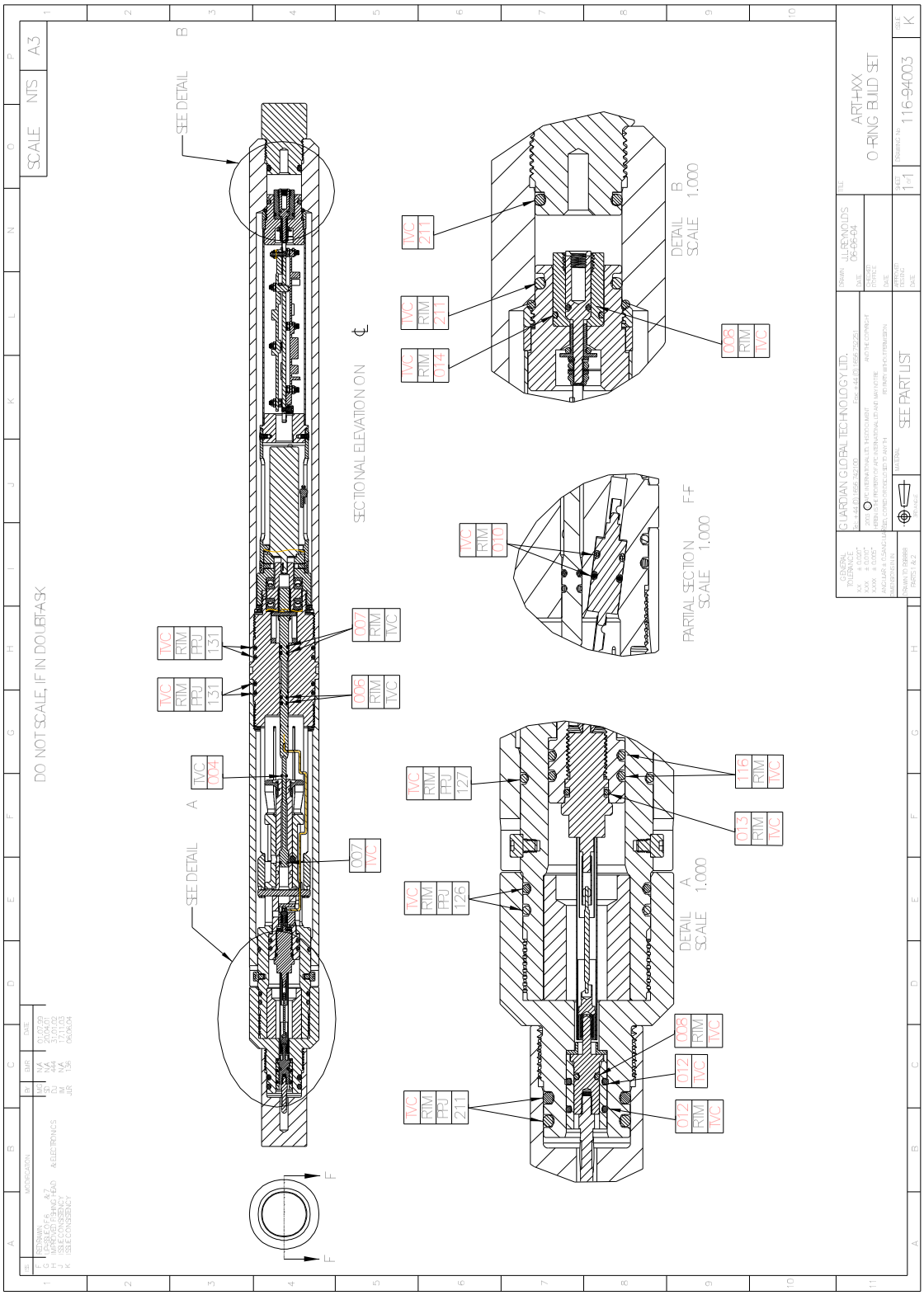

Figure 7-7 - O'ring Location Drawing - 116-94003-K

Item:	Qty:	Part No:	Description:	Reference:
1	1	204-90004	O'ring, Viton, 90, 004	
2	2	204-90006	O'ring, Viton, 90, 006	
3	3	204-90007	O'ring, Viton, 90, 007	
4	2	204-90008	O'ring, Viton, 90, 008	
5	2	204-90010	O'ring, Viton, 90, 010	
6	2	204-90012	O'ring, Viton, 90, 012	
7	1	204-90013	O'ring, Viton, 90, 013	
8	1	204-90014	O'ring, Viton, 90, 014	
9	2	204-90116	O'ring, Viton, 90, 116	
10	2	204-90126	O'ring, Viton, 90, 126	
11	1	204-90127	O'ring, Viton, 90, 127	
12	4	204-90131	O'ring, Viton, 90, 131	
13	4	204-90211	O'ring, Viton, 90, 211	

Table 7-4 - O'Ring Listing, ART-H Main Assembly - 116-94003-K

Item:	Qty:	Part No:	Description:	Reference:
1	1	204-90004	O'ring, Viton, 90, 004	
2	1	204-90007	O'ring, Viton, 90, 007	
3	1	204-90008	O'ring, Viton 90, 008	
4	2	204-90010	O'ring, Viton, 90, 010	
5	2	204-90012	O'ring, Viton 90, 012	
6	1	204-90013	O'ring, Viton, 90, 013	
7	2	204-90116	O'ring, Viton, 90, 116	
8	2	204-90126	O'ring, Viton, 90, 126	
9	1	204-90127	O'ring, Viton, 90, 127	
10	2	204-90211	O'ring, Viton, 90, 211	

Table 7-5 – O'Ring Listing, Fishing Head Assembly, ART-H - 116-00247-E

P/N 116-00247 is available as an o'ring kit for servicing the fishing head only. The main o'ring kit (116-94003) includes all o'rings required for a complete tool build, including fishing head.

8 Spares and Accessories

8.1 Field Ready Box

The following is a list of recommended spares for a field ready box:

