Alpha Lubricator System
Operation Manual
MC Engines

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List of Abbreviations:

This is a list of abbreviations used in this manual.

AC	Alternating Current
ACC	Adaptive Cylinder oil Control
ALCU	Alpha Lubricator Control Unit
AMS	Engine alarm System
BCU	Backup Control Unit
DC	Direct Current
ECR	Engine Control Room
FBU	Fuse Board Unit
FPGA	Fast Programmable Graphic Array
HMI	Human Machine Interface
IC	Integrated Circuit
Lcd	Load change dependent
LED	Light Emitting Diode
MCU	Master Control Unit
MEP	Mean Effective Pressure
PCB	Printed Circuit Board
RPM	Revolutions Per Minute
SBU	Switch Board Unit
TDC	Top Dead Centre
UPS	Uninterruptable Power Supply

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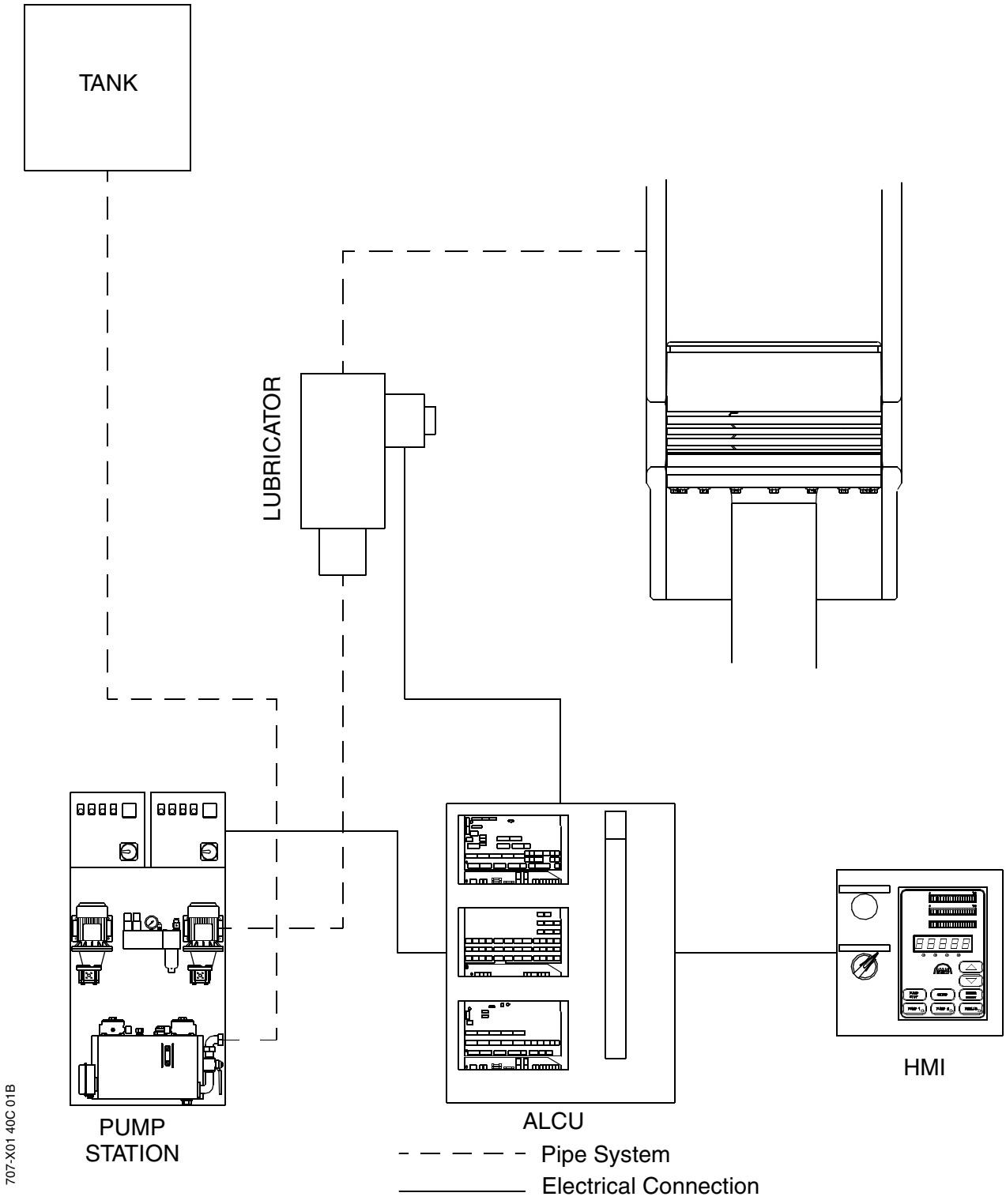
1. General Information

1.1 Main components

The Alpha Lubricator System Layout is shown in the diagram below:

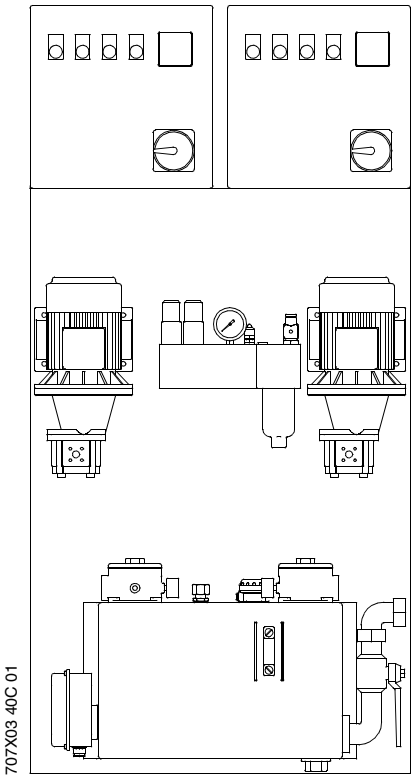
Alpha Lubricator System Layout



Pump station and starter panels

The pump station consists of two individually operating pumps, heating coil, filters and a suction tank. The power supply to the pump station starter panels is taken from two separate circuit breakers, one supplying each pump.

For further information, see Maker's pump station manual.

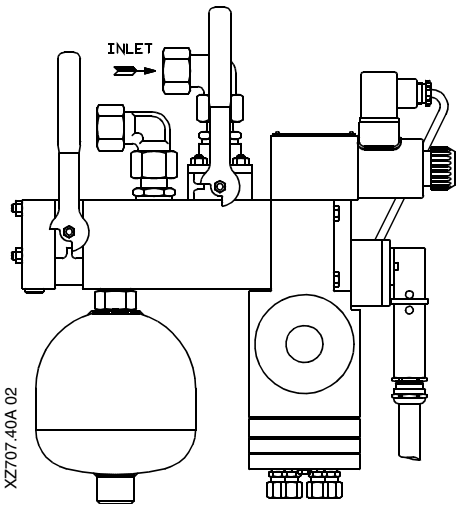


Lubricator units

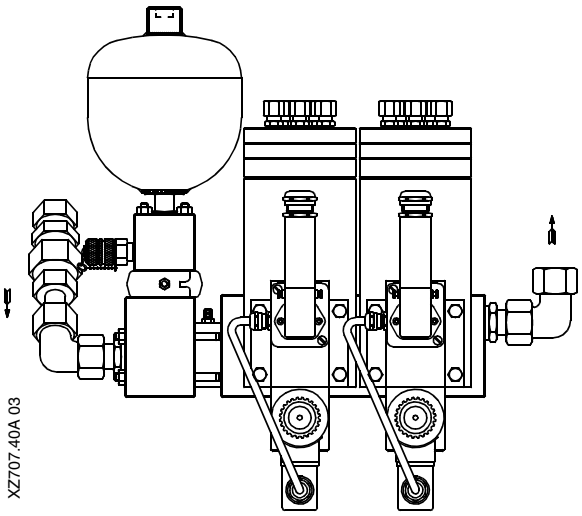
The lubricator units, one for each cylinder, each comprise two lubricators for 98-70 bore engines and one lubricator for medium and small bore engines. Each lubricator unit is equipped with one accumulator with nitrogen pre-pressure of 25-30 bar on the inlet side, and one accumulator on the outlet side of each lubricator, with nitrogen pre-pressure of 1.5 bar.

Each lubricator features 3, 4, 5 or 6 lubricating pistons, depending on engine type, a feedback pickup and a solenoid valve.

One-lubricator unit



Two-lubricator unit

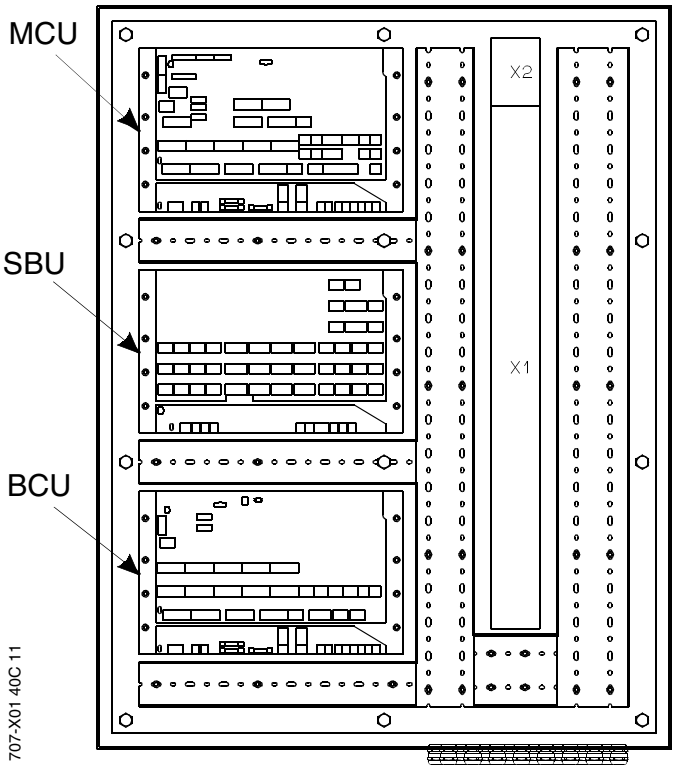


Alpha lubricator control unit – ALCU

The three main electronic components for controlling the lubricating oil are comprised in one steel cabinet – the so-called ALCU unit.

The three units are:MCU(Master Control Unit)
BCU (Backup Control Unit)
SBU (Switch Board Unit)

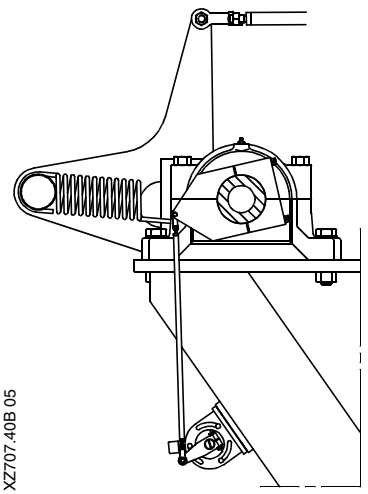
A terminal block interfaces all electrical connections to the engine.



The 24 V DC power is supplied from two individual power sources, from different breakers in the UPS unit. Please note that some installations might be connected differently by the shipyard.

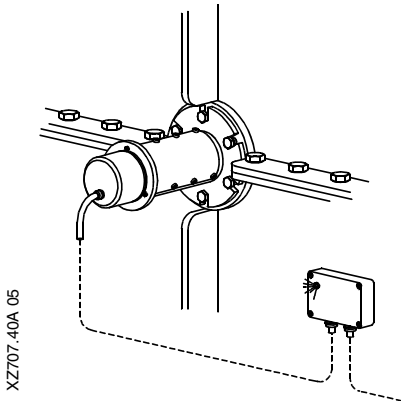
Load transmitter

The load transmitter is connected to the fuel rack, thereby continuously transmitting the fuel index % to the MCU, which calculates the engine load from this information and the detected engine rpm.



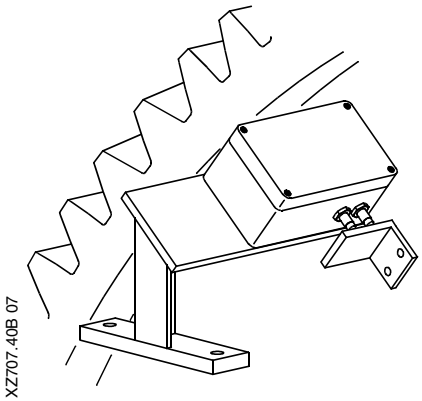
Trigger system (Shaft encoder)

The shaft encoder is connected to the fore end of the crankshaft, and the signals are transmitted to the computer panels via a terminal box. For engines on which the crankshaft fore end is not available for angle encoder installation, a trigger ring and tacho pickups are installed at the turning wheel.



Backup trigger system

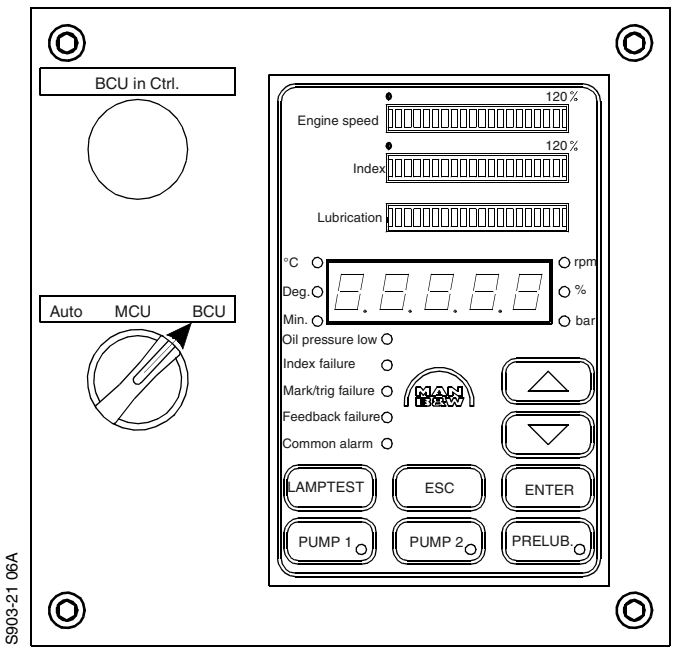
The backup trigger system comprises two tacho pickups in a box at the turning wheel, thereby transmitting the engine rpm to the BCU. The backup pickups are also connected to the MCU for surveillance purposes.



Human Machine Interface (HMI) panel

On the HMI panel, individual cylinder lubrication adjustment is possible, various values and alarms are displayed, control buttons for the pump station are available, and manual execution of prelubrication is possible.

As standard the HMI-panel is mounted in the engine control room.



1.2 Working principle

- The pump station supplies the Alpha Lubricators with 40-50 bar oil pressure.
- The MCU controls the oil injection by activating a solenoid valve situated on the relevant lubricator.

- A feedback signal from each lubricator indicates that oil injection has taken place. This is shown by Light Emitting Diodes (LEDs) on intermediate boxes for each cylinder.
- Timing is based on two signals from the angle encoder, a TDC cyl. 1 marker and a crankshaft position trigger. The Alpha Lubricator system is normally timed to inject cyl. oil into the piston ring pack during the compression stroke.
- The cylinder lubrication is based on a constant amount of oil being supplied per injection. The specific feed rate is controlled by variation of the injection frequency.
- The injection frequency is calculated from index and speed, and is normally proportional to the engine MEP. However, a power Mode or RPM Mode is possible.
- The basic cylinder oil feed rate at MCR (100%) is calculated as a correlation between a number of injections / rpm and the stroke of the lubricators.
- On the HMI panel, adjustment of lubrication feed rate for individual cylinders is possible between 60% and 200%. Default value is 100%.
- During normal operation the system is controlled by the MCU. If any failures are detected in the system, a common alarm is activated in the control room. The detailed alarm reference is displayed on the HMI panel.
- If a critical failure in the MCU is detected, the BCU automatically takes over (Note – control switch must be in “auto” position). An indication lamp “BCU in control” is lit on the panel that contains the HMI panel.
  Note that on older installations, the indication lamps can be situated elsewhere.
- The BCU is based on random timing and RPM Mode. The injection frequency is adjustable on the BCU and is normally, as minimum, set to the basic cylinder oil feed rate for the engine, plus 50%.

1.3 Guidance values automation

Cylinder Lub. Oil Pressure		Cylinder Lub. Oil Temperature	
Normal Service Value	40 – 50 bar	Normal Service Value	30 – 60° C
Alarm min.	35 bar	Alarm max.	70° C
Alarm max.	60 bar		

2. Operation of the System

2.1 HMI-Panel / Operating Panel

1. As standard, the HMI panel *(for description, see Section 3)*, a three-position mode switch, and an indicator lamp are mounted in the engine control room.

However, an additional HMI panel, etc. can, as an option, be installed in one of the pump station starter panels. In this case a local/remote switch has to be installed.

The three-position mode switch enables selection between

- **Auto-mode** – BCU takes over automatically, if lubrication cannot be maintained by the MCU. If the BCU has taken over the control, this mode can only be cleared by manually switching to MCU-mode, and back to Auto-position.
- **MCU-mode** – Forced MCU control.
- **BCU-mode** – Forced BCU is in control.

2. An orange Indicator lamp – Indicates that BCU is in control.

2.2 Control buttons and indicator lamps on pump station starter panels

Each starter panel contains the following switches, buttons and lamps:

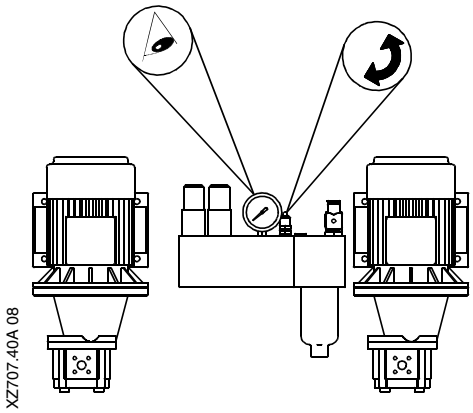
1. A three-position switch controls the pump activity as follows:
   - **REM.(Remote)** – Automatic control of pumps (normal working position)
   - **LOC.(Local)** – Manual start of the pump
   - **OFF** – Manual stop of pump.
2. A two-position main switch – Switches off 3 x 440 V AC power supply.
3. A green indicator lamp – lights if pump is running.
4. A white indicator lamp – lights if 3 x 440 V AC from fuse panels is switched ON.

2.3 Start-up of Alpha Lubricator System *(Engine not running)*

1. To fill the pump station with cylinder oil, open the valves for the cylinder oil supply line and the venting cock (if installed). Close the venting cock when cylinder oil flows out into the venting line.
2. Switch on the main switches on the pump station starter panels.
3. Switch to “Local” and manually start pump 1 and subsequently pump 2. Check that both pumps can run simultaneously.
4. Check that the pressure differential indicator on the pump station filter is green, when one pump is operating.

5. Check that the oil pressure builds up to 40-50 bar, or carry out adjustment on the pressure control valve on top of the pump station.

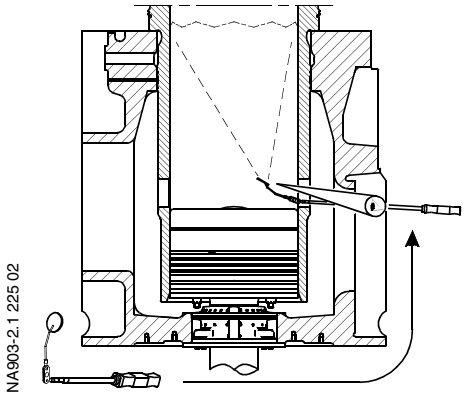
   Check that the pressure remains at an acceptable level, also with two pumps running.



6. Press [ESC] and [PRELUB] at the same time on the HMI panel to activate the test sequence, and check that all lubricators are operating correctly by watching the LEDs (feedback signals) on the intermediate boxes for each lubricator.

   Stop the test sequence by pressing [PRELUB] again.

   At commissioning or after overhaul of the system, check visually from the scavenge air receiver that all non-return valves inject cylinder oil into the cylinder liners.



7. Stop the pumps manually, and switch to “Remote” on the starter panels.

   The Alpha Lubricator System is now ready for normal operation.

8. For engineers commissioning the Alpha Lubrication System, procedures are made for Testbed Commissioning and Dock Trial Commissioning. The procedures are shown in the Commissioning chapter. For flushing the system, please read special instruction.

2.4 Checks during start-up of the engine

1. Upon start of the engine's auxiliary blowers, the Alpha Lubricator System is programmed to carry out automatic prelubrication. The pump station will automatically stop if the engine is not started shortly after.

2. Check that a pump on the pump station automatically starts up when the engine is started, and that the cyl. oil pressure builds up to 40-50 bar.

3. Check that all the green LEDs flash on the intermediate boxes for each lubricator.

4. Check that no alarm is detected in the control room and on the HMI panel.

2.5 Periodic checks during normal operation of the engine

1. Check that all lubricating points supply oil by:

   a) inspecting that all LEDs for feedback indication on the intermediate boxes are flashing

   b) feeling the pressure shocks from injection of the lubricators on each lubricator pipe. If in doubt, dismantle the pipe at the cylinder liner to observe the oil flow.

2. Inspect the local oil pressure gauge on the pump station. Normal service value = 40 – 50 bar.

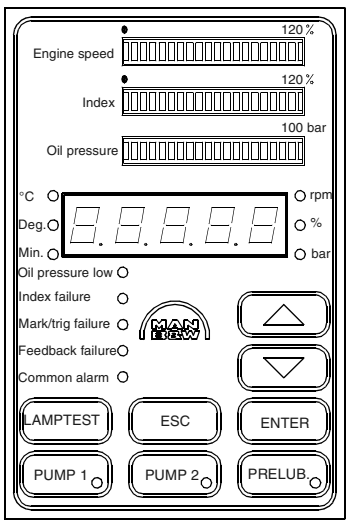
3. Check for oil leakages in the system.

3. HMI-Panel and Configuration of MCU

3.1 Description of HMI Panel

<u>Bar graphs</u>

The two upper bar graphs display relative values in percent of engine speed and fuel index (≈ mep%), respectively. The range is from 0 to 120 percent, where 100 percent corresponds to the physical values at MCR. The third upper bar graph displays oil pressure in the range of 0 to 100 bar.



<u>Fault category indicators</u>

Five LEDs for indication of fault category are placed below the numerical display, as follows:

- Oil pressure low
- Fuel index failure
- Marker/Trigger failure
- Feedback failure
- Common alarm –
  For explanation of the alarm code, see the alarm list in Section 5.

<u>Buttons</u>

[▲]	Move up in the HMI panel menu structure. *See item 3.2.9.*
[▼]	Move down in the HMI panel menu structure. *See item 3.2.9.*
[ESC]	Move to the left in the HMI panel menu structure. *See item 3.2.9.*

[ENTER]	Move to the right in the HMI panel menu structure. *See item 3.2.9.*
[LAMPTEST]	All lamps are lit in the HMI panel.
[PUMP1]	Starts or stops booster pump 1.
[PUMP2]	Starts or stops booster pump 2.
[PRELUB]	Can only be activated when engine is stopped. Activates prelubrication sequence. The lubricators will be activated continuously from Lubricator 1A, 1B, 2A,... 14B. The cycles will be repeated a pre-programmed number of times (normally 12).
[ESC] + [PRELUB]	Starts test sequence of 1000 pre lubrications. The test sequence is stopped by pressing [PRELUB] again.
[ESC] + [PUMP1]	Selects default booster pump to be pump 1.
[ESC] + [PUMP2]	Selects default booster pump to be pump 2.

3.2 HMI-Panel operation and configuration of MCU

This section describes the menu system in the HMI-panel numerical display. Six of the most common manoeuvres are described below and the complete structure and parameters are shown in items 3.2.9 and 3.2.10.

3.2.1 Navigation principle

HMI panel menu system is a hierarchic menu system. The following four buttons are used to navigate through the menu system.

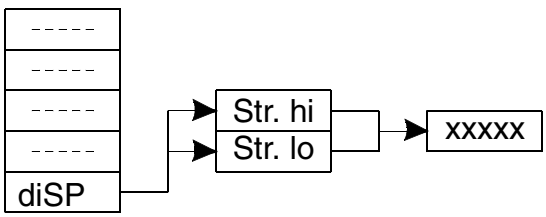
[▲]	Move up in the HMI panel menu structure. *See item 3.2.9.*
[▼]	Move down in the HMI panel menu structure. *See item 3.2.9.*
[ESC]	Move to the left in the HMI panel menu structure. *See item 3.2.9.*
[ENTER]	Move to the right in the HMI panel menu structure. *See item 3.2.9.*

3.2.2 Reading of total stroke/min [rXXX]

Press [▲] or [▼] until rXXX is shown in the display
(Note that this value is an average value over 1 min.).

3.2.3 Reading of total strokes [Str.hi] and [Str.lo]

1. Press [▲] or [▼] until diSP is shown in the display.
2. Press [ENTER] and [▲] or [▼] until Str.hi or Str.lo is shown in the display.
3. Press [ENTER] to read the stroke counter.

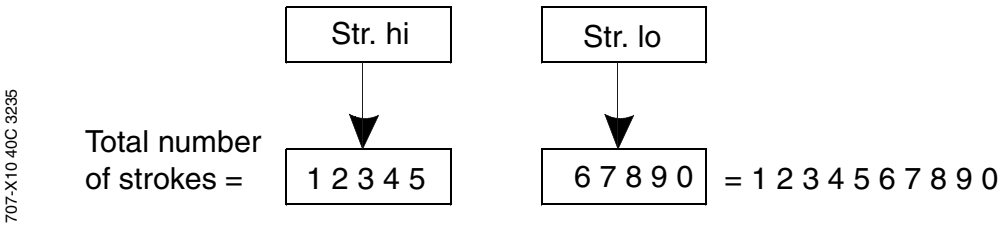


4. Press [ESC] to return to main menu (one press [ESC] = one step backwards).

5. The total number of strokes is a ten digit number and is obtained by combining the values of Str.hi and Str.lo as follows:

   The value of Str.lo represents the five rightmost figures and the value of Str.hi the five leftmost figures.

   Example:

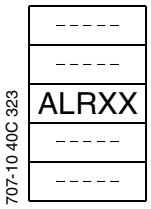


The total stroke amount is used to calculate the amount of cylinder lube oil used within a specified amount of time. The following formula can be used:

See example on page 31 (str.hi).

3.2.4 Reading of active alarms [ALRXX]

Press [▲] or [▼] until ALRXX is shown in the display.
For explanation of the alarm code see the alarm list in Section 5.



3.2.5 Reading of logged alarms [LALXX]

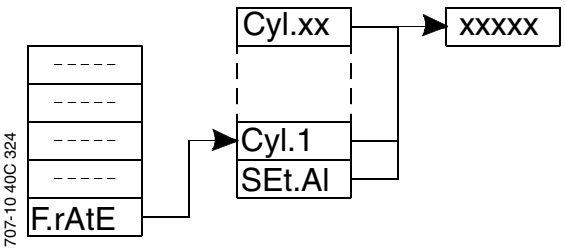
1. Press [▲] or [▼] until LALxx is shown in the display.
   For explanation of the alarm code see the alarm list in Section 5.

2. To clear a logged alarm, press [ENTER] when the alarm is shown in the display. To clear all logged alarms, press [ENTER] for 5 seconds while an LALxx is shown in the display.

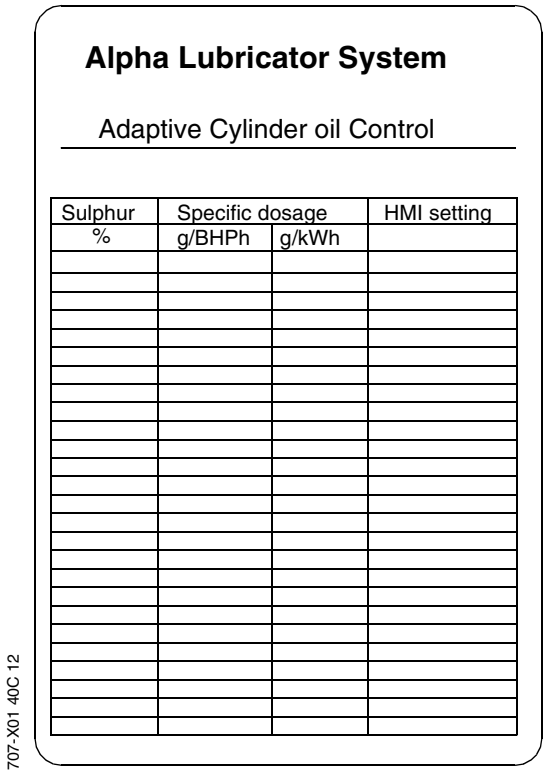
3.2.6 Adjustment of cylinder oil feed rate [F.rAtE]

The feed rate is entered in the HMI panel as a percent value.

– For systems with MEP regulation, 100% feed rate setting normally corresponds to the basic setting with reference to service letters and general guidelines for cylinder lubrication.



– For systems with Alpha ACC (Adaptive Cylinder oil Control) the feed rate is set proportionally to the sulphur content in the fuel oil. The feed rate setting percentage can be obtained from the regulation plate.



1. Press [▲] or [▼] until F.rAtE is shown on the display.
2. Press [ENTER] and [CYL1] is shown on the display.
3. Press [▲] or [▼] until the cylinder to be adjusted is shown or select SEt.Al to set all the cylinders to the same value.
4. Press [ENTER] and the current feed rate is shown. Please note that if SEt.Al was selected the value shown is the last value saved in SEt.Al, and this value is not true if any cylinder has been individually adjusted since.
5. Press [▲] or [▼] – The oil feed rate can be changed to the desired value between 60 and 200%.
6. Press [ENTER] – The value is stored in the computer memory, and the main display will prompt with “Save”.
7. Press [ESC] three times to return to main menu.

3.2.7 Monthly change of operating pumps (master pump)

1. Check which pump is running (1 or 2)
2. Press [ESC] + [PUMP 1] or [PUMP 2] (pump not running).
3. New master pump is now chosen and running.

3.2.8 Test sequence for inspection during standstill

1. Press [ESC] + [PRELUB] simultaneously
   (the lubricators will lubricate 1000 times).
2. Press [PRELUB] the test sequence will stop.

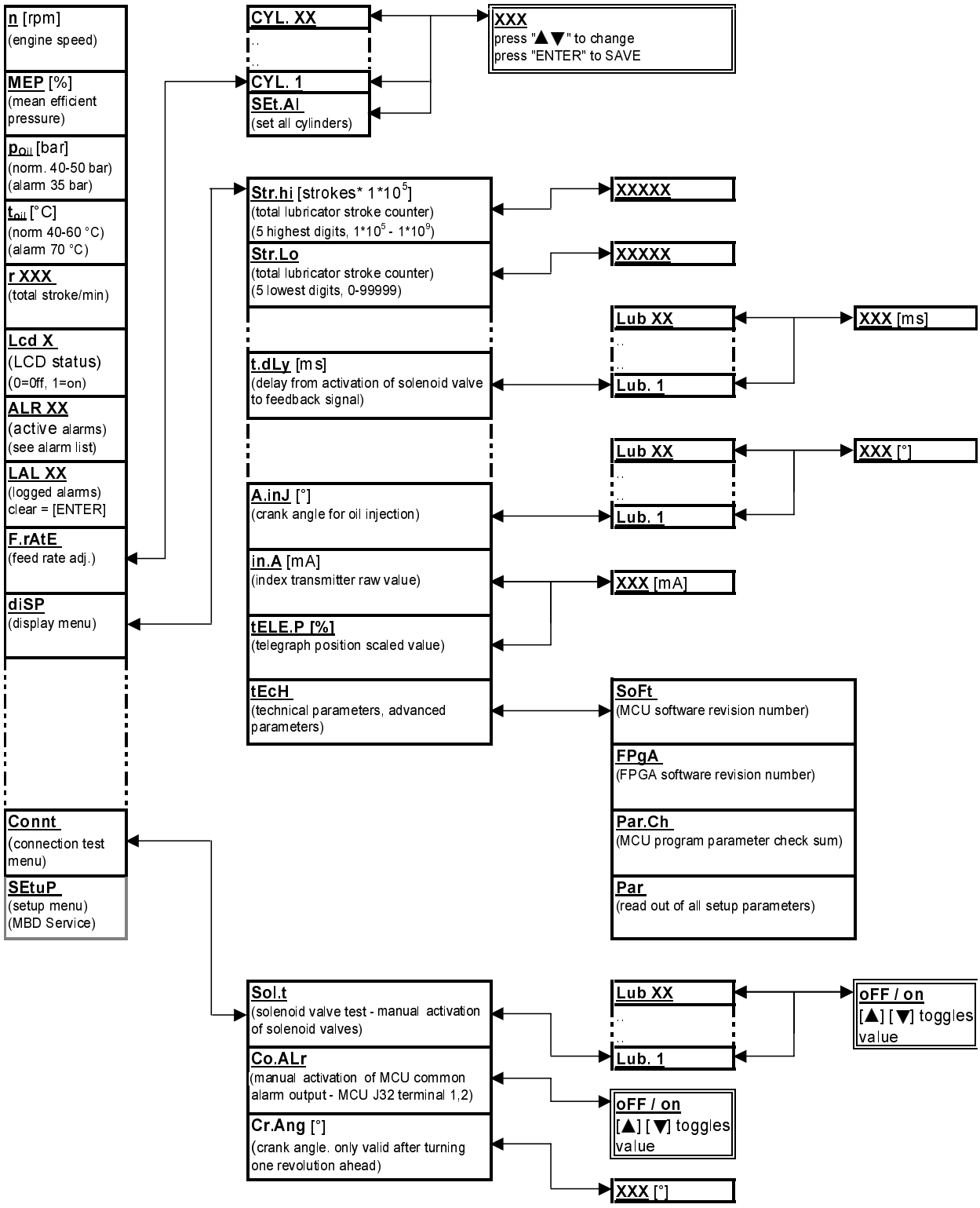
3.2.9 Menu structure

The following pages show how to navigate in the HMI-panel menu structure.

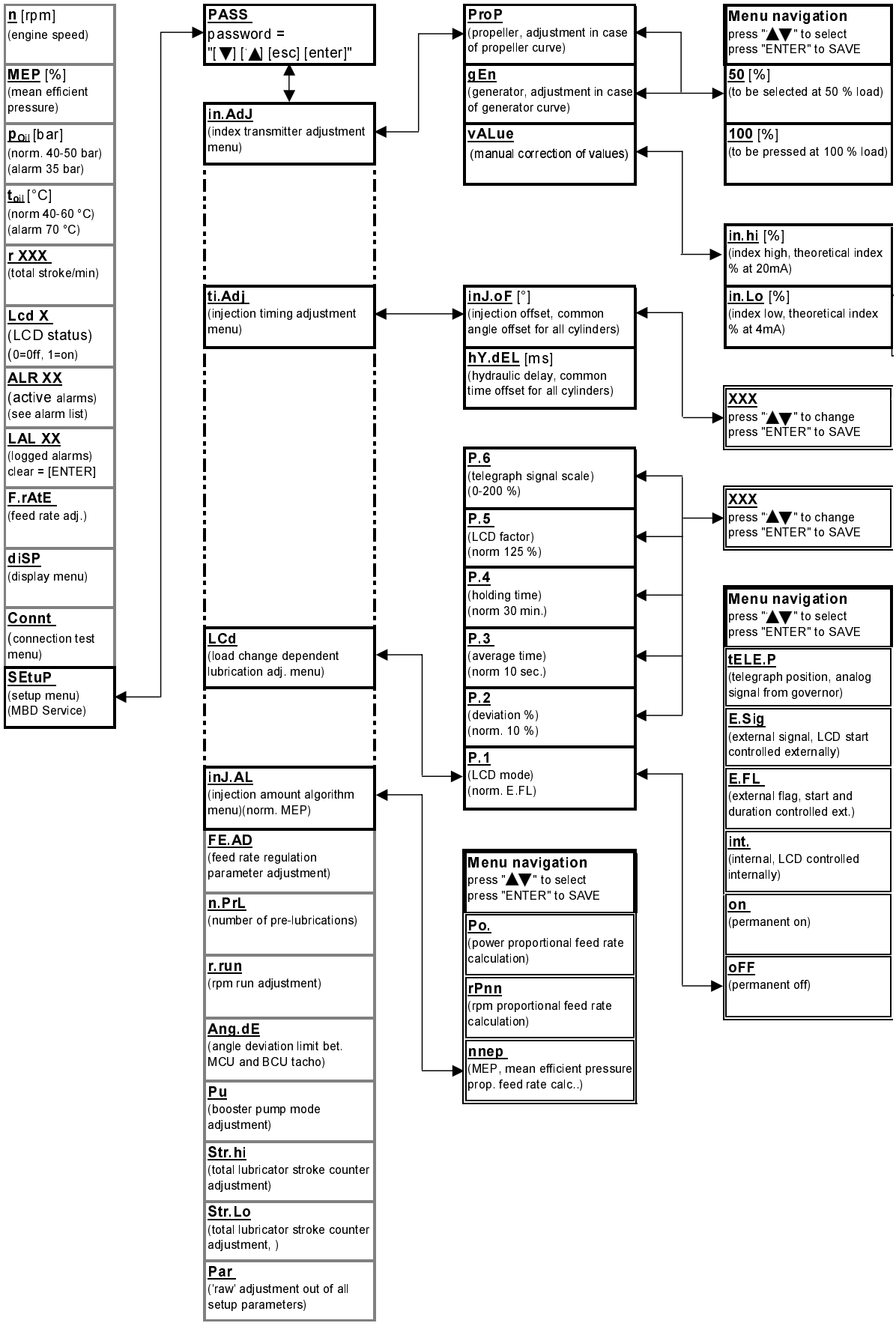
Alpha Lubricator HMI Panel menu structure – part 1

Menu navigation :

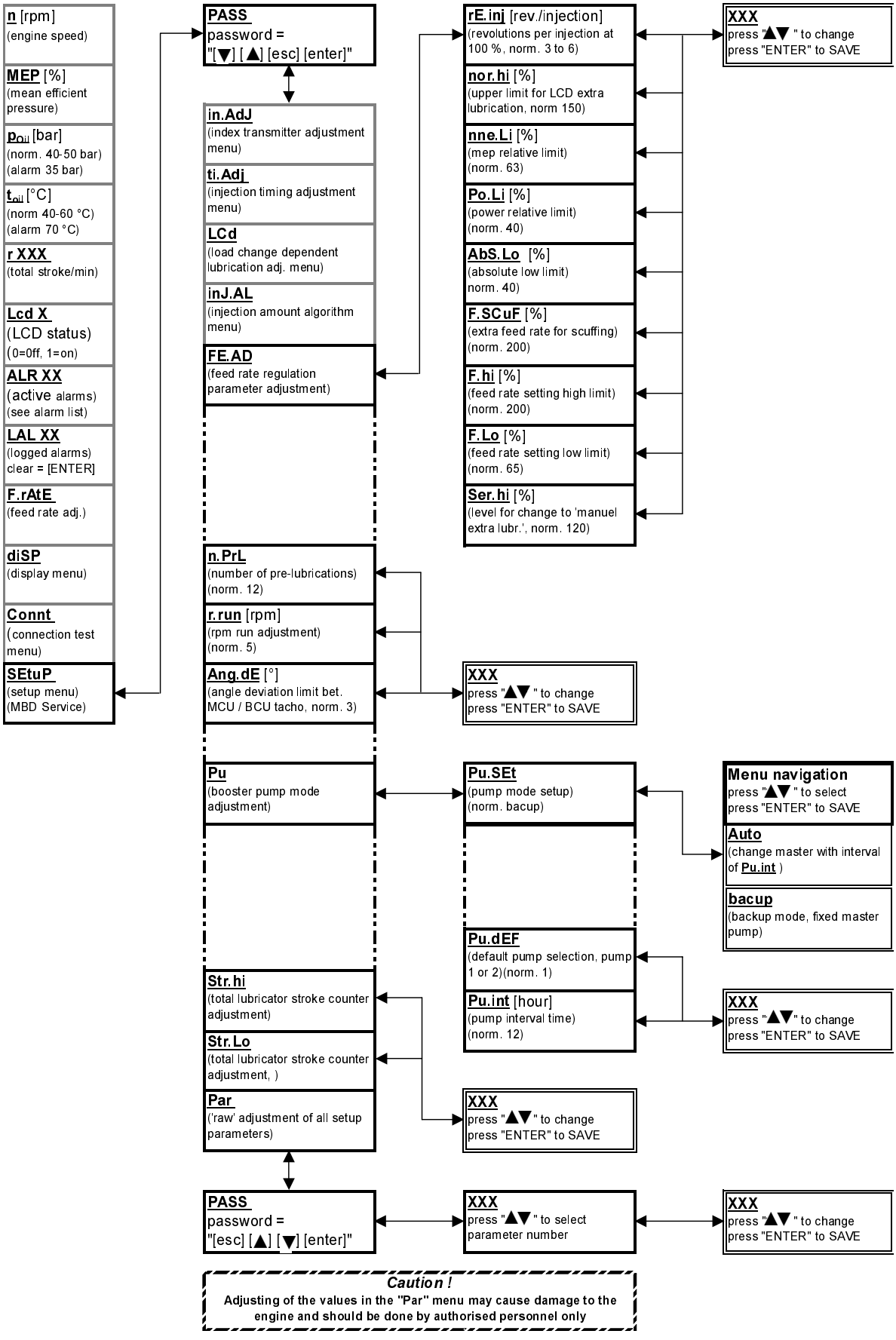
up = [▲] down = [▼] right = [ENTER] left = [ESC]



Alpha Lubricator HMI Panel – menu structure – part 2, setup menu



Alpha Lubricator HMI Panel – menu structure – part 3, setup menu



3.2.10 HMI panel parameter reference list

A.inJ [°] (abbr. of angle injection)

The specific crank angles for oil injection for each lubricator. Normally it is the crank angle at the point where No. 1 piston ring passes the oil quills on the upward stroke of the piston.

The number consists of an online measurement of the angle for the first flank of the feedback signal plus the angle corresponding to the hydraulic delay time.
Only active when engine is running ahead.
Normal value for cylinder one is around 270 to 310°.

AbS.Lo [%] (abbr. of absolute low)

Absolute minimum reduction percentage. The injection frequency can be reduced to the value of **AbS.Lo** in % of the basic frequency. The basic frequency is the frequency at 100 % load, 100 % rpm, 100 % feed rate setting and is defined as 1/**rE.inj**

Example:

Maximum number of revolutions between injections = 10 revolutions =>

$$\textit{minimum injection frequency} = \frac{1}{\text{max. nos. of rev between injections}} = \frac{1}{10} = 0.1[inj/rev]$$

rE.inj = 4 revolutions => $\text{basic frequency} = \frac{1}{rE.inJ} = \frac{1}{4} = 0.25[inj/rev]$

AbS.Lo = $\frac{\text{minimum injection frequency}}{\text{basic frequency}} = \frac{0.1}{0.25} = 0.40 = 40\%$

The normal maximum number of revolutions between injections is 15.

ALR XX (abbr. of alarm XX)

Code number for active alarms, where the number 'XX' represents the alarm code.
For explanation of the alarm code see the alarm list in Section 5.

Ang.dE (abbr. of angle deviation)

The Maximum allowable angle difference between the marker signal (TDC signal) from the encoder (or trigger ring) and the marker signal from the BCU pickups.
Only valid when engine is running ahead.
Normal value is 2 degrees.

Co.ALr (abbr. of common alarm)

Manual activation of the MCU common alarm output.
ALCU/x1:1, ALCU x1:2 (MCU/J32:1, MCJ/J32:2), dry contact, normally closed.

Connt (abbr. of connection test)

Connection test menu. Blocked when the engine is running.

Cr.Ang [°] (abbr. of crank angle)

Indication of actual crank angle from the shaft encoder. Blocked when the engine is running. Only valid when continuously turned in same direction by turning gear and after having passed TDC cyl. 1. The indication is sensitive to rocking motion and should therefore only be used as an indication.

diSP (abbr. of display)

Display menu. Values and parameters are displayed, but cannot be changed from **diSP** menu.

F.hi [%] (abbr. of feed rate high)

Feed rate setting high limit. The maximum possible feed rate setting on the HMI panel. The value is a percentage of the basic recommended feed rate setting. Normal value is 200 %.

F.Lo [%] (abbr. of feed rate low)

Feed rate setting low limit. The minimum possible feed rate setting on the HMI panel. The value is a percentage of the basic recommended feed rate setting. Normal value is 60 %.

F.rAtE (abbr. of feed rate)

Feed rate setting adjustment. The feed rate can be adjusted individually for each cylinder or for all cylinders at one time with the **SEt.AI** function. Please note that the value shown when entering the **SEt.AI** menu is the last value saved in the **SEt.AI** menu. Thus if the cylinders have been adjusted individually since, the value shown when entering the **SEt.AI** function is no longer true for all cylinders.

100 % feed rate setting normally corresponds to basic setting. (Reference is made to the guidelines for cylinder lubrication)

F.SCuF [%] (option) (abbr. of feed rate scuffing)

Feed rate increase in case of scuffing. Input for each cylinder on the MCU board can receive signal from a cylinder liner temperature monitoring system. If beginning scuffing is detected, a signal can be given and extra lubrication activated. Please contact MAN B&W if this function is needed.
Normal value is 200 %

FE.AD (abbr. of feed rate adjustment)

Feed rate regulation parameter adjustment menu.

FPgA (abbr. of fast programmable graphic array)

FPGA software revision number. The IC (Integrated Circuit) (u33) contains the program for the FPGA. If the FPGA code is updated, a new IC will have to be installed. The current FPGA software revision is 6.

gEn (abbr. of generator)

Load transmitter calibration menu for generator curve running. When the engine is running 50 % load and 100 % load (with reference to testbed results), enter the menu by pressing [ENTER] and choose the correct engine load (50 % or 100 %) followed by pressing [ENTER]. The program will respond with **donE**.

hY.dEL [ms] (abbr. of hydraulic delay)

Hydraulic delay (time offset value). The value is inserted to compensate for the time-delay from the first flank of the feedback signal, until the oil enters the cylinder through the cylinder liner non-return valves. The longer the hydraulic delay - the earlier the solenoid valve is activated. The Hydraulic delay is calculated in the design process and is confirmed by measurements on prototype engines. A good estimate of the value is 1 ms for each meter pipe length from the lubricator to the cylinder liner. The value cannot be adjusted individually for each cylinder, but is common for all cylinders.
Normally values are from 1 to 6 ms.

in.A [mA] (abbr. of index ampere)

Read out of the index transmitter current. The mA signal from the index transmitter without scaling. Used for mechanical adjustment of the index transmitter during commissioning. The index transmitter is adjusted to 4.5 mA at mechanical minimum index and to 19.5 mA at mechanical maximum index. The adjustment is made on testbed before initial start up.

in.AdJ (abbr. of index adjustment)

Index transmitter adjustment/calibration menu. The adjustment is done during running at testbed, at 50 % load and at 100 % load. Choose between propeller curve (**ProP**) or generator curve (**gEn**). Select the load percentage (50 % or 100 %) corresponding to the actual load. Press [ENTER] and the system replies **donE**. Afterwards press [ESC] 4 times until you are back in the main menu showing **RPM**. The system has now been calibrated. Use the **vALue** menu if manual correction of the parameters is necessary.

in.hi [%] (abbr. of index high)

Index transmitter raw calibration value. The index transmitter calibration values are given as an index low (**in.Lo**) value and an index high (**in.hi**) value. These values are the theoretical index percentages when the pickup gives respectively 4 and 20mA. Estimated values are pre-programmed from MAN B&W, and the system is calibrated by means of the (**ProP**) or (**gEn**) menus on testbed. **The raw values should only be changed if the automatic calibration in the ProP and gEn menus, proves insufficient.**

The values are normally around –30 to –10 for [in.Lo] and around 125 to 140 for [in.hi].

in.Lo [%] (abbr. of index low)

*See **in.hi**.*

inJ.AL (abbr. of injection algorithm)

Injection amount algorithm menu. Injection rate calculation can be chosen in proportion to mean efficient pressure (**nneP**), rpm (**rPnn**) or power (**Po.**).
Normal mode is **nnep** proportional.

inJ.oF [°] (abbr. of injection offset)

Injection offset. Angle offset inserted to compensate for small deviations between the injection angle determined in the design process and the actual crank angle for injection. The actual crank angle for injection is normally when the first piston ring passes the oil quill during the upward stroke of the piston. **inJ.oF** can be adjusted within +/– 5 °.

The value cannot be adjusted individually for each cylinder, but is common for all cylinders.
Normal value is 0.

LALXX (abbr. of logged alarm XX)

Logged alarms where the number 'XX' represents the alarm code. When an alarm is activated, it will appear as both **ALRXX** and **LALXX.** The **LALXX** will remain after the alarm is gone. *For explanation of the alarm code see the alarm list in Section 5.*

To clear a logged alarm press [ENTER] while the alarm code is displayed. To clear all logged alarms press [ENTER] for 5 seconds while one of the alarm codes is displayed.

Lcd X (abbr. of load change dependent X)

Load change dependent extra lubrication status. **X** indicates the status. When LCD is active, i.e. when a load change situation occurs, the status changes from 0 (=off) to 1 (=on). The normal hold time is 30 min.

Lcd (abbr. of load change dependent)

Load change dependent extra lubrication parameter adjustment menu. Six parameters, **P1** to **P6,** can be adjusted. *For further explanation see **P1** to **P6**.*

MEP [%] (abbr. of mean efficient pressure)

Mean effective pressure percentage (equal to torque percentage and index percentage). Scaled read out of the index transmitter input. The value is used for the amount regulation. When generator curve running the value is equal to the load percentage. When ideal propeller curve running normal values are: 25 % load =

40 % MEP, 50 % load = 63 % MEP, 75 % load = 82 % MEP, 100 % load = 100 % MEP. The value changes according to the propeller margin.

n [rpm] (abbr. of speed)

Engine speed.

n.PrL (abbr. of number prelubrications)

Number of prelubrications. Number of prelubrication sequences carried out when signal is given to ALCU/X1:25, ALCU/X1:26 (MCU/J30:7, M CU/J30:8) or [PRELUB.] button in HMI panel is pressed. Only active when the engine stopped. Normal value is 12.

nne.Li [%] (abbr. of MEP limit)

MEP relative limit. Only used when **inJ.AL** is set to **nnep**. Minimum relative reduction percentage for the MEP dependent amount regulation. The parameter is used for defining the level where the algorithm changes from MEP dependent regulation to RPM dependent regulation. The parameter is relative i.e. the load point of change is independent of the feed rate setting.

Example 1 (propeller curve running):

Desired: Change to RPM dependent lubrication under 25 % load.

Conditions at change point: Load % = 25 % propeller curve ~ MEP % = 40 % ~ RPM % = 63 %.

$$nne.Li = \frac{MEP\% \times 100}{RPM\%} = \frac{40\% \times 100}{63\%} = 63\%$$

Example 2 (generator curve running):

Desired: Change to RPM dependent lubrication under 25 % load.