Item:	Qty:	Part No:	Description:	Reference:
1	1	116-00053	Drive Nut, ART-H	
2	1	116-00056	A/R Pin, ART-H	
3	1	116-00057	Mushroom, ART-H	
4	1	116-00059	Locking Piston, ART-H	
5	1	116-00062	Retaining Sleeve, ART-H	
6	4	116-00066	A/R Pin, Motor ART-H	
7	6	116-00071	Screw, Modified M4 x 6	
8	2	116-00113	Retaining Plug, 6mm	
9	1	116-00121	Anti-rotation Pin, Slotted Insert, ART	
10	1	116-00145	A/R Pin, Valve Piston	
11	1	201-00019	Chassis Tube Retaining Ring	
12	1	201-00020	Chassis Tube Anti-Rotation Collar	
13	1	202-00003	Cup Insulator, P I Head	
14	2	202-00007	Pin, Banana, 4mm, Male, M3x6mm	
15	1	202-00011	Insulator, T Section, Pressure Isolation Head	
16	1	202-00026	Insulator, Lower Head, Inner (Short)	
17	1	202-00030	Connector, P I Head, GO Type A	
18	1	202-00040	Insulator, Lower Head, PPL Type.	
19	1	203-00003	Wave Spring, OD1.25	
20	1	203-00004	Wave Spring, BRG OD28mm	
21	4	208-00040	Circlip, 3/8", External, S/S	
22	10	208-00056	Spring Tension Pin, 2mm x 6mm ISO 8750	
23	10	208-00182	Circlip, 3/16", External, BeCu	
24	1	210-00003	Ready Box Kit, ART-HXX	
25	2	212-00002	Thrust Bearing, 28mm OD, 15mm Bore	
26	2	212-00028	Ball Bearing, Tungsten Carbide, Dia. 3/16"	
27	4	213-00001	Filter Screen, Flange Mounted	
28	1	303-00056	Cable Assembly, Intermediate, ART-H	
29	1	303-00057	Cable Assembly, Lower, ART-H	
30	1	404-00183	Socket Contact, Crimp 20 AWG	
31	1	404-00327	Contact, Socket, Crimp, 20AWG, Green code	
32	1	404-00328	Contact, Pin, Crimp, 20AWG, Green code	
33	1	406-00004	Motor, Assembled (With Key)	

Table 8-1 - Recommended Spares List, ART-H, 116-93003-K

Item:	Qty:	Part No:	Description:	Reference:
1	1	116-00053	Drive Nut, ART-H	
2	1	116-00056	A/R Pin, ART-H	
3	1	116-00057	Mushroom, ART-H	
4	1	116-00059	Locking Piston, ART-H	
5	1	116-00062	Retaining Sleeve, ART-H	
6	1	116-00063	Pin, Retaining Sleeve	
7	4	116-00066	A/R Pin, Motor ART-H	
8	6	116-00071	Screw, Modified M4 x 6	
9	1	116-00105	Line Isolation PCB, Assembled	
10	2	116-00113	Retaining Plug, 6mm	
11	1	116-00121	Anti-rotation Pin, Slotted Insert, ART	
12	1	116-00145	A/R Pin, Valve Piston	
13	1	116-00421	ART Power Supply/Signal PCB Assembly	
14	1	201-00019	Chassis Tube Retaining Ring	
15	1	201-00020	Chassis Tube Anti-Rotation Collar	
16	1	201-00108	Adapter, A3 Plunger, Mount	
17	1	201-00109	Button Head, A2/A3	
18	1	202-00003	Cup Insulator, P I Head	
19	1	202-00011	Insulator, T Section, Pressure Isolation Head	
20	1	202-00026	Insulator, Lower Head, Inner (Short)	
21	1	202-00030	Connector, P I Head, GO Type A	
22	1	202-00040	Insulator, Lower Head, PPL Type.	
23	1	202-00090	Plunger Contact, A2/A3 Head	
24	1	203-00003	Wave Spring, OD1.25	
25	1	203-00004	Wave Spring, BRG OD28mm	
26	4	208-00040	Circlip, 3/8", External, S/S	
27	10	208-00056	Spring Tension Pin, 2mm x 6mm ISO 8750	
28	10	208-00182	Circlip, 3/16", External, BeCu	
29	1	210-00003	Ready Box Kit, ART-H/F/J/T	
30	2	212-00002	Thrust Bearing, 28mm OD, 15mm Bore	
31	2	212-00028	Ball Bearing, Tungsten Carbide, Dia. 3/16"	
32	4	213-00001	Filter Screen, Flange Mounted	
33	1	303-00056	Cable Assembly, Intermediate, ART-H	
34	1	303-00057	Cable Assembly, Lower, ART-H	
35	1	404-00183	Socket Contact, Crimp 20 AWG	
36	1	404-00327	Contact, Socket, Crimp, 20 AWG, Green code	
37	1	404-00328	Contact, Pin, Crimp, 20AWG, Green code	
38	1	406-00004	Motor, Assembled (With Key)	