Conditions at change point: Load % = 25 % generator curve ~ MEP % = 25 % ~ RPM % = 100 %.

$$nne.Li = \frac{MEP\% \times 100}{RPM\%} = \frac{25\% \times 100}{100\%} = 25\%$$

nor.hi [%] (abbr. of normal high)

Normal high limit. Upper limit for automatic extra lubrication (LCD).
Example: If the feed rate setting is set to 145 % and **nor.hi** is set to 150 %, the LCD function can only increase the feed rate from 145 % to 150 %.
Normal value is 150 %

P.1 (abbr. of parameter 1)

LCD mode. The following modes can be chosen:

oFF	Off	Permanent off – e.g. used for testing
on	On	Permanent on – e.g. used for testing
int.	Internal	All functions controlled internally by ALCU, based on index deviation.
E.FL	External flag	Start and duration is controlled externally by binary input from governor. Only amount is controlled by ALCU. Dry contact from governor to ALCU/X2:1, ALCU/X2:2 (MCU/J30:3, MCU/J30:4)
E.Sig	External signal	Start is controlled externally by binary input from governor. Duration and amount are controlled by ALCU. Dry contact from governor to ALCU/X2:1, ALCU/X2:2 (MCU/J30:3, MCU/J30:4)
tELE.P	Telegraph position	All functions controlled internally by ALCU based on analogue input from governor proportional to telegraph handle position. 4-20 mA signal from governor to ALCU/X1:33, ALCU/X1:34 (MCU/J40:1, MCU/J40:3) Used in case of mechanical governor.

Normal mode is **E.FL.**

P.2 [%] (abbr. of parameter 2)

LCD deviation percentage. Used only when **P.1** is set to **int.** or **tELE.P**. To activate LCD, the index (or telegraph position in case of **tELE.P** mode) must change more than the LCD deviation percentage (**P.2**) within the reset time (**P.3**).

Normal value is 10 % in case of internal mode (**int.**). Normal value in telegraph position mode (**tELE.P**) is 2 % or a sufficient value to insure that the smallest step on the telegraph handle (e.g. dead slow to slow) releases LCD.

P.3 [sec.] (abbr. of parameter 3)

Average time or more correct: reset time. Used only when **P.1** is set to **int.** or **tELE.P**. To activate LCD, the index (or telegraph position in case of **tELE.P** mode) must change more than LCD deviation percentage (**P.2**) within the reset time (**P.3**).
Normal value is 10 sec.

P.4 [min.] (abbr. of parameter 4)

Holding time. Used only when **P.1** is set to **int.**, **E.Sig**, or **tELE.P**. When the LCD function is activated, it will remain active for a period of the holding time (**P.4**).
Normal value is 30 min.

P.5 [%] (abbr. of parameter 5)

LCD factor. When LCD is active the feed rate setting for each cylinder multiplied by the LCD factor (**P.5**). When the LCD function is active, the injection algorithm (**inJ.AL**) is set to RPM (**rPnn**).
Normal value is 125 %.

P.6 [%] (abbr. of parameter 6)

Telegraph signal scale (used in **tELE.P** mode only). Scale factor for the mA input to terminals ALCU/X1:33, ALCU/X1:34 (MCU/J40:1, MCU/J40:3).

Examples:
1) If 4-20 mA corresponds to 0-100 % RPM, the value of **P.6** should be 100 %.
2) If 4-20 mA corresponds to -100 to 100 % RPM, the value of **P.6** should be 200%:
Normal value is 100 %.

Par (abbr. of parameter) (in **diSP** menu) ***(for MAN B&W service engineers)***

'Raw' read out of all setup parameter values. The parameters are numbered 1 through 178. *Please contact MAN B&W for further information.*

Par (abbr. of parameter) (in **SEtuP** menu) ***(for MAN B&W service engineers)***

Caution!
Adjusting the values in the "Par" menu may cause damage to the engine and should be done by authorised personnel only.

'Raw' adjustment of setup parameters. The parameters are numbered 1 through 178. *Please contact MAN B&W for further information.*

The menu is entered in the following way:

1. Navigate through the **SEtuP** menu until **Par** is displayed on the HMI panel.
2. Press [ENTER] – the system will respond **PASS.**
3. Enter the password sequence: [ESC] [▲] [▼] [ENTER]
4. Press ""▲ ▼"" to select parameter number.

Par.Ch (abbr. of parameter check)

MCU program code parameter check sum.

PASS (abbr. of password)

Password required. The menu you wish to enter is password protected to prevent access.

The password for the **SEtuP** menu is = [▼] [▲] [ESC] [ENTER]

The password for the **Par** sub menu in the **SEtuP** menu is = [ESC] [▲] [▼] [ENTER]

Po.Li [%] (abbr. of power limit)

Power relative limit. Only used when **inJ.AL** is set to **Po.** Minimum relative reduction percentage for the power dependent amount regulation. The parameter is used for defining the level where the algorithm changes from power dependent regulation to RPM dependent regulation. The parameter is relative, i.e. the load point of change is independent of the feed rate setting.

Example 1 (propeller curve running):

Desired: Change to RPM dependent lubrication under 25 % load.

Conditions at change point:
Load % = 25 % propeller curve ~ MEP % = 40 % ~ RPM % = 63 %.

$$Po.Li = \frac{Load\% \times 100}{RPM\%} = \frac{25\% \times 100}{63\%} = 40\%$$

Example 2 (generator curve running):

Desired: Change to RPM dependent lubrication under 25 % load.

Conditions at change point:
Load % = 25 % generator curve ~ MEP % = 25 % ~ RPM % = 100 %.

$$Po.Li = \frac{Load\% \times 100}{RPM\%} = \frac{25\% \times 100}{100\%} = 25\%$$

Normal value is 40 %.

pOil [bar] (abbr. of oil pressure)

Booster pump pressure.
Normal value is 40-50 bar.
Alarm level is 35 bar

ProP (abbr. of propeller)

Propeller curve index adjustment menu. Used for calibrating the index transmitter during propeller curve running. Please note that load conditions must be similar to testbed.

Pu (abbr. of pump)

Booster pump adjustment menu. The following parameters can be adjusted: **Pu.SEt**, **Pu.dEF**, **Pu.int**. *For details see the respective parameters.*

Pu.dEF (abbr. of pump default)

Default pump selection. Used only when **Pu.SEt** is set to **backup** mode. If e.g. **P1** is chosen, pump no. 2 will only start in case of low pressure alarm. The default pump can also be chosen by "short cut" from the HMI panel by pressing [ESC] and [PUMP1] or [PUMP2] simultaneously.

Pu.int [hour] (abbr. of pump interval)

Pump interval time. Used only when **Pu.SEt** is set to **Auto** mode. After an interval of **Pu.int** the master pump is automatically changed from pump 1 to 2 and vice versa.
Normal value is 12.

Pu.SEt (abbr. of pump setup)

Pump mode setup. **backup** or **Auto** mode can be chosen. In **backup** mode the master pump is selected manually by the operator by pressing [ESC] and [PUMP X] on the HMI panel. In **Auto** mode the master pump changes automatically after an interval of **Pu.int.**
Normal value is **backup.**

r XXX (abbr. of rate xxx)

Strokes per minute. Read out of total number of lubricator strokes per minute for the whole engine. The number is the average over one minute. The instant feed rate can be calculated based on total strokes per minute:

Example:

Lubricator volume (compensated for volumetric efficiency 0.97) = 1.8 cm^3
(The value can be found on page 2 of the setup document enclosed with the ALCU unit)
oil desity = 0.94 kg/l
power = 70000 bhp
r XXX = strokes per minute = 462

$$\text{Feed rate}[\text{g/bhph}] = \frac{\text{rXXX}[\text{stroke/min}] \times \text{lubricator volume}[\text{cm}^3] \times \text{oil desity}[\text{g/cm}^3] \times 60}{\text{power}[\text{bhp}]}$$

$$\text{Feed rate}[\text{g/bhph}] = \frac{462[\text{stroke/min}] \times 1.8[\text{cm}^3] \times 0.94[\text{g/cm}^3] \times 60}{70000[\text{bhp}]} = 0.65[\text{g/bhph}]$$

Please note that a much more accurate calculation can be made using the **Str.hi** and **Str.Lo** in the **diSP** menu.

rE.inj [revolutions] (abbr. of revolutions/injection)

Revolutions per injection. The number of revolutions between oil injections on a cylinder at 100 % load, 100 % rpm and 100 % feed rate setting. The parameter has to be changed if the recommended basic setting of cylinder oil feed rate is

changed. Reference is made to our general guidelines for cylinder lubrication and service letters.
Normal values are 3 to 6.

r.run [rpm] (abbr. of rpm run)

Rpm run. Engine run detection limit. When the engines rpm is above **r.run**, lubrication will start and when rpm is below **r.run** lubrication will stop**.**

Please note that the parameter influences the alarm delays for the tacho system and should therefore not be changed without consideration.
Normal value is 8 rpm.

Ser.hi [%] (abbr. of service high)

Feed rate setting max. normal service. Only used when **inJ.AL** is set to **nneP** or **Po.** If the feed rate is set above **Ser.hi** – the feed rate is set over the limit for normal service lubrication. A feed rate setting over the limit for normal service lubrication is per definition “manual extra lubrication”, i.e. used for breaking-in new liners and rings. The feed rate calculation algorithm is therefore changed to RPM dependent, disregarding the setting of **inJ.AL.** (Reference is made to the guidelines for cylinder lubrication and service letters).
Normal value is 120 %

SEtuP (abbr. of setup)

Setup menu. Values and parameters can be changed in the **SEtuP** menu. The menu is password protected to prevent access.

The menu is entered in the following way:

1. Navigate through the outer menu level until **SEtuP** is shown in the display.
2. Press [ENTER] – the system will respond **PASS.**
3. Enter the password sequence: [▼] [▲] [ESC] [ENTER]
4. Press ""▲ ▼"" to select the parameter you want to adjust.

SoFt (abbr. of software)

MCU software revision number.
The current MCU software revision is 1.66

Sol.t (abbr. of solenoid valve test)

Solenoid valve test – Manual activation of solenoid valves. Blocked when the engine is running.

Each solenoid valve can be activated in the following way:

1. Enter the **Sol.t** menu
2. Choose the lubricator number by pressing the [▲] and [▼]key.
3. Select the lubricator by pressing [ENTER].
4. Press [▲] to set lubricator on, press [▼] to set lubricator off.

Str.hi [strokes* 10^5] (abbr. of stroke high) (in **diSP** menu)

Total lubricator stroke counter. The total number of solenoid valve activations during the lifetime of the engine. The **Str.hi** menu shows the values from 10^5 to 10^9. The **Str.Lo** shows the values from 1 to 10^5.
The feed rate can be calculated based on the change of **Str.Lo** and **Str.hi** over a period of time.

Example:

Lubricator volume (compensated for volumetric efficiency.) = 1.8 cm^3
(The value can be found on page 2 of the setup document enclosed with the ALCU unit)
oil desity = 0.94 kg/l
power = 70000 bhp

Measurements at time = 00:00
Str.Lo = 11111
Str.hi = 12345

Measurements at time = 01:00
Str.Lo = 44444
Str.hi = 12345

$$\text{Feed rate}[\text{g/bhph}] = \frac{(\text{total stroke 2 - total stroke 1}) \times \text{lubricator volume}[\text{cm}^3] \times \text{oil desity}[\text{g/cm}^3]}{\text{power}[\text{bhp}] \times .(\text{time 2 - time 1}[\text{hour}])}$$

$$\text{Feed rate}[\text{g/bhph}] = \frac{(1234544444 - 1234511111) \times 1.8[\text{cm}^3] \times 0.94[\text{g/cm}^3]}{70000[\text{bhp}] \times .(01{:}00 - 00{:}00[\text{hour}])} = 0.81[\text{g/bhph}]$$

Str.hi [strokes* 10^5] (abbr. of stroke high) (in **SEtuP** menu)

Total lubricator stroke counter. Adjustment of total stroke counter in case of i.e. change of MCU board, etc.

Str.Lo [strokes] (abbr. of stroke low) (in **diSP** menu)

*See **Str.hi** (in **diSP** menu)*

Str.Lo [strokes] (abbr. of stroke low) (in **SEtuP** menu)

*See **Str.hi** (in **SEtuP** menu).*

t.dLy [ms] (abbr. of time delay)

Activation delay time. On line measurement of the time from activation of solenoid valve to the first flank of the feedback signal, used for automatic compensation of timing of the solenoid valve activation.

The delay can also be used for trouble shooting by observing if the delay time deviates on a lubricator.

tEcH (abbr. of technical)

Technical parameters. Sub menu in **diSP** menu containing the menu items, which are not used for normal operation.
*For explanation of their functionality see **SoFt**, **FPgA**, **Par.Ch** and **Par**.*

tELE.P [mA] (abbr. of telegraph position)

Telegraph position raw value. Used with mechanical governor. Read out of the 4-20 mA signal from governor to ALCU/X1:33, ALCU/X1:34 (MCU/J40:1, MCU/J40:3).

ti.Adj (abbr. of timing adjustment)

Injection timing adjustment menu. Used during commissioning.
*For further explanation see **hY.dEL** and **inJ.oF**.*

toil [°C] (abbr. of temperature oil)

Booster pump suction tank oil temperature.
Normal value is 40 to 60 °C.
Alarm level is 70 °C.

vALue (abbr. of value)

Manual correction of index transmitter calibration values.
*For further explanation see **in.hi** and **in.Lo***

XXX

Display of a number.

3.3 MCU setup

3.3.1 Dip switches for MCU

Three double 4-position dip switches are available on the MCU board, SW 1, SW2 and SW 3. The dip switches represent binary values of 1, 2, 4 and 8, respectively, when counting from the left. A switch is ON in the “up-position” and OFF in the “down-position”.

SW1 positions 1 and 2 are used to define the Baud rate at which the MCU communicates via a serial connection with a PC.

SW1.1-2:	OFF, –>	38400 Baud
SW1.1:	OFF,SW1.2: ON–>	19200 Baud
SW1.1:	ON, SW1.2: OFF–>	9600 Baud
SW1.1-2:	ON, –>	4800 Baud

SW1.3-8, SW2.1-8 and SW3.1-6 are presently not used, and the positions are not relevant.

SW3.7 is to be set toOFF(Multiple trigger systems)
SW3.8 is to be set toON(MCU revision C and later)
OFF (MCU Null-series)

3.3.2 Upload of MCU basic program

A VT100 terminal is part of the standard Windows software on a PC, and the 'Hyper Terminal' can be found in the Programs directory 'Accessories' and 'Communications'.

Connect the PC to the MCU by means of the serial cable, and start the VT100 terminal. The settings for the serial port in the PC are:

– Bits per second: 19,200 (must correspond to setting of Dip Switch SW1, pos. 1 and 2, *see item 3.3.1.*)

If the MCU main led (positioned in the upper left corner) is flashing red/green, the MCU only contains production test software. In this case the baud rate must be set to 38,400. When the main program has been uploaded to the MCU, set the baud rate to 19,200 before uploading the set-up file.

– Data bits: 8
– Parity: None
– Stop bits: 1
– Flow control: None

Transfer menu: Transmit / Receive Protocol: Xmodem.

Press [Space] on the PC keyboard and the screen will display a menu as follows:

(/) Alpha Lubricator
[1] Transfer of set-up data [2] Connection test [3] System and alarm status [4] Feedback failure status [5] Mechanical delay [6] Logged alarms [7] Logged feedback alarms [8] Revision menu [9] MBD development menu [R] Reset

The PC is connected to the MCU by means of the RS 232 serial cable, and the VT100 terminal is started.

From the Alpha Lubricator menu, press [R] followed by [Y], [ASD and [Ctrl-U]. Send / transfer the latest version from ASD of the E-prompt file called ***.epr** from the PC to the MCU by means of menus in the VT100 terminal program. Make sure to use Xmodem protocol. When the file is transmitted to the MCU, press [Ctrl-P] after confirming that calculated and read check sums are equal. Now the basic program is uploaded to the MCU board.

If a new basic program is uploaded to a MCU in service, the original set-up file is deleted and a default set-up file is loaded in the MCU. Consequently, a new set-up file must be uploaded to the MCU in this case.

3.3.3 Upload MCU set-up file

The PC is connected to the MCU by means of the RS 232 serial cable, and the Vt100 terminal is started.

From the Alpha Lubricator menu, press [1] (Transfer of setup data), followed by [1] (Upload setup file). A capital C will start moving from left to right, indicating the time remaining for uploading of set-up file. If the file is not uploaded successfully the first time, just try again. This is not critical.

In the VT100 terminal, select menu item [Transfer] followed by [Send File], then browse until you have found the correct setup file on your PC. Select the file and press [Send].

When the file is transferred, ignore the command “Type password”, which is displayed for a few seconds. Press [Y]. Now the new configuration parameters are uploaded.

Interrupt the 24DC volt power supply. The green light will turn on and the MCU is ready for operation.

If the MCU set-up file generated by the set-up program does not match the basic MCU program, the VT100 terminal will display an error message and the MCU will load the default set-up file.

The remedy for this is to download the default set-up file from the MCU to your PC and manually change the displayed parameters for this specific file to match the originally generated parameters. Save the new set-up file on your PC and upload it to the MCU.

If the MCU is not able to receive the set-up file, turn to the VT100 menu 9 (MBD Development menu) in order to reset RAM.

3.3.4 MCU LED information

On the MCU a main LED is positioned in the upper left corner. The status of the unit is given as follows:

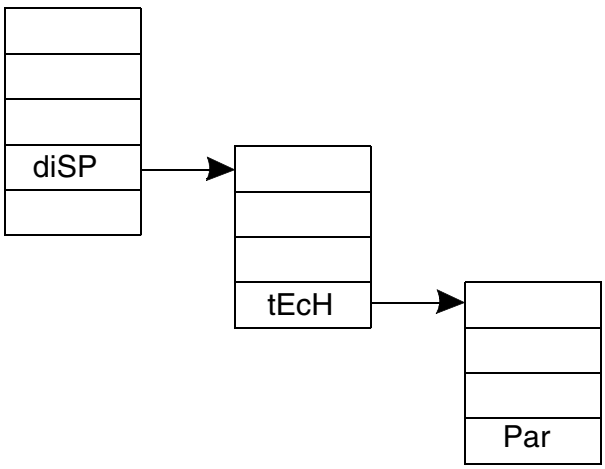
Red/green flashing: The MCU basic program file is not loaded.
Green flashing: MCU set-up file is not loaded.
Green light: Normal condition.
Red light: Alarm condition

3.3.5 Read-out of raw parameters in HMI Panel

The HMI panel facilitates a menu that enables the use of read-out of all set-up parameters. This feature might be helpful when troubleshooting the system.

To read-out the raw parameter, follow the instruction below:

Navigate through the menu as follows:



Press [▲] or [▼] to display the parameter number. When the requested parameter number is displayed, press [ENTER]. The parameter value is displayed.

To view a new parameter number, press [ESC] until the parameter number is displayed again. Press [▲] or [▼] to select a different parameter. To return to the RPM read-out, press [ESC] four times.

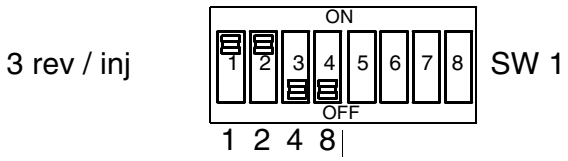
4. Configuration of BCU

Two dip switches, SW1 and SW2, are placed in the upper left corner of the BCU board. These dip switches are used to configure the BCU, *see below in Items 4.1 to 4.6.*

4.1 Injection rate with BCU in control

Injection rate for the BCU is set on the dip switches SW1 positions 1 – 4, as a binary value.

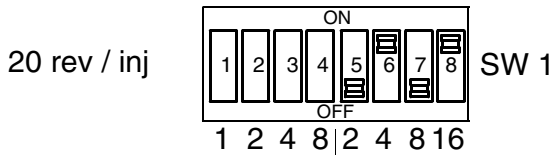
Examples:
If SW1.1-2 is ON and SW1.3-4 is OFF, the injection rate will be 3 rev/injection.



4.2 **Detection rate** (BCU take over from MCU)

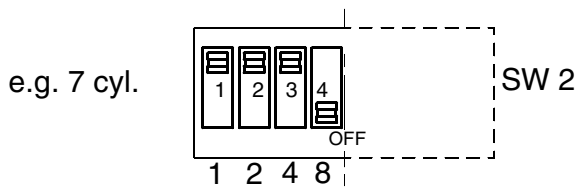
The lowest injection rate the MCU can perform before the BCU takes over, is set on the dip switches SW1 positions 5-8, as a binary value.

Examples:
If SW1.6 and SW1.8 are ON and SW1.5 and SW1.7 are OFF, the lowest injection rate is 20 rev/injection for the MCU before BCU will take over control.



4.3 Number of cylinders for the engine

The number of cylinders for the specific engine is set on SW2 positions 1-4, as a binary value.



4.4 BCU board revision

The revision number of the printed circuit board is set on SW2.6.

For installations with revision B, SW2.6 must be OFF.
For other installations SW2.6 must be ON.
The revision is printed on top of the board below the MAN B&W logo, as “BCU-250-X” where X is the revision.

4.5 Slow down output

The slow down output switch (BCU terminal J8.3, 4) is NC (normally closed) if SW2.7 is ON and NO (normally open) if SW2.7 is OFF.

4.6 Number of lubricators

The number of lubricators for each cylinder is set on SW2.8.
For installations with one lubricator on each cylinder SW2.8 must be ON.
For installations with two lubricators on each cylinder SW2.8 must be OFF.

4.7 Upload of BCU basic program

Connect the PC to the BCU by means of the serial cable and start the Philips WINISP program.

1. Set switch SW3 on the BCU in position: [Program]
2. Press reset button (SW4) on the BCU (the lamp will turn off).
3. In the Philips WINISP program key in the following data:
   a. **Chip** : 89C51RD+
   b. **Port** : Choose COM1 or the relevant port setting
   c. **OSC** : 22 Mz
   d. **Vector** : FC
   e. **Status** : 0
4. Warning! If parameters 3d and 3e are not set to FC and 0 respectively, the processor chip 89C51RD+ will be permanently damaged.
5. Erase blocks by opening the [Erase Blocks] menu. Erase the first three blocks (32 k), by marking the three blocks and press the [ERASE] button.
6. Load the BCU basic program file designated BCU*-*.hex.
7. After loading, the status display should read: “File loaded ok”.
8. Press [Program Part], and the new program will be uploaded to the BCU.

9. When the uploading is completed (see Status Display), set switch SW3 on the BCU in position: [Normal] and interrupt the power supply. The green light will turn on, and the BCU is ready for operation.

Caution!
The Reset button (SW 4) must not be pressed during normal operation. This will cause "Internal Failure" (Alarm LED #8).

If, by mistake, the Reset button has been activated and the LED #8 is lit, the error message can be removed by interrupting the 24V power as follows:

– Remove plug FJ1 on the filter board of the BCU.

5. Alpha Lubricator – Alarm Handling and Trouble Shooting Guide

If you encounter difficulties while operating the engine with the Alpha Lubricator system, this guide will help find and solve some of the problems.

The information in this section will help you with:

5.1 Fuses

Schematic drawing of the ALCU power connections are shown in Appendix 2, page 3.

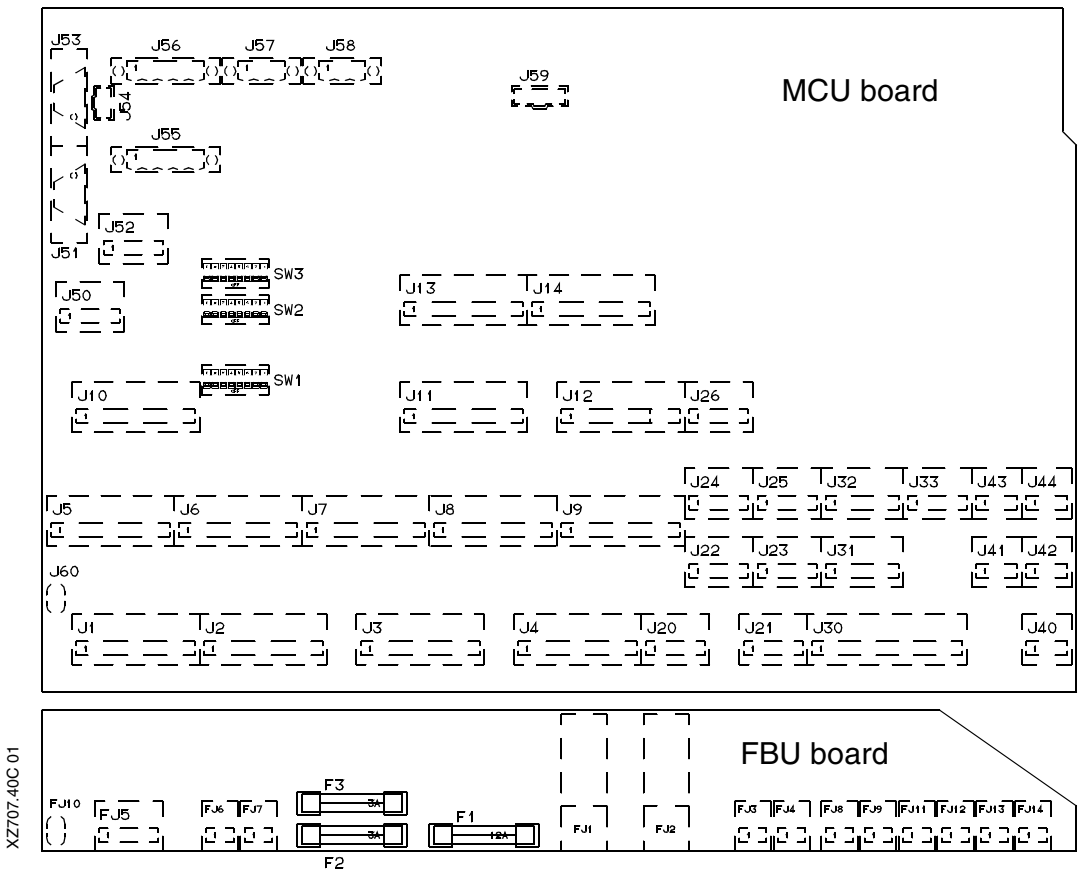
5.1.1 MCU-Unit

Normally, a fuse does not blow without reason. It is therefore important to locate and correct the problem before normal operation can be restored.

There are two different fuse ratings: 12 Amp and 3 Amp. It is very important to replace a fuse with one of the correct rating and type.

MCU fuses

The MCU unit has three fuses located on the filter board, as indicated in the drawing below.



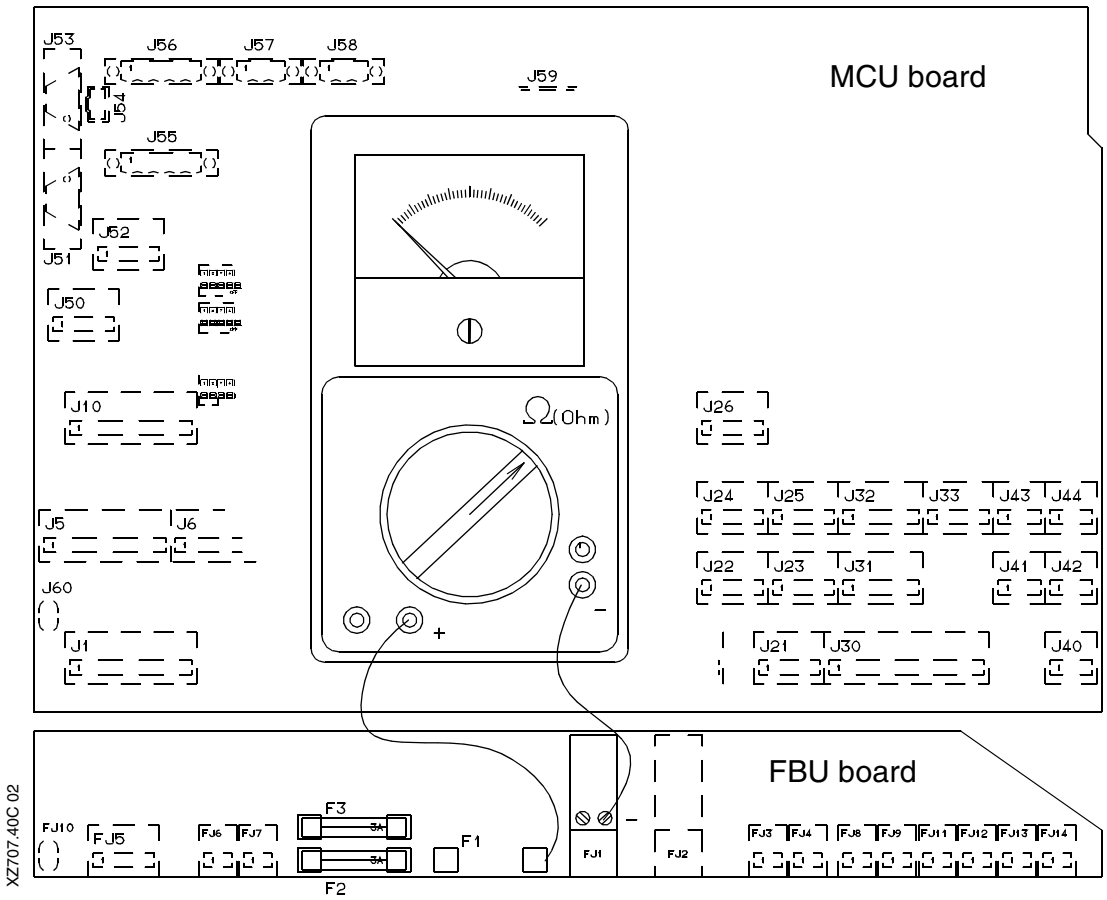
The designations are F1, F2 and F3.

F1 Main fuse

Fuse F1 is rated 12 Amp and is the main fuse for the MCU unit.

If this fuse is blown, a consumer connected to plugs FJ8, FJ9, FJ11, FJ12, FJ13, FJ14 may be suspected of overloading the fuse.

Check for shorts by removing the fuse. Connect a multimeter to the right fuse holder and measure the resistance to the negative terminal of FJ1



A measurement below 10 ohm is defined as a short. If the measurement indicates a short, disconnect plugs FJ8 to FJ14 one by one and observe the reading on the meter.

If the short can be located by this method, continue investigating the problem in the circuit connected to the suspected plug.

If the reason for the short cannot be found by the procedure described above, an internal MCU failure may be suspected.

F2 and F3

Fuse F2 is rated at 3 Amp and is the main fuse for the SBU unit when running MCU mode.

This fuse supplies control power (pump running signal) to the pump station via the SBU unit when running in MCU mode as well as power to the feedback sensors.

If this fuse is blown, a fault in the pump station wiring or in the connections to the cylinder intermediate boxes may be suspected.

In order to check whether the problem is in the pump station or the intermediate boxes, follow the check procedure below:

Remove fuse F2. Connect a multimeter to the right fuse holder clip, and measure the resistance to the negative terminal of FJ1 (right terminal). A measurement below 10 ohm is defined as a short.

If the measurement indicates a short, disconnect plug FJ5 on the MCU filter board (disconnecting the supply to the pump station) and observe the meter reading. If the short is still present, disconnect the plugs L1 to L14 in the SBU one by one until the short is located. Investigate the problem further by disconnecting the plug J1 in the intermediate box and reconnect the suspected plug in the SBU. If the problem disappears, the short is located in the intermediate box or the lubricator units.

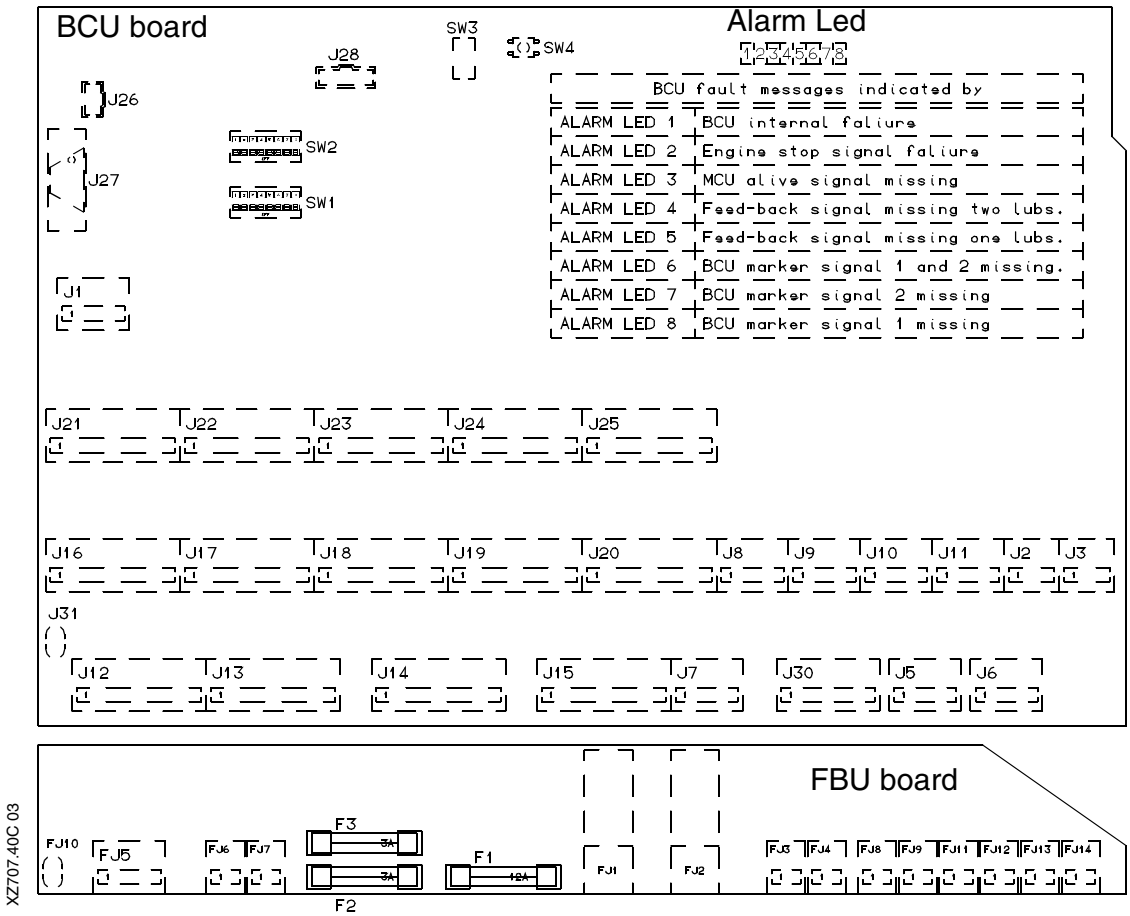
Fuse F3 is rated at 3 Amp, and is the main fuse for the shaft encoder.
If this fuse is blown, a fault in the encoder connections may be suspected.

5.1.2 BCU-Unit

There are two different fuse ratings 12 Amp and 3 Amp. It is very important to replace a fuse with one of the correct rating and type.

BCU fuses

The BCU unit has three fuses located on the filter board as indicated in the drawing below.



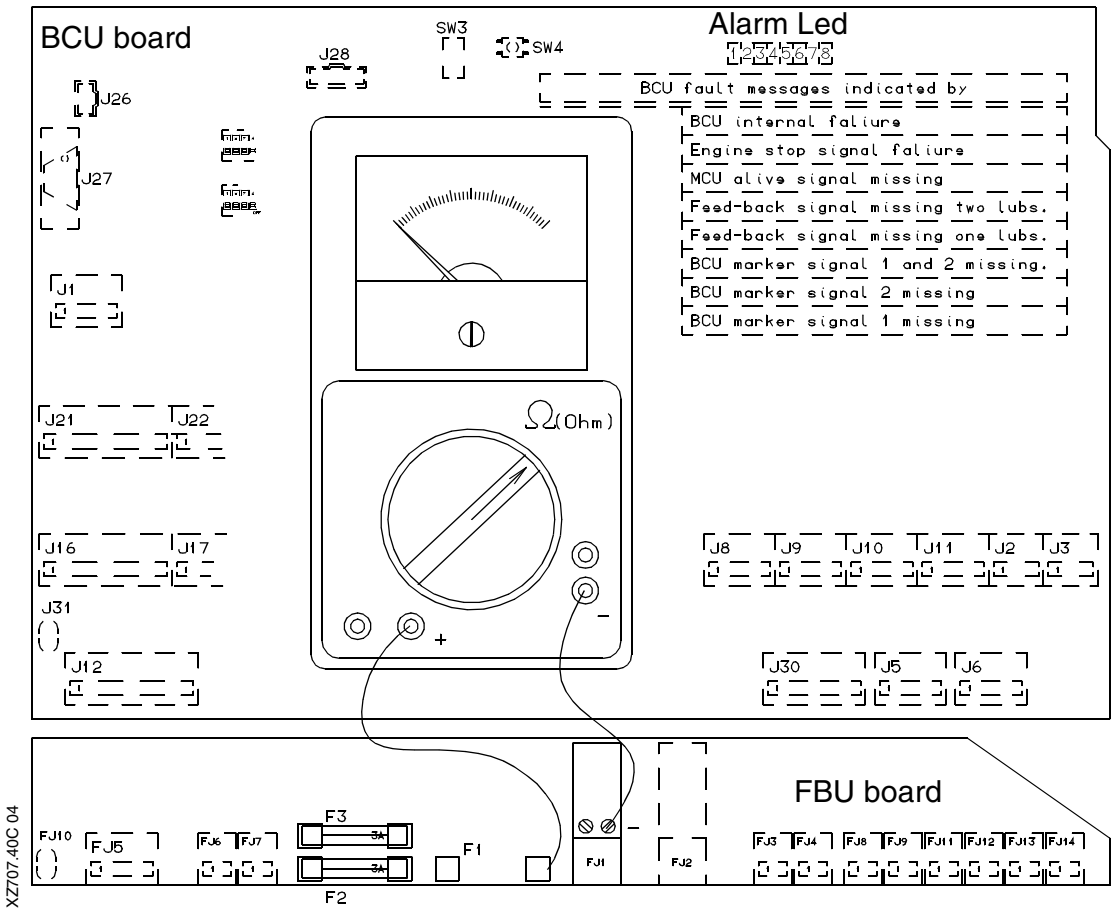
The designations are F1, F2 and F3.

F1 Main fuse

Fuse F1 is rated at 12 Amp and is the main fuse for the BCU unit.

If this fuse is blown, a consumer connected to the plugs FJ8, FJ9, FJ11, FJ12, FJ13, FJ14 may be suspected of overloading the fuse.

Check for shorts by removing the fuse. Connect a multimeter to the right fuse holder, and measure the resistance to the negative terminal of FJ1.



A measurement below 10 ohm is defined as a short. If the measurement indicates a short, disconnect plugs FJ8 to FJ14 one by one and observe the reading on the meter.

If the short can be located by this method, continue investigating the problem in the circuit connected to the suspected plug.

F2 and F3

The fuse F2 is rated at 3 Amp and is the main fuse for the SBU unit when running BCU mode. This fuse supplies power to the feedback sensors in BCU mode as well as power to the pump station.

If this fuse is blown, a fault in the pump station wiring or in the connections to the cylinder intermediate boxes might be suspected.

Remove fuse F2. Connect a multimeter to the right fuse holder clip, and measure the resistance to the negative terminal of FJ1 (right terminal). A measurement below 10 ohm is defined as a short.

If the measurement indicates a short, disconnect plug FJ5 on the BCU filter board (disconnecting the supply to the pump station) and observe the meter reading. If

the short is still present, disconnect the plugs L1 to L14 in the SBU one by one until the short is located. Investigate the problem further by disconnecting the plug J1 in the intermediate box and reconnect the suspected plug in the SBU. If the problem disappears, the short is located in the intermediate box or the lubricator units.

Fuse F3 is rated at 3 Amp, and is the main fuse for the BCU pickups. If this fuse is blown, a fault in the wiring to the BCU pickups or a fault in the BCU box connections might be suspected.

5.2 External alarm signals

Alarm system signals:
- Common alarm
- MCU power failure
- BCU power failure
- MCU failure
- BCU failure

Safety system signals:
- Slow-down

State indicator:
- BCU in control

Please note that some installations might have some alarm signals connected in serial to save alarm channels in the alarm system.

5.2.1 Common alarm

The common alarm is a normally closed contact. In case the MCU system detects a fault, the alarm will be released. Information about the cause of the alarm can be read of the number in the HMI panel.

To solve the problem, read the information related to the alarm number found in the HMI panel.

5.2.2 MCU power failure

The MCU power failure alarm is a normally closed contact.
In case the power to the MCU system is interrupted the alarm will be released.

Start by checking the breaker and fuse in the UPS cabinet.
If no problem can be found in the UPS, check that 24 V is present at terminal X1 PWR A in the ALCU box. Continue by checking the fuse F2 on the MCU filter board (see page 40).

5.2.3 BCU power failure

The BCU power failure alarm is a normally closed contact.
In case the power to the BCU system is interrupted, the alarm will be released.

Start by checking the breaker and fuse in the UPS cabinet.
If no problem can be found in the UPS, check that 24 V is present at terminal X1 PWR B in the ALCU box. Continue by checking the fuse F2 on the BCU filter board (see page 43).

5.2.4 MCU failure

The MCU failure alarm is a normally closed contact.
The BCU system has detected that the MCU system program execution has halted.

Start by checking if the power to the MCU system is OK.
See Item 5.2.2 MCU power failure.

If the Power supply is OK interrupt the power to the MCU for 5 secs. in order to reset the MCU. If the MCU failure alarm is still active, the MCU itself might be damaged and has to be replaced.

Note that if the power to the BCU is interrupted, the MCU failure will be activated eventhough the MCU system is working well.

5.2.5 BCU failure

The BCU failure alarm is a normally closed contact.
The BCU system has detected a fault in the BCU system.
Check the LED on the BCU board and read the instruction in item 5.4.

The BCU is not connected to the HMI panel and, consequently, no alarms from the BCU will be displayed.

5.2.6 Slow-down

The slow-down output is a normally open contact.
The slow-down command is released if the MCU and BCU systems fail to lubricate one or more cylinders.
Check for other alarms in the HMI panel and follow the recommendations stated.

5.2.7 BCU in control

The BCU in control is a normally closed contact.
This output indicates that the backup control unit is controlling the lubrication.

If the BCU system is able to re-establish the lubrication, the lubricators are working properly. The problem is to be found in the MCU system. Check for other alarms

and read the alarm codes on the HMI panel and follow the recommendations stated.

5.3 MCU – alarm handling and trouble shooting

5.3.1 Alarms 1-24 – Feedback failure

If for any reason a feedback signal from a lubricator is measured as abnormal by the MCU a feedback alarm will be given. A common alarm will trig the AMS system (engine alarm and monitoring system) and an alarm code will be stored in the HMI panel.

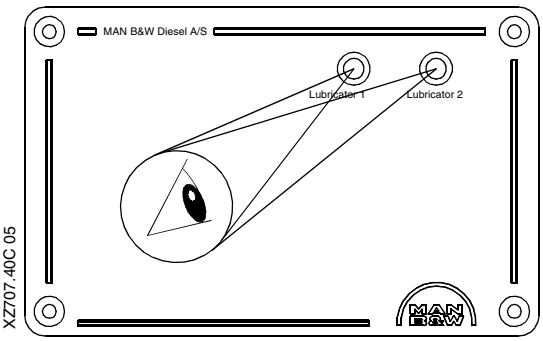
If the alarm stated in the HMI panel is a logged alarm (the alarm has disappeared again) the alarm will be displayed as LAL XX

The alarm code in the HMI panel provides information about which lubricator is suspected to fail. (Alr 2 in the HMI panel indicates that lubricator 2 on cylinder 1 is failing.)

Note that in case of one lubricator per cylinder (engines with a bore below 0,60 m), the alarm will only read uneven numbers e.g. 1, 3, 5, 7 for cylinder 1, 2, 3, 4.

Generally it is recommended that a defect lubricator is replaced completely with a spare when convenient (in case of one lubricator per cylinder, the defect unit must be replaced immediately)

In the event of feedback failure, check as follows:



First check the feedback indicator light on the intermediate box

If the feedback indicator light is:

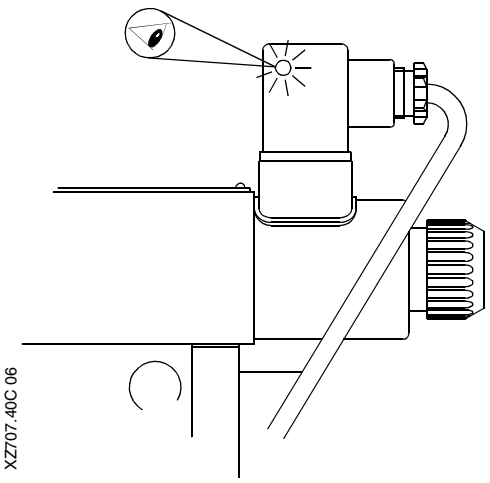
- **Continually on** the lubricator might be sticking in a position where the feedback sensor gives signal all the time.

  To verify that the problem is in the lubricator, disconnect the plug for the lubricator and observe the indicator light on the intermediate box. If the light turns off after the plug is removed, the problem is located in the lubricator. The lubricator must be replaced and overhauled (instruction 903-2).

  Alternatively, if the light in the intermediate box remains lit after the plug to the lubricator has been removed, the fault is not in the lubricator. Check the cable and plugs from the intermediate box to the lubricator for shorts.

  The intermediate PCB might also be suspected.

- **Continually off** start by checking if the red light in the lubricator solenoid plug flashes.

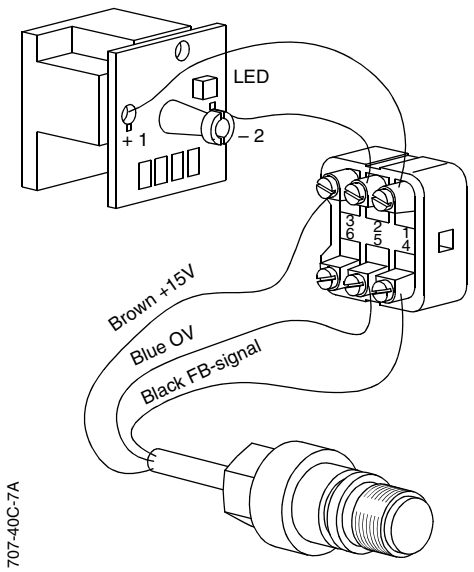


Note that in the event of a feedback failure, the remaining working lubricator is running double feed rate, and the defective lubricator is only activated once every ten lubricator strokes by the MCU to check if the lubricator is still failing.

If no light flashes in the solenoid plug, remove the plug from the solenoid and check again if the light starts flashing. If yes, the solenoids coil may have an internal short, which can be confirmed by measuring the coil resistance. The normal resistance is 15 to 22 ohm for a new solenoid.

If the red light flashes in the solenoid plug, but no feedback is observed, check the connections in the lubricator plugs, mounted on the cable from the intermediate box, for loose connections or shorts.

If connections in the plug are OK, the lubricator must be replaced and overhauled (Instruction 903-2 (change of sensor)).



Flashes according to the light in the lubricator plug (once every ten lubricator strokes) the lubricator is working well but the feedback signals are not detected by the MCU. Replace the intermediate box PCB (Printed Circuit Board).

If the fault is still present, check the cable to the ALCU box.

5.3.2 Alarm 29 – Marker signal failure from encoder

The Marker signal (one pulse per revolution) is abnormal. The system will change to random lubrication based on the remaining good signals. First check the electrical connections in the encoder terminal box as well as the connections to the ALCU control box.
If no problems are found in the wiring or fuse, replace the encoder.
Adjustment procedure can be found in Procedure 905-8.

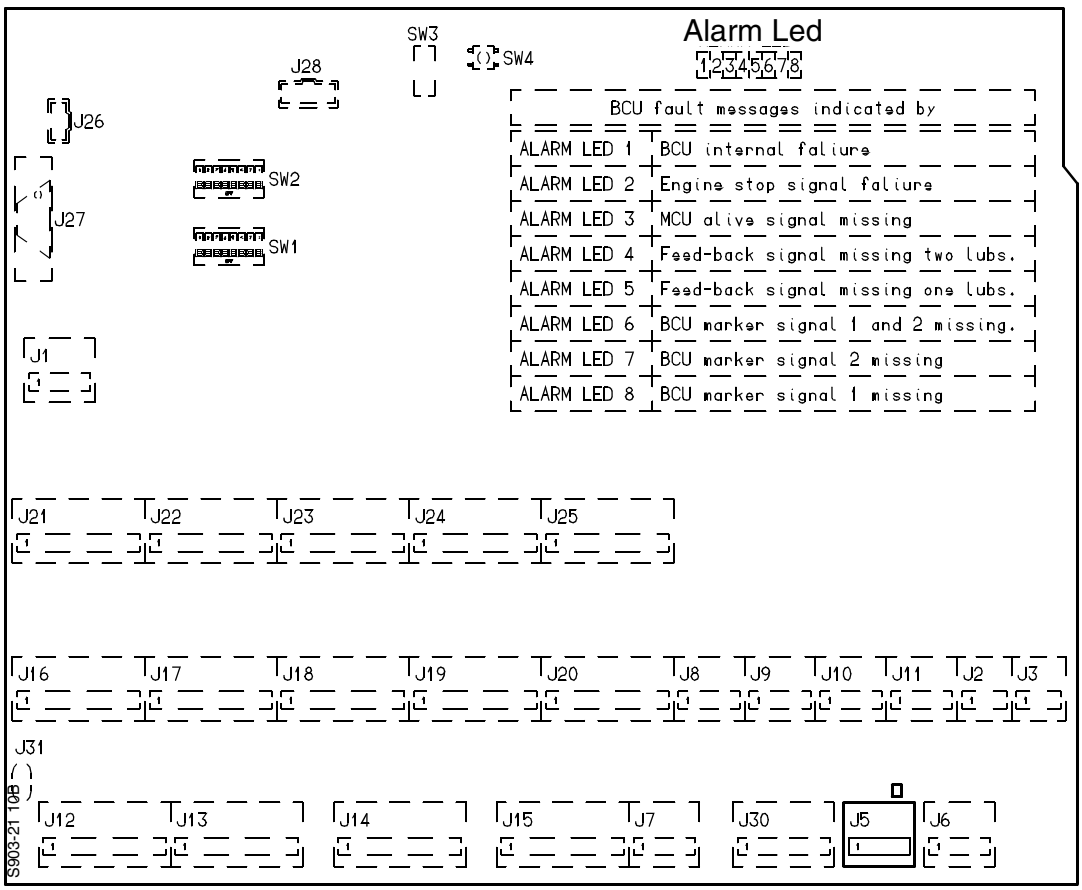
In the event of failure of all Tacho signals, see item 5.5.

5.3.3 Alarm 30 – BCU pickup 1 failure

The two marker pickups mounted on the flywheel side of the engine gives one pulse every one engine revolution. These signals are used by the BCU system to determine the engine speed. The signals are also used by the MCU system to monitor the signals and release an alarm in case of signal failure.

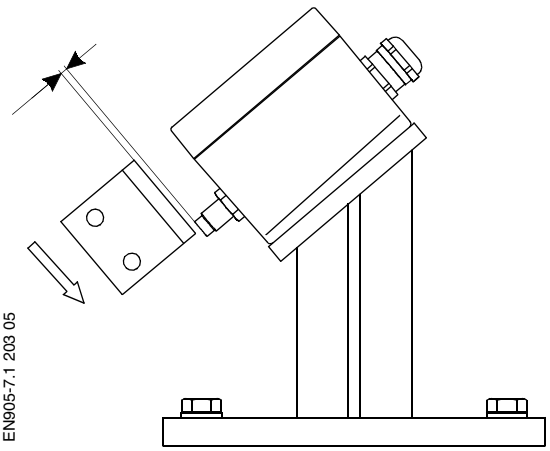
Alarm number 30 indicates that BCU pickup # 1 is abnormal and alarm number 43 indicates that BCU pickup # 2 is abnormal.