Table 8-2 - Recommended Spares List, ART-F, 116-93011-A

Item:	Qty:	Part No:	Description:	Reference:
1	1	116-00053	Drive Nut, ART-H	
2	1	116-00056	A/R Pin, ART-H	
3	1	116-00057	Mushroom, ART-H	
4	1	116-00059	Locking Piston, ART-H	
5	1	116-00062	Retaining Sleeve, ART-H	
6	1	116-00063	Pin, Retaining Sleeve	
7	4	116-00066	A/R Pin, Motor ART-H	
8	6	116-00071	Screw, Modified M4 x 6	
9	1	116-00105	Line Isolation PCB, Assembled	
10	2	116-00113	Retaining Plug, 6mm	
11	1	116-00121	Anti-rotation Pin, Slotted Insert, ART	
12	1	116-00145	A/R Pin, Valve Piston	
13	1	116-00421	ART Power Supply/Signal PCB Assembly	
14	1	201-00019	Chassis Tube Retaining Ring	
15	1	201-00020	Chassis Tube Anti-Rotation Collar	
16	1	201-00108	Adapter, A3 Plunger, Mount	
17	1	201-00109	Button Head, A2/A3	
18	1	202-00003	Cup Insulator, P I Head	
19	1	202-00011	Insulator, T Section, Pressure Isolation Head	
20	1	202-00026	Insulator, Lower Head, Inner (Short)	
21	1	202-00030	Connector, P I Head, GO Type A	
22	1	202-00040	Insulator, Lower Head, PPL Type.	
23	1	202-00090	Plunger Contact, A2/A3 Head	
24	1	203-00003	Wave Spring, OD1.25	
25	1	203-00004	Wave Spring, BRG OD28mm	
26	4	208-00040	Circlip, 3/8", External, S/S	
27	10	208-00056	Spring Tension Pin, 2mm x 6mm ISO 8750	
28	10	208-00182	Circlip, 3/16", External, BeCu	
29	1	210-00003	Ready Box Kit, ART-HXX	
30	2	212-00002	Thrust Bearing, 28mm OD, 15mm Bore	
31	2	212-00028	Ball Bearing, Tungsten Carbide, Dia. 3/16"	
32	4	213-00001	Filter Screen, Flange Mounted	
33	1	303-00056	Cable Assembly, Intermediate, ART-H	
34	1	303-00410	Cable Assembly, Lower, ART-J	
35	1	404-00183	Socket Contact, Crimp 20 AWG	
36	1	404-00327	Contact, Socket, Crimp, 20AWG, Green code	
37	1	404-00328	Contact, Pin, Crimp, 20AWG, Green code	
38	1	406-00004	Motor, Assembled (With Key)	

Table 8-3 - Recommended Spares List, ART-J, 116-93018-A

The Ready Box Kit (210-00003) contains the following items:

Item:	Qty:	Part No:	Description:	Reference:
1	5	208-00008	Washer, 3mm, Plain, S/S	
2	5	208-00009	Washer, 3mm, Spring, S/S Square Section.	
3	1	208-00040	Circlip, 3/8", External, S/S	
4	4	208-00056	Spring Tension Pin, 2mm x 6mm ISO 8750	
5	2	208-00066	Screw, Skt Cap Hd, M3 x 6mm, S/S A2	
6	4	208-00101	Grubscrew, Skt Hd, M4 x10	
7	4	208-00125	Screw, Csk Hd Pozi, M3 x 12mm, S/S	
8	4	208-00130	Screw, Csk Hd Skt, M4 x 8mm, S/S	
9	4	208-00141	Nut, Full, M3, S/S	
10	2	208-00180	Nut, M3, Aerotight, A2 S/S	
11	6	208-00182	Circlip, 3/16", External, BeCu	
12	4	208-00203	Screw, Csk Hd Pozi, M3 x 6mm	
13	2	208-00242	Grubscrew, Skt Hd, M4 x 4, A4 S/S	
14	2	208-00404	Screw, Button Hd, Skt., M3 x 12mm	
15	4	208-00430	Screw, Skt Cap Hd, 10-32 UNF x 0.375	Used only for ART-J

Table 8-4 - Ready Box Kit List - 210-00003

9 Interpretation and Data Processing

There are no interpretation or data processing operations associated with the ART-H.

10 Trouble Shooting

10.1 Operational

1. If the tool does not take current for a sufficient period to release (2-3 minutes), switch off and then perform a further operation sequence. Do this as many times as is necessary for the tool to have taken correct current for at least twice as long as the nominal release time.

2. If the tool does not separate after taking current for the appropriate or longer period, gradually work the cable up and down to ensure that tension has reached the head of the toolstring. It may also be necessary to wait (up to 3-4 hours) in the event that the fluid ports in the tool have become partially blocked.

10.2 Electronic

1. If no signal can be obtained from the tool, perform basic trouble-shooting procedures - e.g. ACP 'GAIN' Control setting, continuity & insulation, check of dummy cable etc.

2. For trouble-shooting purposes the ART system can be logically broken down into 3 sections - ACP Control Panel, Tool Line Isolation and Tool Control Section.

3. For initial electronic trouble-shooting, follow the TVC(E) procedures described in section 6.3.3. If either switch mode or linear power supplies have failed, return the item to Guardian for replacement. These items are not field repairable.

4. The surface panel can be checked independently for power and signal transmission. If power is present, but no pulses are output, check the pulse drive lines from the Processor Board to the Power/Drive Board on Power/Drive Board J2 (Pins 2 & 3).

5. If power is applied to the tool, and there is no response from the panel, check that line power is reaching the Control Board. If line volts are not present on the 'Line In' to the control board, there is a fault on the Line Isolation Board.

6. If power and correct pulses in are present on 'Line In' but positive pulses are not output from the Control Board when it is addressed, then there is a fault on the Control Board.

7. If pulses are being output from the tool, but not recognised by the panel check the output from the ACP Control Board to the Processor Board on Processor Board PL4 pin 4. The Line Signal Conditioning is tolerant of a wide range of line lengths with the GAIN Control in the mid-range setting, and adapts its detector level to the signal received. It may be turned up if the tool return is very attenuated on long lines, or turned down if the signal overloads on short lines.

8. Subsequently refer to the detailed electronics descriptions given in section 6.2 to identify the component level problem.

9. If the indicated tool current at surface with the motor running is in excess of 65mA, firstly check the current meter on the ACP by carrying out procedure 13 of section 7.5.2. If the ACP meter is reading correctly then either the tool is not built correctly, in which case it should be disassembled and rebuilt or the motor gearbox is worn and requires replacement. If the gearbox is worn it is likely to be particularly noisy.

10.3 Mechanical

There are no specific mechanical trouble shooting procedures.

ART-H Index

Pre/Post Job Maintenance Check Sheet

(See Section 7.3 in manual)

ART-H / ART-F / ART-J / ART-T	S/N:

Item	Procedure	Completed
1	Thoroughly clean and degrease tool	
2	Check tool outer body for damage or excessive wear	
3	Check condition of thread protectors and grease lightly	
4	Clean all threads and check for damage	
5	21.Remove upper and lower pressure housings. Check/replace all o'rings reference PPJ in o'ring location drawings	
6	Check all o'ring sealing surfaces for damage or scoring.	
7	Remove chassis tube. Visually inspect for loose, damaged or burnt components	
8	Check security of all fasteners	
9	Check for bent, corroded or damaged contacts	
10	Check position of groove in valve piston seen through finger slots.	
11	Check upper end of locking piston butts against lower end of valve piston	
12	Check 004 o'ring is seated in groove in locking piston shaft	
13	Replace upper and lower housings, greasing seals and threads	
14	Check insulation between upper head and ground (+ve on UH) Result: (Min. 750kΩ)	
15	Check insulation between upper head and ground (-ve on UH) Result: (Min. 400kΩ)	
16	Check continuity between upper head and lower head Result: (Max. 0.25Ω)	
17	Check Lower Head to Lower Housing clearance gap.	
18	Service pressure ports/filter screens.	
19	Perform operational check as per section 4.1. Check tool address setting.	
20	Lubricate end threads and replace thread protectors.	

Routine Tool Maintenance Check Sheet - RTM(M&E)

ART-H / ART-F / ART-J / ART-T	S/N:

Item	Procedure	Completed
1	Perform all pre/post job maintenance procedures	
2	Clean circuit boards of dirt, grease etc.	
3	Replace RTV as required	
4	Check security of PI Head connection	
5	Check for excess play between chassis/lower chassis mount	
6	Replace all o'rings referenced RTM in appropriate o'ring location drawing	
7	Perform functional check	

Tool Verification Check Sheet - TVC(M&E)

(See Section 7.5 in manual)

ART-H / ART-F / ART-J	S/N:

Item	Procedure	Completed
1	Perform all pre/post job maintenance procedures	
2	Perform all RTM maintenance procedures	
3	Replace all o'rings referenced **TVC** in o'ring location drawings	
4	Service thrust bearings (41 in Assembly Drawings)	
5	Replace two wave springs (43 in Assembly Drawings, E17 in Electronics Assembly Drawings)	
6	Perform pressure housing wear measurement	
7	Perform elongation check on Fishing Body	
8	Check power supply rails of ACP	
9	Check line voltage	
10	Check signal level from ACP	
11	Check ACP 'MONITOR' output	
12	Perform RTM functional tests	
13	Perform ACP current meter check	

ART-H Section 15 – Heads