If the Alpha lubricator system is running in BCU mode due to a MCU unit failure the alarms for pickup failure can be found by observing the LED on the BCU pcb *(see picture below).*



The BCU system can be operated with only one pickup signal present. Failure of one sensor is not critical and can be replaced when convenient.

The BCU pickups have a built-in indicator lamp which will flash once every one engine revolution.



In case one of the pickup alarms is observed, first check that the light flashes in the pickup. If not, check that there is 24 volt at terminals 1, 2 and 4-5 in the BCU terminal box. If power is present at terminal 1 and 2 disconnect the sensor wire connected to terminal # 3 (sensor # 1) or terminal # 6 (sensor # 2) and observe if the light starts flashing. If yes the wiring from the sensor to the ALCU box is shorted. If the indicator light still does not flash, replace the pickup.

Sensor gap is to be adjusted to 3+0/-1 mm.
Regarding distance: Always refer to manufacturer's recommendation.

In the event of failure of all Tacho signals, see item 5.5.

5.3.4 Alarm 31 – Trigger signal failure from encoder

The trigger signals (1024 pulses per revolution) are abnormal. The system will change to random lubrication based on the remaining good signals. First check for loose connection and shorts in the encoder terminal box, as well as the wiring to the ALCU control box.

If no problems are found in the wiring or fuse, replace the encoder. Adjustment procedure can be found in Procedure 905-8.

In the event of failure of all Tacho signals, see item 5.5.

5.3.5 Alarm 33 – Engine stop signal failure

Engine stop signal failure will be released if the engine stop signal is detected as abnormal by the MCU.

There are two cases that will trigger the stop signal alarm.

1. The engine is running above 8 r/min and engine stop signal is present at the MCU input for more than 20 minutes.

   Check the engine stop signal circuit in the bridge control system.

2. The engine is stopped (detection is only active for 30 seconds after stop) but there is no engine stop signal present at the MCU input.

   Check the engine stop signal circuit in the bridge control system.

5.3.6 Alarm 34 – LCD signal abnormal

The MCU has detected that the external LCD signal has been continuously ON for more than 48 hours.

Check the LCD signal and parameters in the governor system.

5.3.7 Alarm 35 – BCU active signal missing

The MCU has detected that the BCU is abnormal.

Start checking if there are other alarms from the system. Power fail from the BCU will give this alarm.

Check the wiring in MCU plug J52 terminal 4 and 5 as well as BCU plug J7 terminal 3 and 4. (BCU alive signal connections)

If none of the above problems are found, try to interrupt the power to the BCU unit for 5 sec. If the problem is still present, the BCU is probably damaged and must be replaced. However, the engine can be operated in MCU mode until a new BCU unit can be obtained.

5.3.8 Alarm 36 – Astern signal abnormal

The MCU unit has detected that the astern signal has been ON for more than 24 hours.

The engine can be operated with this alarm present, however the lubrication amount is increased.

Check the astern signal circuit in the bridge control system.

5.3.9 Alarm 37 – Prelubrication signal abnormal

The MCU has detected that the prelubrication signal is ON and the index is higher than 80%.
This fault is not critical.

Check the prelubrication signal circuit.

5.3.10 Alarm 38 – Oil temperature high

The oil temperature has exceeded the alarm level normally adjusted to 70°C.

Check the oil temperature sensor (Pt-100 type) by disconnecting the plug from the sensor and measure the sensor resistance.

At: 20°C, the reading must be 100.0 ohm
50°C, the reading must be 119.4 ohm

60°C, the reading must be 123.2 ohm
70°C, the reading must be 127.1 ohm.

If the readings do not correspond the values stated above, the sensor is damaged and must be replaced. This fault is not critical and the sensor can be replaced when convenient.

5.3.11 Alarm 39 – Oil pressure low

The oil pressure is below the normal alarm level of 35 bar.

Automatic start of stand-by pump and common alarm is activated plus alarm 49 in the HMI panel.

If oil pressure is re established after start of stand-by pump, common alarm is not de-activated until the stand-by pump is manually stopped.

Both pumps will run continuously due to the detected fault. This fault is cleared by manually pressing one of the PUMP-buttons on the HMI panel.

Check if the pumps are running. Check for leaks in the high-pressure supply lines.

Check the oil pressure sensor (4-20 mA type) by measuring the sensor current and comparing it with the pressure.

If the current and pressure differ, the sensor must be replaced/calibrated.

5.3.12 Alarm 40 – Speed deviation alarm

The MCU has detected that one or more of the four speed measurements are abnormal.

Check the alarm list in the HMI panel to see which sensor is abnormal (BCU pick-ups or the angle encoder) alarm 29, 30, 31 and 43 and read the chapter concerning the alarm.

5.3.13 Alarm 41 – Index transmitter abnormal

The index level does not correspond to the engine rpm.

Fuel index is internally set to a fixed value of 100 percent due to the detected fault. The fault is cleared by activation of engine stop signal.

Check the adjustment of the index transmitter, according to instruction S903-21. The index transmitter itself might be damaged.

5.3.14 Alarm 42 – Cable failure index transmitter

The index transmitter cable is interrupted or the index transmitter is damaged.

Correct the cable failure or replace the index transmitter.

If the index transmitter is replaced, readjustment is needed. Follow the index adjustment instruction S903-25.

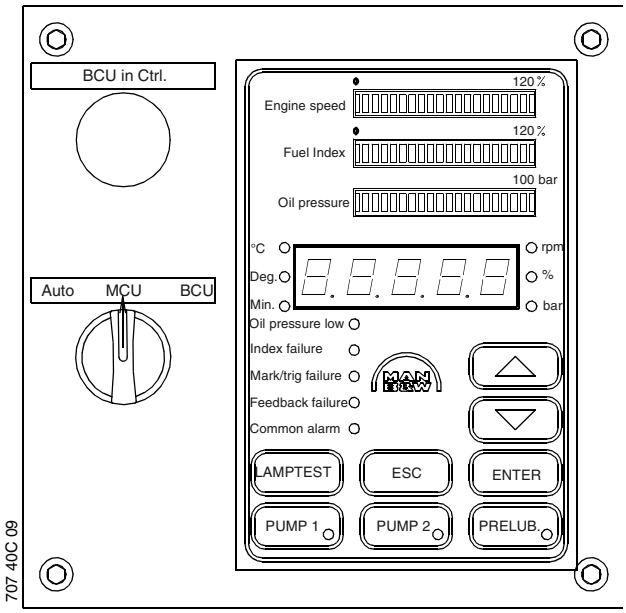
5.3.15 Alarm 43 – BCU pickup 2 failure

Please see item 5.3.3.

5.3.16 Alarm 44 – BCU in control

The lubricators are running BCU mode.
Check that the mode switch is in auto position.

Find the cause for the BCU take-over. If the BCU mode has been started automatically and is running without slow down command, the MCU system may be abnormal.



5.3.17 Alarm 45 and 46 – Thermal overload electric motor

Electric motor # 1 or 2 is tripped by thermal overload.
Check the thermal trip breaker in the pump station control box.

Press the reset button on the thermal overload breaker to reactivate the pump motor and check the current at the ammeter local side.

Check that the voltage on all three phases is OK. If not, check the fuses in the feeder panel. Also verify that the motor windings are OK by measuring the resistance of the individual windings.

If no electrical fault can be found check the oil pump for mechanical damage.

5.3.18 Alarm 47 – MCU parameter list not loaded

This alarm indicates that the MCU computer has lost its configuration file or that it is missing.

Change to forced BCU operation by using the mode switch and replace the MCU with a spare when possible.

5.3.19 Alarm 48 – Angle deviation fail

The angle difference between the TDC marker from the angle encoder and the TDC markers from the BCU pickups exceeds the alarm level.

Check the Initial adjustment of the angle encoder and adjust as necessary.

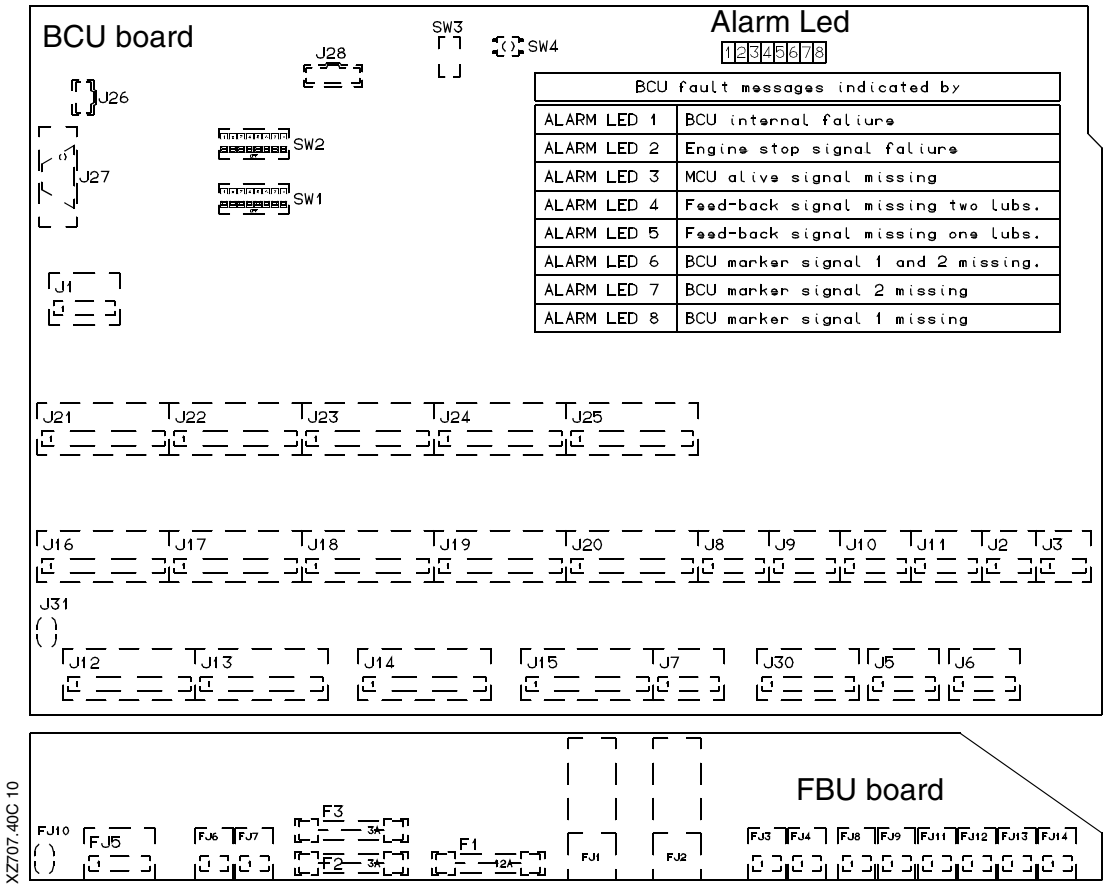
The adjustment procedure can be found in Procedure 905-8.

Also check the flexible coupling between the engine and angle encoder for good condition.

5.3.20 Alarm 49 – Stand-by pump is running

The stand-by pump has been activated either by the user or automatically due to a low-pressure alarm. *See alarm 39*.

5.4 BCU alarms



BCU fault messages indicated by	
ALARM LED 1	BCU internal faliure
ALARM LED 2	Engine stop signal faliure
ALARM LED 3	MCU alive signal missing
ALARM LED 4	Feed-back signal missing two lubs.
ALARM LED 5	Feed-back signal missing one lubs.
ALARM LED 6	BCU marker signal 1 and 2 missing.
ALARM LED 7	BCU marker signal 2 missing
ALARM LED 8	BCU marker signal 1 missing

Below is a list of BCU alarms and their description:

5.4.1 Led # 1 BCU internal failure

An internal failure in the BCU is detected. Check that the small switch SW3 on the BCU board is in the normal position.

Reboot the BCU computer by interrupting the power supply for 5 sec. (Plug FJ 1).

Warning! **DO NOT PRESS THE RESET BUTTON** on the BCU unit.

If the alarm comes on again, the BCU board might be damaged and must be replaced.

5.4.2 Led # 2 Engine stop signal failure

The engine stop signal has been on for more than 20 minutes with the engine running. The engine stop signal is off and the engine is not running (only for 30 seconds). Check the stop signal wiring and the engine control system for correct operation.

5.4.3 Led # 3 MCU alive signal missing

The BCU unit has detected that the MCU unit is abnormal. The BCU is still full operational in this condition.

Start checking if there are other alarms from the system. Power failure from the MCU will give this alarm as well as a common alarm.

Normally this situation will give a BCU take over.

Check the wiring in MCU plug J52 terminal 2 and 3 as well as BCU plug J7 terminal 1 and 2. (MCU alive signal connections).

The alive signal is a pulse signal with a frequency of approx. 0,5 Hz.
An oscilloscope must be used to measure this signal.

If no problems, as described above, are found try to interrupt the power to the MCU unit for 5 sec. If the problem is still present the MCU unit is probably damaged and must be replaced. However, the engine can be operated in BCU mode until a new MCU unit can be obtained.

5.4.4 Led # 4 Feedback signal missing on two lubricators

If, for any reason, a feedback signal from a lubricator is measured as abnormal by the BCU, an alarm will be given (BCU fail alarm).

Note that if the system is running in BCU mode due to a MCU failure, the MCU might not be able to show any alarm codes in the HMI panel. The defect lubricators are to be found by observing the feedback signal indicator lights at the intermediate boxes at the engine.

This alarm indicates that the lubrication is stopped on a cylinder. A slow-down command will be released.

First check if the fault is concerning more than one cylinder. If more than one cylinder is affected, check the oil supply system. The oil pressure might be low or the oil supply from the gravity tank has stopped. Check for leaks on the oil supply lines.

If the problem can be isolated to only one cylinder, check the feedback wiring from the defect cylinders intermediate box to the control box (ALCU). The intermediate PCB (Printed Circuit Board) itself might be damaged.

To check if the BCU board is damaged, the plug for the defect cylinder can be removed from the BCU and a plug from a working cylinder can temporally be mounted instead. If this cylinder that previously worked well is now faulty, the BCU board is probably damaged.

Remember to remount the plugs in the correct sockets.

The BCU computer can be rebooted by interrupting the main power supply for 5 sec. (Remove plug FJ1 on the BCU filter board).*)*

Warning! **DO NOT PRESS THE RESET BUTTON!**

5.4.5 Led # 5 Feedback signal missing one lubricator

If, for any reason, a feedback signal from a lubricator is measured as abnormal by the BCU, an alarm will be given (BCU fail alarm).

Note that if the system is running in BCU mode due to a MCU failure, the MCU might not be able to show any alarm codes on the HMI panel. The defective lubricators are to be found by observing the feedback signal indicator lights at the intermediate boxes on the engine.

Generally it is recommended that a defect lubricator is replaced completely with a spare when convenient (in the case of one lubricator per cylinder, the defective unit must be replaced immediately)

For further information, see chapter covering MCU feedback fail alarms.

5.4.6 Led # 6 BCU marker signal 1 and 2 missing

The two marker pickups mounted on the turning wheel end of the engine give one pulse every engine revolution. These signals are used by the BCU system to determine the engine speed. The signals are also used by the MCU system to monitor the signals and release an alarm in case of signal failure.

Note that if the system is running in BCU mode due to a MCU failure, the MCU may not be able to show any alarm codes on the HMI panel.

This case needs prompt attention. The lubrication will stop, and a slowdown command will be activated.

This type of fault is normally caused by mechanical damage to the pickups or interruption of the power supply to the BCU pickups.

Check the sensors and the trigger-bracket on the flywheel for mechanical damage. Sensor gap is 3.0 mm. (Regarding distance: always refer to manufacturer's recommendation).

Check that there is 24 volt on terminals 1 and 2 in the BCU terminal box. If there is no power present on terminals 1 and 2, investigate further for short-circuited wiring to the BCU pickup system.

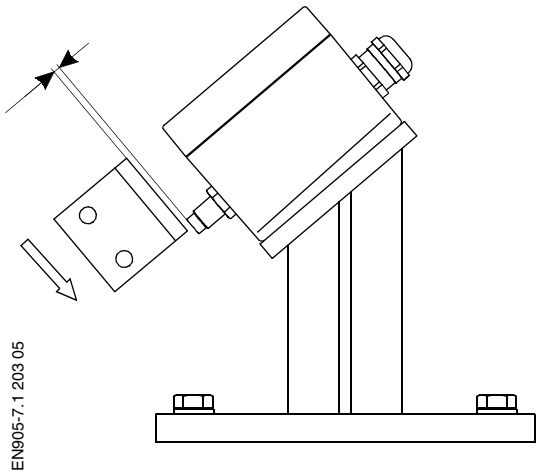
5.4.7 Led # 7 and 8 BCU marker signal 1 or 2 missing

The BCU system can be operated with only one pickup signal present.

Failure of one pickup is not critical and it can be replaced when convenient.

The BCU pickups have a built-in indicator which flashes once for each engine revolution.

If one of the pickup alarms are observed, first check that the lamp in the pickup is flashing. If not, check that there is 24 volt on terminals 1 and 2 in the BCU terminal box. If power is present at terminals 1 and 2, disconnect the pickup wire connected to terminal # 3 (pickup # 1) or terminal # 6 (pickup # 2) and observe if the light starts flashing. If yes, the wiring from the pickup to the ALCU box is shorted. If the indicator light still does not flash, replace the pickup.



Pickup gap is to be adjusted to 3+0/-1 mm.
(Regarding distance: Always refer to manufacturer's recommendation).

5.5 Emergency running without external trigger signals

We strongly recommend that all efforts are made to repair the trigger system before switching to the emergency mode.

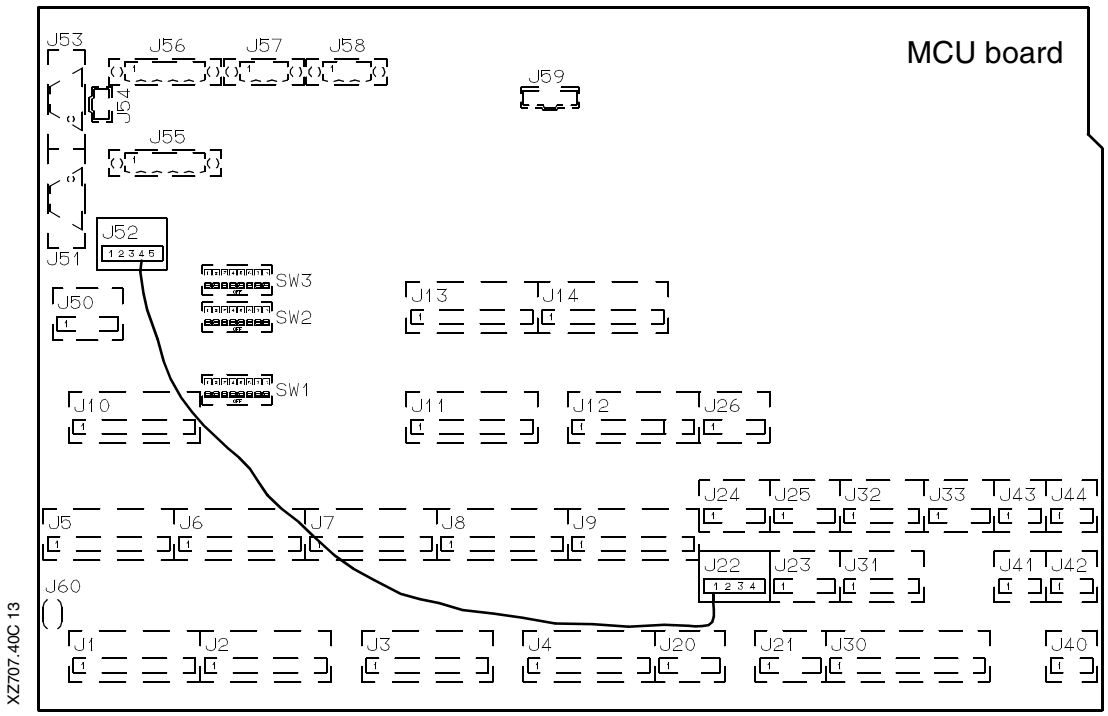
In the event that all trigger signals to the lubricator system fails (angle encoder and pickups for the BCU system), it is possible to maintain a certain level of lubrication by means of an internal stroke generator on the MCU or BCU card.

This stroke generator emits one pulse per second, i.e. approx. 60 rpm.

To be able to run in this "emergency mode", the following electrical connections must be changed:

Remove the wire from MCU-J22 terminal 1

Connect an extra wire from MCU-J52 terminal 4 to MCU-J22 terminal 1.



The system now starts lubricating regardless of whether the engine is running or stopped.

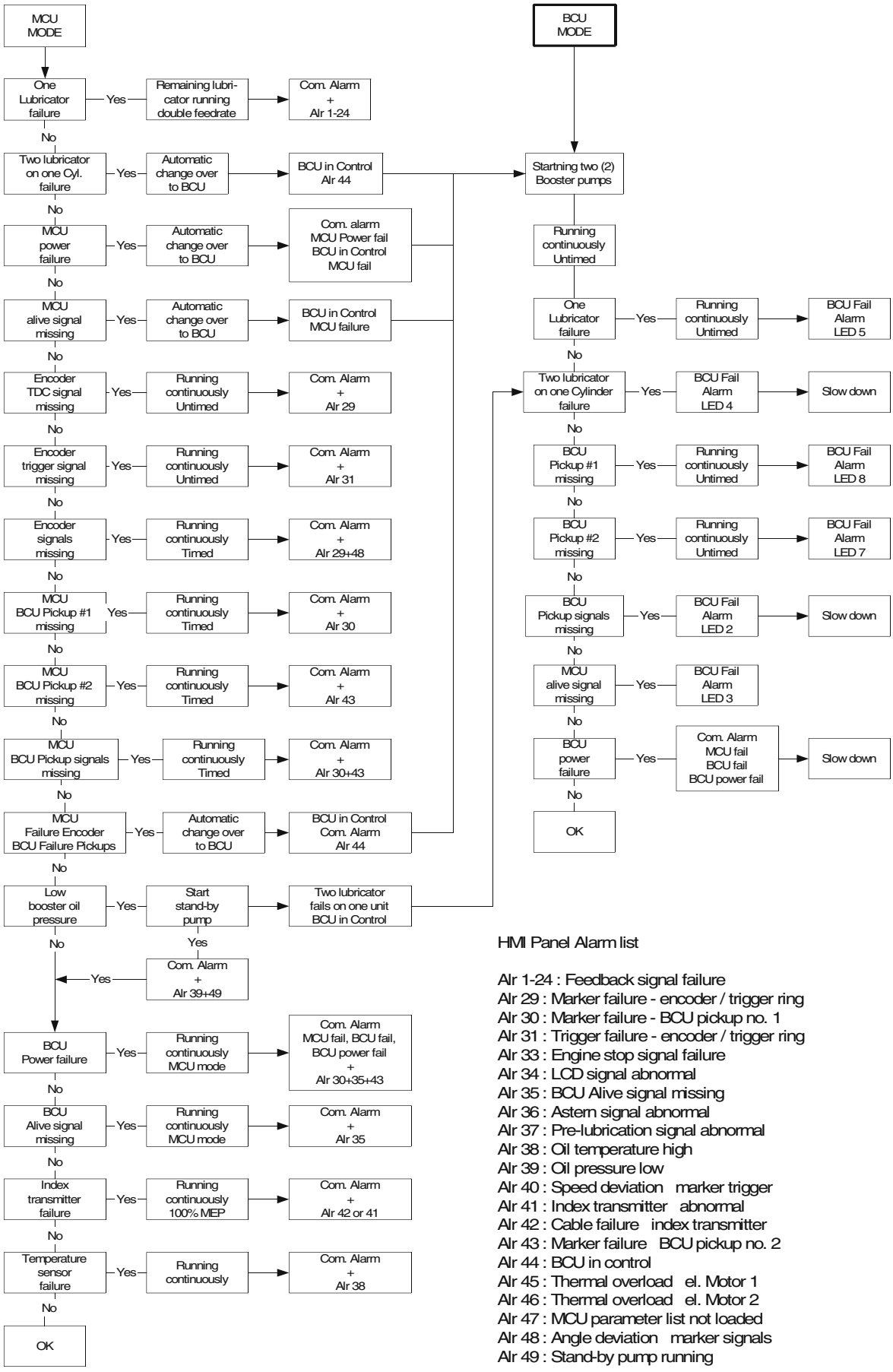
The system will also give various alarms.

However, feedback alarms will still function and indicate whether all cylinders are being lubricated. When running in this mode, the BCU system is not active.

The MCU slow-down function remains active.

Lubrication is effected as “random” and “rpm-dependent”, however with a supplement of 25% of the amount set for the individual cylinders, but with a fixed number of revolutions of 60.

5.6 Sequence diagram for alarm handling

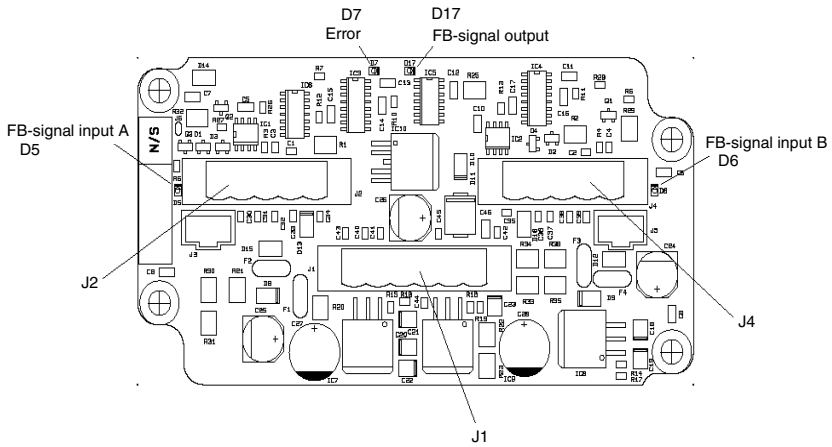


HMI Panel Alarm list

Alr 1-24 : Feedback signal failure
Alr 29 : Marker failure - encoder / trigger ring
Alr 30 : Marker failure - BCU pickup no. 1
Alr 31 : Trigger failure - encoder / trigger ring
Alr 33 : Engine stop signal failure
Alr 34 : LCD signal abnormal
Alr 35 : BCU Alive signal missing
Alr 36 : Astern signal abnormal
Alr 37 : Pre-lubrication signal abnormal
Alr 38 : Oil temperature high
Alr 39 : Oil pressure low
Alr 40 : Speed deviation marker trigger
Alr 41 : Index transmitter abnormal
Alr 42 : Cable failure index transmitter
Alr 43 : Marker failure BCU pickup no. 2
Alr 44 : BCU in control
Alr 45 : Thermal overload el. Motor 1
Alr 46 : Thermal overload el. Motor 2
Alr 47 : MCU parameter list not loaded
Alr 48 : Angle deviation marker signals
Alr 49 : Stand-by pump running

Appendix 1

Function of the LEDs in the Intermediate Box



The two green LEDs D_5 and D_6 (FB-signal input A and FB-signal input B) light when there is an input from one of the feedback sensors.

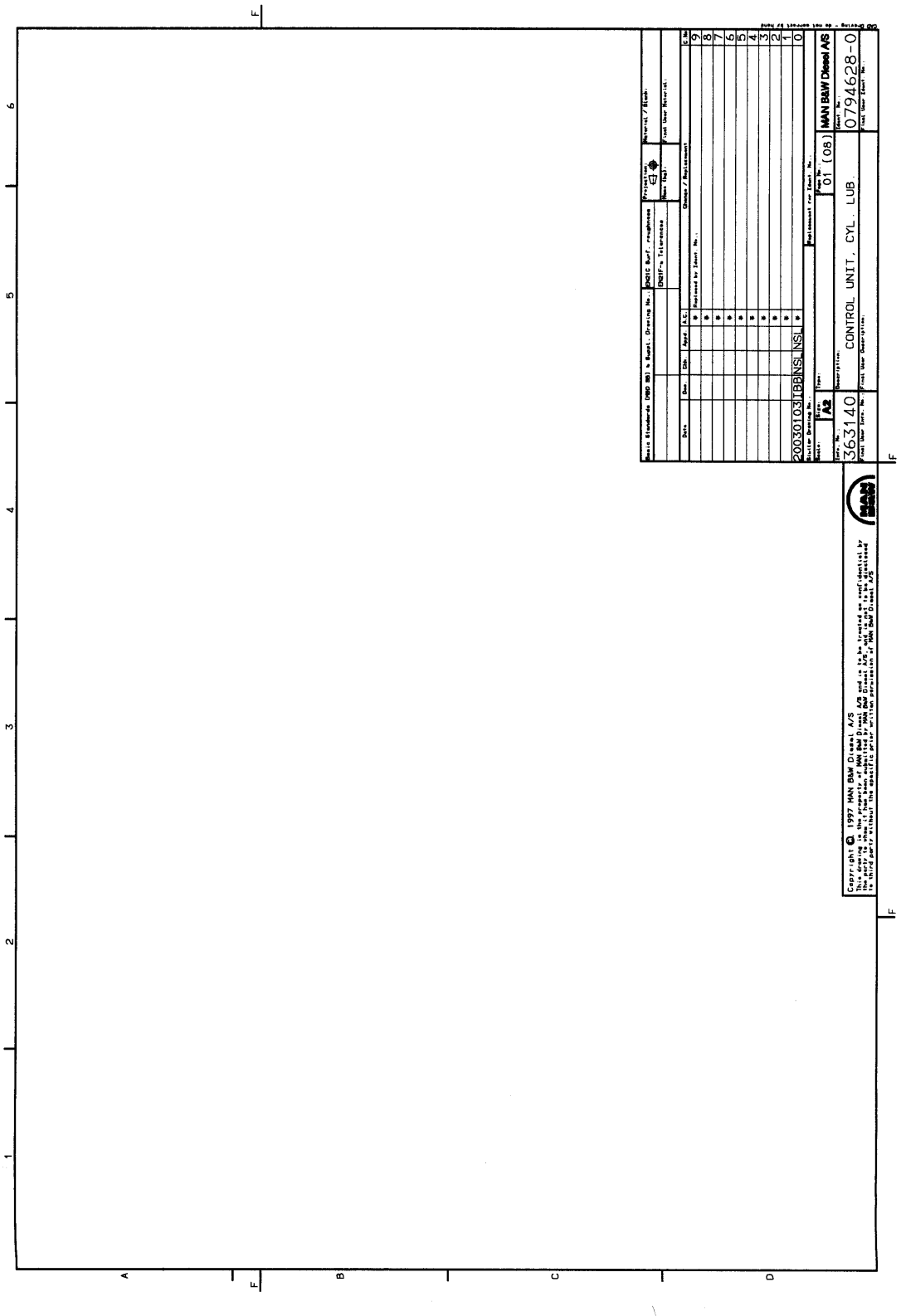
FB-signal output is also a green LED D_{17}, which flashes every time a feedback signal is sent to the Switch Board Unit. There has to be a flash at FB-signal output every time, shortly after there is an input on one of the two FB-signal input.

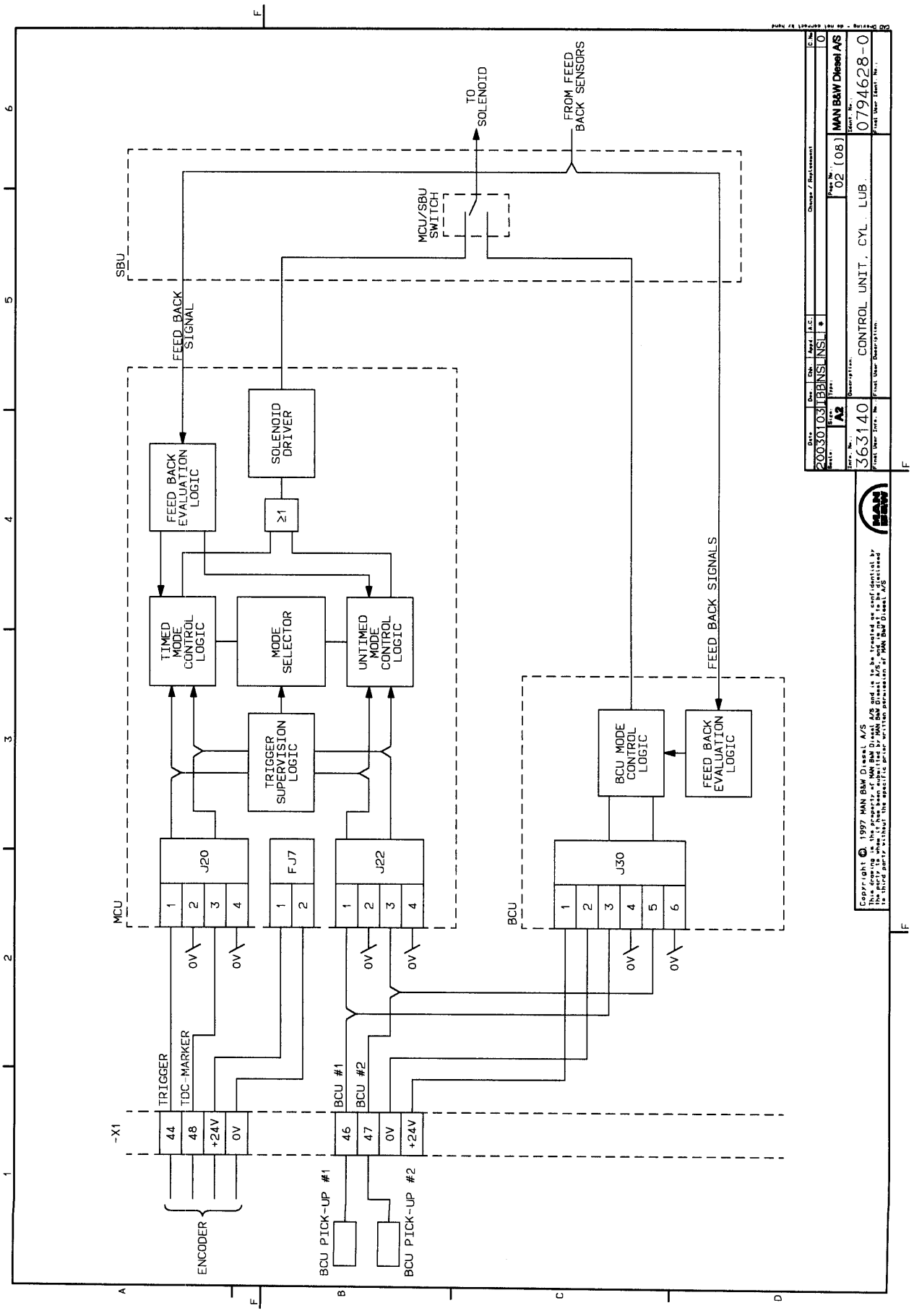
The Error LED D_7 indicates with a red light, if there is an error on the cable from the FB-signal output, or if the input at the Switch Board Unit has an error.

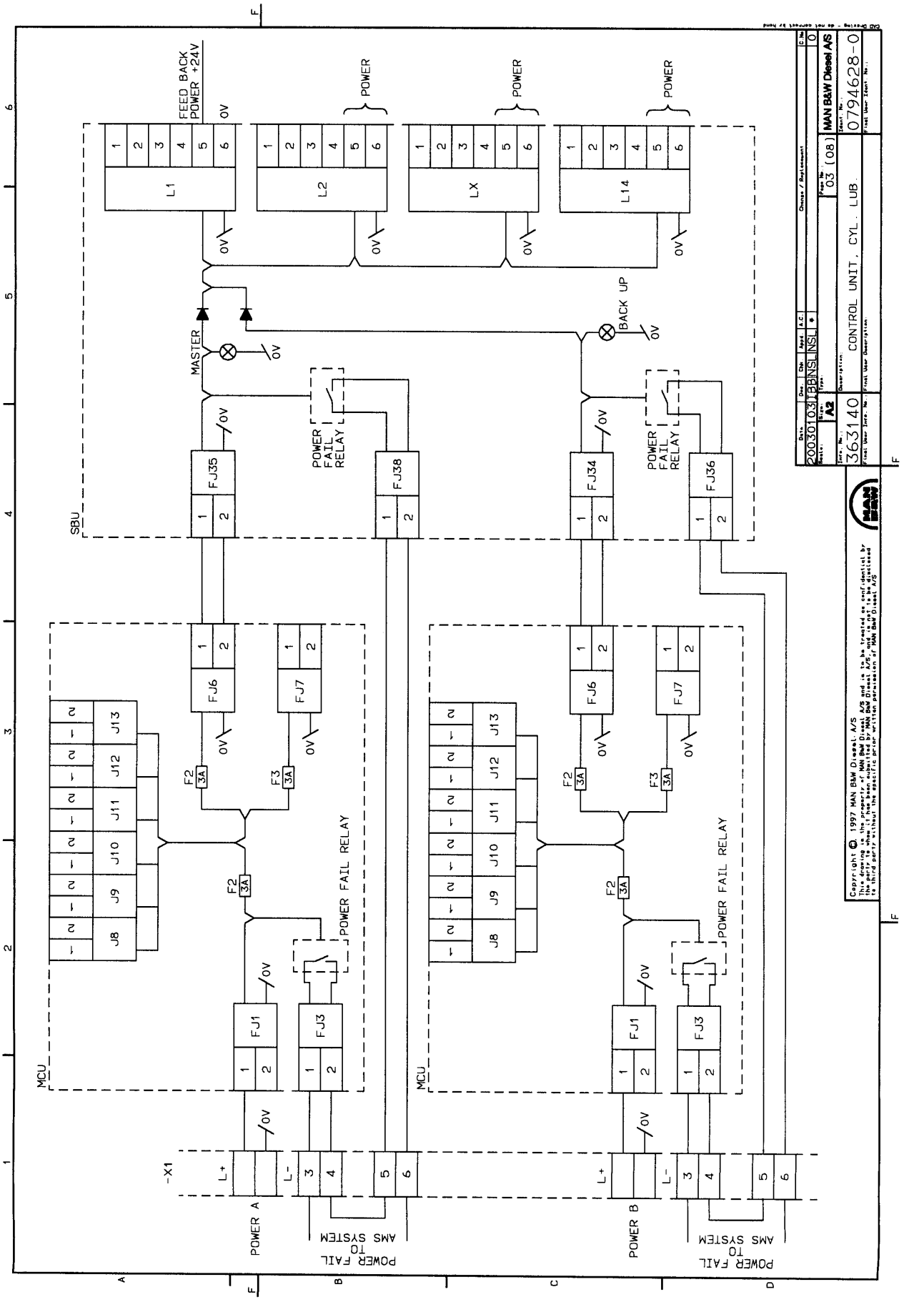
If there is an error, remove the plug from J_1 and see if the LED still indicates error. If it does then change the circuit board, if this does not remove the indicated error, then look for any damage on the cable. If the cable is damaged, then change it or, if possible, repair the damage. If there is not any damage on the cable, then the source of the error could be the input channel at the Switch Board Unit.

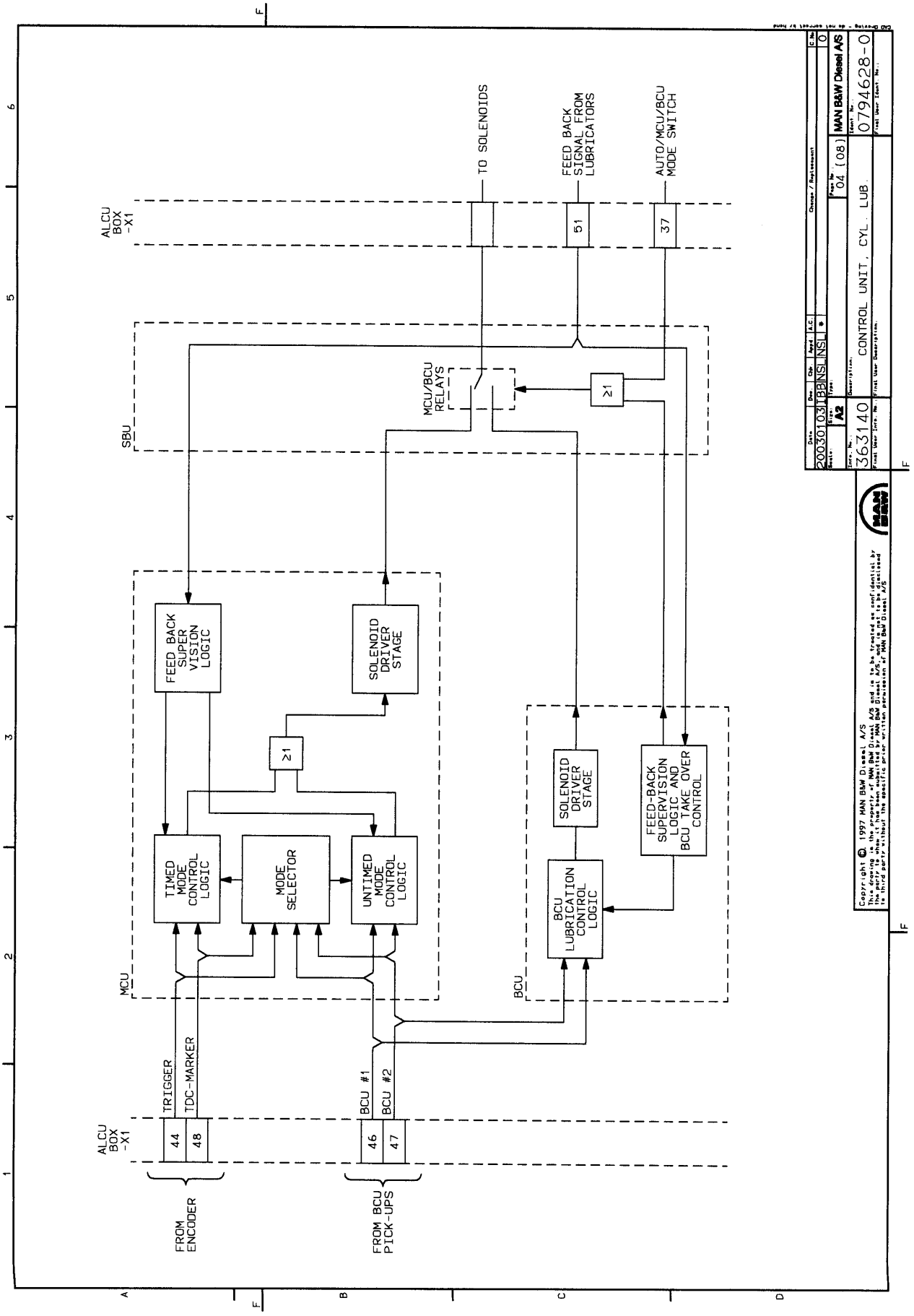
Appendix 2

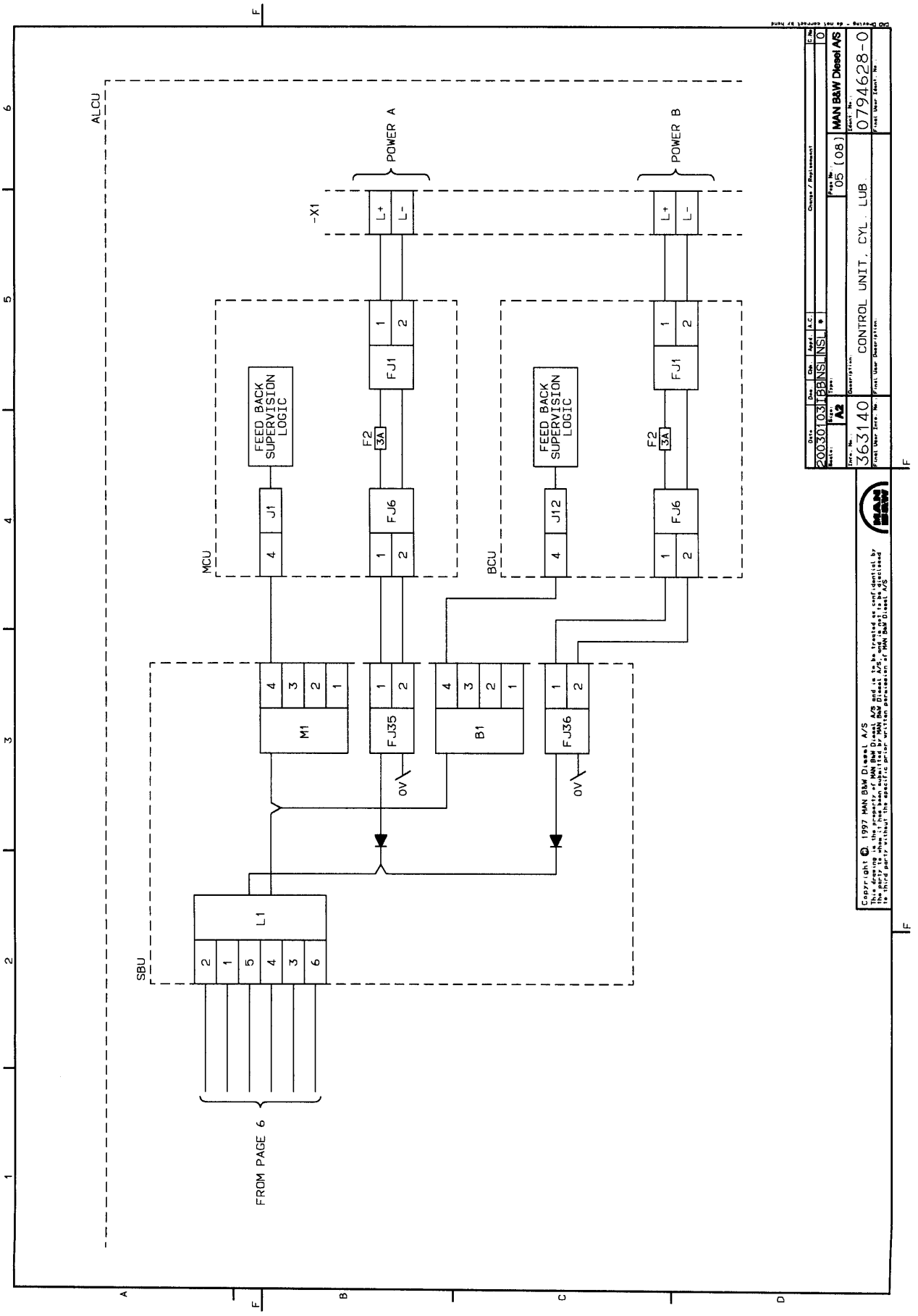
Control Unit Cylinder Lubrication – Logic Diagram

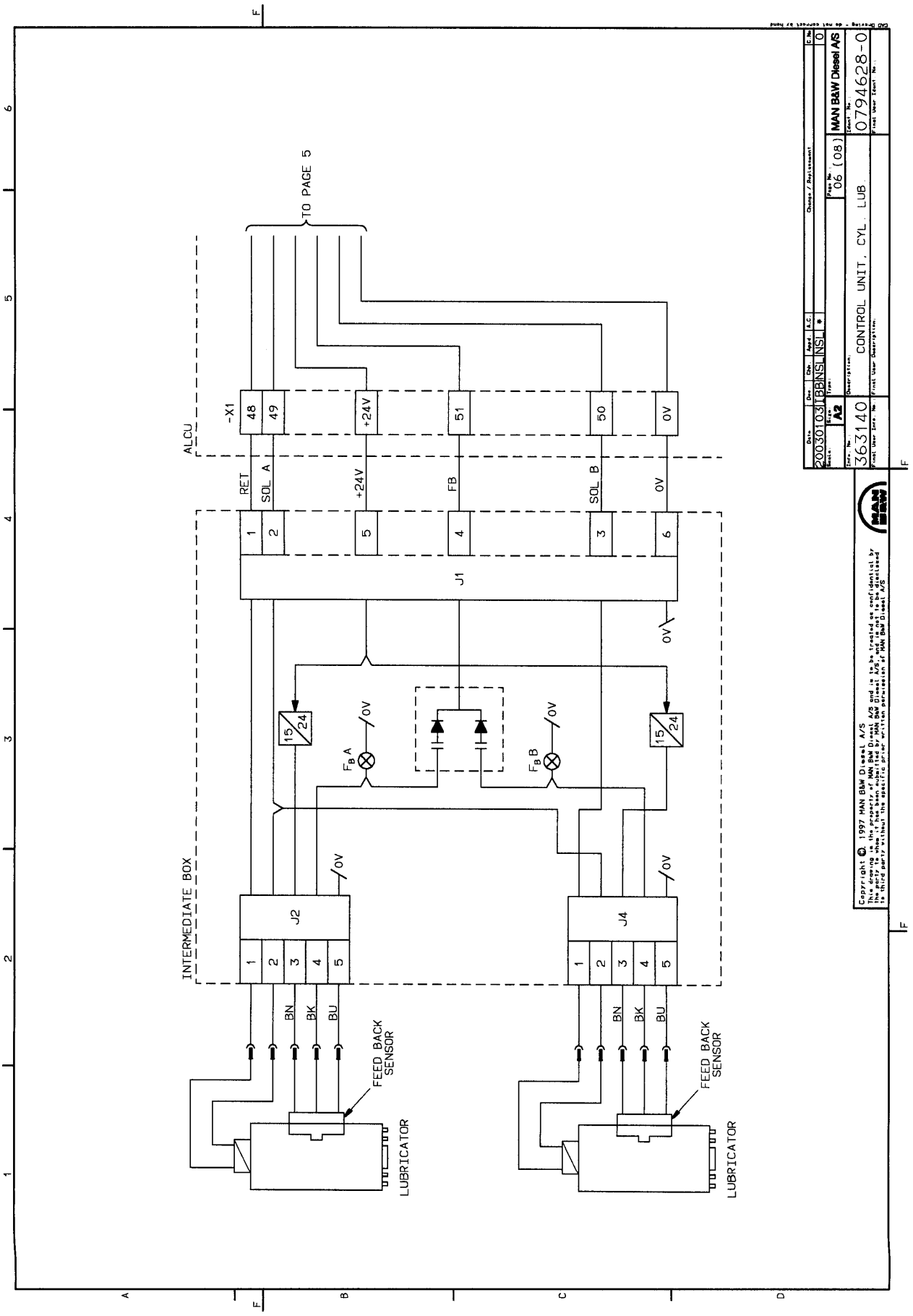


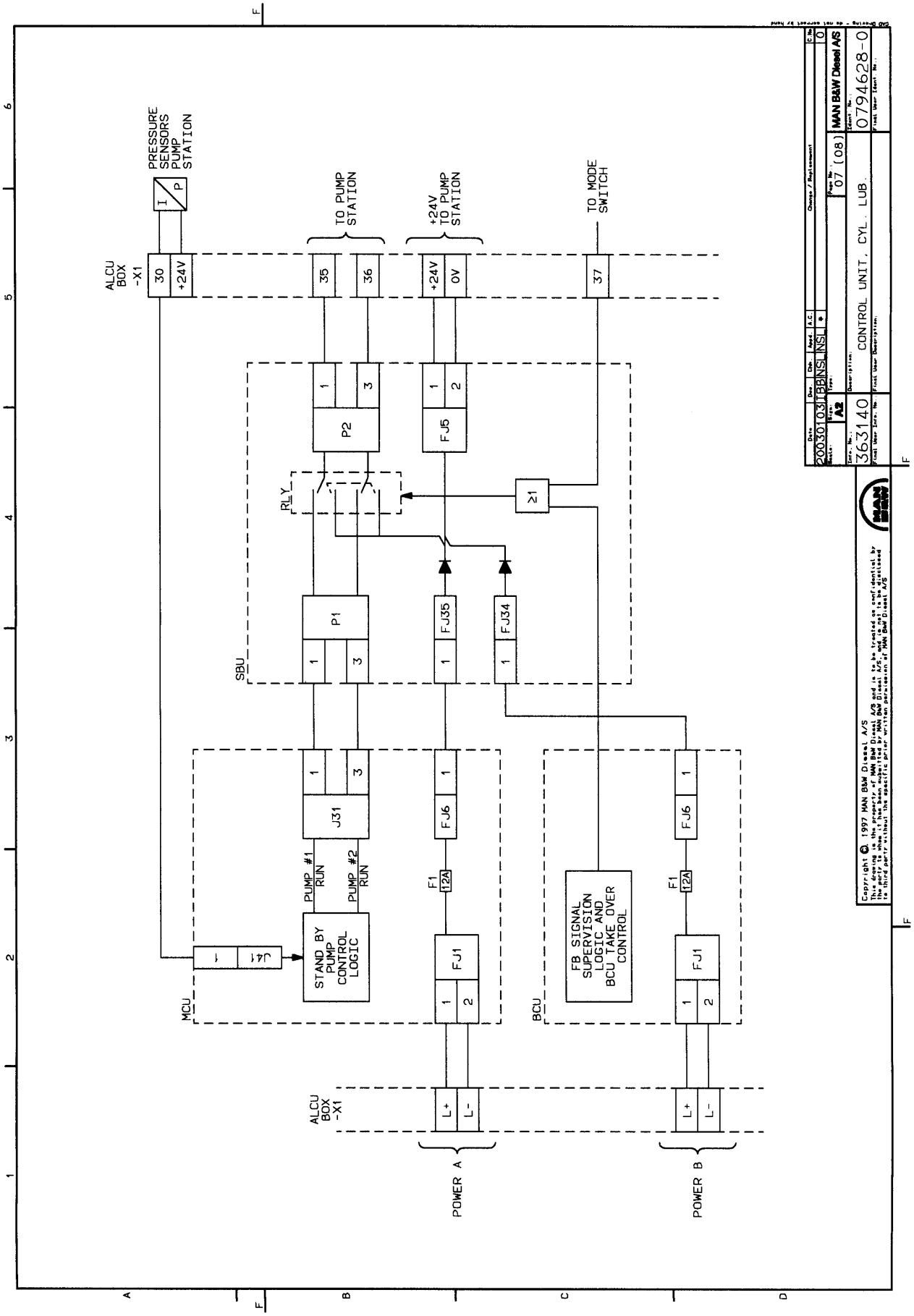

TO SOLENOID
FROM FEED BACK SENSORS
MCU/SBU SWITCH
SBU
FEED BACK SIGNAL
SOLENOID DRIVER
FEED BACK EVALUATION LOGIC
≥1
TIMED MODE CONTROL LOGIC
MODE SELECTOR
UNTIMED MODE CONTROL LOGIC
TRIGGER SUPERVISION LOGIC
MCU
J20
FJ7
J22
BCU
J30
BCU MODE CONTROL LOGIC
FEED BACK EVALUATION LOGIC
FEED BACK SIGNALS
0V
TRIGGER
TDC-MARKER
BCU #1
BCU #2
-X1
44
48
+24V
0V
46
47
0V
+24V
ENCODER
BCU PICK-UP #1
BCU PICK-UP #2
CONTROL UNIT, CYL. LUB.
MAN B&W Diesel A/S
07946628-0
363140
2003-01-03
A2
02 (08)

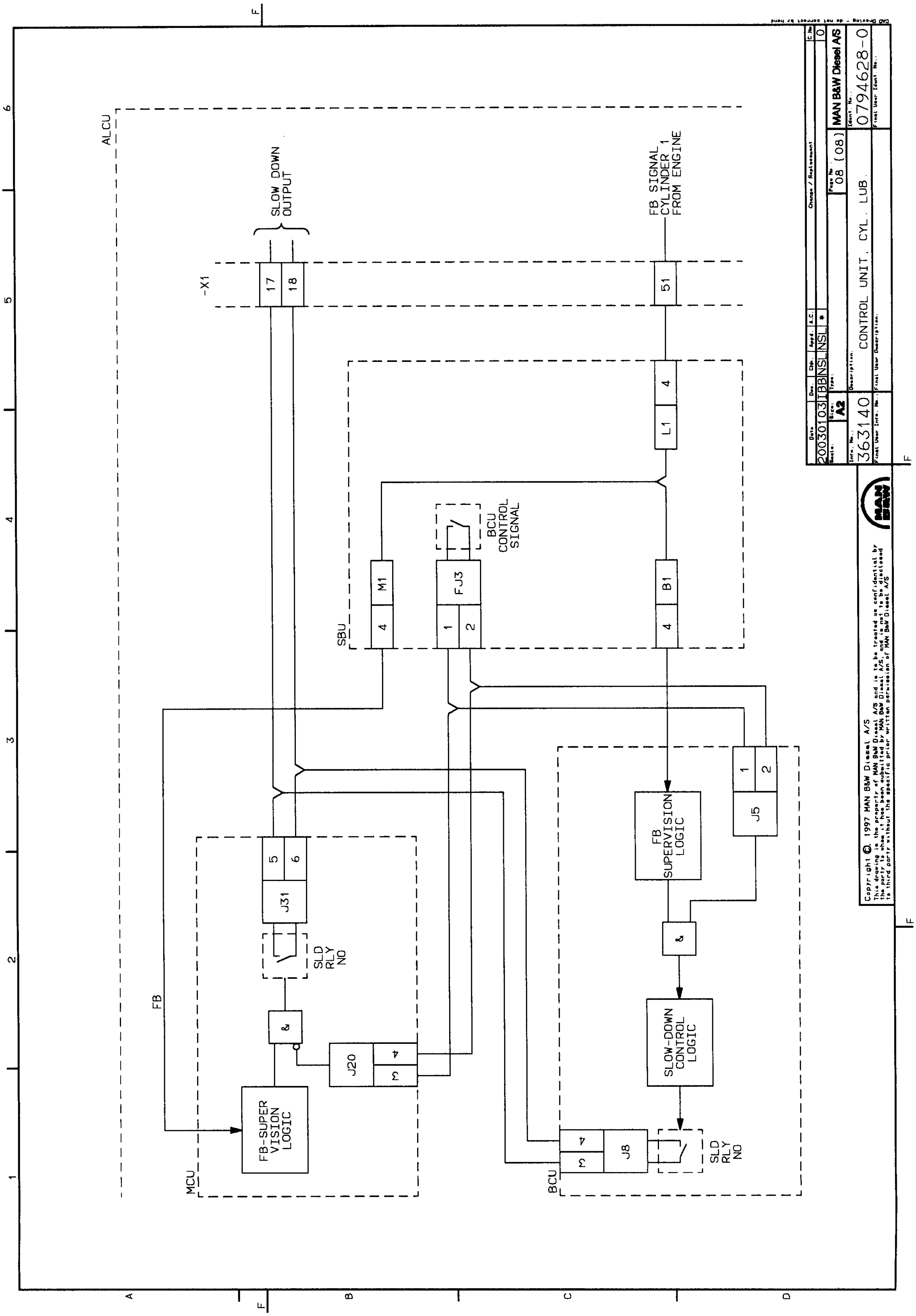

FEED BACK POWER +24V
0V
POWER
L1
L2
LX
L14
BACK UP
MASTER
SBU
POWER FAIL RELAY
FJ35
FJ38
FJ34
FJ36
FJ6
FJ7
FJ1
FJ3
F2 3A
F3 3A
POWER FAIL RELAY
MCU
J8
J9
J10
J11
J12
J13
-X1
L+
L-
POWER A
POWER B
POWER FAIL TO AMS SYSTEM
CONTROL UNIT, CYL. LUB
MAN B&W Diesel A/S
07946628-0
363140
2003010 3
Copyright © 1997 MAN B&W Diesel A/S


TO SOLENOIDS
FEED BACK SIGNAL FROM LUBRICATORS
AUTO/MCU/BCU MODE SWITCH
ALCU BOX -X1
51
37
SBU
MCU/BCU RELAYS
≥1
FEED BACK SUPER VISION LOGIC
SOLENOID DRIVER STAGE
≥1
TIMED MODE CONTROL LOGIC
MODE SELECTOR
UNTIMED MODE CONTROL LOGIC
MCU
SOLENOID DRIVER STAGE
FEED-BACK SUPERVISION LOGIC AND BCU TAKE OVER CONTROL
BCU LUBRICATION CONTROL LOGIC
BCU
TRIGGER
TDC-MARKER
BCU #1
BCU #2
ALCU BOX -X1
44
48
46
47
FROM ENCODER
FROM BCU PICK-UPS
MAN B&W Diesel A/S
CONTROL UNIT, CYL. LUB
07946280
363140
2003010 3
A2
04 (08)


ALCU
POWER A
POWER B
-X1
L+
L-
MCU
BCU
SBU
FEED BACK SUPERVISION LOGIC
FJ1
FJ6
F2
3A
J1
J12
M1
B1
L1
FJ35
FJ36
0V
FROM PAGE 6
CONTROL UNIT, CYL. LUB.
MAN B&W Diesel A/S
0794628-0
363140
05 (08)
2003-01-03
TBBNS
INSL
A2


TO PAGE 5
ALCU
-X1
48
49
+24V
51
50
0V
RET
SOL A
+24V
FB
SOL B
0V
1
2
5
4
3
6
J1
0V
15
24
F_B A
F_B B
INTERMEDIATE BOX
J2
J4
BN
BK
BU
FEED BACK SENSOR
LUBRICATOR
CONTROL UNIT, CYL. LUB
363140
0794628-0
MAN B&W Diesel A/S
06 (08)
A2
2003-01-03
TBBINSL
INSL
Copyright © 1997 MAN B&W Diesel A/S


PRESSURE SENSORS PUMP STATION
I/P
ALCU BOX -X1
30
+24V
TO PUMP STATION
35
36
+24V TO PUMP STATION
+24V
0V
TO MODE SWITCH
37
P2
FJ5
RLY
≥1
SBU
P1
FJ35
FJ34
J31
FJ6
PUMP #1 RUN
PUMP #2 RUN
F1
12A
STAND BY PUMP CONTROL LOGIC
MCU
FJ1
FB SIGNAL SUPERVISION LOGIC AND BCU TAKE OVER CONTROL
BCU
L+
L-
POWER A
POWER B
CONTROL UNIT, CYL. LUB.
MAN B&W Diesel A/S
07 (08)
0794628-0
363140
2003-01-03
TBRNS
INSL
A2


ALCU
SLOW DOWN
OUTPUT
FB SIGNAL
CYLINDER 1
FROM ENGINE
-X1
17
18
51
SBU
BCU
CONTROL
SIGNAL
FJ3
M1
B1
L1
J5
J31
J20
J8
FB
SUPERVISION
LOGIC
SLOW-DOWN
CONTROL
LOGIC
FB-SUPER
VISION
LOGIC
SLD
RLY
NO
FB
MCU
BCU
20030103
A2
363140
0794628-0
CONTROL UNIT, CYL. LUB.
MAN B&W Diesel A/S

Appendix 3

Replacement of MCU, BCU, SBU Boards

If one of the PCB's in the ALCU box is to be replaced, note as follows:

Before removing any plugs from the PCB ensure that the plugs are numbered in order to remount them in the correct place.

The SBU unit does not need any programming or setup. This board can be replaced directly with a spare.

MCU and BCU units:
Normally the spare units are delivered programmed and ready to use.

Remove all plugs from the PCB.
Remove the eight screws that fasten the unit to the ALCU.
Mount the new unit and remount the plugs in the correct position.

MCU replacement

If the MCU unit has been replaced, check the following:

Note that a new MCU unit is adjusted to a feed rate of 200% (factory setting).

1. Read out the feed rate setting for the individual cylinders on the old MCU in order to adjust the new MCU to the same setting
2. Start the PRELUBRICATION sequence and check that all cylinders are lubricated by observing that all LEDs on the intermediate boxes flash. Also check that no feedback alarms are present in the HMI panel.
3. With the engine running, check the injection angles in the HMI panel and compare these with the angles stated in the test sheet supplied with the ALCU box.
4. Adjust the lubrication feed rate according to the settings the engine had before this replacement.

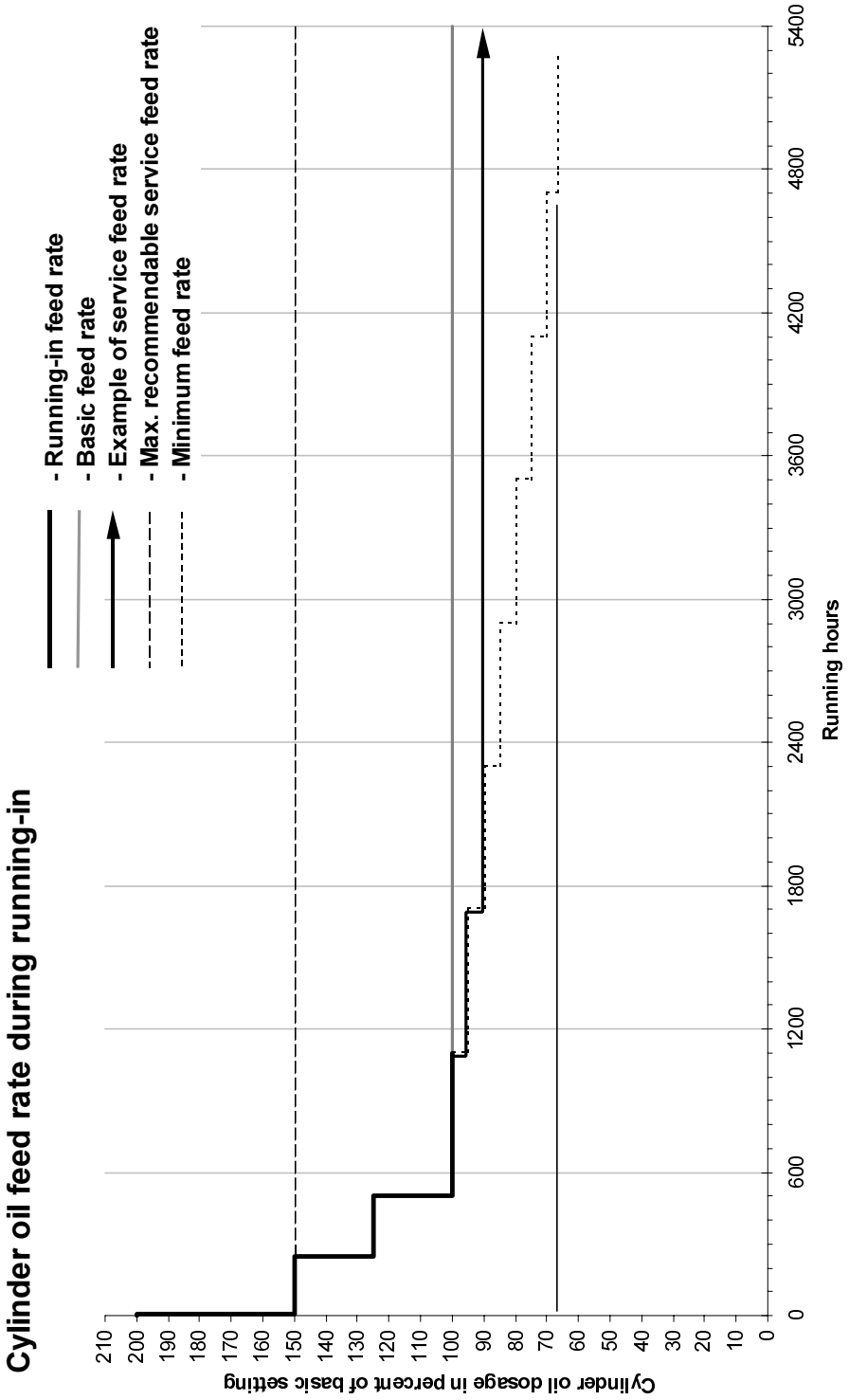
BCU replacement

If the BCU unit has been replaced, check the following:

1. Check that the DIP switch settings on the new board are corresponding to the settings of the old board.
2. With the engine running, switch to forced BCU operation and check that all cylinders are lubricated by observing that all LEDs on the intermediate boxes flash. Switch back to AUTO mode.
3. Check that no alarms from the BCU are present.
4. If the SBU unit has been replaced, check the function by carrying out the checks stated under both MCU and BCU replacements.

Appendix 4

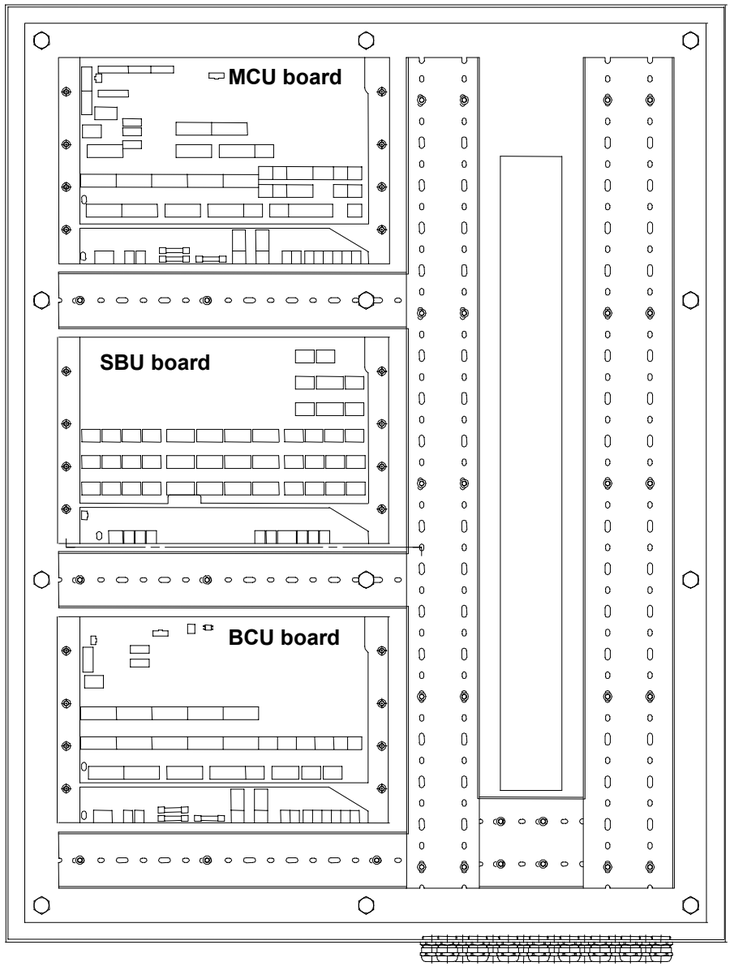
Cylinder oil feed rate during running-in



Guiding Cylinder Oil Feed Rates S/L/K-MC/MC-C/ME/ME-C engines with Alpha Lubricators, based on a BN 70 cylinder oil				
		Standard guidelines (ref. to MCR load)		Alpha Adaptive Cylinder oil Control (Alpha ACC)
Basic setting		**0.8 g/bhph 1.1 g/kWh**		**0.25 g/bhph x S% 0.34 g/kWh x S%**
Minimum feed rate		0.6 g/bhph 0.8 g/kWh		0.5 g/bhph 0.7 g/kWh
Maximum feed rate during normal service		1.25 g/bhph 1.7 g/kWh		1.25 g/bhph 1.7 g/kWh
Part-load control		Proportional to mean cylinder pressure		Proportional to engine load
		Below 25% load, proportional to engine speed.		
Running-in new liners and piston rings	Feed rate:	Alu-coat piston rings:	First 5 hours: 1.6 g/bhph From 5 to 250 hours: Basic setting +50% From 250 to 500 hours: Basic setting +25%	
		Non-coated or hard-coated rings:	First 15 hours: 1.6 g/bhph From 15 to 250 hours: Basic setting +50% From 250 to 500 hours: Basic setting +25%	
	Engine load:	Alu-coat piston rings:	Stepwise increase to max. load over 5 hours	
		Non-coated or hard-coated rings:	Stepwise increase to max. load over 15 hours	
Running-in new rings in already run-in liners:		Alu-coat piston rings: No load restrictions Non-coated or hard-coated rings: Stepwise load increase to max. load over 5 hours. Feed rate: Basic setting +25% for 24 hrs.		
Load change device (LCD)		During starting, manoeuvring and load changes, regulation proportional to load or mean effective pressure should be replaced by rpm proportional control, and the dosage increased by 25%.		
Lubrication of cylinders that show abnormal conditions:		Frequent scavenge port inspections of piston rings and cylinder liners are very important for maintaining a good cylinder condition. If irregularities are seen, adjustments of the lube oil rate should be considered. In case of scuffing, sticking piston rings or high liner temperature fluctuations, the feed rate should be raised by 25–50%.		

Appendix 5

ALCU signal description



Basic Standards (MBD SB) & Suppl. Drawing No.:		EN21C Surf. roughness		Material / Blank:
		EN21F-m Tolerances	Mass (kg)	Final User Matrial:

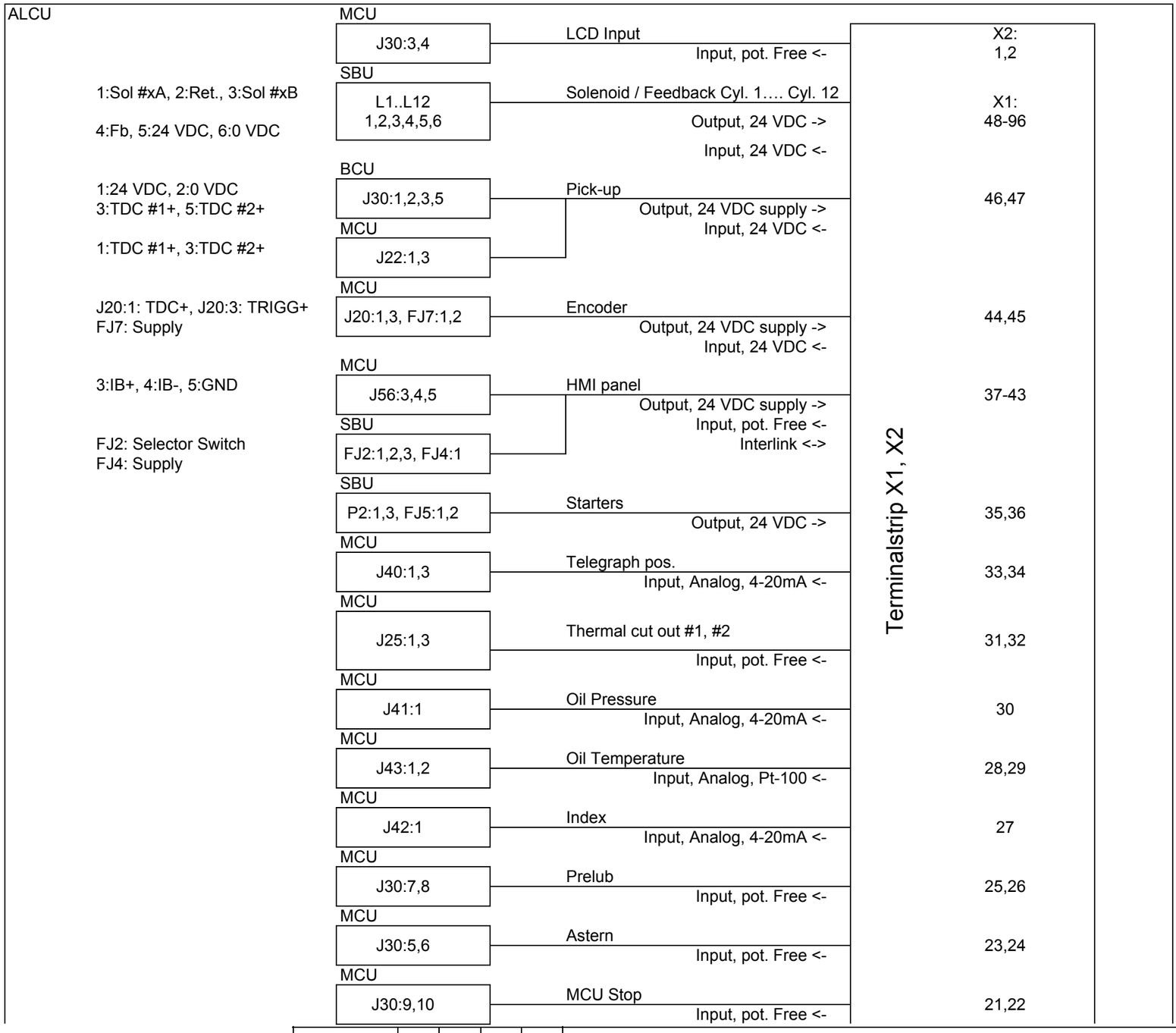
Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	
				*	Replaced by Ident No.:	9
						8
						7
						6
						5
						4
						3
						2
						1
20020508	DFA	JHV	JHV			0

Similar Drawing no.:	Replacement for Ident no.:

Scale:	Size:	Type	Page No.:	
1:1	A3	ALCU signal description	01 (03)	MAN B&W Diesel A/S

Info No.	Description	Ident. No.
3 63 140	Control Unit. Cyl. Lub.	0789390-3
Final User Info No.	Final User Description	Final User Ident. No.

LCD Input:	LCD signal as potential free contact from Governor. For Electronic Governors.
Solenoid / Feedback: Cyl. 1…. Cyl. 12	Activation of Solenoid valves for injection of lub. Oil. Feedback signals generated by inductive sensor on lubricator.
Pick-up:	Pickups supply BCU with TDC for backup running.
Encoder:	Shaft Encoder supplies MCU with TDC and trigger pulses for calculation of lub. oil injection.
HMI panel:	Human machine interface for Operational and parametter setting of the ALCU.
Starters:	Pump station starters. Start / Stop of Pump 1 and 2.
Telegraph pos.:	Analog 4-20mA LCD signal from Governor. For Mechanical governors. Signal to be powered by ALCU.
Thermal cut out #1, #2:	Potential free contact to ALCU from Pump station starters. Contact close when motor protection relay trips.
Oil Pressure:	Analog signal from Pressure transmitter on pump station. 4-20 mA=0-100 bar.
Oil Temperature:	Analog signal from Pt-100 temperature sensor on pump station. 100 ohm at 20 C.
Index:	Analog 4-20 mA signal from index transmitter.
Prelub:	Potential free contact to ALCU, to close when prelubrication required.
Astern:	Potential free contact to ALCU, to be closed when engine in Astern.
MCU Stop:	Potential free contact to ALCU, to be closed when engine in Stop.



Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	
20020508	DFA	JHV	JHV	*		0

Similar Drawing no.: | Replacement for Ident no.:

Scale:	Size:	Type	Page No.:	
1:1	**A3**	ALCU signal description	**02 (03)**	**MAN B&W Diesel A/S**

Info No.	Description	Ident. No.
3 63 140	Control Unit. Cyl. Lub.	0789390-3
Final User Info No.	Final User Description	Final User Ident. No.

BCU Stop:	Potential free contact to ALCU, to be closed when engine in Stop.		BCU FJ13:1, J5:3	BCU Stop, Input, pot. Free <-	19,20
Slow down:	Potential free contact from ALCU, closed when Slow down is generated.		MCU J31:5,6	Slow down, Output, pot. Free ->	17,18
			BCU J8:3,4		
BCU fail:	Potential free contact from ALCU, open when BCU has alarm.		BCU J10:1,2	BCU fail, Output, pot. Free ->	15,16
MCU fail:	Potential free contact from ALCU, open when MCU fails.		BCU J8:1,2	MCU fail, Output, pot. Free ->	13,14
BCU Power fail:	Potential free contact from ALCU, open when BCU loses 24 VDC supply.		BCU FJ3:1,2	BCU power fail, Output, pot. Free ->	9,10,11,12
			SBU FJ36:1,2		
BCU In CTRL:	Mode indication, potential free contact from ALCU, closed when BCU in Control.		SBU FJ28:1,2	BCU In CTRL, Output, pot. Free ->	7,8
MCU Power fail:	Potential free contact from ALCU, open when MCU loses 24 VDC supply.		MCU FJ3:1,2	MCU Power fail, Output, pot. Free ->	3,4,5,6
			SBU FJ38:1,2		
Com. Alarm:	Potential free contact from ALCU, open when common alarm is generated.		MCU J32:1,2	Com. Alarm, Output, pot. Free ->	1,2
Modbus:	Optional RS-232 communication link from ALCU.	2:RxD, 4:TxD, 5:GND	MCU J55:2,4,5	Modbus, RS-232 <-> (optional)	TxD, RxD
Power B:	Supply power B to ALCU, Supplies BCU and SBU in BCU mode.	1: 24 VDC, 2: 0 VDC	BCU FJ1:1,2	Power B, 24 VDC supply <-	L+,L-
Power A:	Supply power A to ALCU, Supplies MCU and SBU in MCU mode.	1: 24 VDC, 2: 0 VDC	MCU FJ1:1,2	Power A, 24 VDC supply <-	L+,L-

Terminalstrip X1, X2

Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	
20020508	DFA	JHV	JHV	*		0

Similar Drawing no.: | Replacement for Ident no.:

Scale:	Size:	Type	Page No.:	
1:1	A3	ALCU signal description	03 (03)	MAN B&W Diesel A/S

Info No.	Description	Ident. No.
3 63 140	Control Unit. Cyl. Lub.	0789390-3
Final User Info No.	Final User Description	Final User Ident. No.

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Operation

Commissioning

Maintenance

Components

Electrical Wiring

Table of Contents

1. Preparation

1.1 Connect a 440 V power supply to the two pump starter cabinets, and start the two pumps locally for a brief period to check that they run in the correct direction of rotation.

1.2 Check, and if necessary adjust, the current limits on the two motor-start relays so that they comply with the rating plate on the motor.

1.3 Connect and activate the heating element in the suction tank.

1.4 Dismount the inlet and outlet pipes to the lubricator blocks and mount U-pipes with shut-off cocks instead (bypass the blocks).

Remember to seal off the free pipe connections on the lubricator block to prevent the ingress of dirt.

Mount an extra full-flow filter (15 to 35 μ) in the return pipe from the engine to the pump station.

Disconnect the service tank as hydraulic oil is to be used for flushing.

1.5 Mount a U-pipe with shut-off cock on the end of the oil supply main pipe.

1.6 Close all shut-off cocks on the U-pipes at the lubricator blocks and open the cock at the end of the main pipe.

1.7 Fill the suction tank on the pump station with hydraulic oil.

1.8 Open all relevant cocks on the pumps.

1.9 Start pump No. 1 locally via the starter cabinet.

1.10 Adjust the pressure regulator on the pump station to maximum pressure.

1.11 Check that there are no leaks in the pipe system.

1.12 Check the oil level in the suction tank and, if necessary, top up until the level is stable.

1.13 Shut-down pump No. 1.

1.14 Start pump No. 2 and check that it can maintain a pressure level similar to pump No. 1.

1.15 Start both pumps.

1.16 Regularly check the oil level in the suction tank and top up as necessary.

1.17 Regularly check that the pressure drop across the suction filters and in the full-flow filter in the pressure outlet do not exceed the maximum level. Replace the filters if clogged.

2. Flushing

The following flushing procedure is to be carried out before starting up on the testbed:

2.1 After five hours' flushing, open one half of the shut-off cocks on the U-pipes on the lubricator blocks, and close the cock at the end of the main pipe.

2.2 Continue flushing for at least five hours.

2.3 After five hours' flushing, open the other half of the shut-off cocks on the U-pipes and close the half that were open.

2.4 Continue flushing for at least five hours.

2.5 Close the inlet and outlet cocks on the pump station, and drain the oil from the suction tank.

2.6 Switch-off the 440 V power supply to the pumps and tank heater via the main switch on the starter cabinets.

2.7 Remove the inspection cover on the suction tank and clean the inside of the tank so that it is completely free of any oil or dirt.

2.8 Dismount all U-pipes and re-install all the original pipe connections.

2.9 Open all relevant cocks on the pumps and open for the supply of cylinder oil from the service tank (gravity tank).

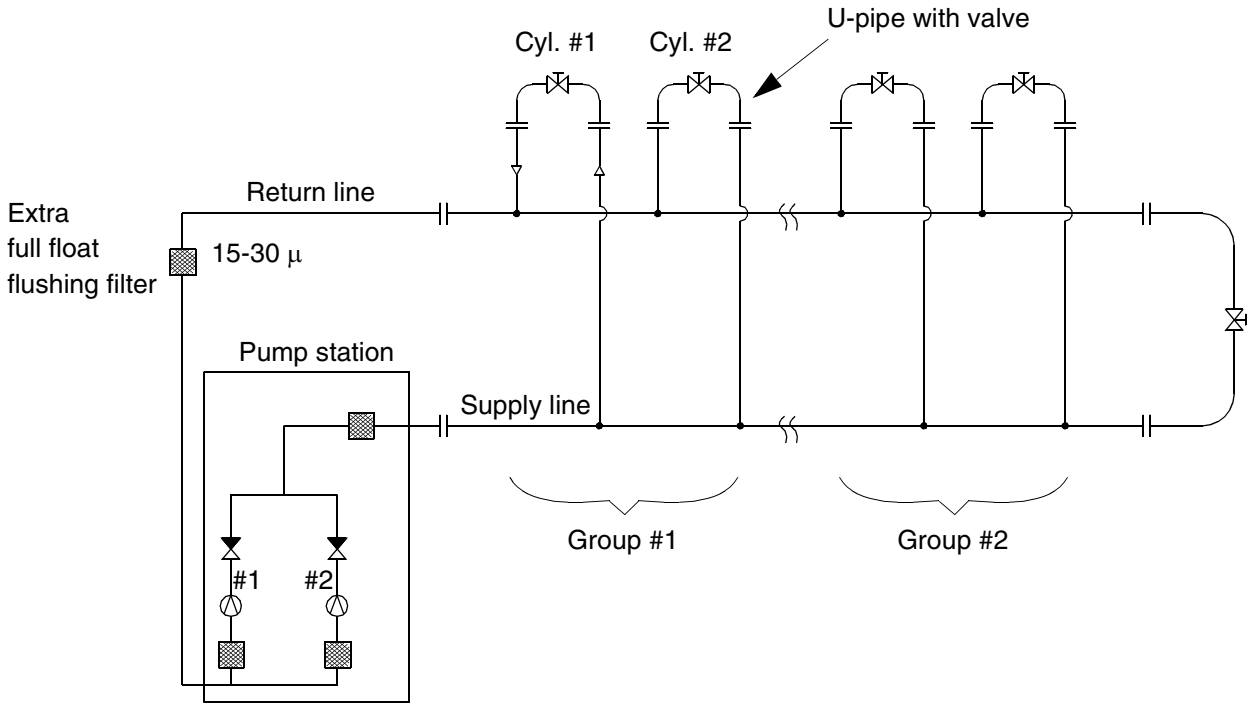
2.10 Start a pump from the pertaining start button on the starter cabinet and adjust the pressure regulator to 45 bar.

2.11 Check that there are no leaks in the pipe system or lubricators.

2.12 Check and, if necessary, adjust the thermostat to 45^{o} C, after dismounting the cover on the heater.

The oil system is now ready for service.

The filter must be a “bag-type” filter

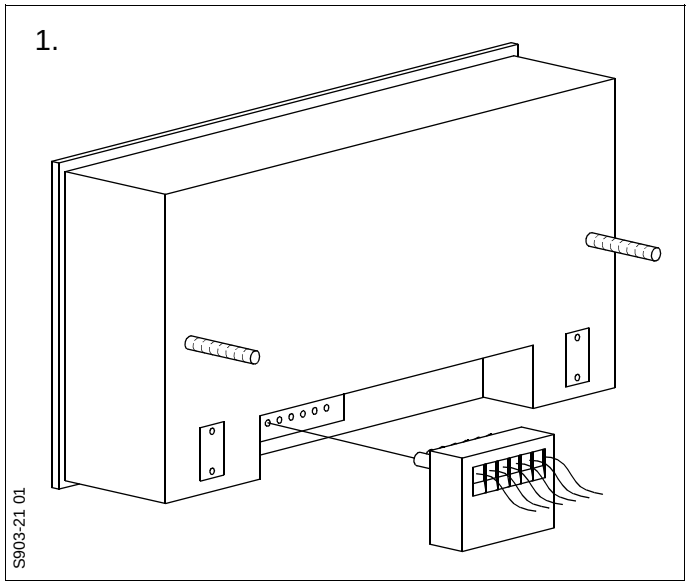


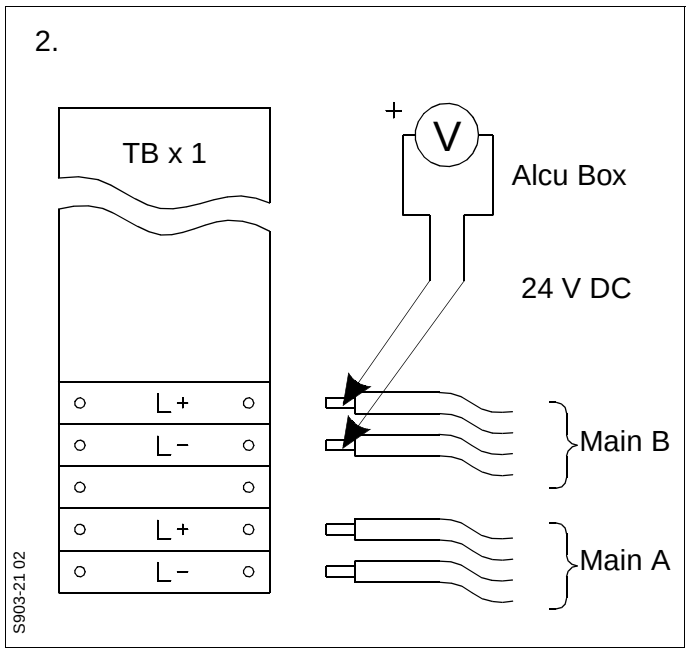
ALCU – Testbed Procedure

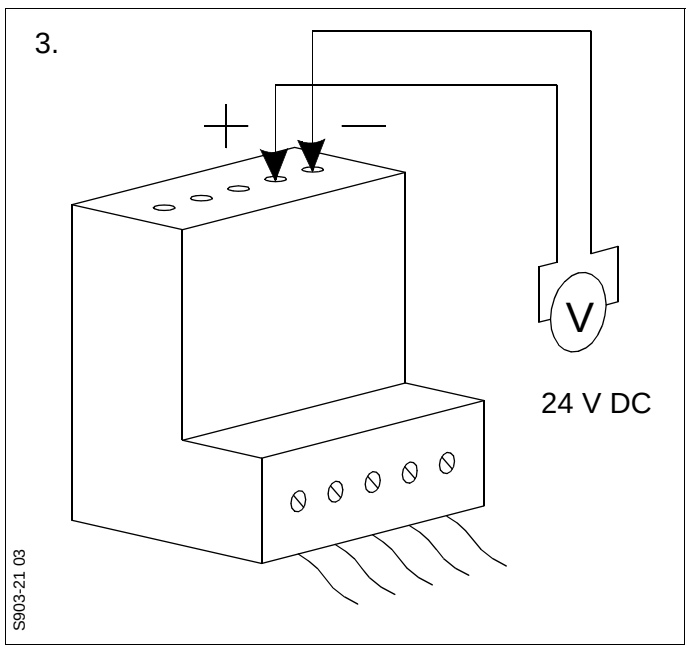
1. Disconnect the connections to the HMI panel. (HMI panel side).

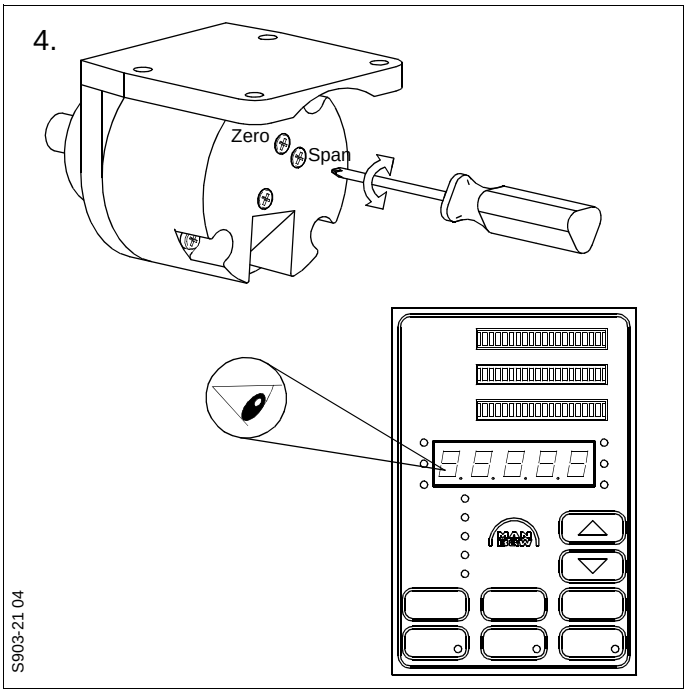
2. Check the power supply for correct polarity before connecting the power to the ALCU control box terminals. Check both Main A and Main B.

3. Check the HMI panel power connection for correct polarity, and connect the HMI panel.





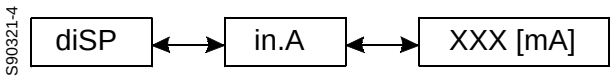


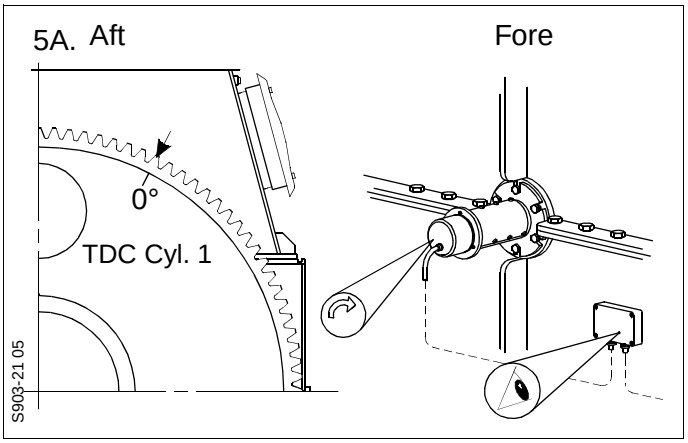


4. Set the Index transmitter to approx. 4.5 mA at 0 mm index and approx. 19.5 mA at maximum possible index on the Local Operating Panel. The mA level can be read on the HMI panel.

   Navigating in the HMI panel menu is done as follows:

   - [ENTER] goes forward (right) in the menu or changes a set point.
   - [ESC] goes backwards (left) in the menu.
   - [▲] goes up in the menu.
   - [▼] goes down in the menu.



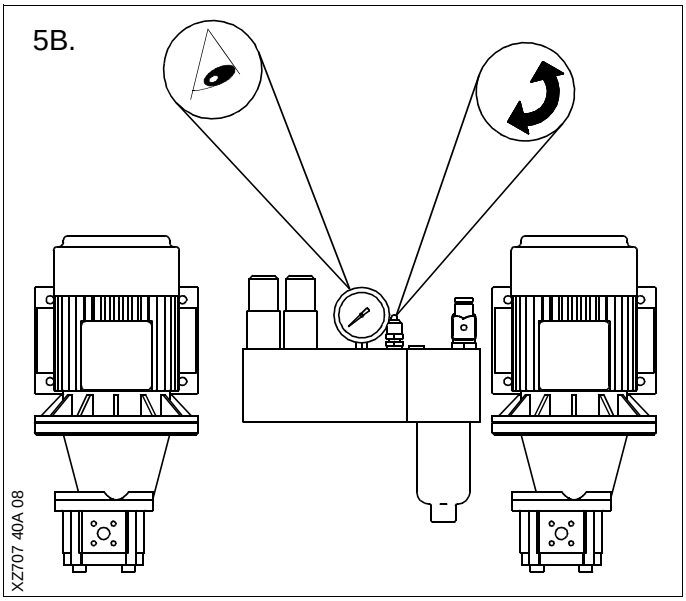


5. Adjust the angle encoder to give TDC signal at TDC cylinder No. 1 (turn the engine to bring the piston of cylinder 1 to TDC position, and turn the encoder until the LED on the encoder junction box lights up).
   See Procedure 905-8 for angle encoder adjustment.

   Adjust the BCU pick-ups, as described in Procedure 905-7.

   Start one pump.
   Check that the oil pressure builds up to 40-50 bar, or carry out adjustment on the pressure control valve on top of the pump station. The pressure can also be read on the HMI panel display.

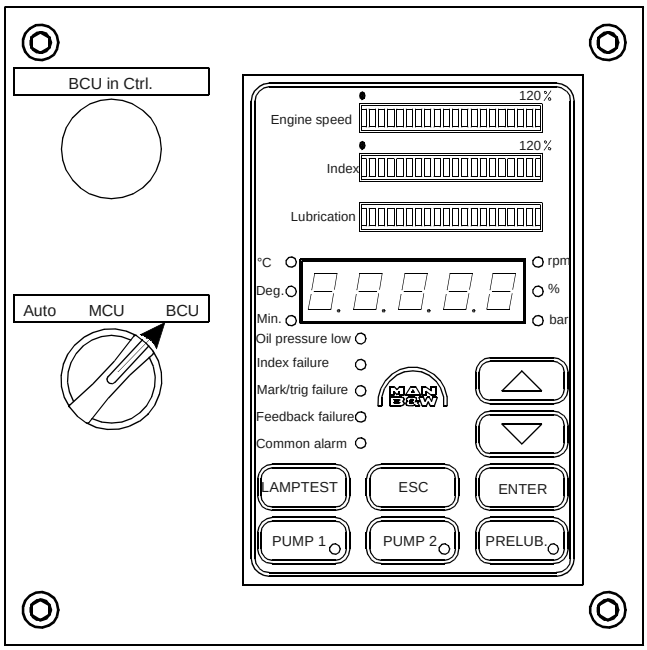
   Check that the pressure remains at an acceptable level, also with two pumps running.



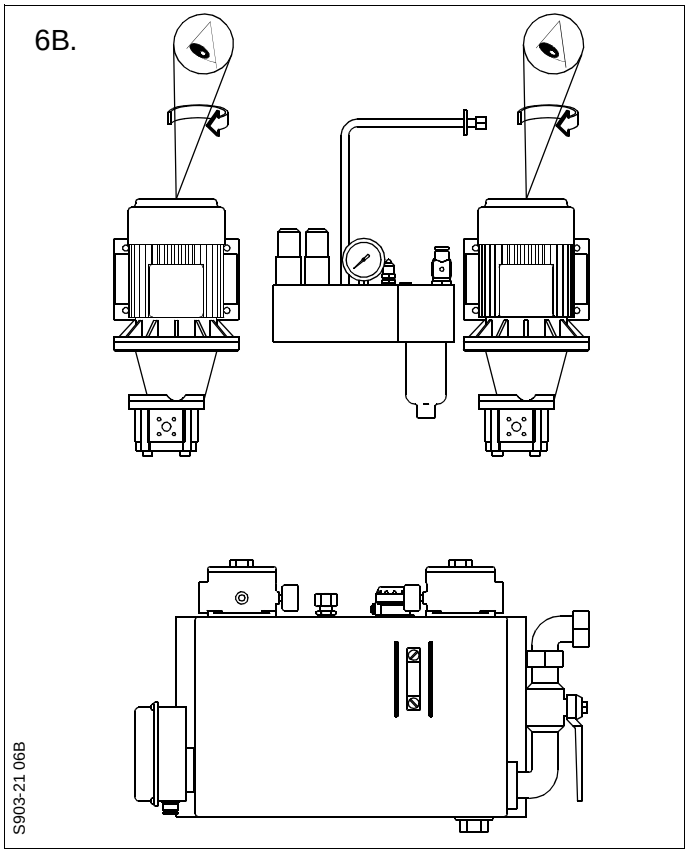
6. Turn the mode switch to BCU position and check that both booster pumps are running.

   Turn the switch back to AUTO position.

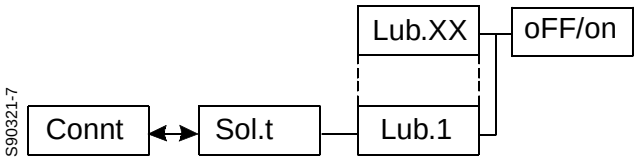
6A.



6B.

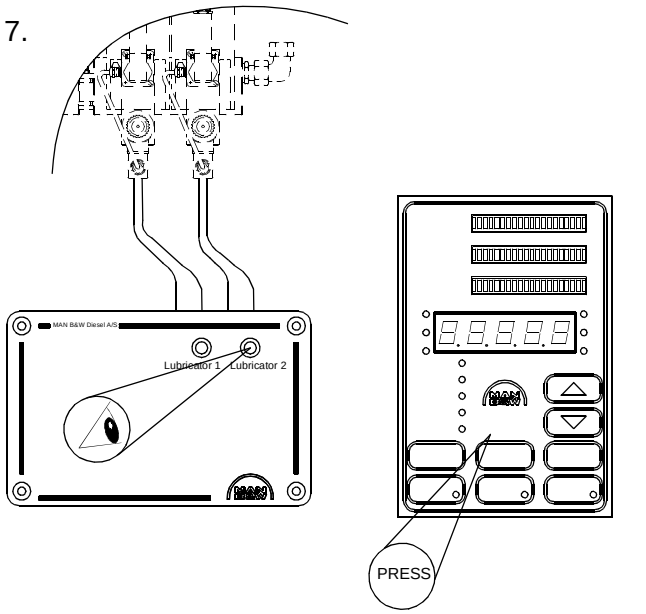


7. Check the connections to the lubricators by activating the lubricators one by one via the HMI panel connection test menu (start one booster pump from the HMI panel).

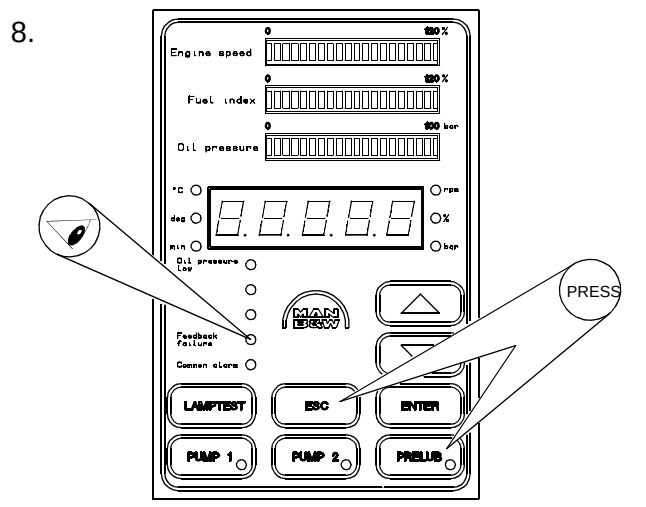


8. Check the lubricator system by activating the pre-lubrication function. Press the ESC button and the PRELUB button on the HMI panel simultaneously. Check that no feed-back alarm is activated.

7.



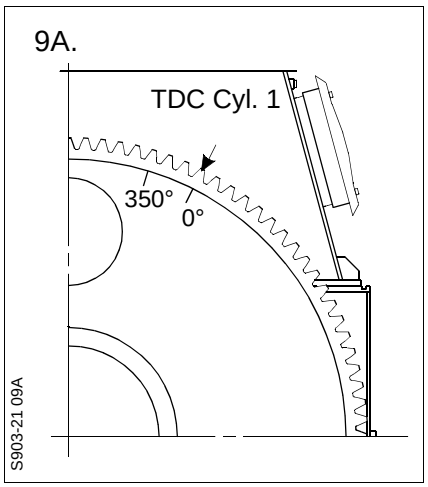
8.

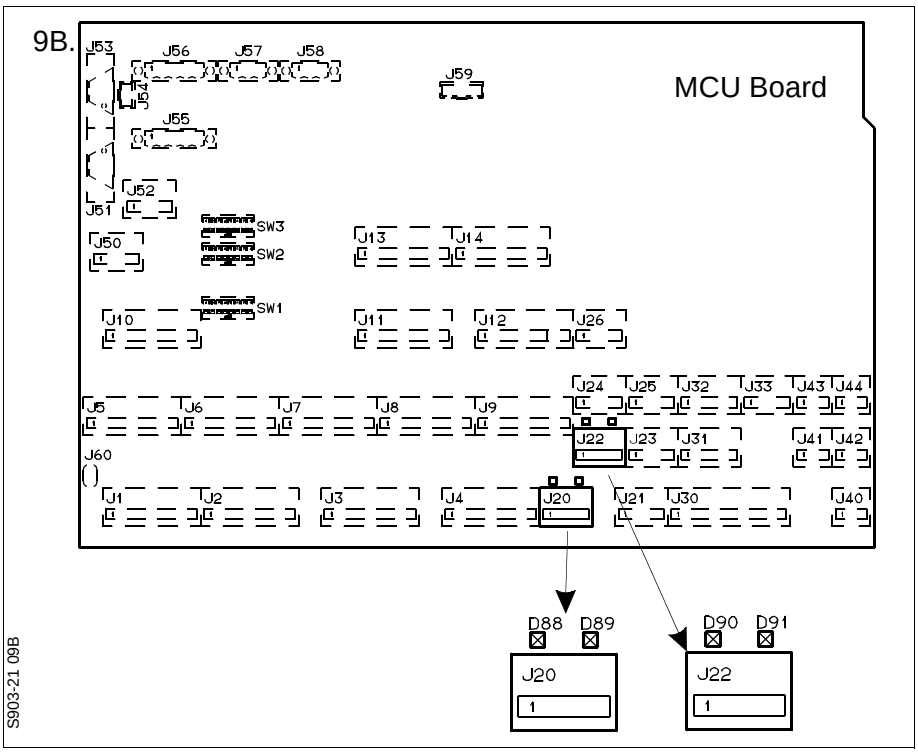


9. Turn the engine to approx. 10° before TDC of cylinder No. 1.

   Continue turning the engine and check that the small LEDs on the MCU unit – designated D88 (above J20) D90, D91 (above J22) – flash when the engine is turned and passes TDC of cylinder No. 1.

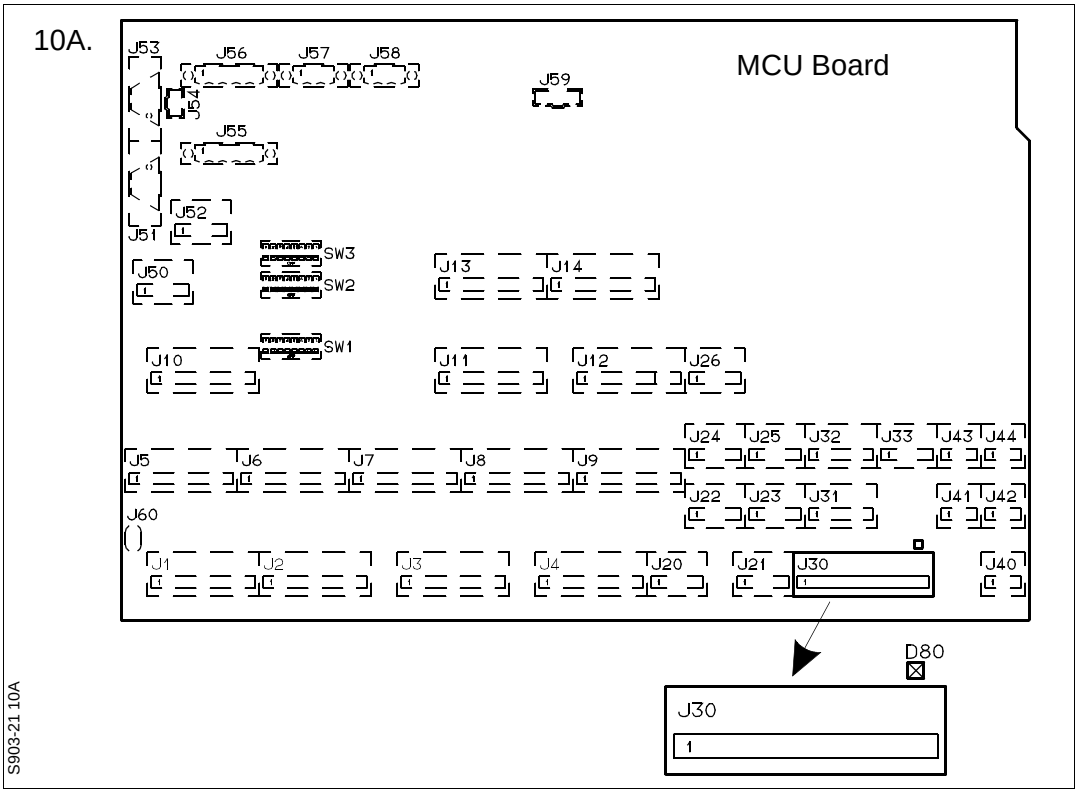
   Also check that the LED on the MCU unit – designated D89 (above J20) – flashes approx. twice each second.



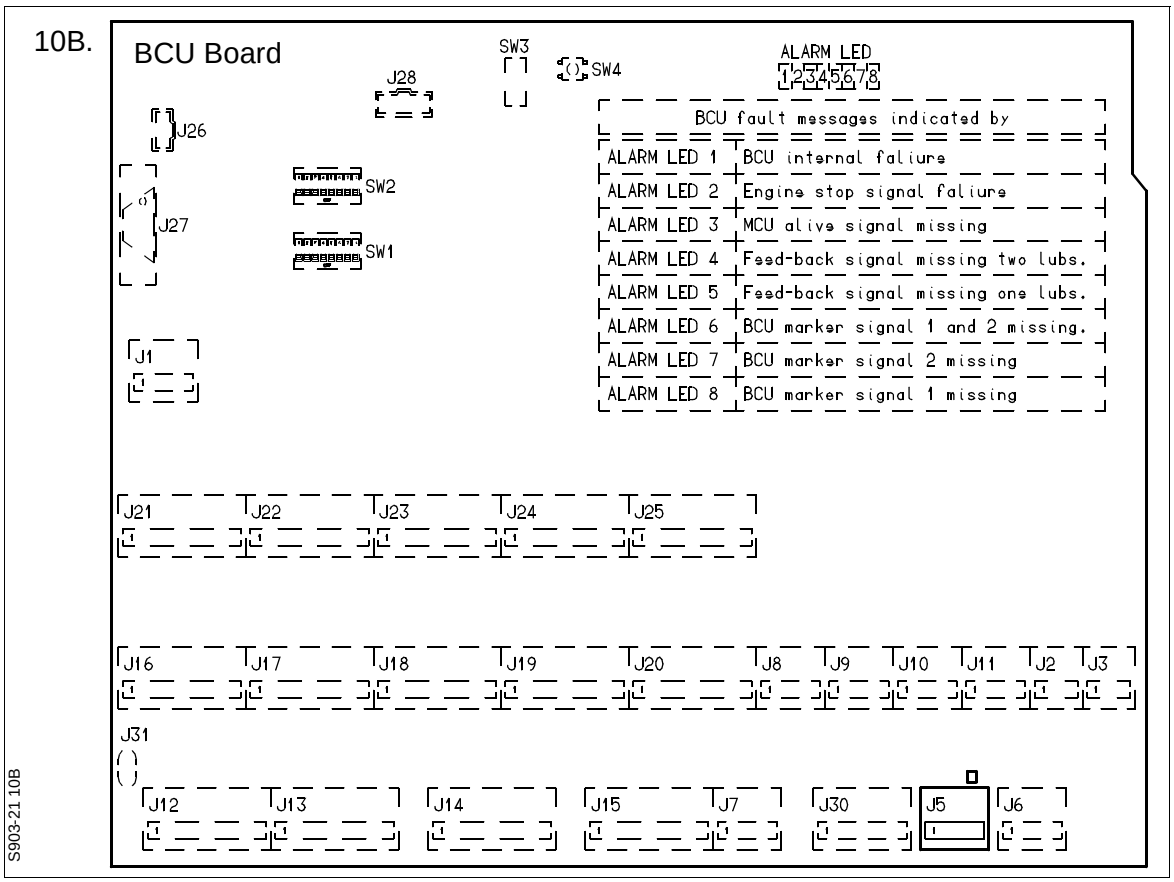


10. Check the engine stop signals by simulating run and stop condition from the governor side. Check that LED D80 (above/right J30) on the MCU and LED D38 (above J5) on the BCU turn on and off accordingly.

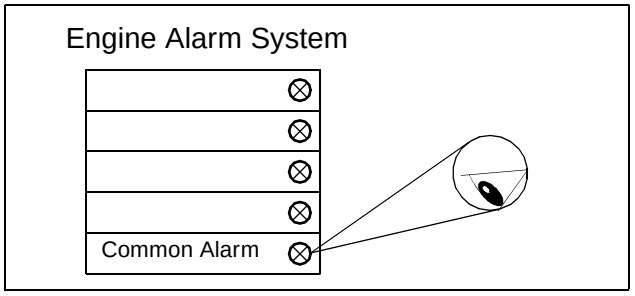
10A.

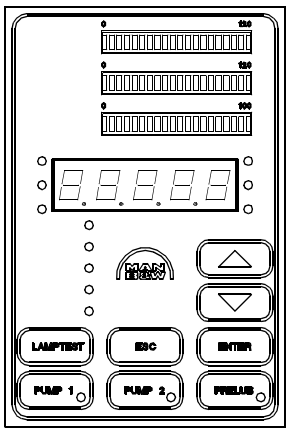


10B.



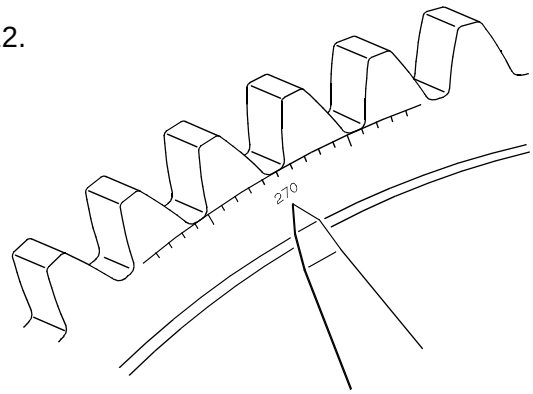
11.





S903-21 11

12.



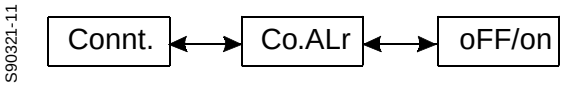
Alpha Lub. test doc.

Injection angle:

	Programmed		Corrected
Cyl. 1:	270		
Cyl. 2:			
Cyl. 3:			

S903-20 04

11. Check the common alarm connection by simulation. Follow the HMI panel menu instruction to activate a common alarm from the lubricator system as shown below.



12. Check the timing adjustment as described in Procedure S903-20.

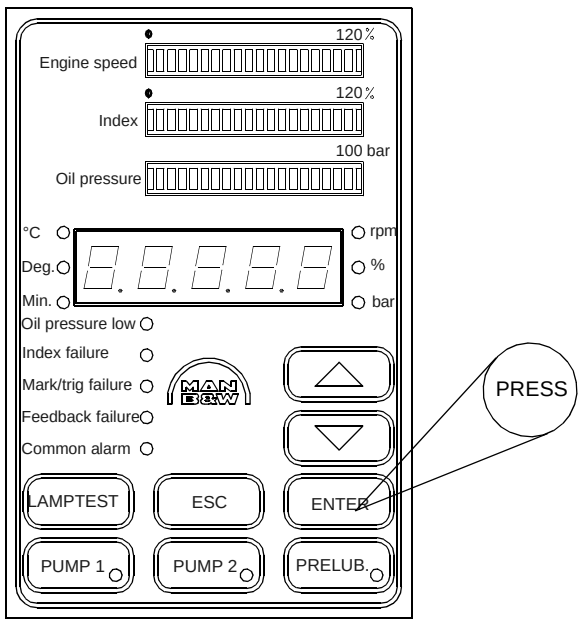
13. Carry out the tests according to the testbed test scheme and fill in the check boxes

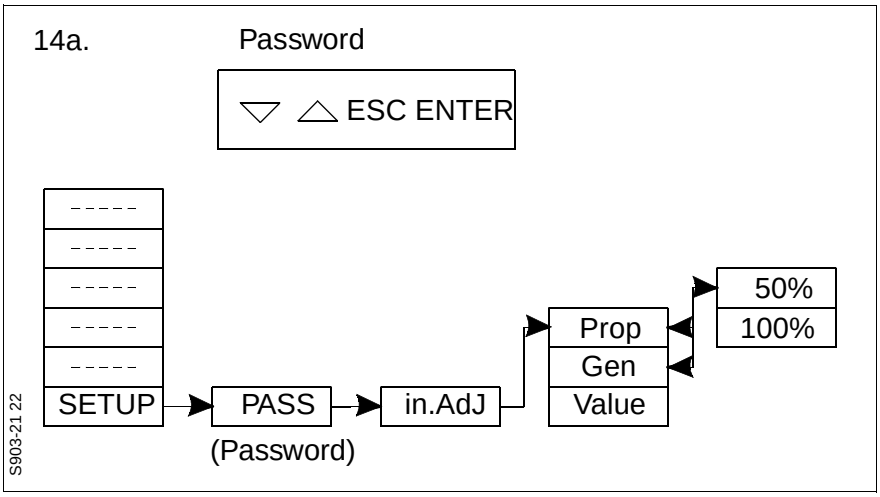
Alpha lubricator testbed trial test scheme					Activated alarm outputs							
Test No.	Function to be tested:	Test by	Alarm number displayed on HMI panel	Action	Com-mon alarm	MCU power fail	BCU power fail	BCU in control	MCU fail	BCU fail	Slow-down	Checked
1	Standby pump	Switching master pump OFF local side	(39) + 49	Stand-by pump starts	X							
2	BCU take-over, standby pump start and slow-down output	Disconnecting plugs on both lubricators for one cylinder	Various	Change over to BCU control and standby pump start, slow-down	X			X		X	X	
3	Common alarm output	Simulating common alarm from HMI panel menu		Common alarm turns ON in alarm system								
4	Engine stop signal	Simulating Stop signal		MCU LED D80 above plug J30 lights BCU LED D49 above plug J5 lights	Simulate engine stop signal from engine control system							
				Alarm output terminal number from:								
				X1	1 + 2	3 + 6						
				X1			9 + 12		13+14	15+16	17+18	
				X1				7 + 8				

(): logged alarm

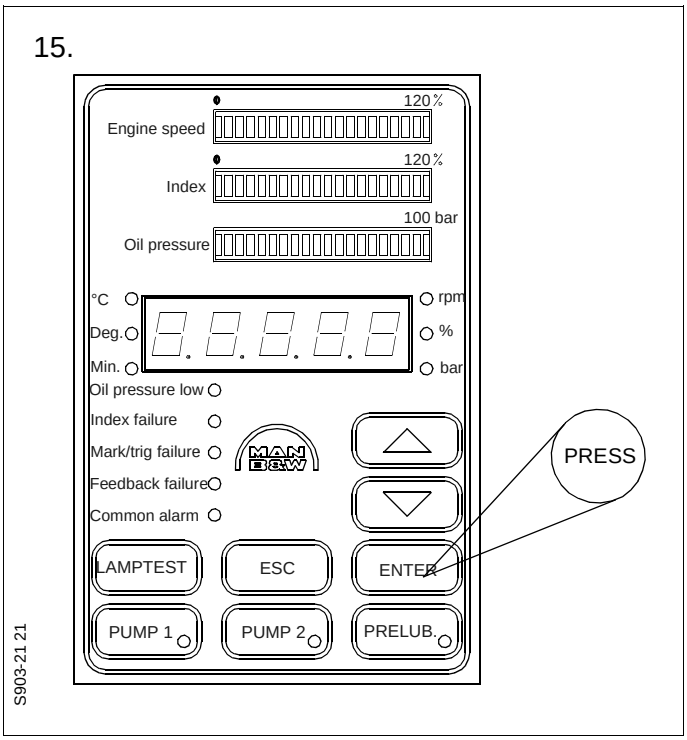
14. When the engine load is increased to 50% load, calibrate the index transmitter at this load by means of the index transmitter adjustment menu in the HMI panel.
Follow the example in drawing 14.a.

14.





15. When the engine load is increased further to 100% load, calibrate the index transmitter at this load by means of the index transmitter adjustment menu on the HMI panel. Follow the HMI panel menu instruction.



Injection timing

1. Adjust the shaft encoder in accordance with Procedure 905-8.3.

2. Remove the lubricator timing hole plug from the exhaust side of cylinder liner No. 1. If there is no timing hole, remove one cylinder oil lubricating point non-return valve from cylinder liner No. 1.

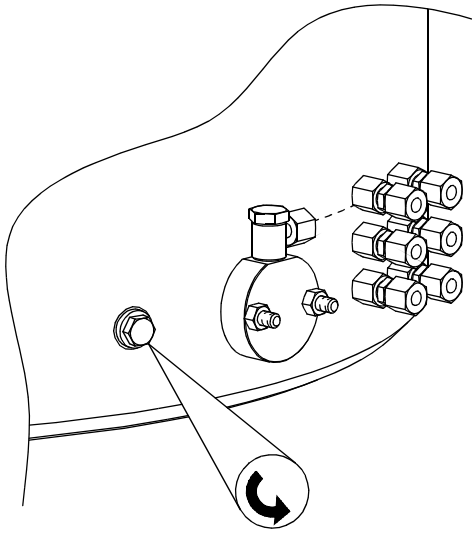
3. Turn the engine to BDC Cyl. 1. Check that the timing hole is clean. Turn the engine ahead until the upper edge of the top piston ring becomes visible.

Note!
Compressed air is coming out of the timing hole when the piston is turned upwards. **Use eye protection.**

4. Note the crank angle on the turning wheel.

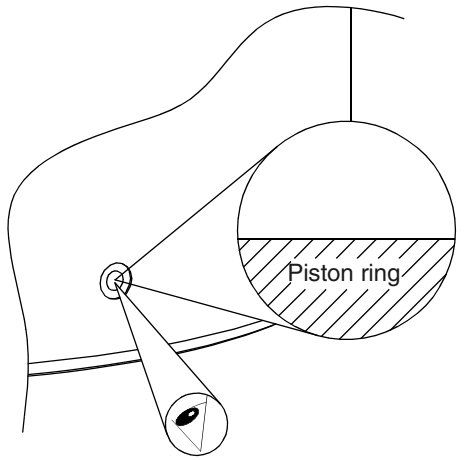
5. Compare the angle obtained with the angle stated on the test sheet in the lubricator control unit. *If the reading is not within the tolerance stated on the test sheet, correct all angles in the test sheet with the observed difference.*

2.



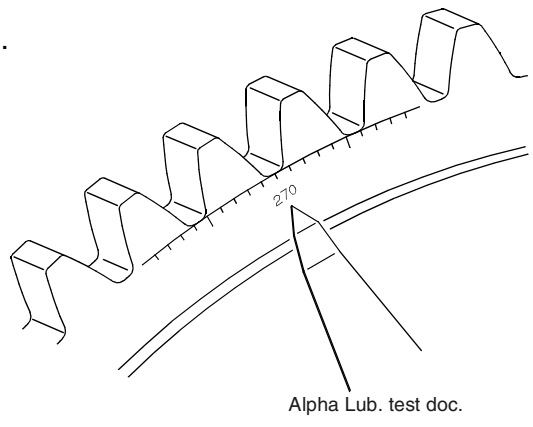
S903-20 02

3.



S903-20 03

4.



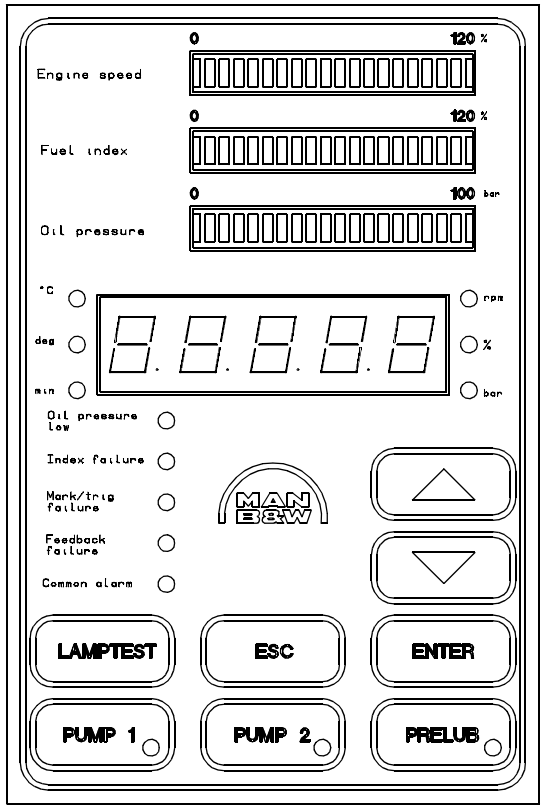
Alpha Lub. test doc.

Injection angle:

	Programmed		Corrected
Cyl. 1:	270		
Cyl. 2:			
Cyl. 3:			

S903-20 04

6.



6. Run the engine at steady load. Read all injection angles on the HMI panel.

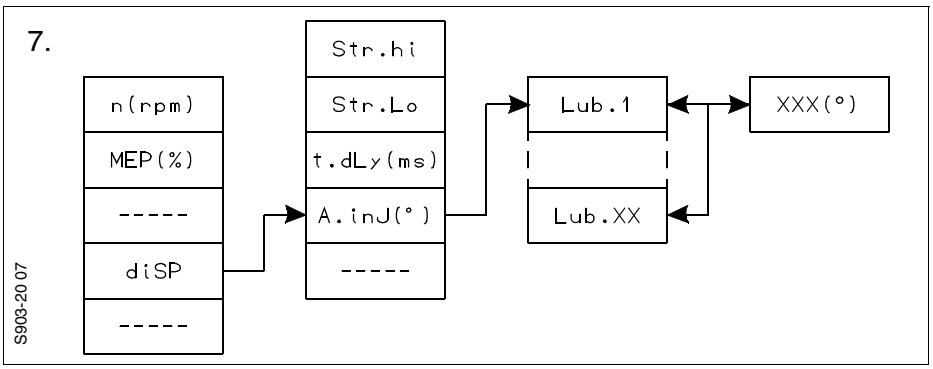
   Navigating in the HMI panel menu is done as follows:

   - [ENTER] goes forward (right) in the menu or changes a set point.
   - [ESC] goes backwards (left) in the menu.
   - [▲] goes up in the menu.
   - [▼] goes down in the menu.

7. Read all injection angles in the HMI panel, starting at the [diSP] menu and follow the sketch.

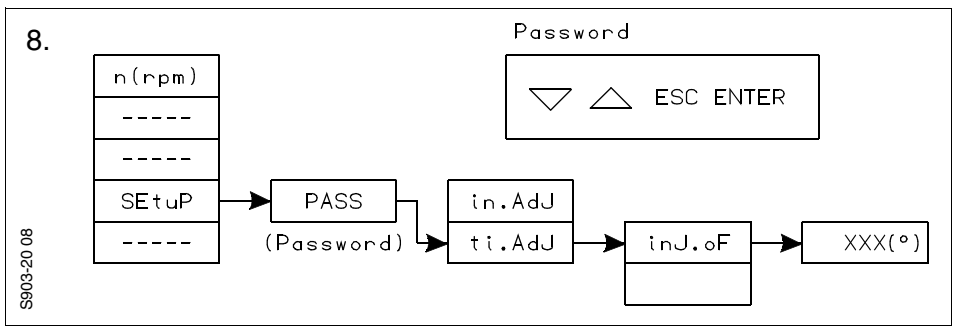
   Check that the angles correspond with the angles on test sheet.

7.



8. In case the angles are not within the stated tolerance, adjust the common offset value in the HMI panel SEtup menu.
   See the sketch.

8.



9. When the Injection offset [InJ.OF] is checked or adjusted (if adjusted) press [ENTER] (the HMI panel will display [SAVE]). Return to the main menu by pressing [ESC].

Alpha lubricator testbed trail test scheme					Alarm outputs to be activated							Checked
Test Nr	**Function to be tested:**	**Test by**	**Alarm number displayed in HMI panel**	**Action**	**Common alarm**	**MCU power fali**	**BCU power fali**	**BCU in ctrl.**	**MCU fail**	**BCU fail**	**Slow down**	
1	Common alarm output	Simulate common alarm from HMI panel menu		Common alarm turns ON in alarm system								
2	Engine stop signal	Simulating Stop signal		MCU LED D80 above plug J30 light BCU LED D49 above plug J5 light	**Simulate engine stop signal from engine control system**							
3	Standby pump	Switch master pump OFF local side	(39) + 49	Standby pump starts	**X**							
4	BCU take-over, standby pump start and slowdown output	Disconnect Plugs on both lubricatores one cylinder	Varius	Change over to BCU control and standby pump start, slowdown	**X**			**X**		**X**	**X**	
			( ) : logged alarm	Alarm output terminal number from:								
Valid for ALCU system and MCU software Rev 1.6X				**X1**	1 and 2	3 and 6						
				X1			9 and 12		13 and 14	15 and 16	17 and 18	
				X1				7 and 8				

* Note that the control switch must be in AUTO position during the test
* All tests can be made with Engine running low load or with trigger simulator without engine running
* After every test the logged alarms must be deleted in the HMI panel
* After test 4 the control switch must be changed to MCU and back to AUTO mode

Minimum requirements at test bed is common alarm to be connected to AMS system

Basic Standards (MBD SB) & Suppl. Drawing No.:		EN21C Surf. roughness		Material / Blank:
		EN21F-m Tolerances	Mass (kg)	Final User Matrial:

Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	
				*	Replaced by Ident No.:	9
						8
						7
						6
						5
						4
						3
						2
						1
20020430	DFA	NSL	JHV			0

Similar Drawing no.:	Replacement for Ident no.:

Scale:	Size:	Type	Page No.:	
1:1	**A3**	Testbed trail test scheme	**01 (01)**	**MAN B&W Diesel A/S**
Info No.		Description		Ident. No.
3 02 023		INSTRUCTION		0788812-9
Final User Info No.		Final User Description		Final User Ident. No.

ALCU –
Dock Trial Commissioning Procedure

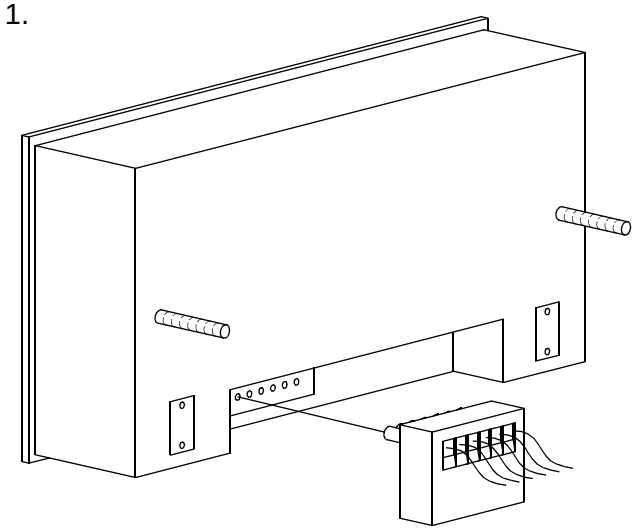
1. Disconnect the connections to the HMI panel. (HMI panel side).

2. Check the power supply for correct polarity before connecting the power to the ALCU control box terminals. Check both Main A and Main B.

3. Check the HMI panel power connection for correct polarity, and connect the HMI panel.

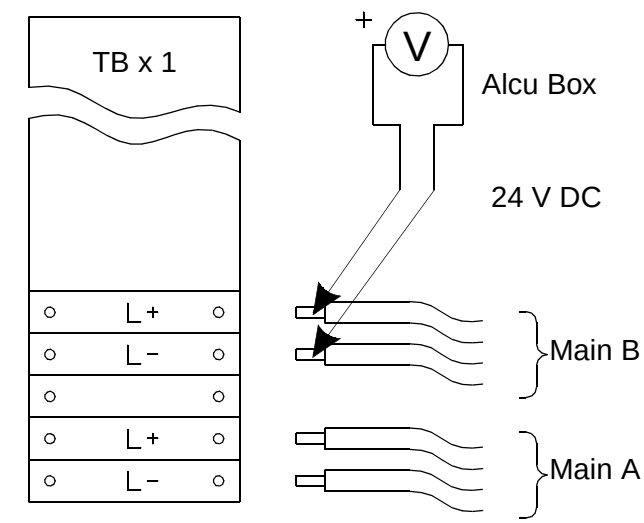
4. 123

1.



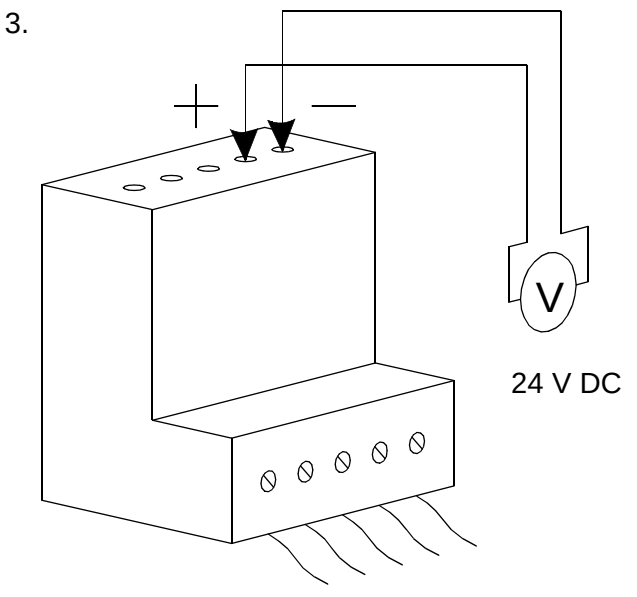
S903-21 01

2.



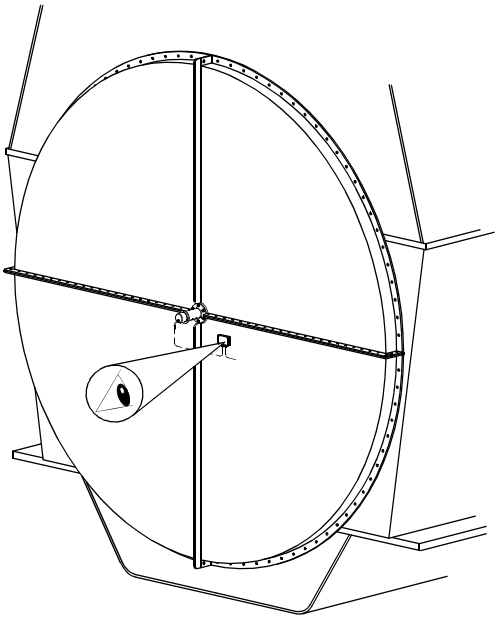
S903-21 02

3.



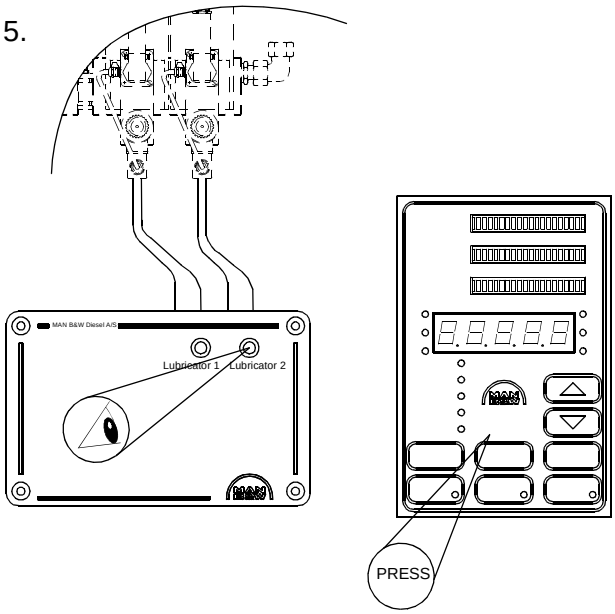
S903-21 03

4.



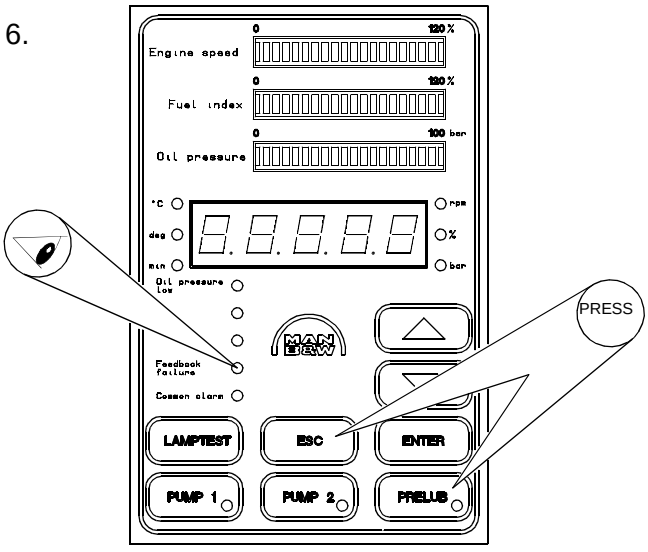
MN905-8.1 202 03

5.



S903-21 07

6.



S903-21 08

5. Check the adjustment of the angle encoder. Turn the engine until the LED on the encoder junction box lights up, and check that the crank angle reading is 0° on the flywheel (TDC cylinder 1). *See Procedure 905-8.*

   Adjust the BCU pick-ups, as described in Procedure 905-7.

6. Check the connections to the lubricators by activating the lubricators one by one via the HMI panel connection test menu. Follow the HMI panel menu instruction.

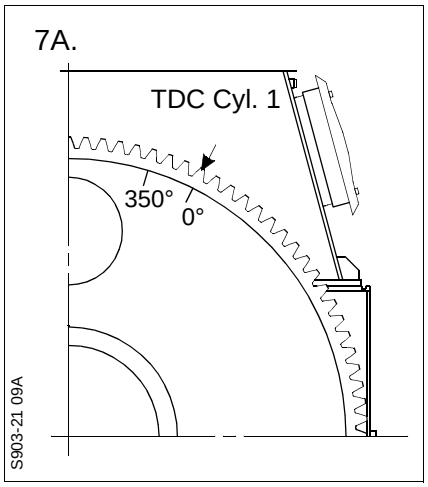
7. Check the lubricator system by activating the pre-lubrication function. Press the ESC button and the PRELUB button on the HMI panel simultaneously. Check that no feedback alarm is activated.

8. Turn the engine to approx. 10° before TDC of cylinder No. 1.

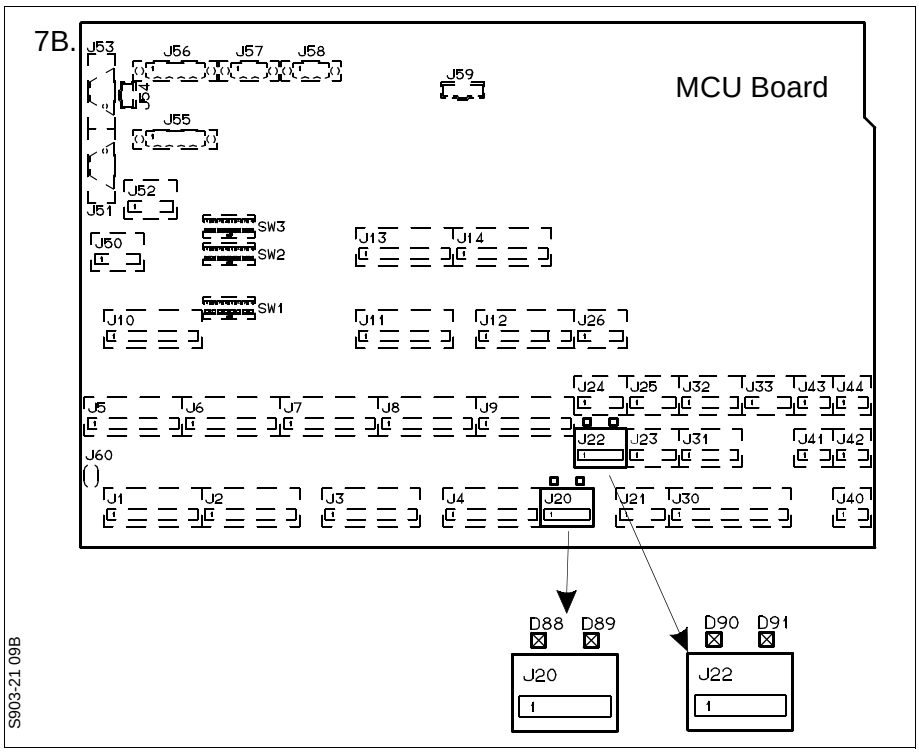
   Continue turning the engine and check that the small LEDs on the MCU unit – designated D88 (above J20) D90, D91 (above J22) – flash when the engine is turned and passes TDC of cylinder No. 1.

   Also check that the LED on the MCU unit – designated D89 (above J20) – flashes approx. twice each second.

7A.



7B.



9. Carry out the external connection test according to the dock trial test scheme and fill in the check boxes.

Alpha lubricator dock trial test scheme					Activated alarm outputs							
Test No.	Function to be tested:	Test by	Alarm number displayed on HMI panel	Action	Common alarm	MCU power fail	BCU power fail	BCU in control	MCU fail	BCU fail	Slow-down	Checked
1	External alarm signals to AMS	Disconnecting X1 PWR A – L+		Change over to BCU control	X	X		X	X			
2	External alarm signals to AMS	Disconnecting X1 PWR B – L+	30+35+43	BCU power fail alarm	X		X		X	X		
3	Engine stop signal	Simulating Stop signal		MCU LED D80 above plug J30 lights BCU LED D49 above plug J5 lights	Simulate engine stop signal from engine control system							
4	Ahead/Astern signal	Simulating Astern signal		MCU LED D78 above plug J30 light	Simulate Astern signal from engine control system							
5	Pre-lubrication signal	Simulating pre. Lub. signal		Pre lubrication sequence start	Simulate pre-lubrication signal from engine control system							
6	Standby pump	Switching master pump OFF local side	(39) + 49	Standby pump starts	X							
7	BCU take-over, stand-by pump start and slow-down output	Disconnecting plugs on both lubricators for one cylinder	44	Change over to BCU control and standby pump start, slow-down	X			X		X	X	

(): logged alarm

Alarm output terminal number from:							
X1	1 + 2	3 + 6					
X1			9 + 12		13+14	15+16	17+18
X1				7 + 8			

Alpha lubricator dock trail test scheme					Activated alarm outputs							Checked
Test Nr	Function to be tested:	Test by	Alarm number displayed in HMI panel	Action	Common alarm	MCU power fali	BCU power fali	BCU in ctrl.	MCU fail	BCU fail	Slow down	
1	External alarm signals to AMS	Disconnect X1 - PWR A – L+		Change over to BCU control	X	X		X	X			
2	External alarm signals to AMS	Disconnect X1 - PWR B – L+	30+35+43	BCU power fail alarm	X		X		X	X		
3	Engine stop signal	Simulating Stop signal		MCU LED D80 above plug J30 light BCU LED D49 above plug J5 light	Simulate engine stop signal from engine control system							
4	Ah/As signal	Simulating Astern signal		MCU LED D78 Above plug J30 light	Simulate Astern signal from engine control system							
5	Prelubrication signal	Simulating pre. Lub. signal		Prelubrication sequence start	Simulate prelubrication signal from engine control system							
6	Standby pump	Switch master pump OFF local side	(39) + 49	Standby pump starts	X							
7	BCU take-over, standby pump start and slowdown output	Disconnect Plugs on both lubricatores one cylinder	44	Change over to BCU control and standby pump start, slowdown	X			X		X	X	

( ) : logged alarm

Alarm output terminal number from:							
X1	1 and 2	3 and 6					
X1			9 and 12		13 and 14	15 and 16	17 and 18
X1				7 and 8			

Valid for ALCU system and MCU software Rev 1.6X

* Note that the control switch must be in AUTO position during the test
* All tests can be made with Engine running low load or with trigger simulator without engine running
* After every test the logged alarms must be deleted in the HMI panel
* After test 7 the control switch must be changed to MCU and back to AUTO mode

Date
Sign.

Basic Standards (MBD SB) & Suppl. Drawing No.:		EN21C Surf. roughness		Material / Blank:
		EN21F-m Tolerances	Mass (kg)	Final User Matrial:

Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	
				*	Replaced by Ident No.:	9
				*		8
				*		7
				*		6
				*		5
				*		4
				*		3
				*		2
20021113	DFA	NSL	JHV	Z4	Drawing updated.	1
20020430	DFA	NSL	JHV	*		0

Similar Drawing no.:	Replacement for Ident no.:

Scale:	Size:	Type	Page No.:	
1:1	A3	Dock trail test scheme	01 (01)	MAN B&W Diesel A/S
Info No.	Description			Ident. No.
3 02 023	INSTRUCTION			0788811-7
Final User Info No.	Final User Description			Final User Ident. No.

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Operation

Commissioning

Maintenance

Components

Electrical Wiring

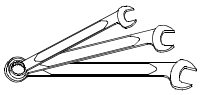
SAFETY PRECAUTIONS

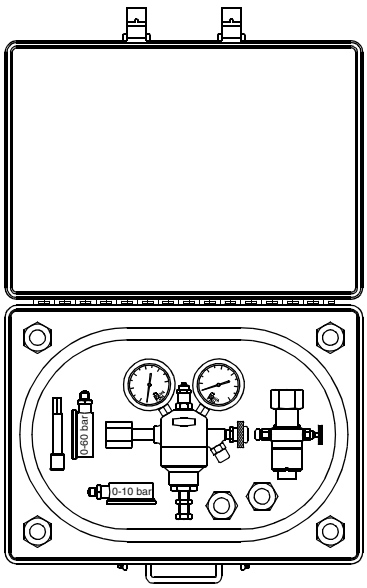
X	Stopped engine
X	Block the starting mechanism
X	Shut off starting air supply
X	Engage turning gear
	Shut off cooling water
	Shut off fuel oil
	Shut off lubrication oil
	Lock turbocharger rotors

Data

Ref.	Description	Value	Unit
D-1	Nitrogen pressure – inlet accumulator	25-30	bar
D-2	Nitrogen pressure – outlet accumulator	1.5	bar
D-3	Plug screw – tightening torque	30	Nm

Standard Tools: See Section 913





Spare Parts

Plate – Item No.	Description	Qty

Check of Oil Injection:

With stopped engine and normally when the system has been disassembled:

1. Press the ESC + PRELUB.-button on the HMI control panel, and check that all lubricators are operating correctly by watching the LEDs on the intermediate boxes for each lubricator.

2. If the cylinder cover or the exhaust valve is removed, check inside the liner that all lubricating points are working properly.

   Otherwise, remove the covers for scavenge port inspection.

   Turn the piston to BDC and check inside the liner with a mirror and a powerful light source that all lubrication points are working properly.

With running engine:

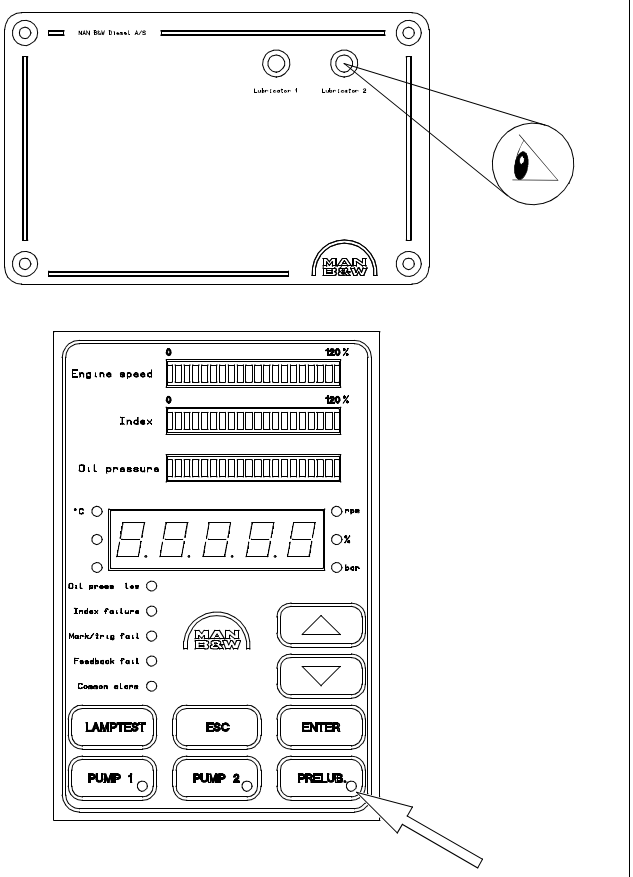
3. Check that all lubricators are operating correctly by watching the LEDs on the intermediate boxes for each lubricator.

   The LEDs give signal when oil is injected.

   Check the pressure shocks from the injection of the lubricators on each lubricator pipe by feeling with a hand.

   If in doubt, disconnect the pipe at the cylinder liner to observe the oil flow.

1.



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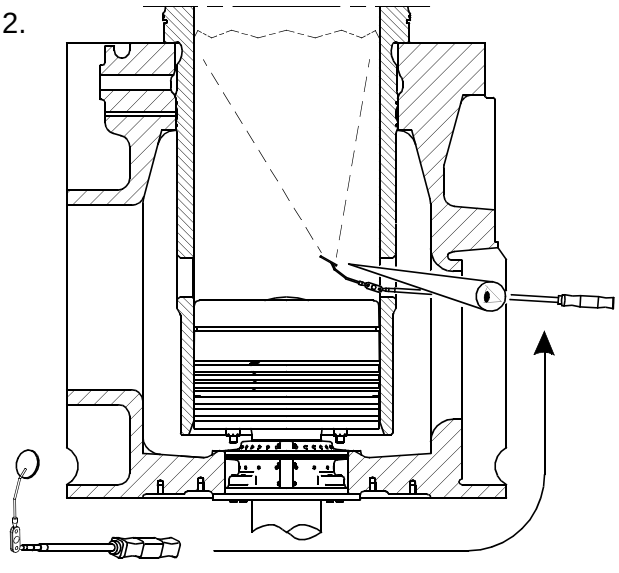

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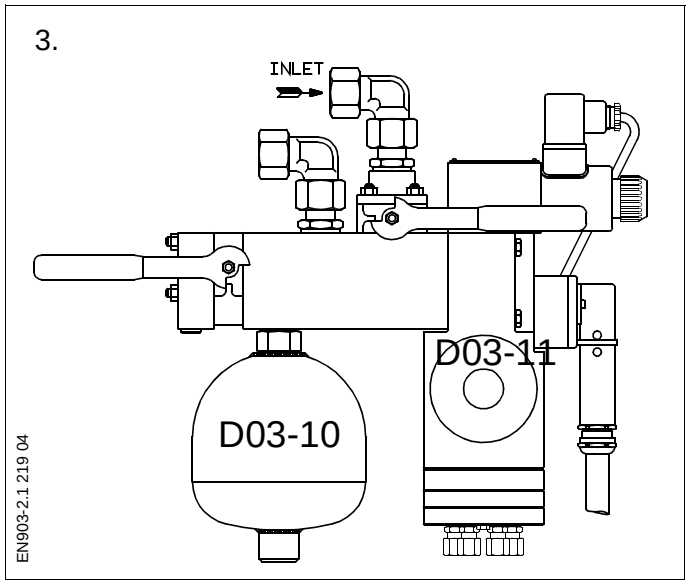
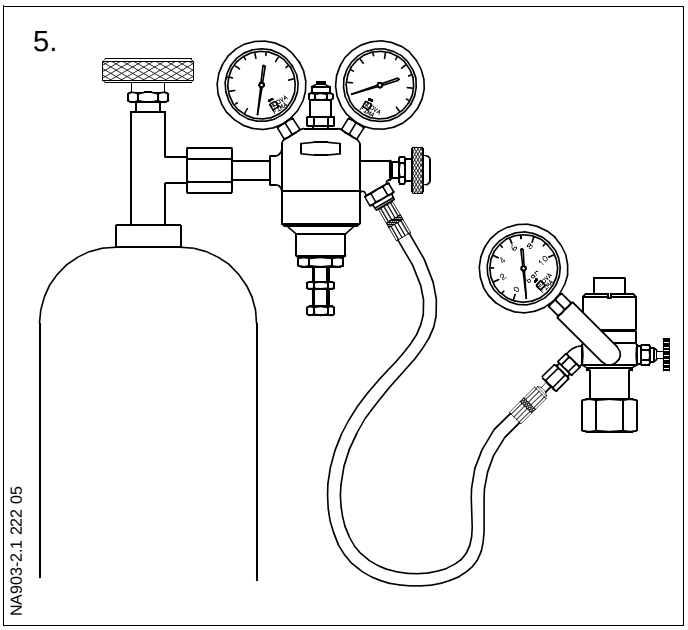




Check of Accumulators:

4. Measuring the nitrogen pre-pressure can only be done with stopped engine and pressure-free lubrication system.

   Stop both oil pumps. Close the inlet valve and open the equalizing valve on the respective lubricator.

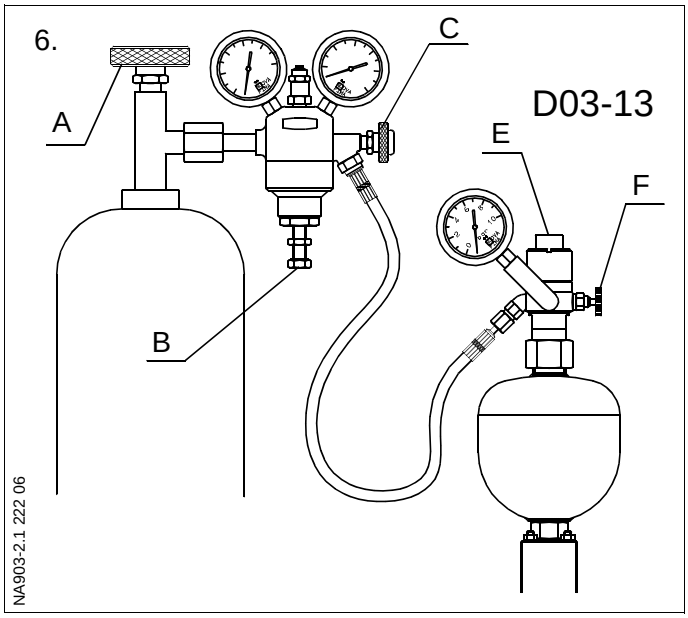
   The nitrogen pressure in the inlet accumulator (0.7 litre) can be checked without dismounting the accumulator. For use of the pressure setting tool, *see Step 5.*

5. To measure the nitrogen pressure in the outlet accumulator (0.16 litre), the accumulator or the lubricator with accumulator must be dismounted.
   See Procedure 903-2.2.

   For nitrogen pressure in the accumulators, see Data.

6. **Use of Pressure Setting Tool**
   Assemble the pressure setting tool as shown in Figure 5, and mount the reducing valve on the nitrogen cylinder. If necessary, use a threaded adaptor.

   Mount a 0-60 bar pressure gauge on the filling valve when the inlet accumulator (0.7 litre) is to be checked, and a 0-10 bar pressure gauge when the outlet accumulator (0.16 litre) is to be checked.



7. Before mounting the filling valve on the accumulator, check that the accumulator top is clean.

   Mount the filling valve on the relevant accumulator with the union nut. Check that valves **C** and **F** are closed.

   Loosen the plug screw in the accumulator using a ½" square drive handle in socket **E**.

   It is now possible to read the actual nitrogen pressure in the accumulator on the dial gauge on the filling valve.

8. If the accumulator needs to be refilled with nitrogen, open valve **A** and increase the outlet pressure from valve **C** on spindle **B** to 1-2 bar above the pressure stated in Data.

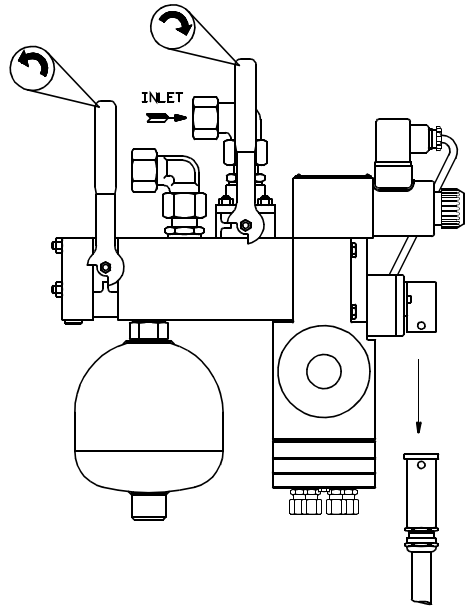
   Open valve **C** until the accumulator is filled to the correct pressure.

   Close valve **C** and tighten the plug screw with socket **E** to the torque stated in Data.

   Release the pressure in the filling valve at bleed screw **F**.

   Unscrew the filling valve from the accumulator. Retighten the plug screw to the torque stated in Data. Remount the accumulator.

1.



EN903-2.2 219 01

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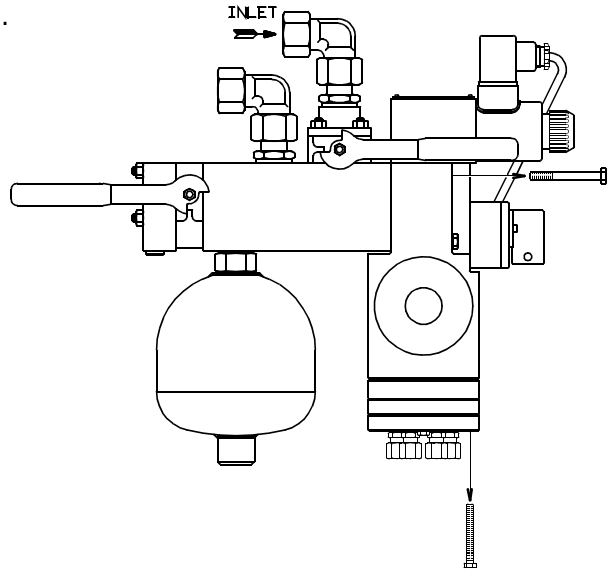


EN903-2.2 219 02

Dismantling of lubricators:

The engine must be stopped and blocked before dismounting a lubricator. Stop the cylinder oil pump station.

1. Close the supply valve for the lubricator and open the equalizing valve (turn both handles to a horizontal position). Remove the upper shield, if installed.

   Disconnect the electrical plug on the side of the lubricator.

2. Unscrew the three screws in the bottom of the lubricator and disconnect the cover with pertaining pipes.

3. Unscrew the four screws on the side that secure the lubricator to the hydraulic block, and remove the lubricator.

Special running

It is possible to change a lubricator while the engine is running if a spare lubricator with O-rings and the necessary tools is available. The change should be done in a maximum of 15 minutes.

- Reduce the engine load to below 40% of MCR
- Let the lubricator pump station run
- Dismount the lubricator as described in steps 1-3
- Mount a spare lubricator as described in Procedure 903-2.4.

Dismantling of accumulators:

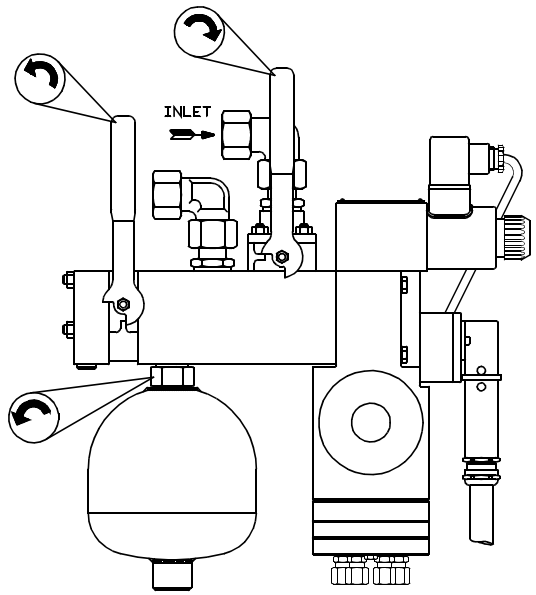
4. The engine must be stopped and blocked before the accumulator is dismounted.

   Stop the cylinder oil pump station.
   Close the supply valve for the lubricator and open the equalizing valve.

Note!
When the oil pressure is released, a nitrogen pre-pressure of 25-30 bar will remain in the accumulator.

   Carefully unscrew the accumulator to release the remaining oil pressure in the system. Remove the accumulator from the hydraulic block.

4.



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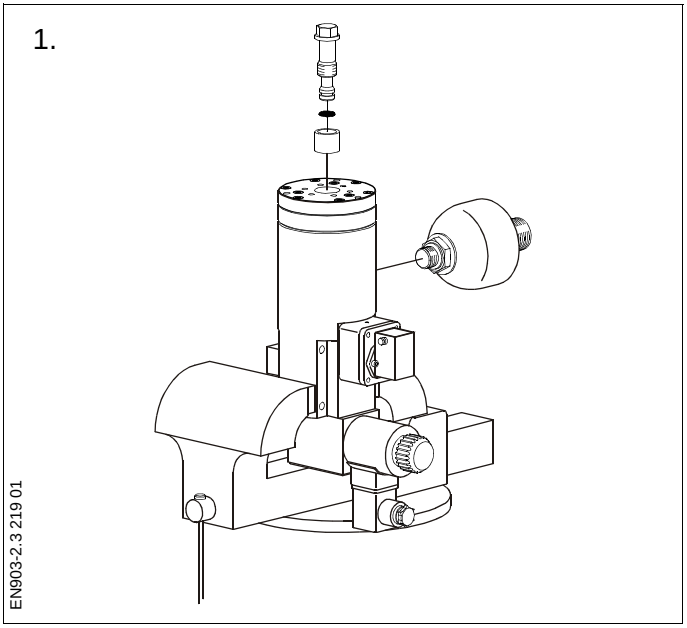

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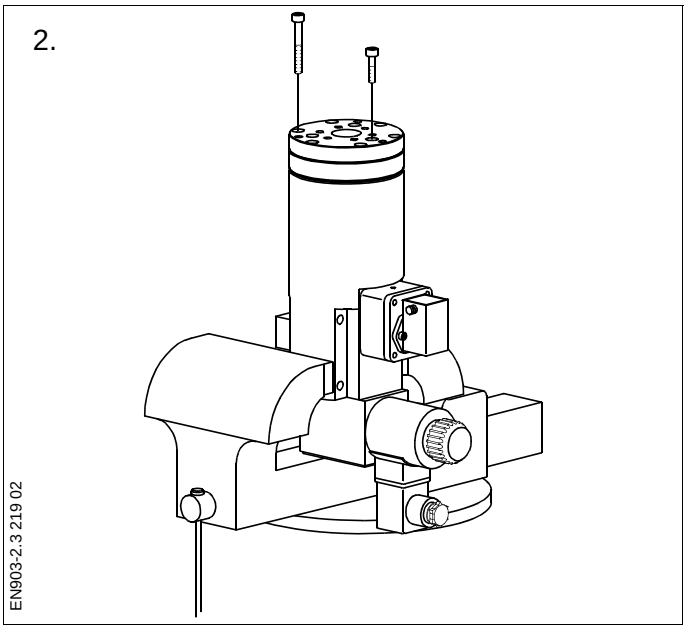

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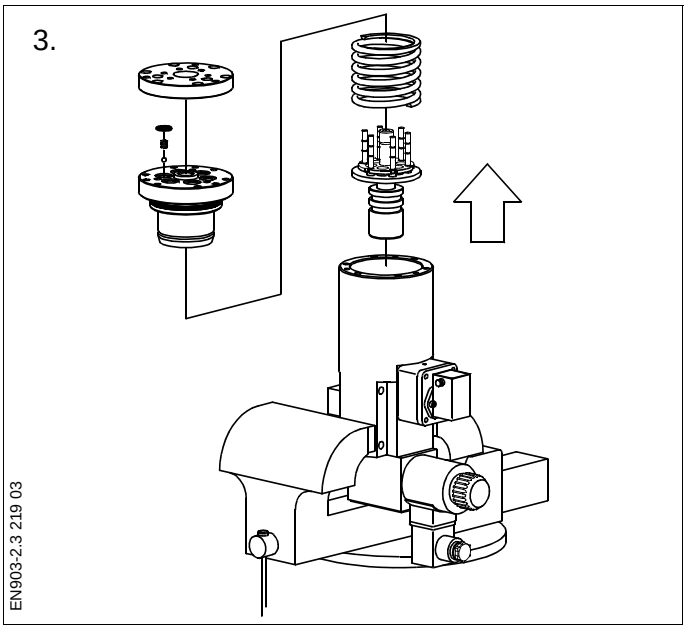


EN903-2.3 219 03

1. Place the lubricator in a bench vice with soft “jaws”.

   Remove the adjusting screw with bushings. Unscrew the oil accumulator.

   Discard the O-ring from the adjusting screw.

2. Remove the screws from the cylinder block.

3. Pull up the cylinder block.

   Remove the spring and actuator piston with plungers.

   Remove and discard the O-ring from the cylinder block.

   Remove the cover for the non-return valves. Take out springs and balls. Remove and discard the O-rings.

4. Remove the cover from the terminal box, and disconnect the wires for the feedback (pick-up) sensor.

   Remove the terminal box.

   Carefully, unscrew the feedback sensor and remove and discard the O-ring.

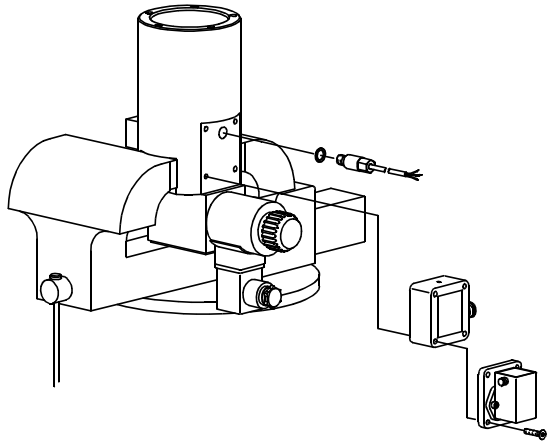
   Clean the housing with diesel oil or kerosene and dry with a non-fluffy cloth.

5. Inspect the plungers, actuator piston and cylinder block for wear, using a magnifying glass.

   Check that the balls from the non-return valves are in good condition.

   Check the seats for the non-return valves.

4.



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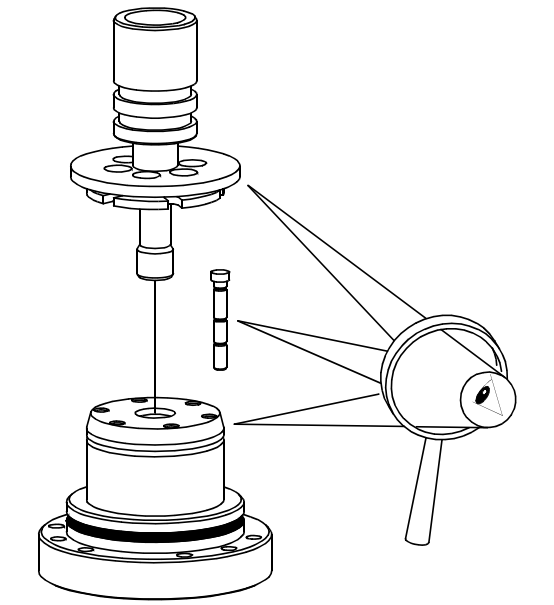

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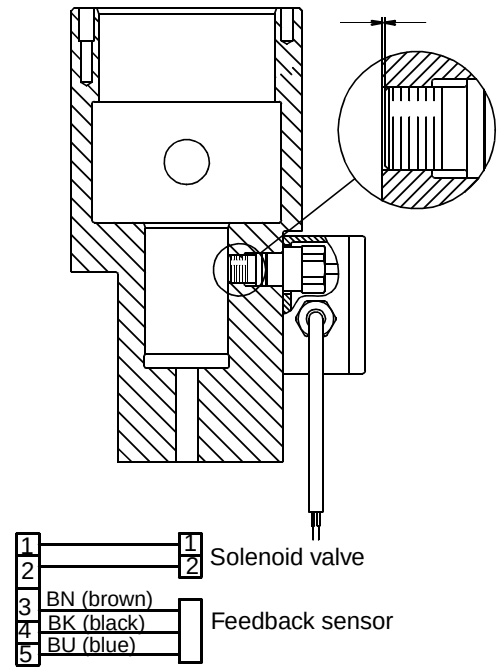

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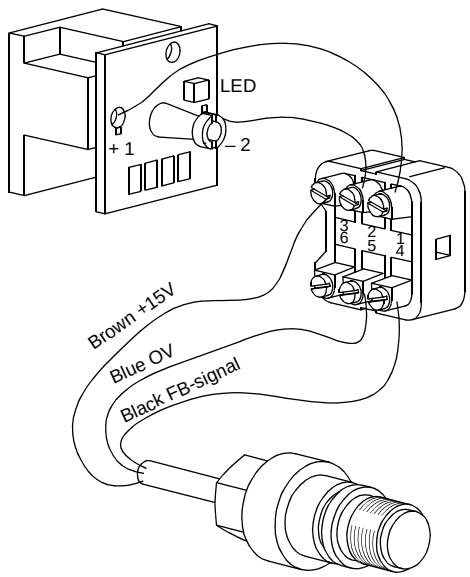
6a.



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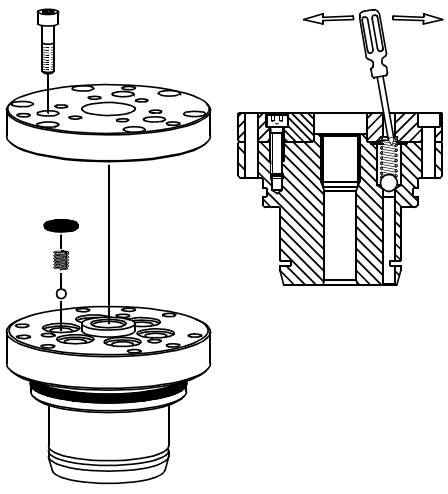


EN903-2.3 219 07

6. Before mounting the feedback sensor, check that the sensor is flush with the sensor housing.

   Mount the feedback sensor or a new one, if necessary, with a new O-ring.

   Check with an object with a straight edge (e.g. the end of a calliper) that the end of the feedback sensor does not protrude into the actuator piston cylinder.

   Mount the terminal box.

   Connect the wires and mount the cover on the terminal box.

7. Fit the cylinder block with new O-rings.

   Assemble the non-return valves in the cylinder block.

   Mount the cover with the three inner screws.

   Check with a small screwdriver that the springs are correctly centered.

8. Fit the cylinder block with a new O-ring. Pre-assemble the cylinder block with the actuator piston and plungers to ensure the correct guidance of the plungers, before finally assembling the cylinder block unit.

   Mount the spring and press down the actuator piston with plungers. Mount an M6 x 60 screw with a washer to keep the spring compressed.

9. Mount the cylinder block assembly in the cylinder housing.

   Mount the screws and tighten the block to the housing.

   Remove the M6 x 60 screw with washer.

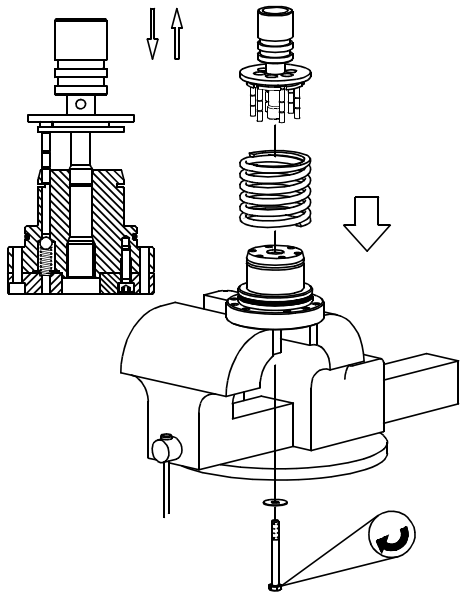
10. Mount the adjusting screw fitted with a new O-ring and the distance bushing.

    Mount the oil accumulator.

11. If the lubricator is not to be mounted on the engine immediately after overhauling, cover all openings with plastic to prevent dirt from entering the lubricator during storage.

    Coat all surfaces with a thin layer of oil.

8.



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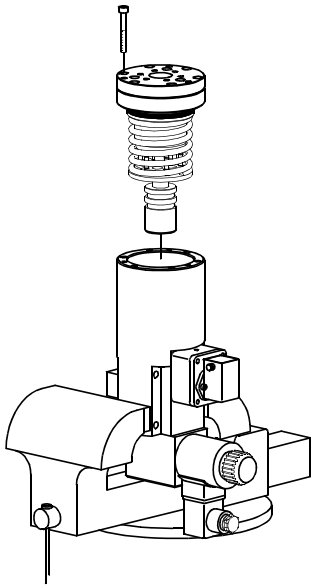

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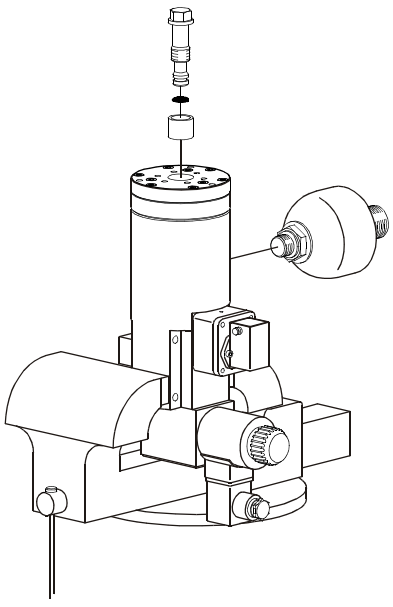

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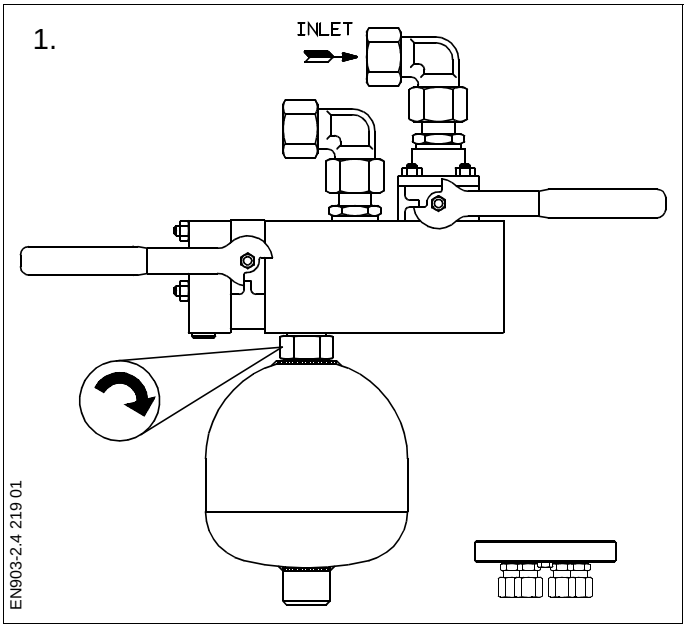
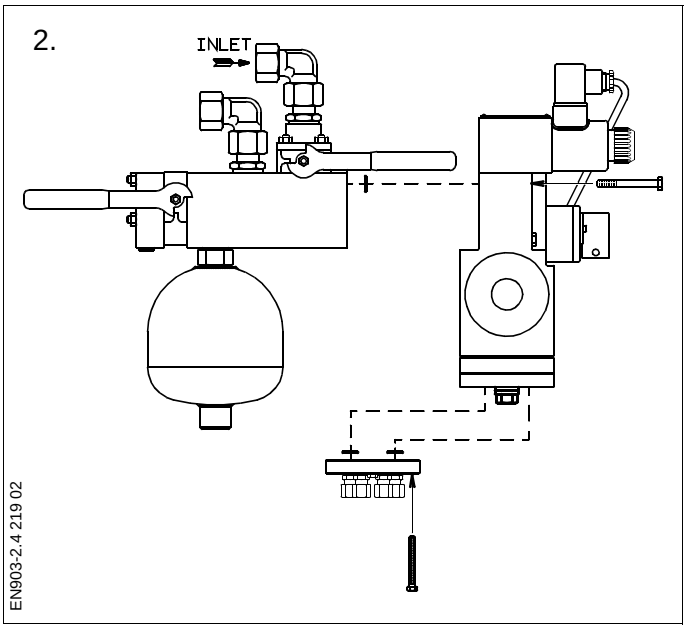
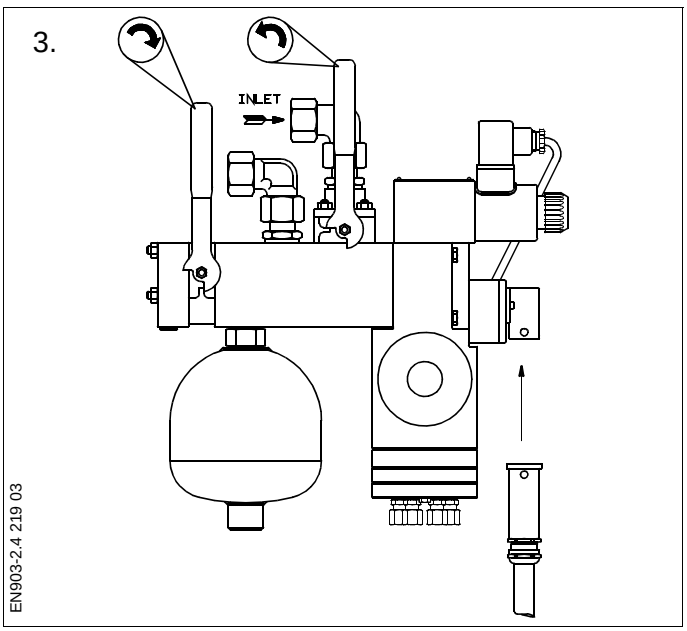






1. Before mounting the accumulator, check the nitrogen pressure, *see Data.*

   Mount the accumulator.

2. Mount new O-rings on the hydraulic block and on the cover with pipes.

   Mount the lubricator and tighten the screws on the hydraulic block.

   Tighten the screws in the bottom of the lubricator to the pipe connection.

3. Close the equalizing valve and open the supply valve (handles to be in a vertical position).

   Mount the electrical plug. Check the injection of cylinder oil on the feedback LED on the terminal box for the specific lubricator.

Check of Oil Injection:

With stopped engine and normally when the system has been disassembled:

1. Press the ESC + PRELUB.-button on the HMI control panel, and check that all lubricators are operating correctly by watching the LEDs on the intermediate boxes for each lubricator.

2. If the cylinder cover or the exhaust valve is removed, check inside the liner that all lubricating points are working properly.

   Otherwise, remove the covers for scavenge port inspection.

   Turn the piston to BDC and check inside the liner with a mirror and a powerful light source that all lubrication points are working properly.

With running engine:

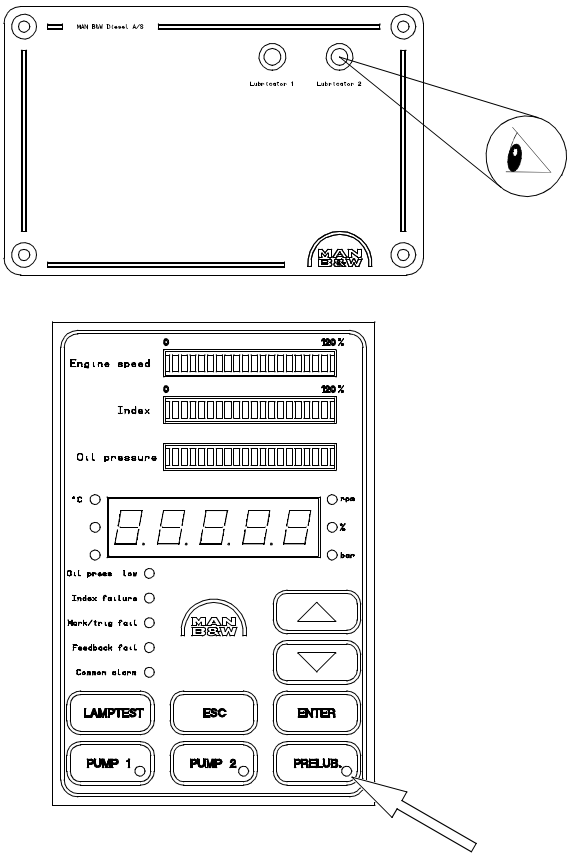
3. Check that all lubricators are operating correctly by watching the LEDs on the intermediate boxes for each lubricator.

   The LEDs give signal when oil is injected.

   Check the pressure shocks from the injection of the lubricators on each lubricator pipe by feeling with a hand.

   If in doubt, disconnect the pipe at the cylinder liner to observe the oil flow.

1.



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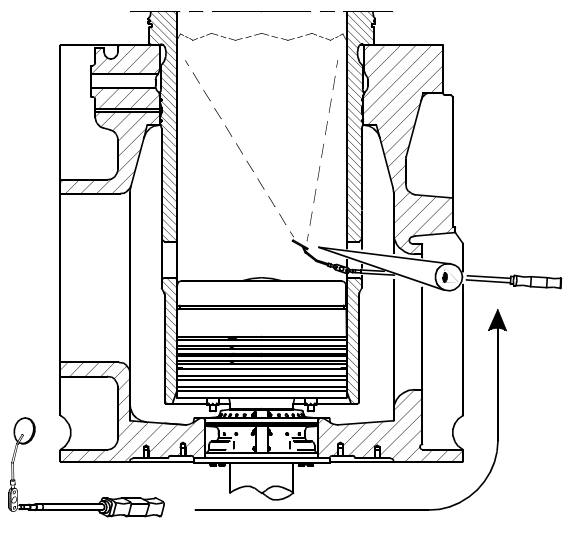

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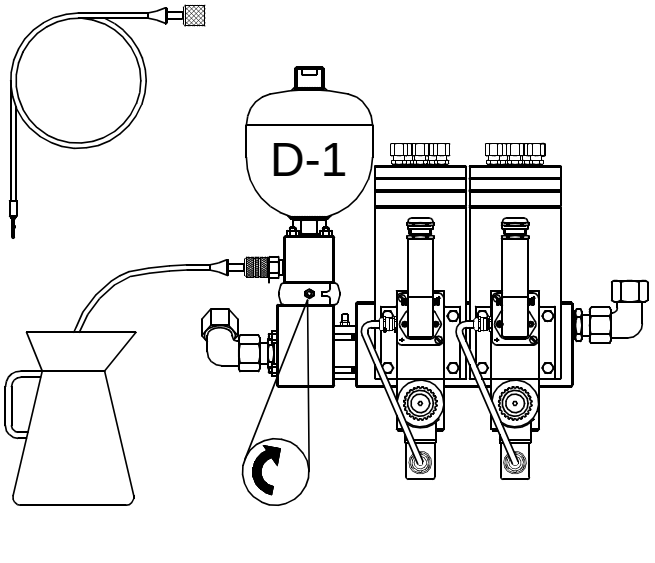

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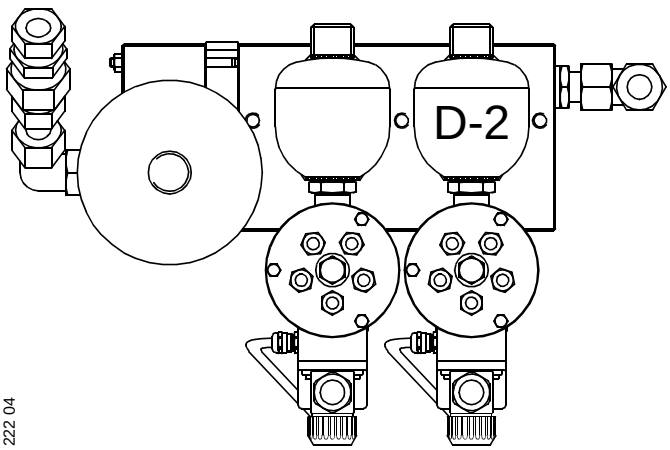

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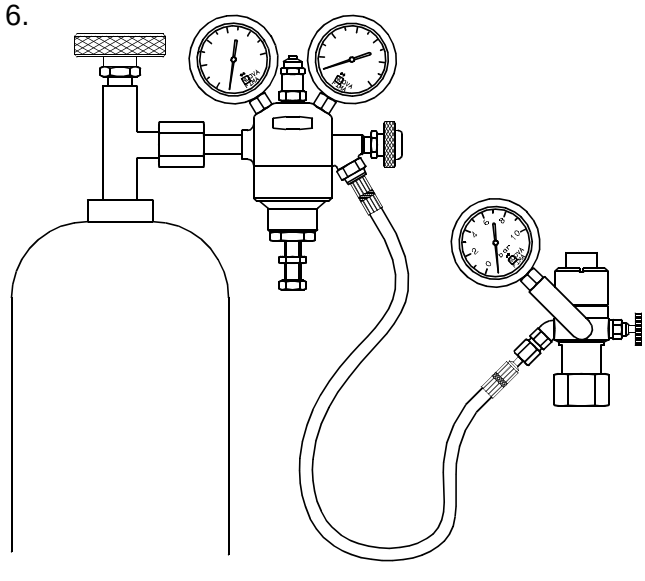


Check of Accumulators:

4. **Check of Inlet Accumulator**
Checking the inlet accumulator can be done with running engine.

Close the valve that connects the accumulator to the distributor block.

Mount the special hose on the minimess coupling and drain all oil out of the accumulator.

Check the nitrogen pressure.
For use of pressure setting tool, see Step 6. For correct pressure, see Data.

5. **Check of Outlet Accumulator**
The outlet accumulators are to be dismounted while the nitrogen pressure is checked.

Dismount the outlet accumulator.
See Procedure 903-2.2.

Check the nitrogen pressure, using the pressure setting tool.

6. **Use of Pressure Setting Tool**
Assemble the pressure setting tool as shown in the Figure, and mount the reducing valve on the nitrogen cylinder. If necessary, use a threaded adaptor.

Mount a 0-60 bar pressure gauge on the filling valve when the inlet accumulator (0.7 litre) is checked, and a 0-10 bar pressure gauge when the outlet accumulators (0.16 litre) are checked.

7. Before mounting the filling valve on the accumulator, check that the accumulator top is clean.

   Mount the filling valve on the relevant accumulator with the union nut. Check that valves **C** and **F** are closed.

   Loosen the plug screw in the accumulator using a ½" square drive handle in socket **E**.

   It is now possible to read the actual nitrogen pressure in the accumulator on the dial gauge on the filling valve.

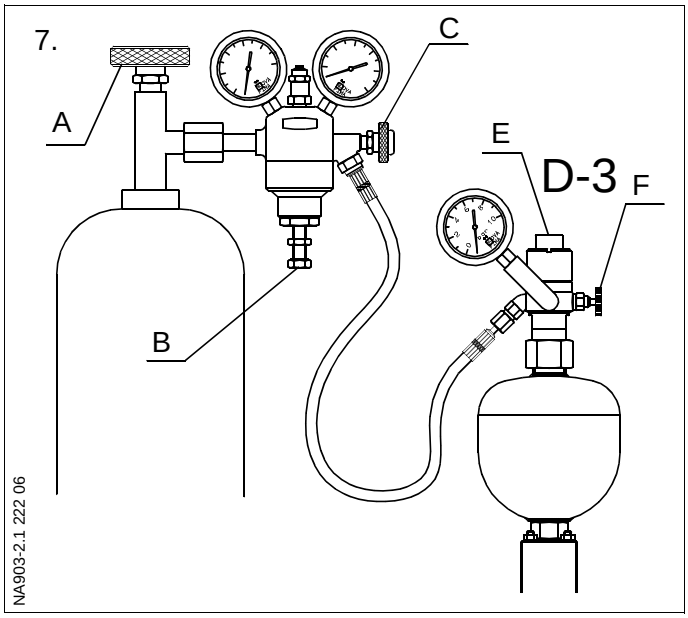
8. If the accumulator needs to be refilled with nitrogen, open valve **A** and increase the outlet pressure from valve **C** on spindle **B** to 1-2 bar above the pressure stated in Data.

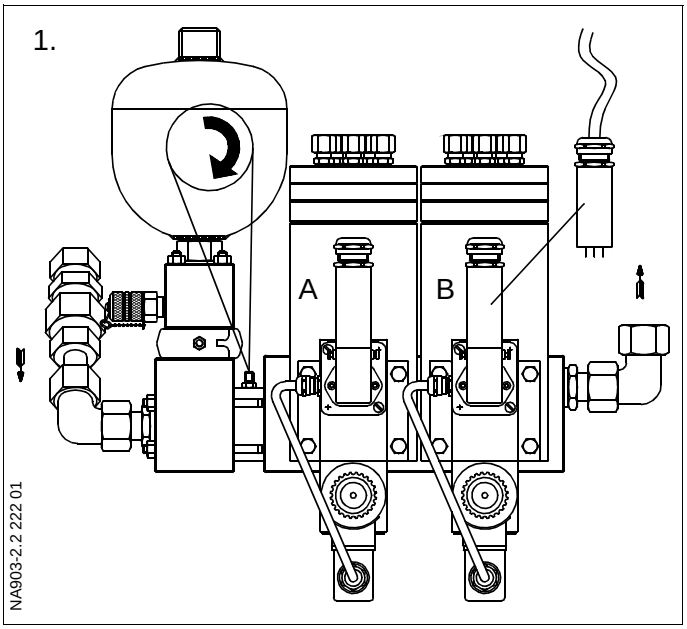
   Open valve **C** until the accumulator is filled to the correct pressure.

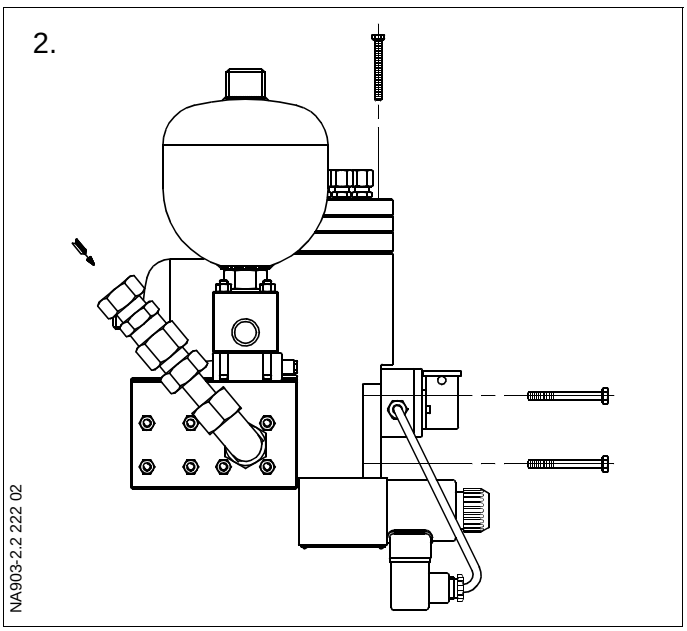
   Close valve **C** and tighten the plug screw with socket **E** to the torque stated in Data.

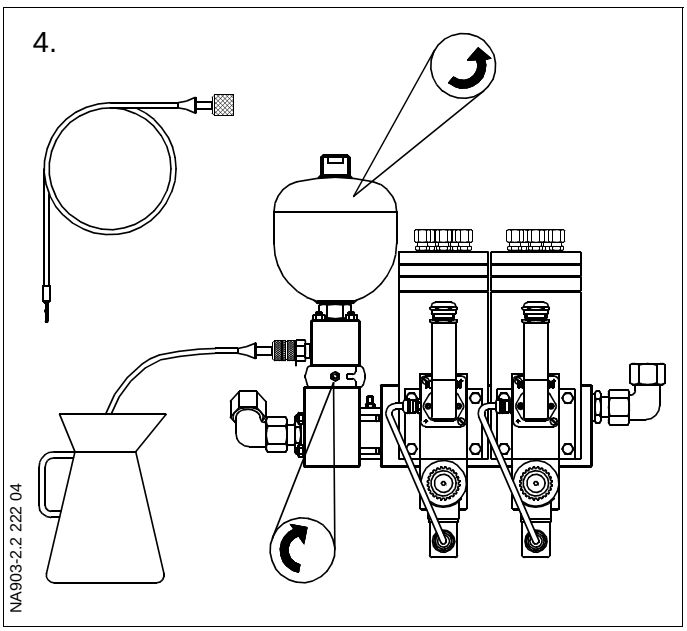
   Release the pressure in the filling valve at bleed screw **F**.

   Unscrew the filling valve from the accumulator. Retighten the plug screw to the torque stated in Data. Remount the accumulator.









Dismantling of lubricators:

Both lubricators can be dismounted with running engine, one at a time. If the engine is running when a lubricator is dismounted, it is important to check that the other lubricator is doubling injection frequency.

1. Close the supply valve for the lubricator concerned, using the special tool. The outer valve is for lubricator marked **A** and the inner valve is for lubricator marked **B**.

   Let the lubricator inject oil until the feedback LED stops flashing. Disconnect the electrical plug on the front of the lubricator.

2. Unscrew the three screws in the top of the lubricator and disconnect the cover with pertaining pipes.

3. Unscrew the four screws on the front that secure the lubricator to the hydraulic block, and remove the lubricator.

Dismantling of accumulators:

4. **Inlet Accumulator**
   Close the valve that connects the accumulator to the distributor block.

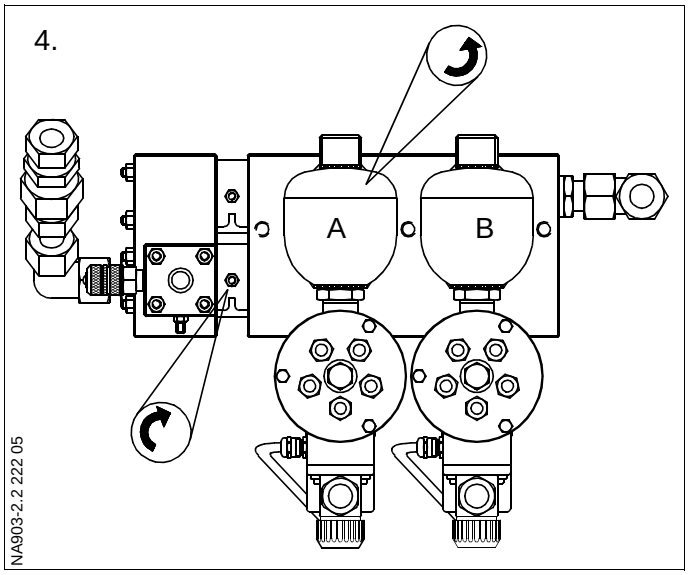
   Mount the special hose on the minimess coupling and drain the oil out of the accumulator.

   Unscrew the accumulator. If the engine is running, a new or checked accumulator should be mounted at once.

5. **Outlet Accumulator**
   Close the supply valve for the accumulator concerned, using the special tool. The outer valve is for accumulator marked **A** and the inner valve is for accumulator marked **B**.

   Let the lubricator inject oil until the feedback LED stops flashing.

   If space conditions permit, unscrew the accumulator; otherwise the lubricator must be dismounted, *see Step 1*.



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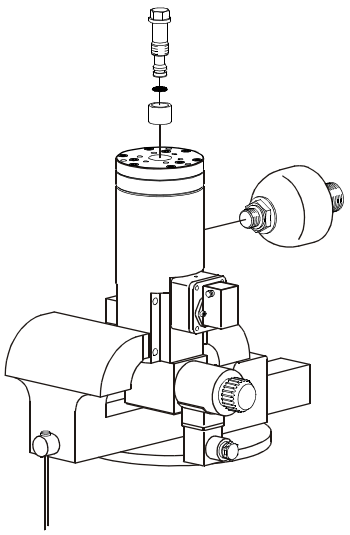

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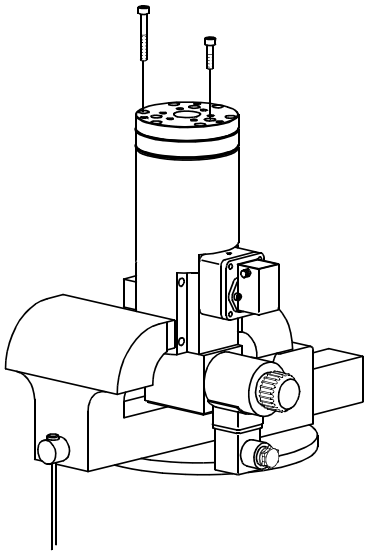

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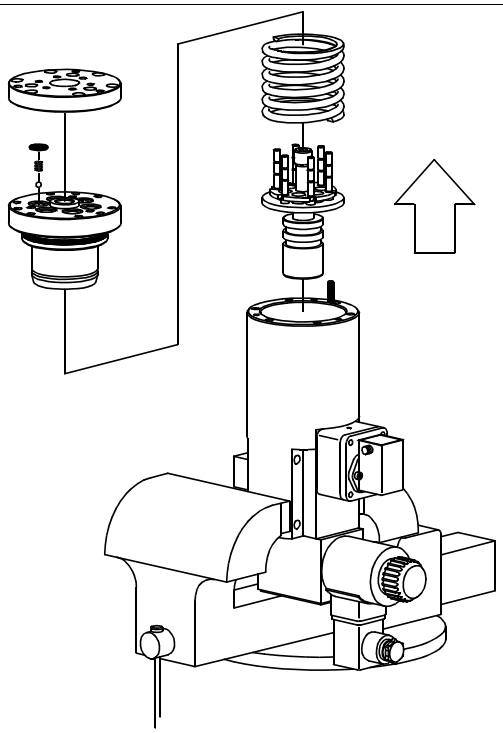


NA903-2.3 222 03

1. Place the lubricator in a bench vice with soft “jaws”.

   Remove the adjusting screw with bushings. Unscrew the oil accumulator.

   Discard the O-ring from the adjusting screw.

2. Remove the screws from the cylinder block.

3. Pull up the cylinder block.

   Remove the spring and actuator piston with plungers.

   Remove and discard the O-ring from the cylinder block.

   Remove the cover for the non-return valves. Take out springs and balls. Remove and discard the O-rings.

4. Remove the cover from the terminal box, and disconnect the wires for the feedback (pick-up) sensor.

   Remove the terminal box.

   Carefully, unscrew the feedback sensor and remove and discard the O-ring.

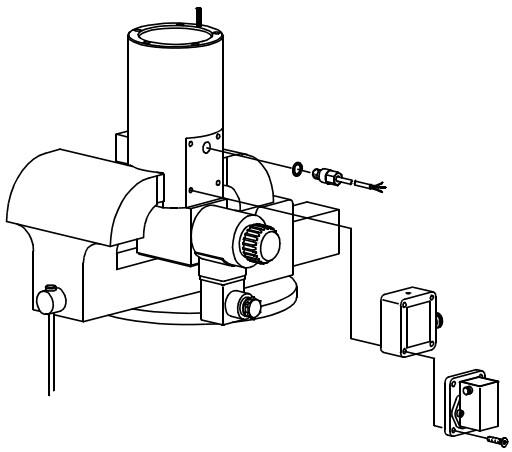
   Clean the housing with diesel oil or kerosene and dry with a non-fluffy cloth.

5. Inspect the plungers, actuator piston and cylinder block for wear, using a magnifying glass.

   Check that the balls from the non-return valves are in good condition.

   Check the seats for the non-return valves.

4.



NA903-2.3 222 04

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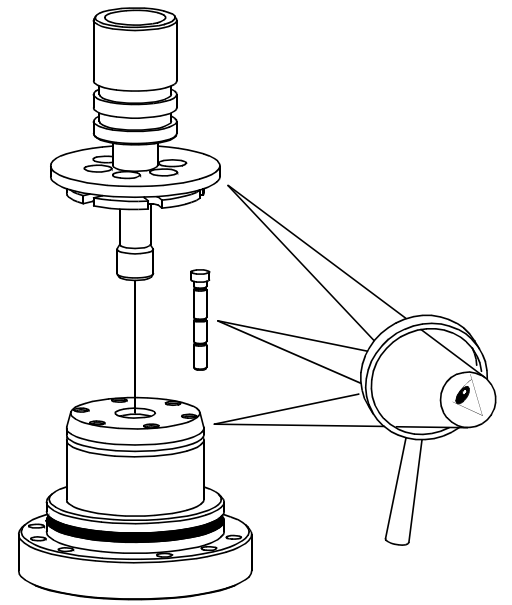

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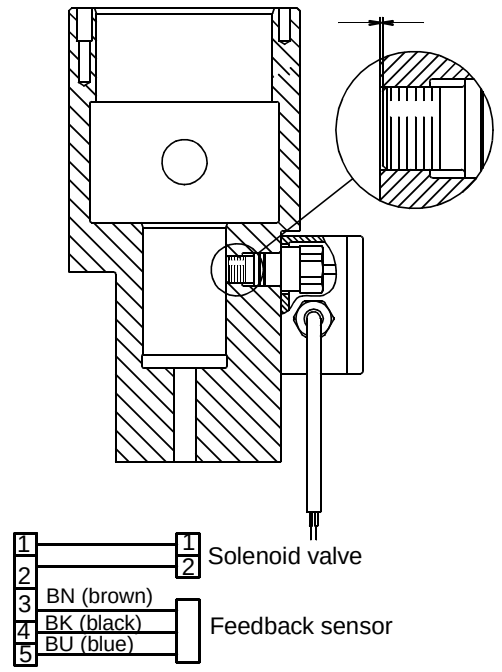

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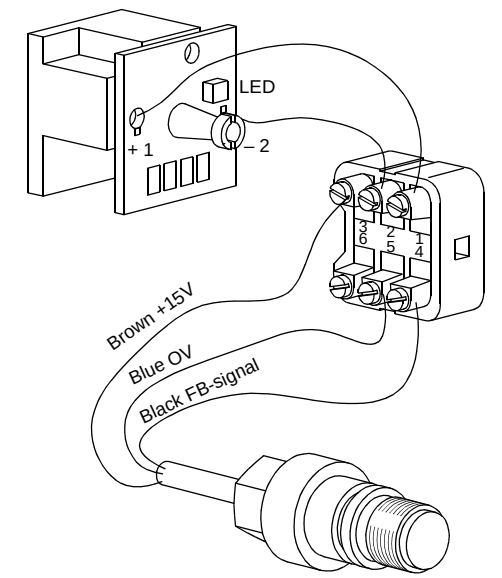

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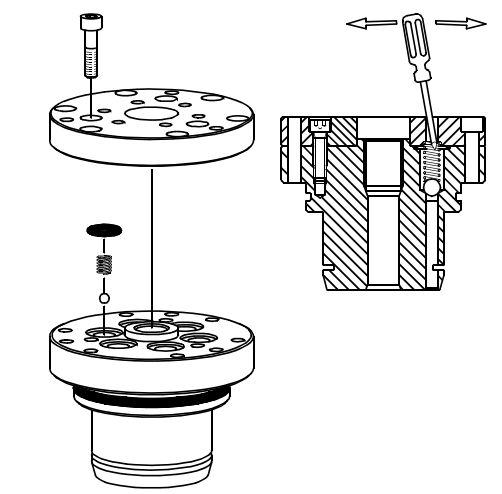


6. Before mounting the feedback sensor, check that the sensor is flush with the sensor housing.

   Mount the feedback sensor or a new one, if necessary, with a new O-ring.

   Check with an object with a straight edge (e.g. the end of a calliper) that the end of the feedback sensor does not protrude into the actuator piston cylinder.

   Mount the terminal box.

   Connect the wires and mount the cover on the terminal box.

7. Fit the cylinder block with new O-rings.

   Assemble the non-return valves in the cylinder block.

   Mount the cover with the three inner screws.

   Check with a small screwdriver that the springs are correctly centered.

8. Fit the cylinder block with a new O-ring. Pre-assemble the cylinder block with the actuator piston and plungers to ensure correct guidance of the plungers, before finally assembling the cylinder block unit.

   Mount the spring and press down the actuator piston with plungers. Mount an M6 x 60 screw with a disc to keep the spring compressed.

9. Mount the cylinder block assembly in the cylinder housing.

   Check that the spring pin engages correctly with the cylinder block assembly.

   Mount the screws and tighten the block to the housing.

   Remove the M6 x 60 screw with disc.

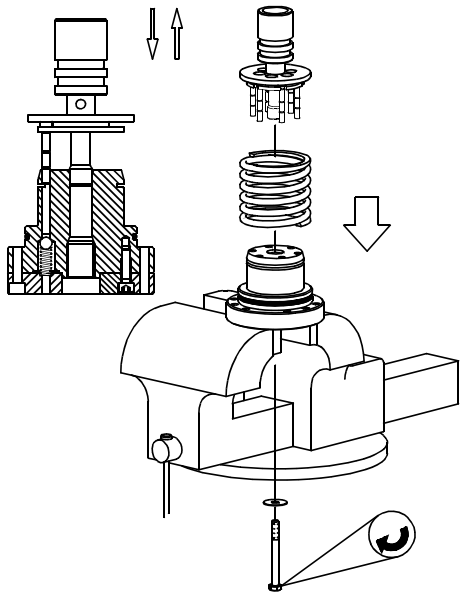
10. Mount the adjusting screw fitted with a new O-ring and the distance bushing.

    Mount the oil accumulator.

11. If the lubricator is not to be mounted on the engine immediately after overhauling, cover all openings with plastic to prevent dirt from entering the lubricator during storage.

    Cover all surfaces with a thin layer of oil.

8.



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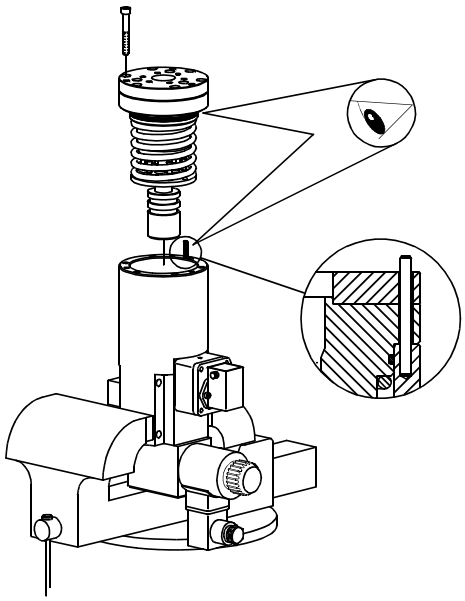

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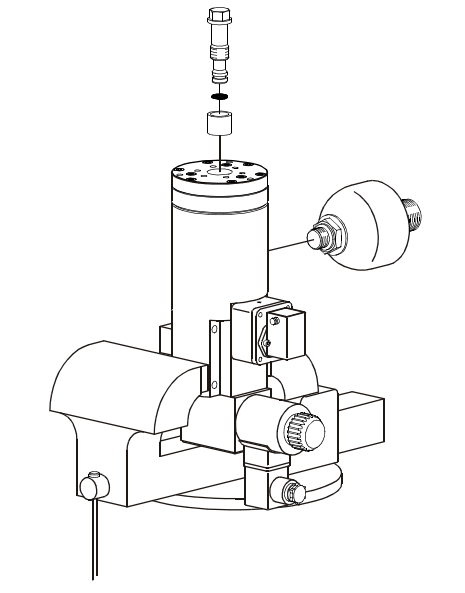

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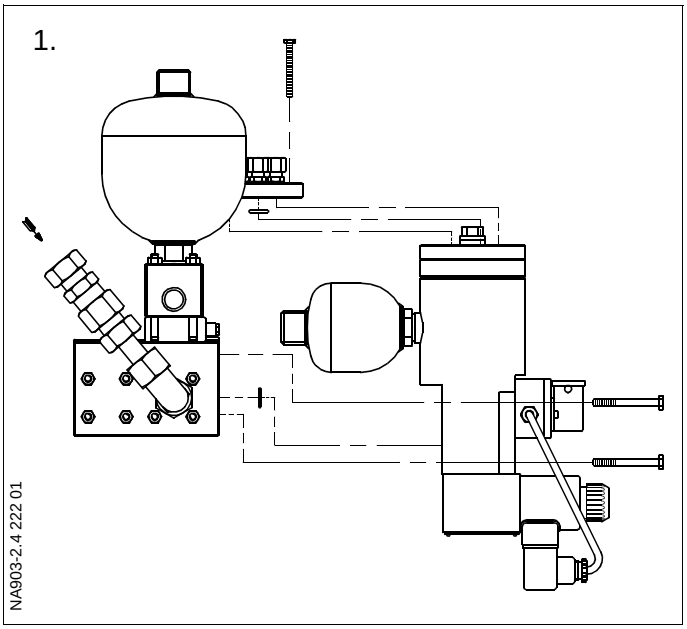
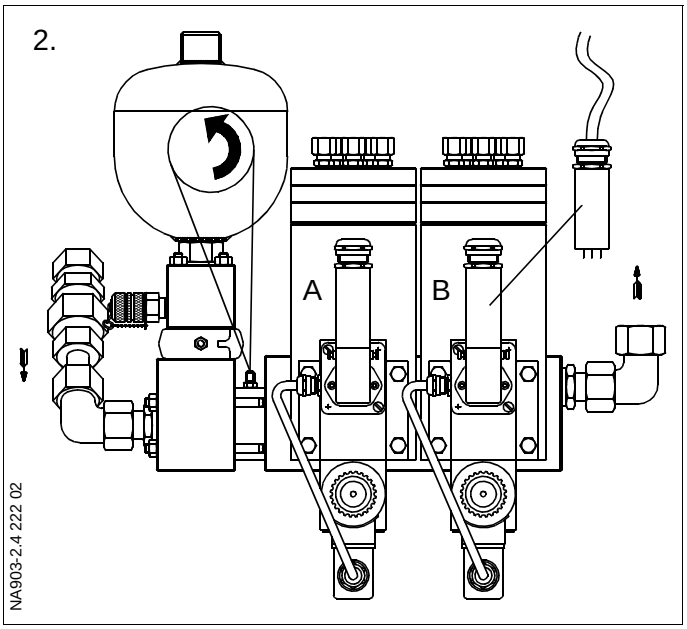
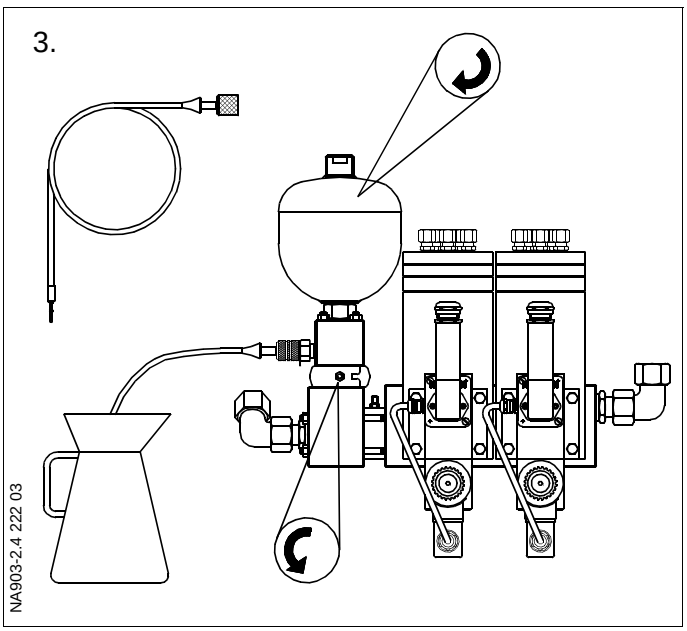






Mounting of Lubricators

1. Mount new O-rings on the hydraulic block and on the cover with pipes.

   Mount the lubricator and tighten the screws on the hydraulic block.

   Tighten the screws in the top of the lubricator to the pipe connection.

2. Open the supply valve and mount the electrical plug. Check the injection of the cylinder oil on the LED on the terminal box for the specific lubricator.

   For checking injection timing, see Procedure 905-8.1.

Mounting of Accumulator

3. Mount the accumulator. Remove the drain hose from the minimess coupling. Open the valve that connects the accumulator to the distributor block.

   Check the oil injection.
   See Procedure 903-2.1.

SAFETY PRECAUTIONS

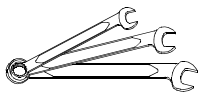
X	Stopped engine
X	Block the starting mechanism
X	Shut off starting air supply
X	Engage turning gear
	Shut off cooling water
	Shut off fuel oil
	Shut off lubricating oil
	Lock turbocharger rotors

Data

Ref.	Description	Value	Unit
D-1	Tacho pick-ups for governor system – check distance	3 ±0.5	mm
D-2	Tacho pick-ups for Alpha lubricator – check distance	3 +0/-1	mm

Regarding distance: Always refer to manufacturer's instructions.

Standard Tools: See Section 913



Spare Parts

Plate – Item No.	Description	Qty

The engine is equipped with two sets of pick-ups:

- Governor system pick-ups
- Alpha lubricator system pick-ups.

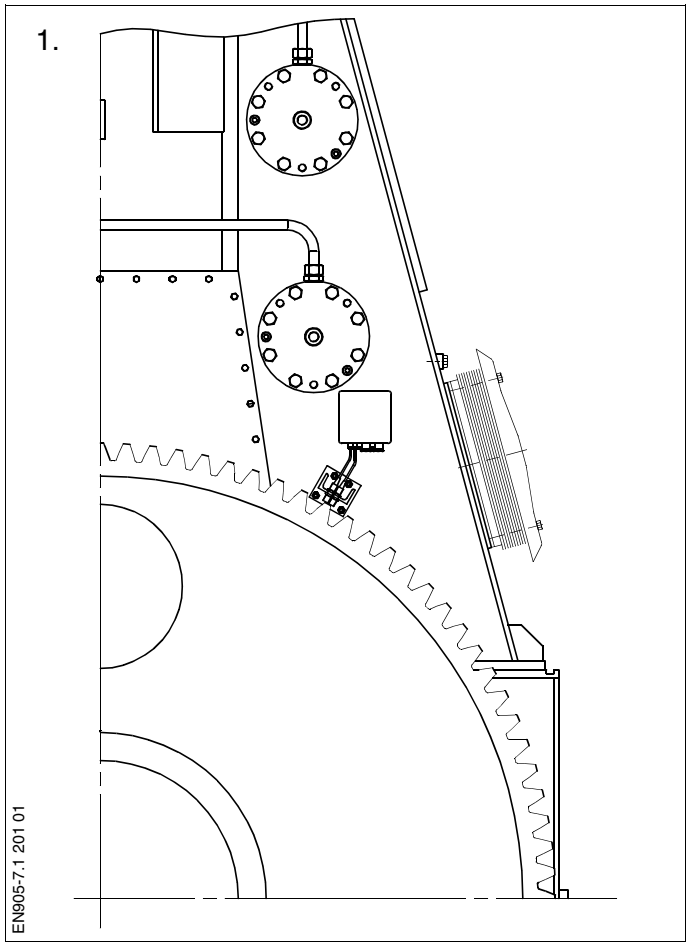
Governor system pick-ups:

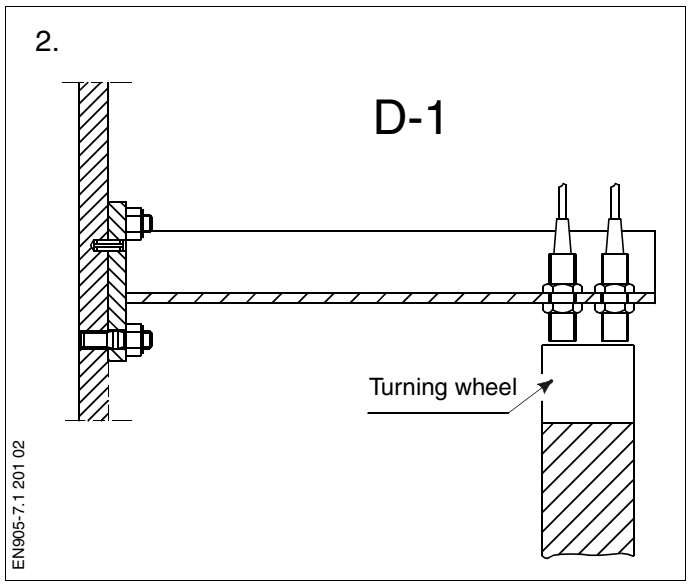
1. The tacho pick-ups are placed next to the turning wheel.

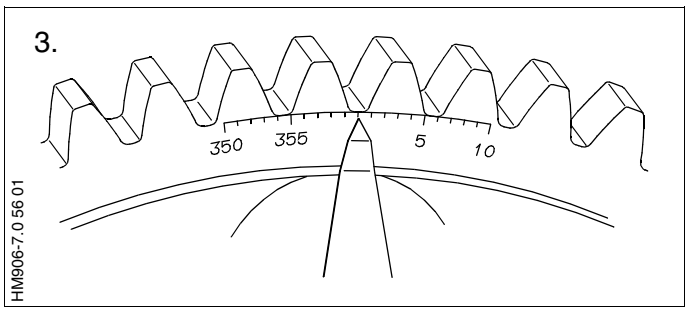
2. Check the distance between the tacho pick-ups and the turning wheel, *see Data*.

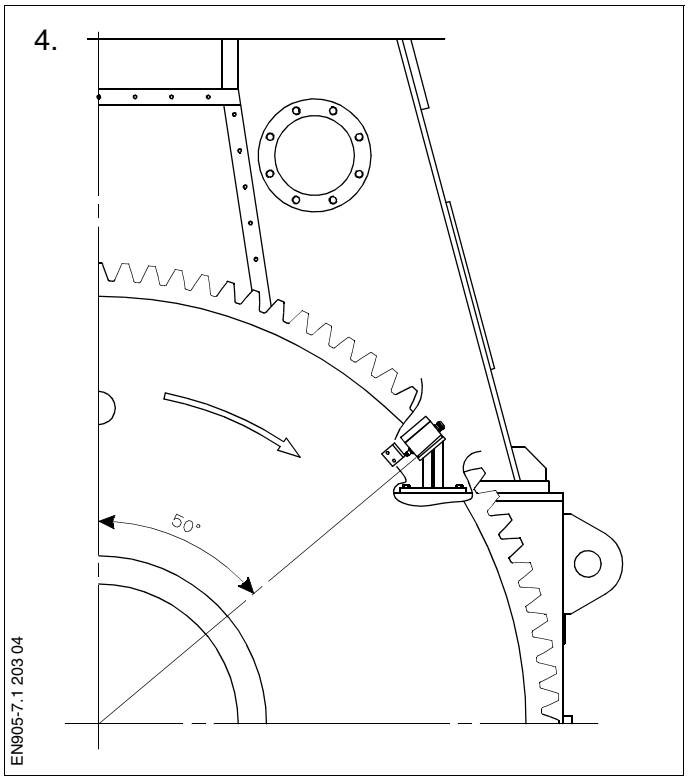
   If necessary, adjust the distance.

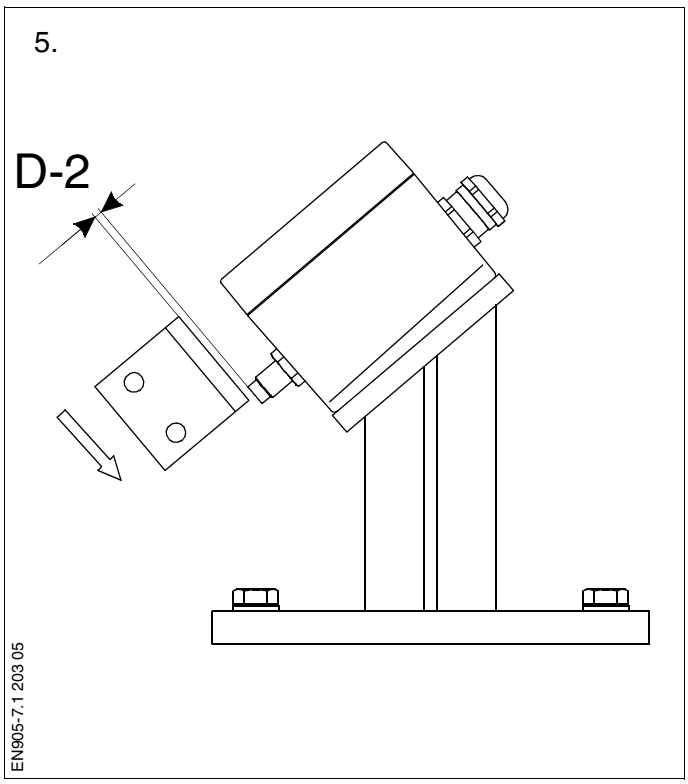
   If the tacho pick-ups are renewed, note down the wiring to ensure the correct re-mounting.











Alpha lubricator system pick-ups
(backup system for angle encoder):

3. Turn the crankthrow for cylinder 1 to TDC.

   Check the TDC of cylinder 1 against the mark on the turning wheel.

4. The pick-ups are placed next to the turning wheel, *see the sketch.*

5. Check that the upper marker piece edge is in the centreline of the pick-ups.

   Check the distance between the pick-ups and the marker piece on the turning wheel.

   Adjust the distance if necessary. *See Data*.

   If the pick-ups are renewed, note down the wiring to ensure the correct remounting.

SAFETY PRECAUTIONS

X	Stopped engine
X	Block the starting mechanism
X	Shut off starting air supply
X	Engage turning gear
	Shut off cooling water
	Shut off fuel oil
X	Shut off lubricating oil
	Lock turbocharger rotors

Data

Ref.	Description	Value	Unit

The task-specific tools used in this procedure are shown on the plates at the end of this chapter or in the chapters indicated by the first three digits in the plate number, e.g. P**909**51 refers to chapter 909.

Plate	Item No.	Description

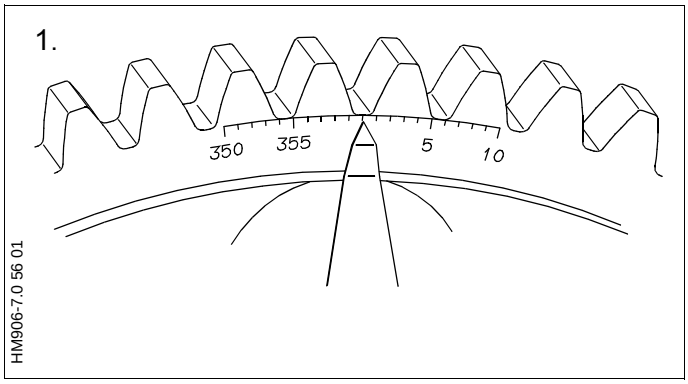
1. Turn the crankthrow for cylinder 1 to TDC.

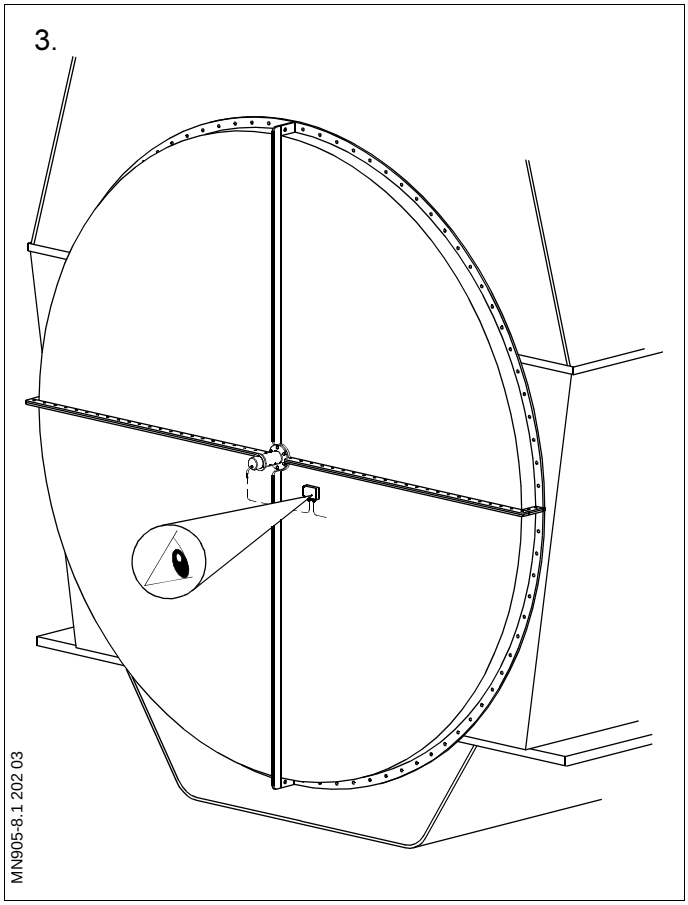
   Check the TDC of cylinder 1 against the mark on the turning wheel.

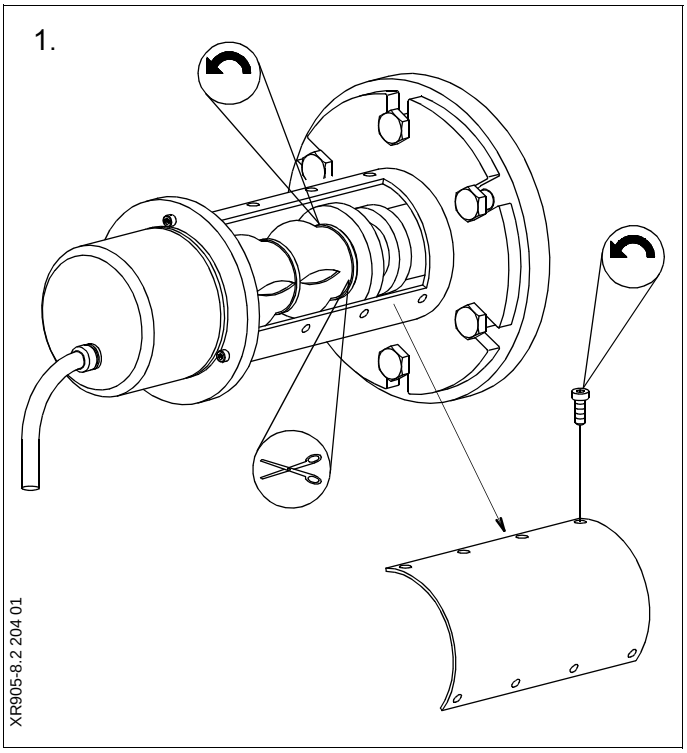
2. Check that power is supplied to the intermediate box.

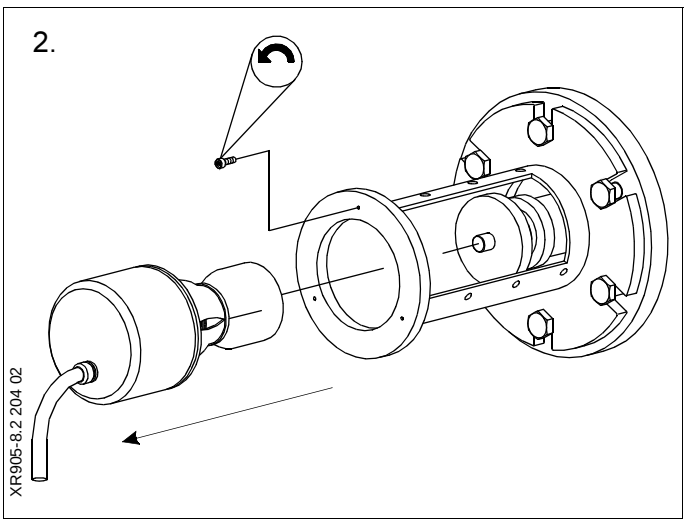
   The green indicator should now light.

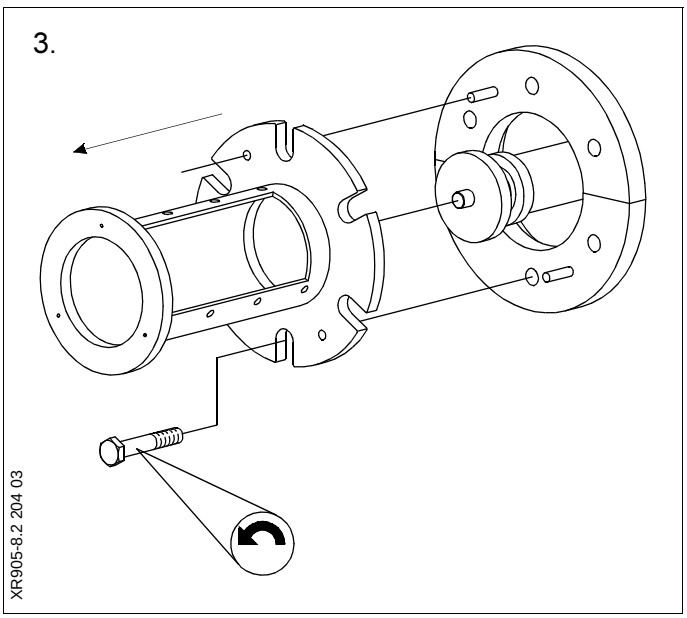
   For adjustment of the angle encoder, see Procedure 905-8.3.











1. Remove the inspection cover.

   Cut the cable tie which holds the rubber damper around the coupling, in the end nearest to the engine, and loosen the coupling.

2. Loosen the three adjusting screws on the front flange, and remove the angle encoder and the coupling.

3. Screw out the flange screws and remove the encoder housing. Take care not to damage the guide pins.

1. Turn the crankthrow for cylinder 1 to TDC.

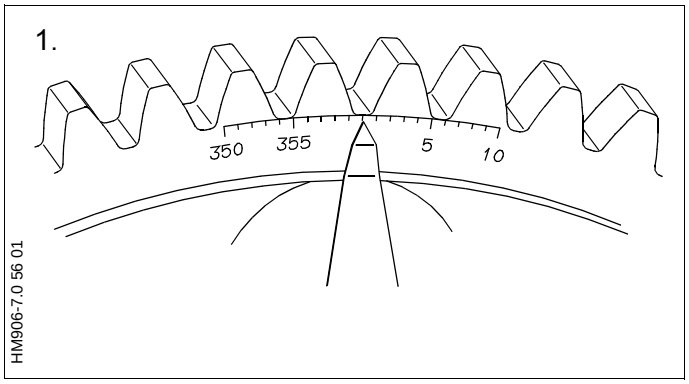
   Check the TDC of cylinder 1 against the mark on the turning wheel.

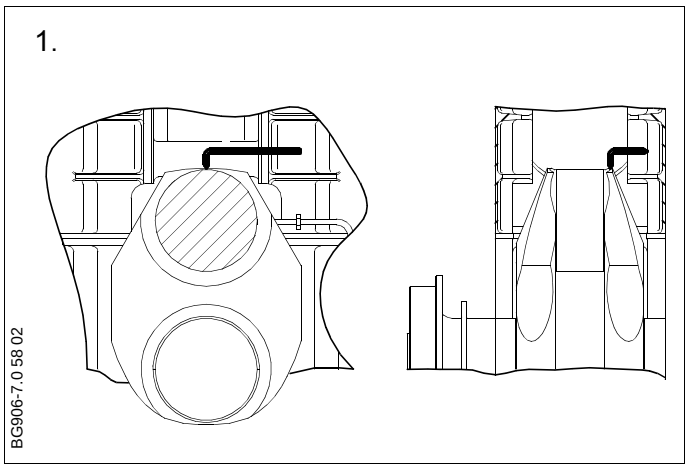
   Check the TDC position with the pin gauge on the crankthrow, cylinder 1.

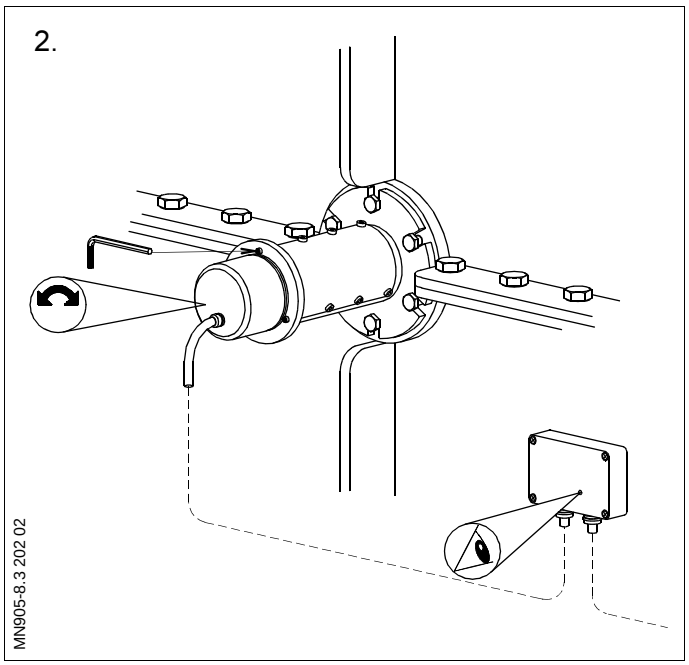
Note!
Before using the pin gauge, check the measurement from tip to tip with the value stamped on the pin gauge, and/or the check-marks stamped on the fore end of the cylinder frame.

2. Loosen the adjusting screws which fasten the encoder to the housing. Slowly turn the encoder until the green indicator lights on the intermediate box.

   Tighten the screws to secure the encoder in the correct position.







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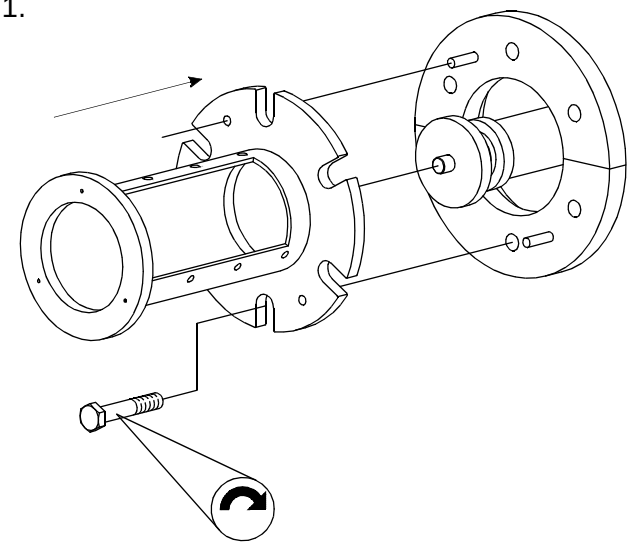

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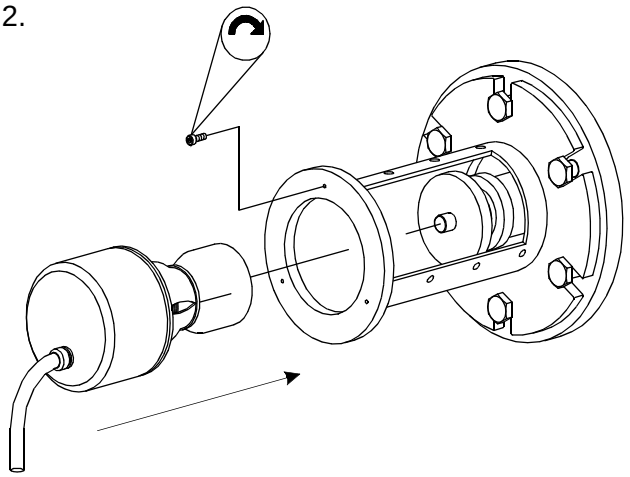

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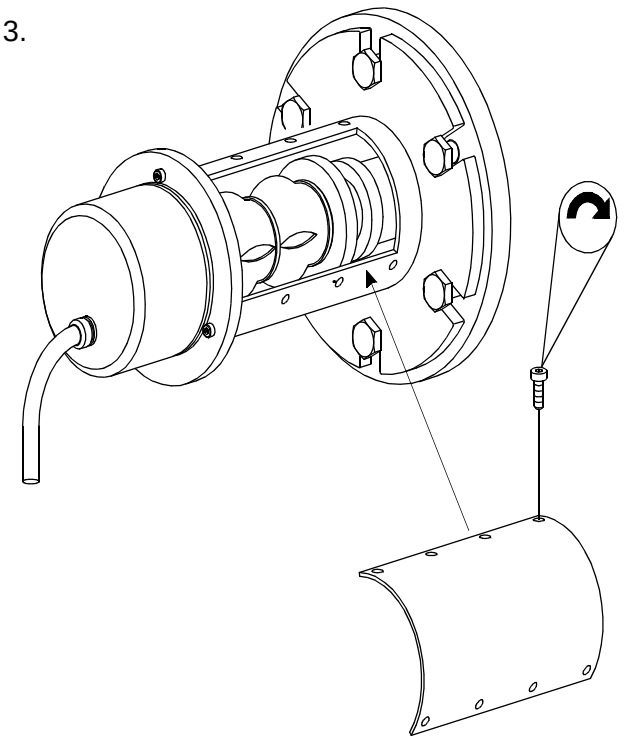


XR905-8.4 204 03

1. Mount the encoder housing. The two guide pins indicate the correct positioning of the housing. Tighten the screws.

2. Mount the angle encoder and the coupling.

   Tighten the coupling, and mount new cable ties around the rubber damper.

   Adjust the angle encoder according to Procedure 905-8.3.

Note!
The adjustment will be easier if mounting is in the same crank position as dismantling.

3. Mount the cover.

Check and adjustment of index transmitter

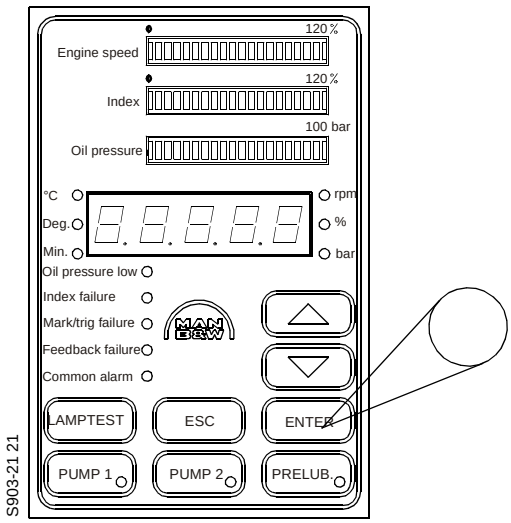
The following guidelines are relevant for the adjustment or replacement of the index transmitter on engines in service.

Adjustment of index transmitter

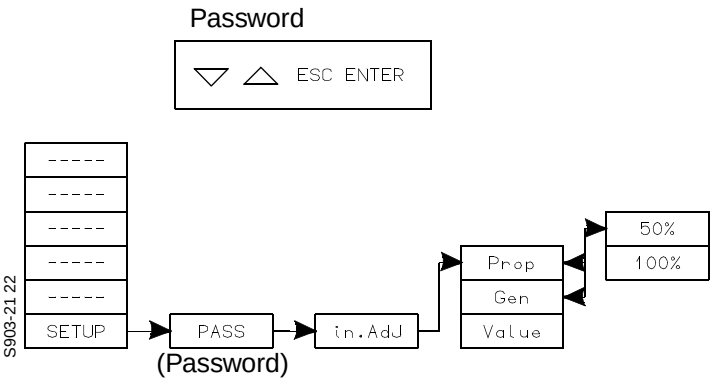
Adjust the index transmitter electrically until:
The minimum index from the engine side control console corresponds to 4.5 MA.
The maximum index from the engine side control console corresponds to 19.5 mA.
See instruction S903-21, Testbed Commissioning Procedure.

Calibration of index signal

Adjust the fuel rack on the engine side control console to an index corresponding to 50% load at testbed conditions (relevant values can be found in the shoptest report).



Navigate, via the HMI panel, to the Index Adjust menu.
Choose either the generator curve or the propeller curve, depending on the measurements obtained on the testbed.



Select 50% in the Menu, and press [ENTER].

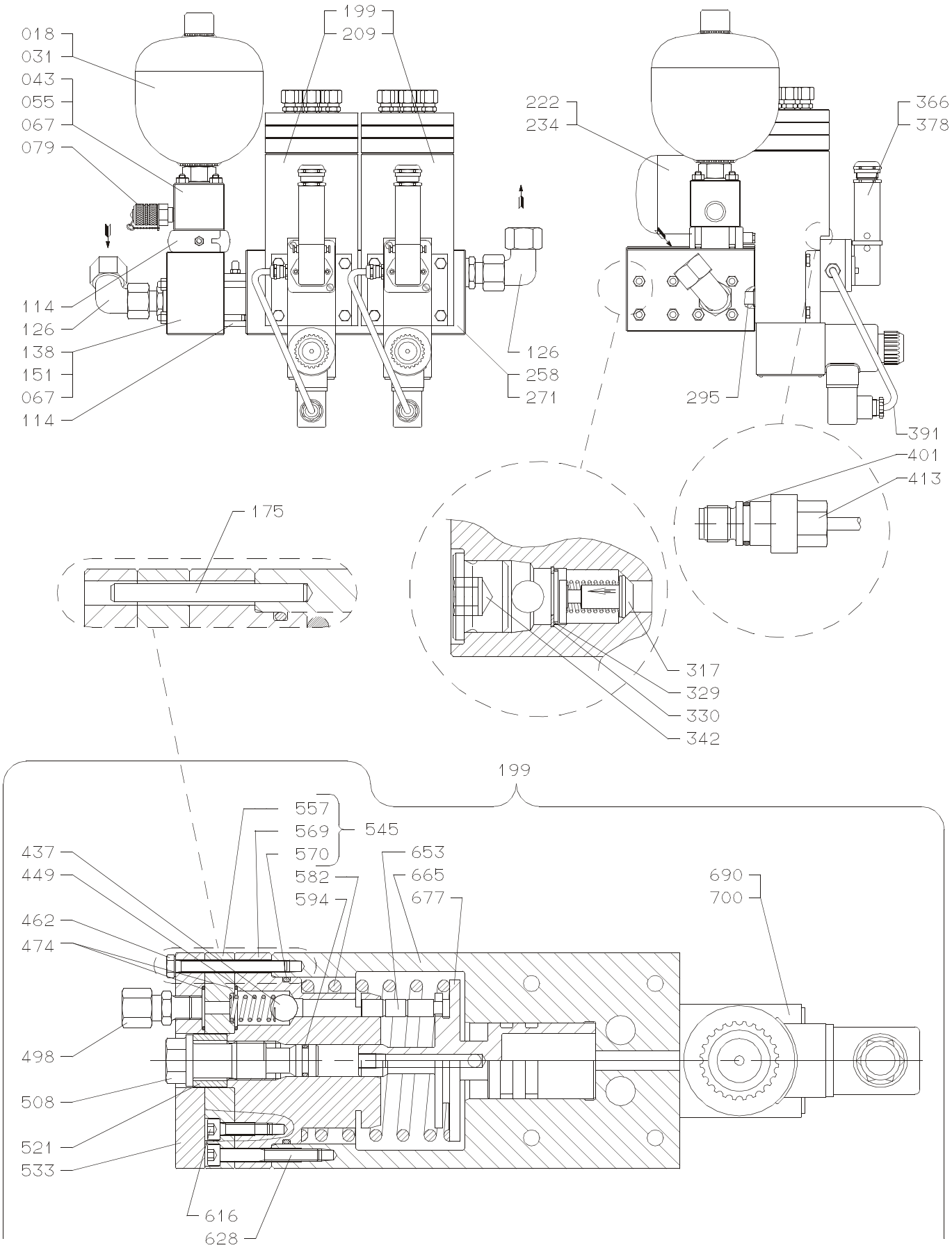
Adjust the fuel rack on the engine side control console to an index corresponding to 100% load at testbed condition (relevant values can be found in the shoptest report).

Navigate, via the HMI panel, to the Index Adjust menu.
Choose either the generator curve or the propeller curve, depending on the measurements obtained on the testbed.

Select 100% in the Menu, and press [ENTER].
The index transmitter has now been adjusted.

These settings are only 100% valid when running on diesel oil. When running on heavy fuel there can be a minor offset, which can be compensated for by adjusting the mechanical connection from the fuel rack to the index transmitter.

Index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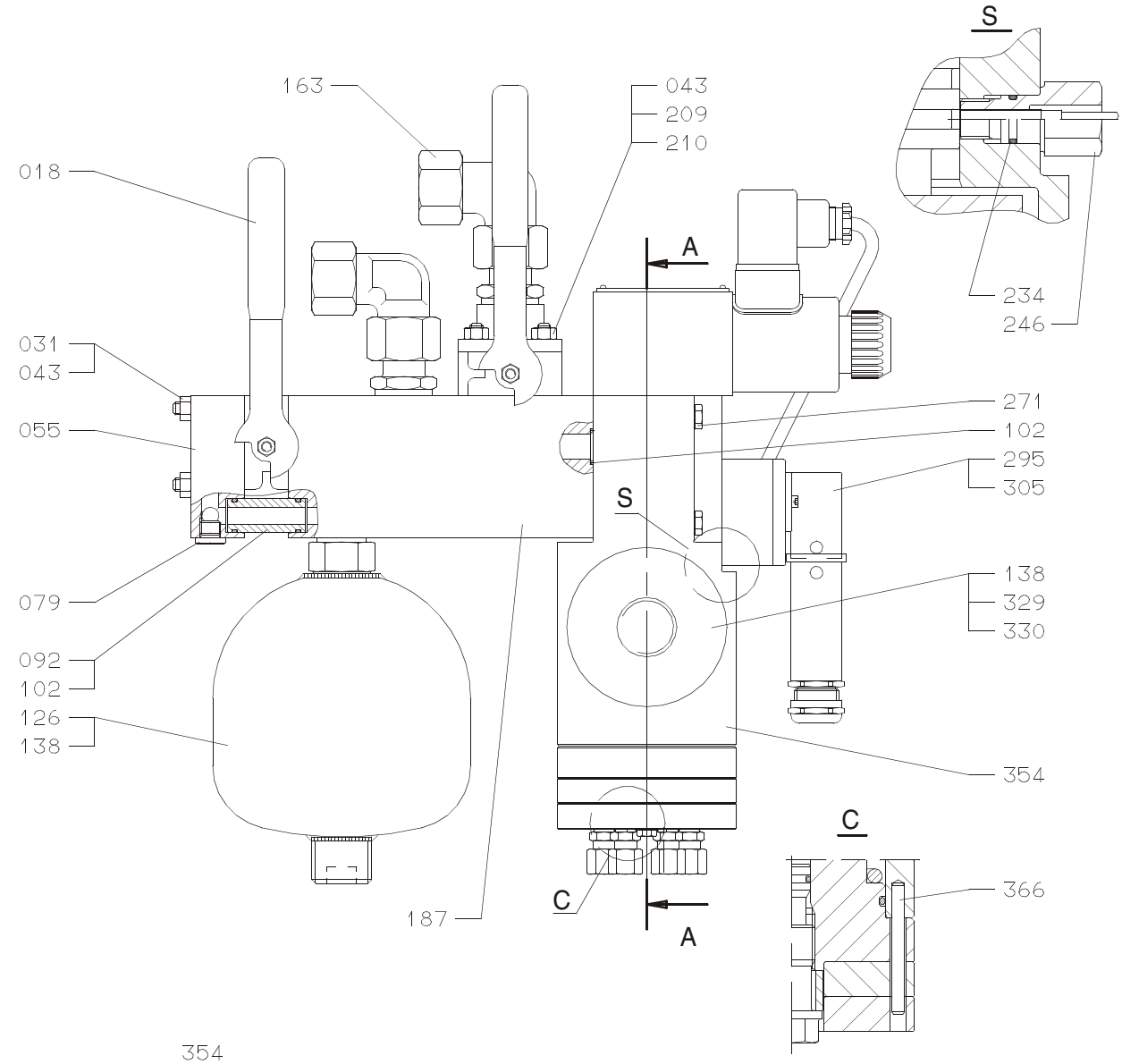
Cylinder Lubricator Assy

Item No.	Item Description
018	Accumulator membrane
031	Shim
043	Distributor block
055	Studs
067	Nut
079	Coupling, minimess
114	Ball valve
126	Coupling
138	Distributor block
151	Stud
175	Spring pin
199	Lubricator
209	Screw
222	Accumulator membrane
234	Shim
258	Distributor block
271	Plug screw
295	O-ring
317	Non-return valve
329	Disc
330	Circlip
342	Plug screw
366	Terminal box, complete
378	Screw
391	Cable
401	O-ring
413	Inductive sensor, complete
437	Steel ball
449	Spring
462	Screw
474	O-ring
498	Coupling
508	Adjustment screw
521	Spacer
533	Cover
545	Cylinder block
557	Cover
569	Cylinder block
570	O-ring
582	Spring
594	O-ring
616	Screw
628	Screw
653	Plunger
665	Cylinder housing
677	Actuator piston
690	Solenoid valve, complete

Item No.	Item Description
700	Screw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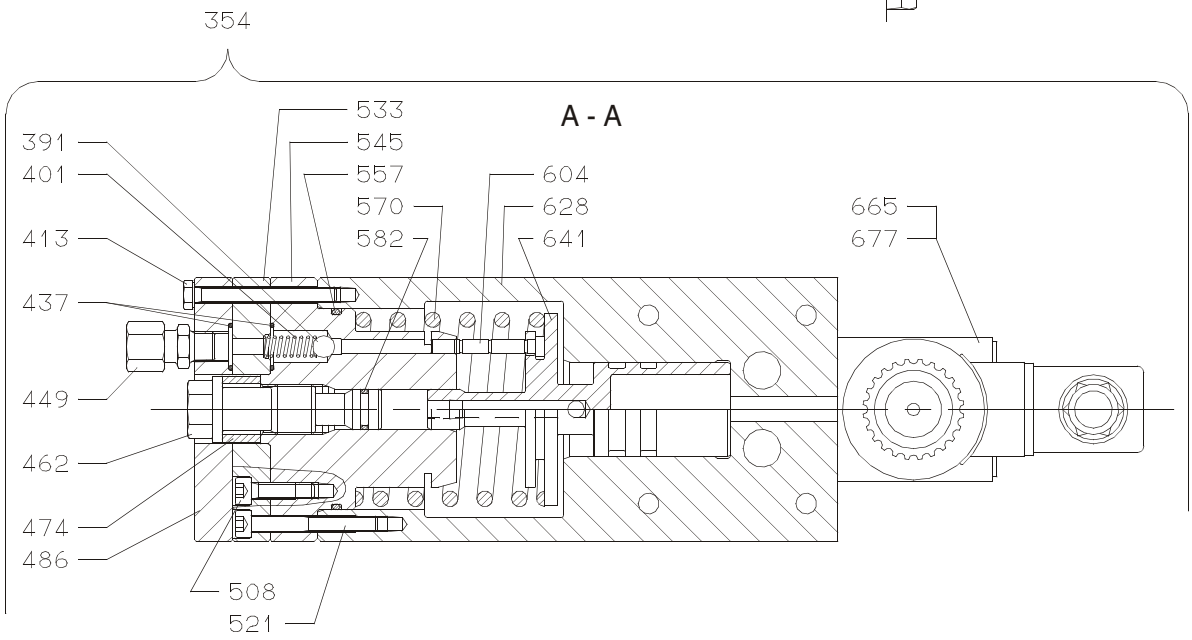
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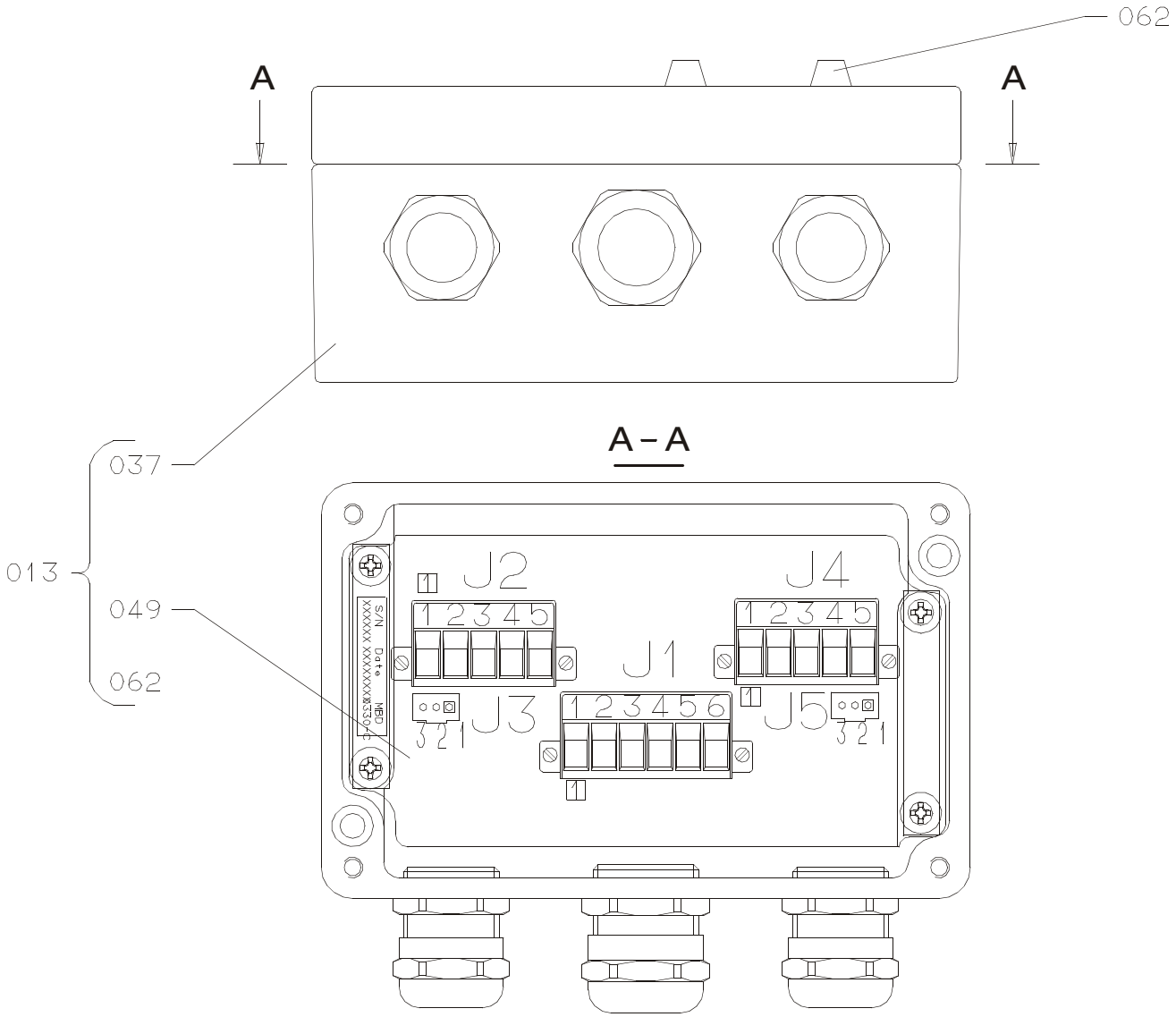
Cylinder Lubricator Assy

Item No.	Item Description
018	Ball valve
031	Stud
043	Nut
055	Hydraulic block
079	Plug screw
092	Intermediate pipe
102	O-ring
126	Membrane accumulator
138	Shim
163	Coupling
187	Hydraulic block
209	Stud
210	Ball valve
234	O-ring
246	Mounting of pick-up, complete
271	Screw
295	Enclosure, complete
305	Screw
329	Membrane accumulator
330	Shim
354	Lubricator
366	Spring pin
391	Steel ball
401	Spring
413	Screw
437	O-ring
449	Union
462	Adjustment screw
474	Spacer
486	Cover
508	Screw
521	Screw
533	Cover
545	Cylinder block
557	O-ring
570	Spring
582	O-ring
604	Plunger
628	Cylinder housing
641	Actuator piston
665	Screw
677	Solonoid valve, complete

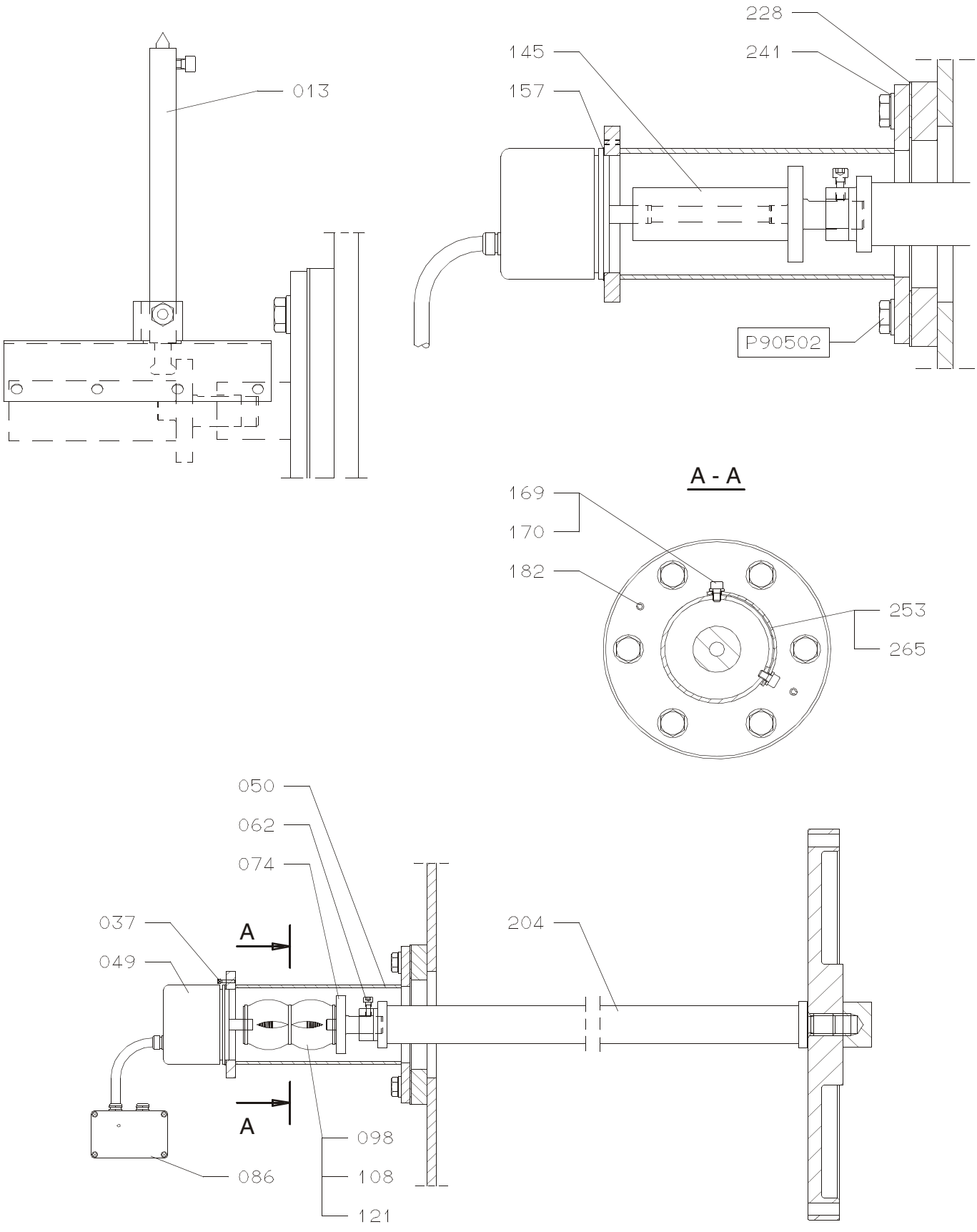
Item No.	Item Description


062
A
A
A – A
037
013
049
062
J2
J4
J1
J3
J5
1 2 3 4 5
1 2 3 4 5
1 2 3 4 5 6
3 2 1
3 2 1
S/N
Date
MBD

Cylinder Lubricator - Intermediate Box

Item No.	Item Description
013	Intermediate box, complete
037	Electric enclosure with cables
049	Printed circuitboard
062	Light emitting diode

Item No.	Item Description

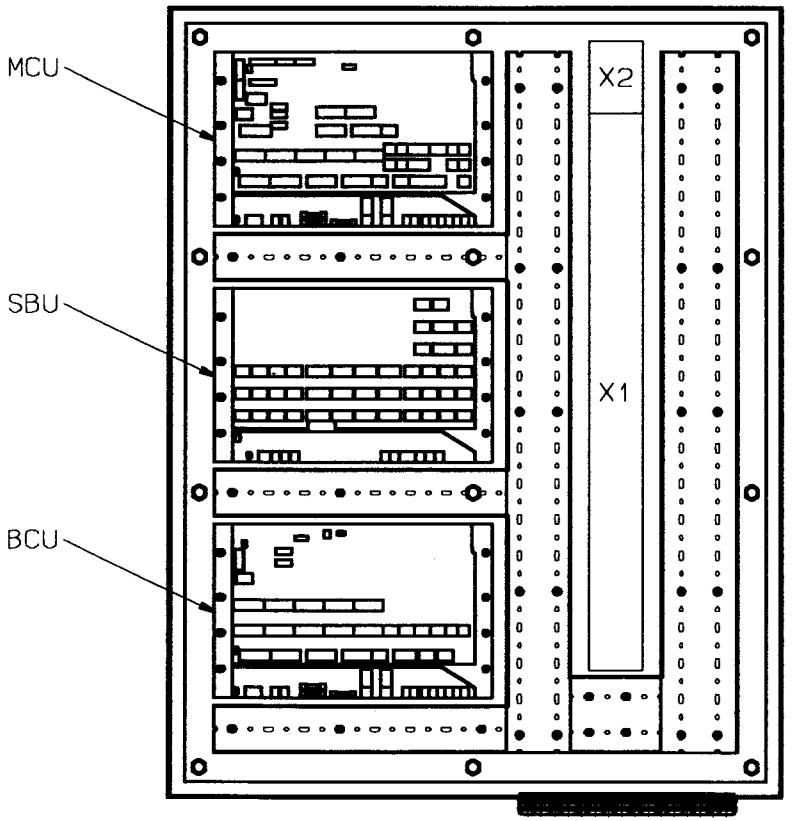

013
228
241
145
157
P90502
A - A
169
170
182
253
265
050
062
074
037
049
A
204
A
098
108
121
086

Arrangement of Angle Decoder

Item No.	Item Description
013	Measuring instrument, axial vibration damper
037	Screw
049	Angle encoder
050	Housing
062	Screw
074	Shaft
086	Intermediate box
098	Coupling
108	Damper plate
121	Cable ties
145	Tools
157	Packing
169	Screw
170	Spring lock
182	Spring pin
204	Shaft
228	Packing
241	Washer
253	Shield
265	Packing

Item No.	Item Description

Index



- Wires 0.75² blue
- Wire marking labels Phoenix Contact PABA-15 HW
- All wire ends are fitted with cable Ferulre

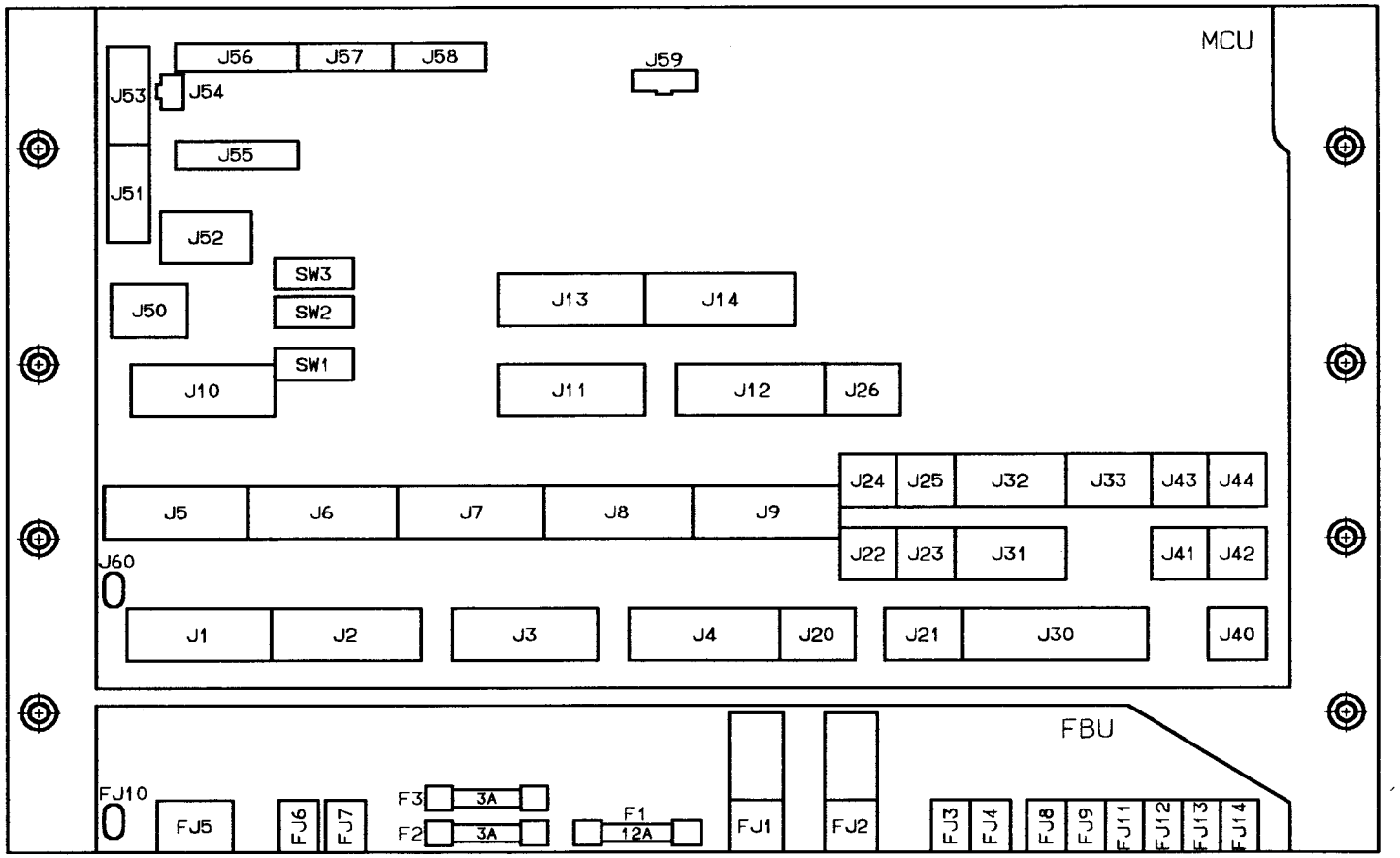
ALCU

Basic Standards (MBD 88) & Suppl. Drawing No.:	EN21C Surf. roughness	Projection:	Material / Blank:
	EN21F-a Tolerances	Mass (kg):	Final User Material:

Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	C.No
				*	Replaced by Ident. No.:	9
				*		8
				*		7
				*		6
				*		5
				*		4
				*		3
20030204	DFA	JHV	JHV	Z4	Page 9. Wire on encoder J20 corr.	2
20020517	IBB	JHV	JHV	Z4	Page 5. Pilot lamps added.	1
20020508	IBB	JHV	JHV	*		0

Similar Drawing No.: | Replacement for Ident. No.:

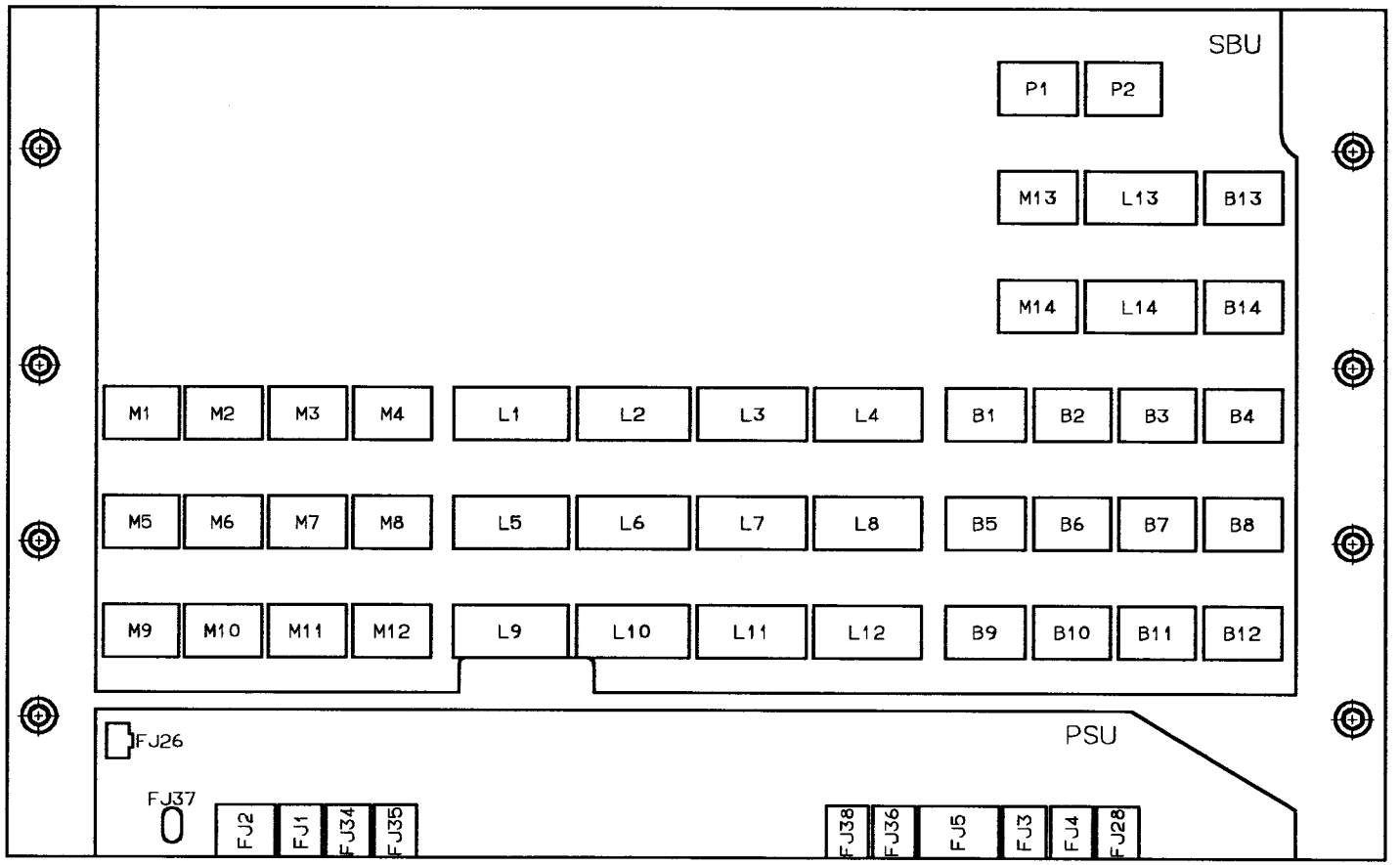
Scale:	Size: A2	Type: INTERNAL CONN. 2 LUB.	Page No.: 01 (13)	MAN B&W Diesel A/S
Info. No.: 363160		Description: CABLING OF EL. LUBRICATOR		Ident. No.: 0794607-6
Final User Info. No.:		Final User Description:		Final User Ident. No.:



Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	C.No.
20030204	DFA	JHV	JHV	Z4	Page 9 Wire on encoder J20 corr.	2

Scale:	Size:	Type	Page No.	
	A2	INTERNAL CONN. 2 LUB.	02 (13)	MAN B&W Diesel A/S
Info. No.: 363160		Description: CABLING OF EL. LUBRICATOR		Ident. No.: 0794607-6
Final User Info. No.:		Final User Description:		Final User Ident. No.:

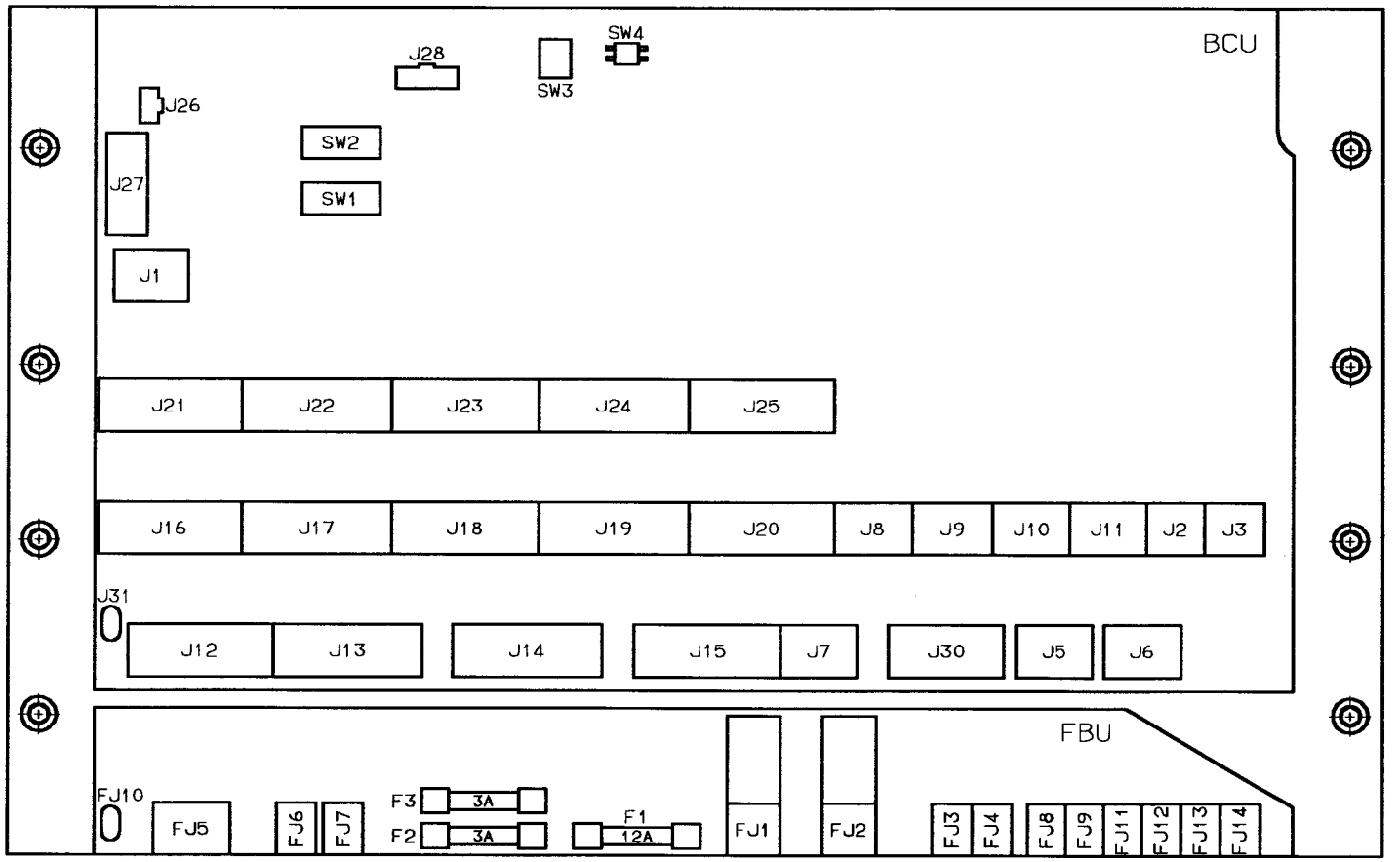
ISO Drawing - do not correct by hand



Date	Dwn.	Chk.	Appd.	A.C.	Change / Replacement	C. No.
20030204	DFA	JHV	JHV	Z4	Page 9: Wire on encoder J20 corr.	2

Scale	Size	Type	Page No.	
	A2	INTERNAL CONN. 2 LUB.	03 (13)	MAN B&W Diesel A/S
Info. No.		Description	Ident. No.	
363160		CABLING OF EL. LUBRICATOR	0794607-6	
Final User Info. No.		Final User Description	Final User Ident. No.	

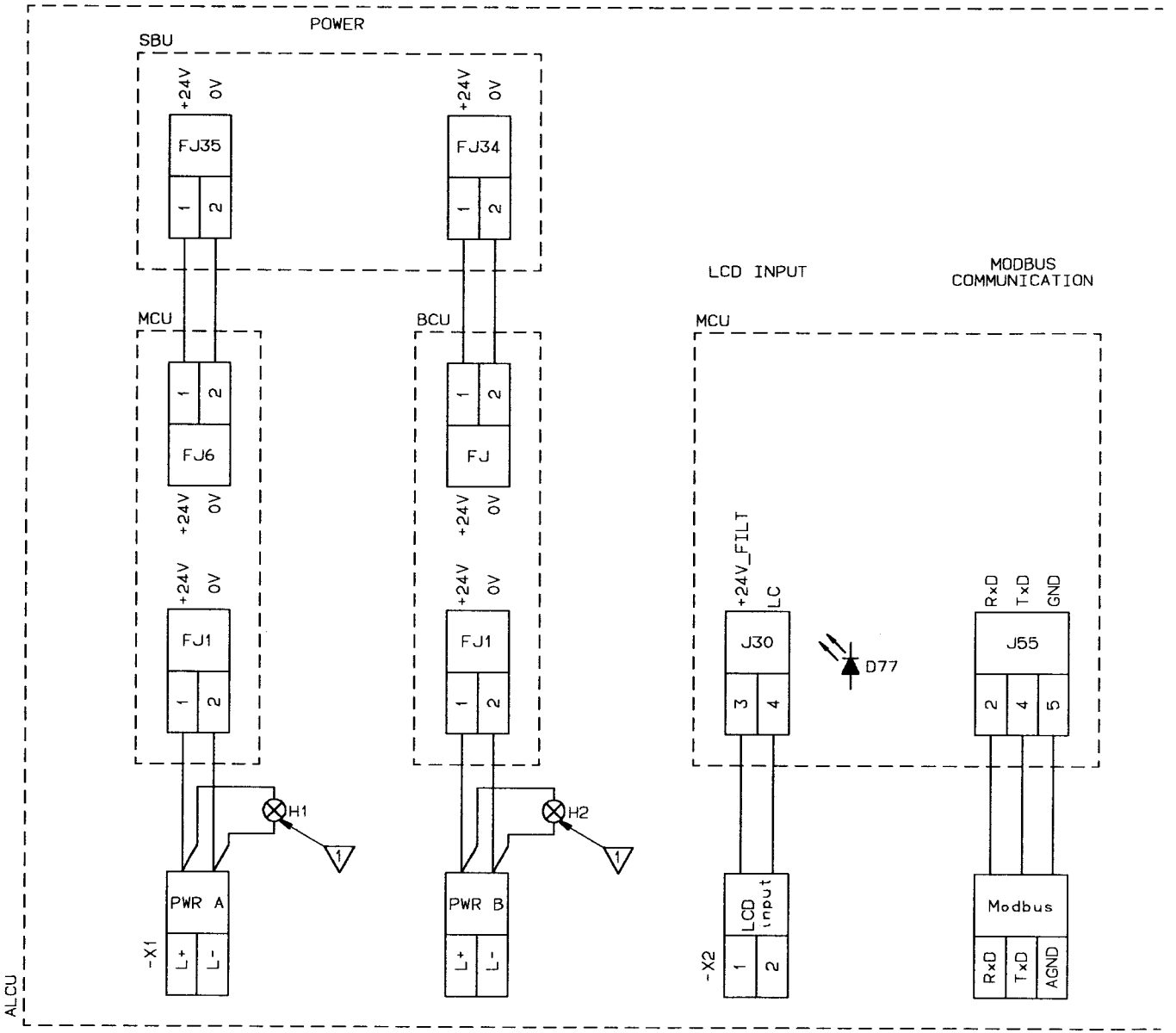
50 Drawing - do not contact by hand



Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	E.No
20030204	DFA	JHV	JHV	Z4	Page 9: Wire on encoder J20 corr.	2

Scale:	Size:	Type:	Page No:	
	A2	INTERNAL CONN. 2 LUB.	04 (13)	MAN B&W Diesel A/S
Info. No.:		Description:		Ident No.:
363160		CABLING OF EL. LUBRICATOR		0794607-6
Final User Info. No.:		Final User Description:		Final User Ident No.:

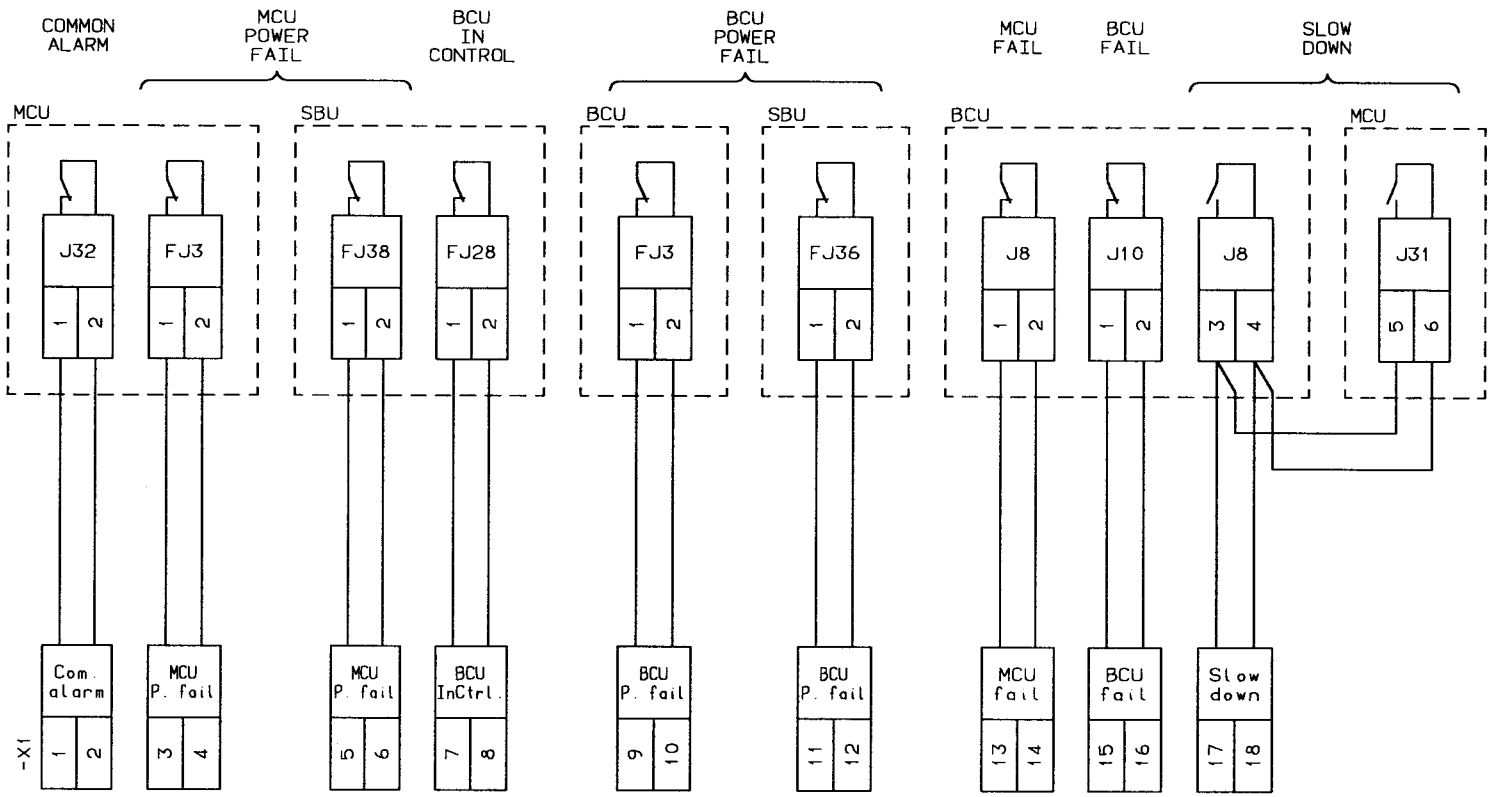
CAD Drawing - do not correct by hand



Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	C No.
20030204	DFA	JHV	JHV	Z4	Page 9: Wire on encoder J20 corr.	2

Scale	Size	Type	Page No.	
	A2	INTERNAL CONN. 2 LUB.	05 (13)	MAN B&W Diesel A/S
Info. No.: 363160		Description: CABLING OF EL. LUBRICATOR		Ident. No.: 0794607-6
Final User Info. No.:		Final User Description:		Final User Ident. No.:

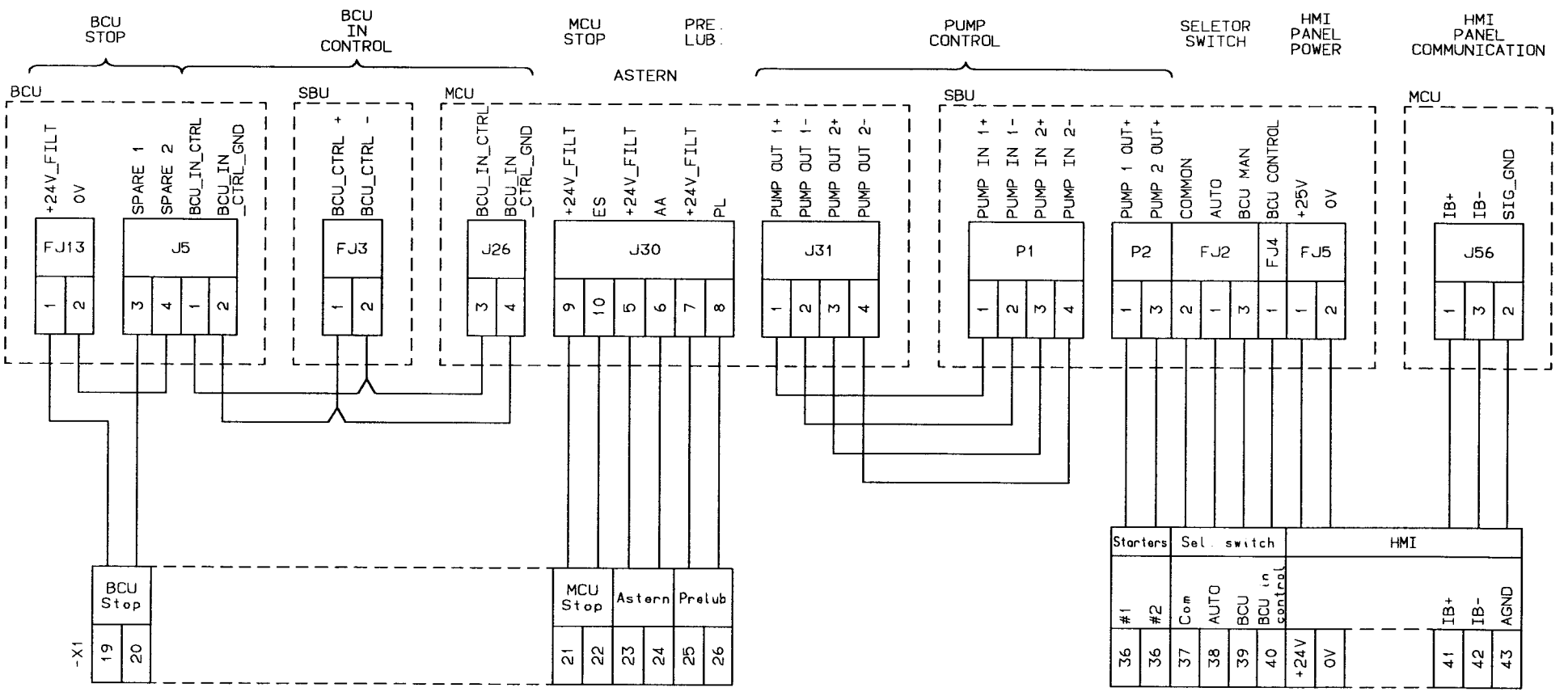
CAD Drawing - do not correct by hand



Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	C.No
20030204	DFA	JHV	JHV	Z4	Page 9. Wire on encoder J20 corr.	2

Scale:	Size:	Type:	Page No.:	
	A2	INTERNAL CONN. 2 LUB.	06 (13)	MAN B&W Diesel A/S
Info. No.:		Description:		Ident. No.:
363160		CABLING OF EL. LUBRICATOR		0794607-6
Final User Info. No.:		Final User Description:		Final User Ident. No.:

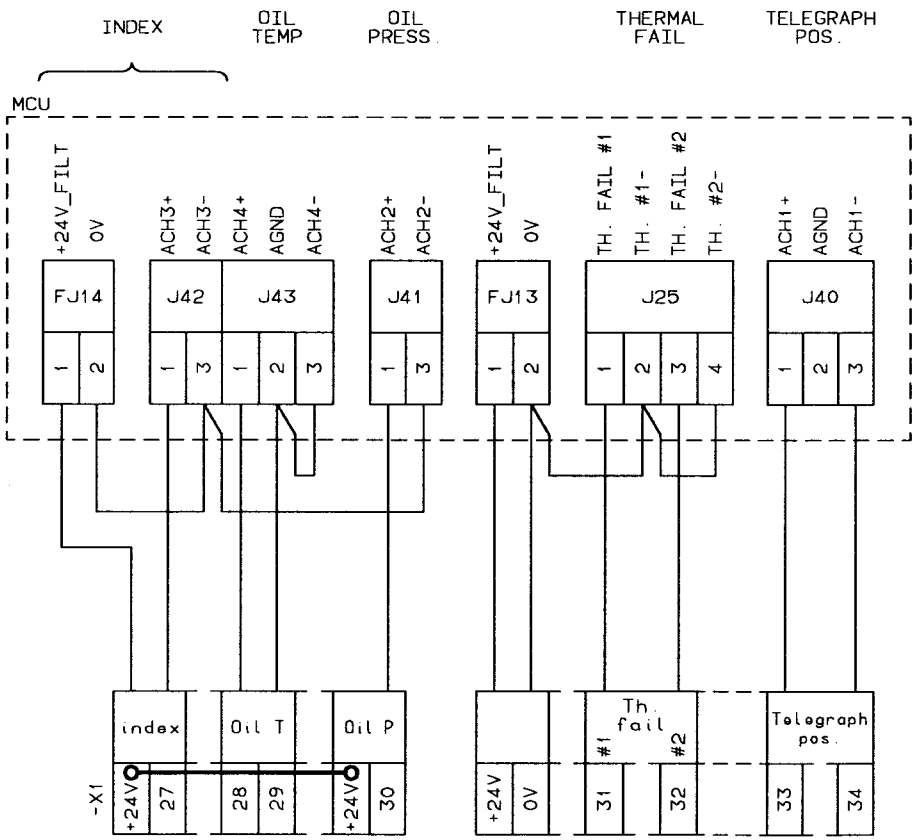
CAD Drawing - do not correct by hand



Date	Dwn	Chk	Appd	A.C.	Change / Replacement	C.No
20030204	DFA	JHV	JHV	Z4	Page 9. Wire on encoder J20 corr.	2

Scale:	Size: A2	Type: INTERNAL CONN. 2 LUB.	Page No.: 07 (13)	MAN B&W Diesel A/S
Info. No.: 363160		Description: CABLING OF EL. LUBRICATOR		Ident. No.: 0794607-6
Final User Info. No.		Final User Description.		Final User Ident. No.

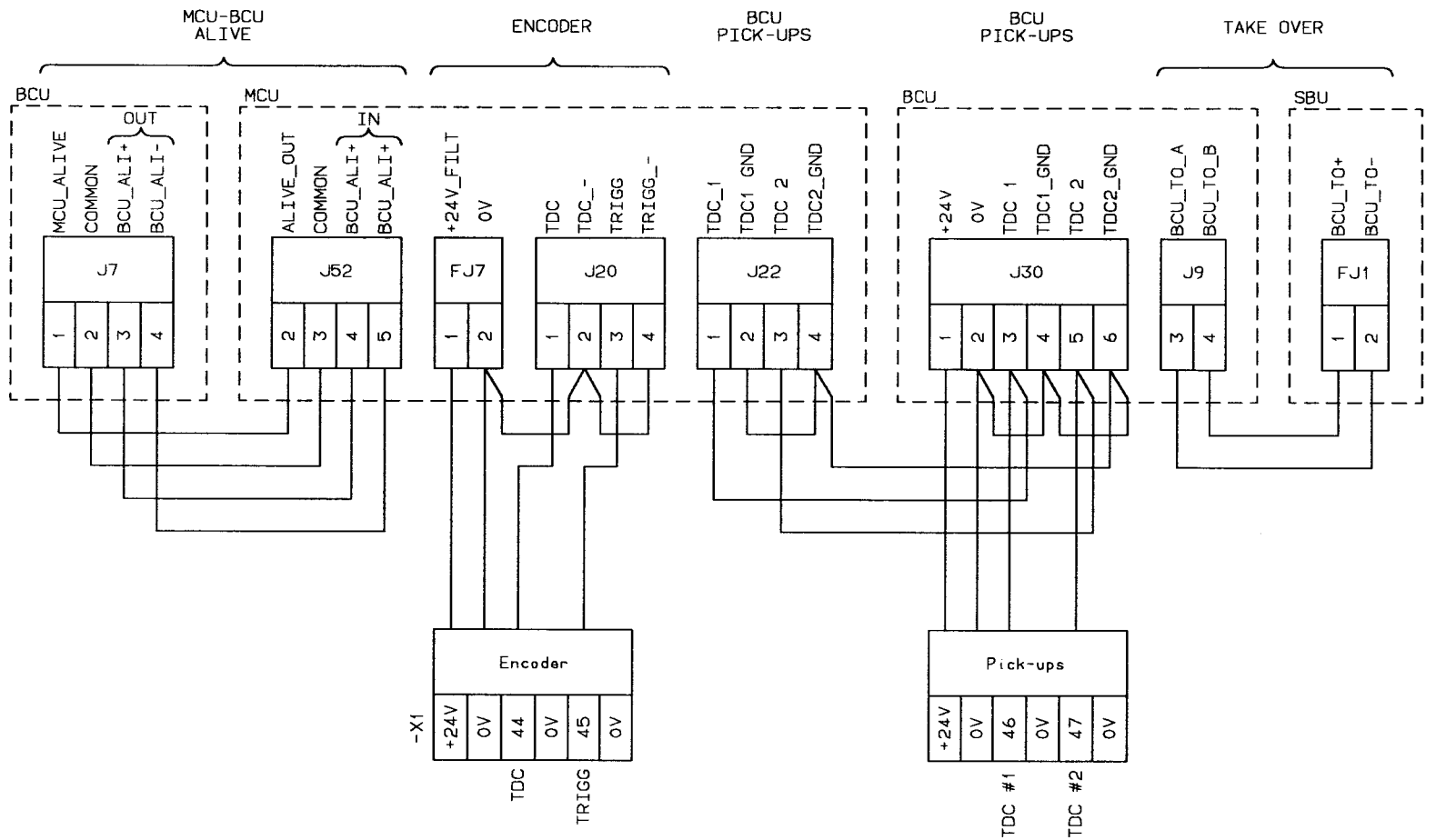
CAD Drawing - do not correct by hand



Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	C.No.
20030204	DFA	JHV	JHV	Z4	Page 9: Wire on encoder J20 corr.	2

Scale:	Size:	Type:	Page No.:	
	A2	INTERNAL CONN. 2 LUB.	08 (13)	MAN B&W Diesel A/S
Info. No.		Description:		Ident. No.
363160		CABLING OF EL. LUBRICATOR		0794607-6
Final User Info. No.		Final User Description:		Final User Ident. No.

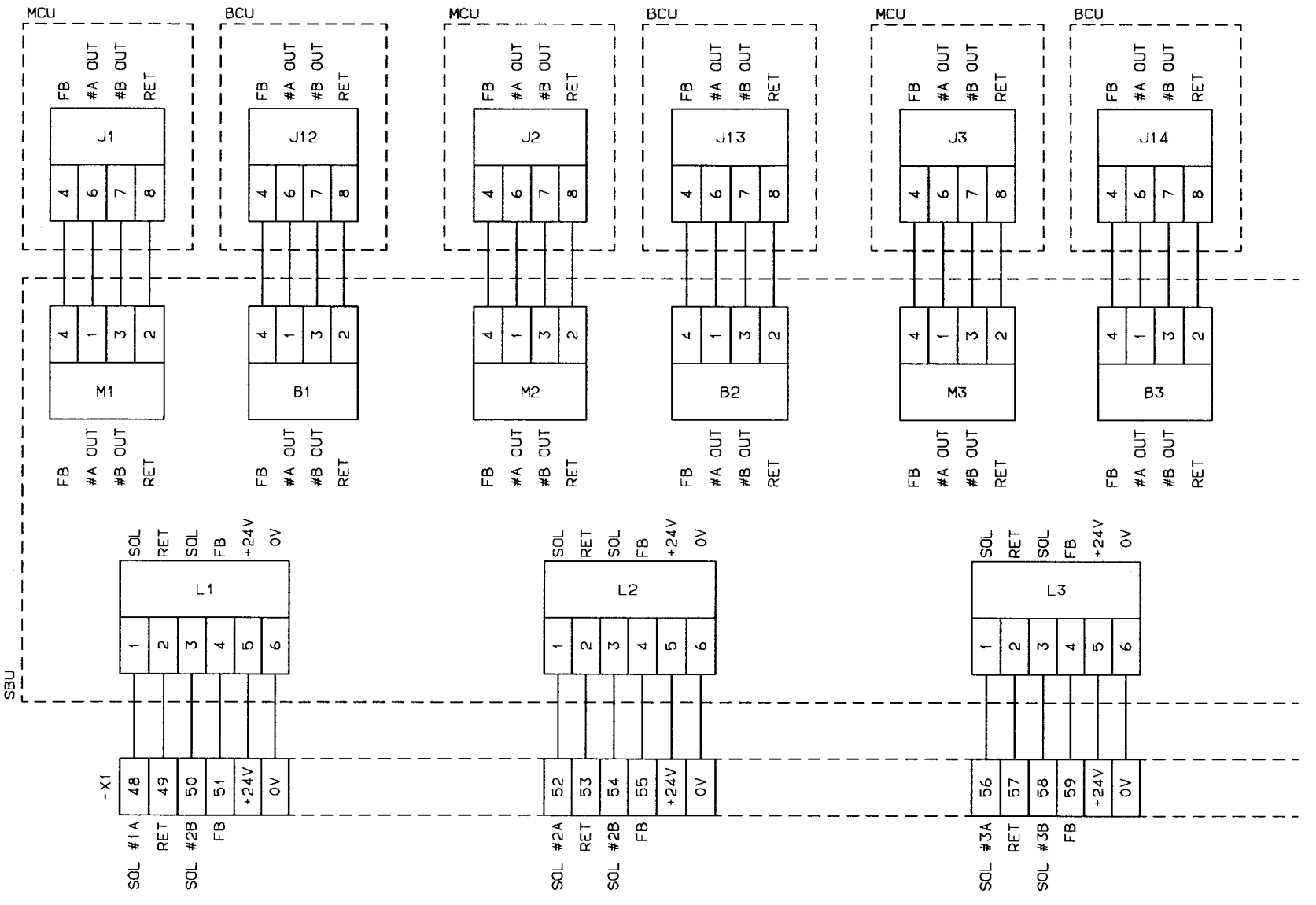
CAD Drawing - do not correct by hand



Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	C.No
20030204	DFA	JHV	JHV	Z4	Page 9: Wire on encoder J20 corr.	2

Scale:	Size:	Type:	Page No	
	A2	INTERNAL CONN. 2 LUB.	09 (13)	MAN B&W Diesel A/S
Info. No: 363160		Description: CABLING OF EL. LUBRICATOR		Ident No: 0794607-6
Final User Info. No.:		Final User Description:		Final User Ident. No.:

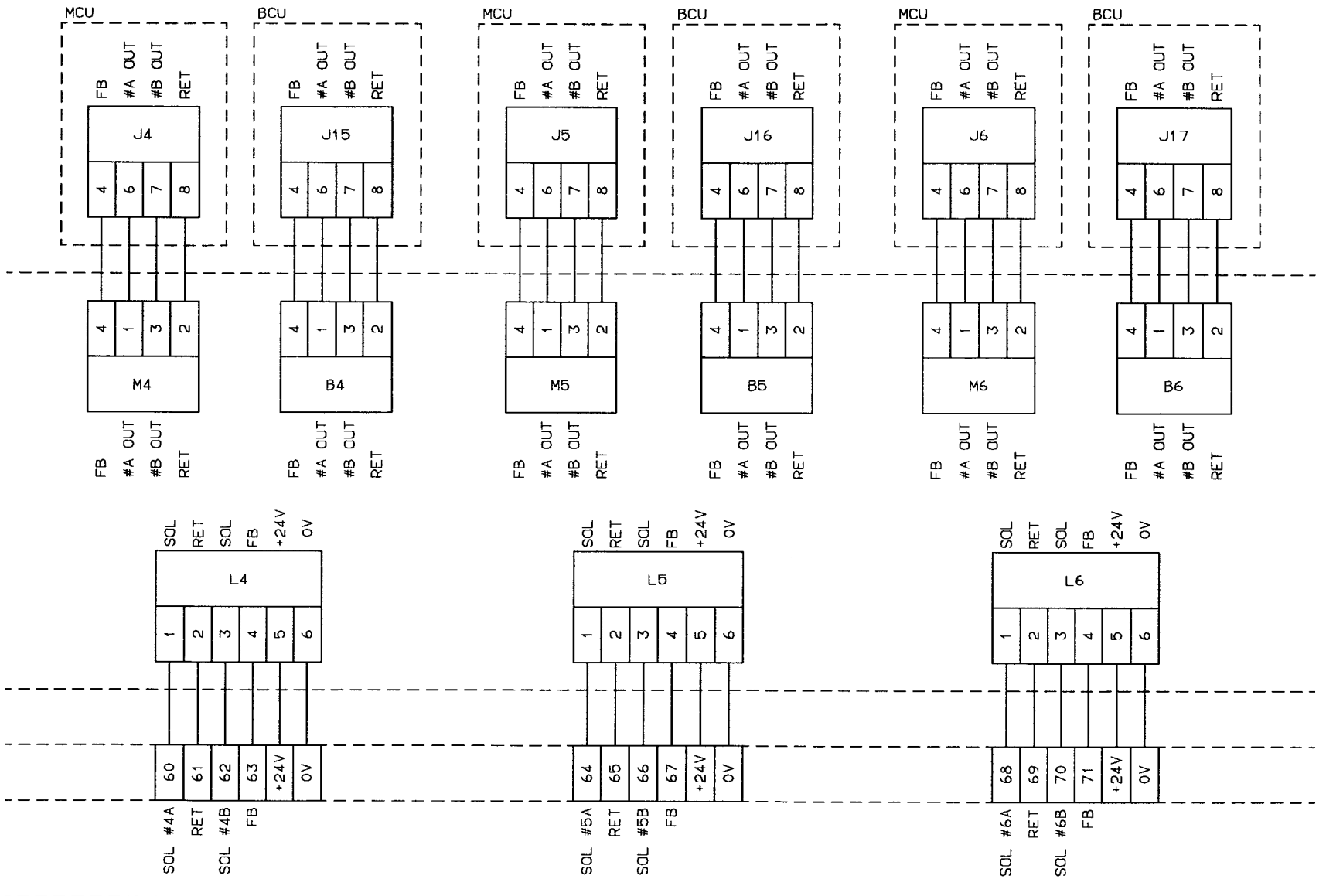
CAD Drawing - do not change by hand



Date	Doc.	Chk.	Appd.	A.C.	Change / Replacement	C.No
20030204	DFA	JHV	JHV	Z4	Page 9: Wire on encoder J20 corr.	2

Scale:	Size:	Type:	Page No.	
	A2	INTERNAL CONN. 2 LUB.	10 (13)	MAN B&W Diesel A/S
Info. No.: 363160		Description: CABLING OF EL. LUBRICATOR	Ident. No.: 0794607-6	
Final User Info. No.:		Final User Description:	Final User Ident. No.:	

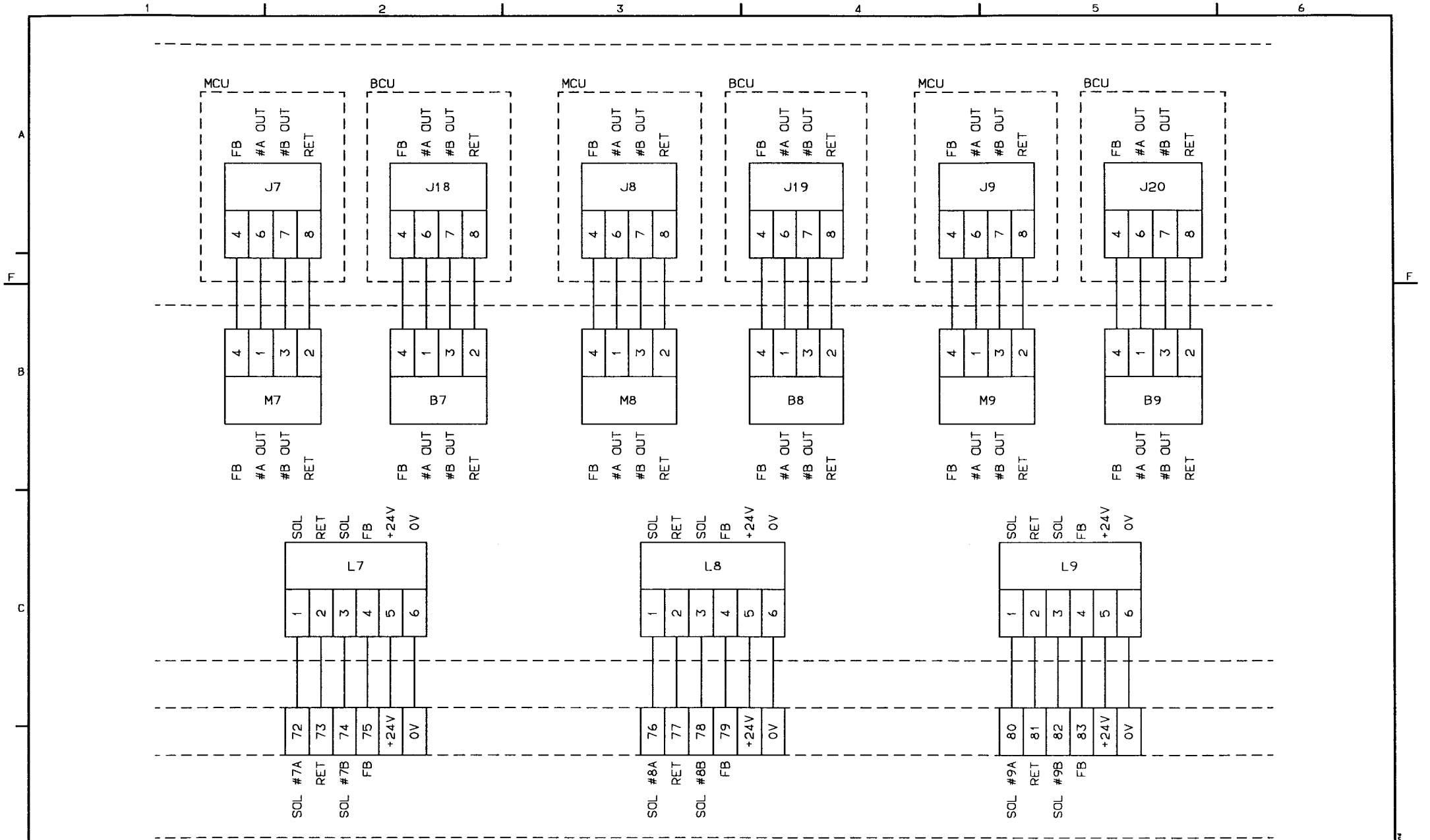
CAD Drawing - do not correct by hand



Date	Doc	Chk	Appd	A.C.	Change / Replacement	C.No
20030204	DFA	JHV	JHV	Z4	Page 9: Wire on encoder J20 corr.	2

Scale	Size	Type	Page No	
	A2	INTERNAL CONN. 2 LUB.	11 (13)	MAN B&W Diesel A/S
Info. No.		Description	Ident. No.	
363160		CABLING OF EL. LUBRICATOR	0794607-6	
Final User Info. No.		Final User Description	Final User Ident No.	

CAD Drawing - do not correct by hand

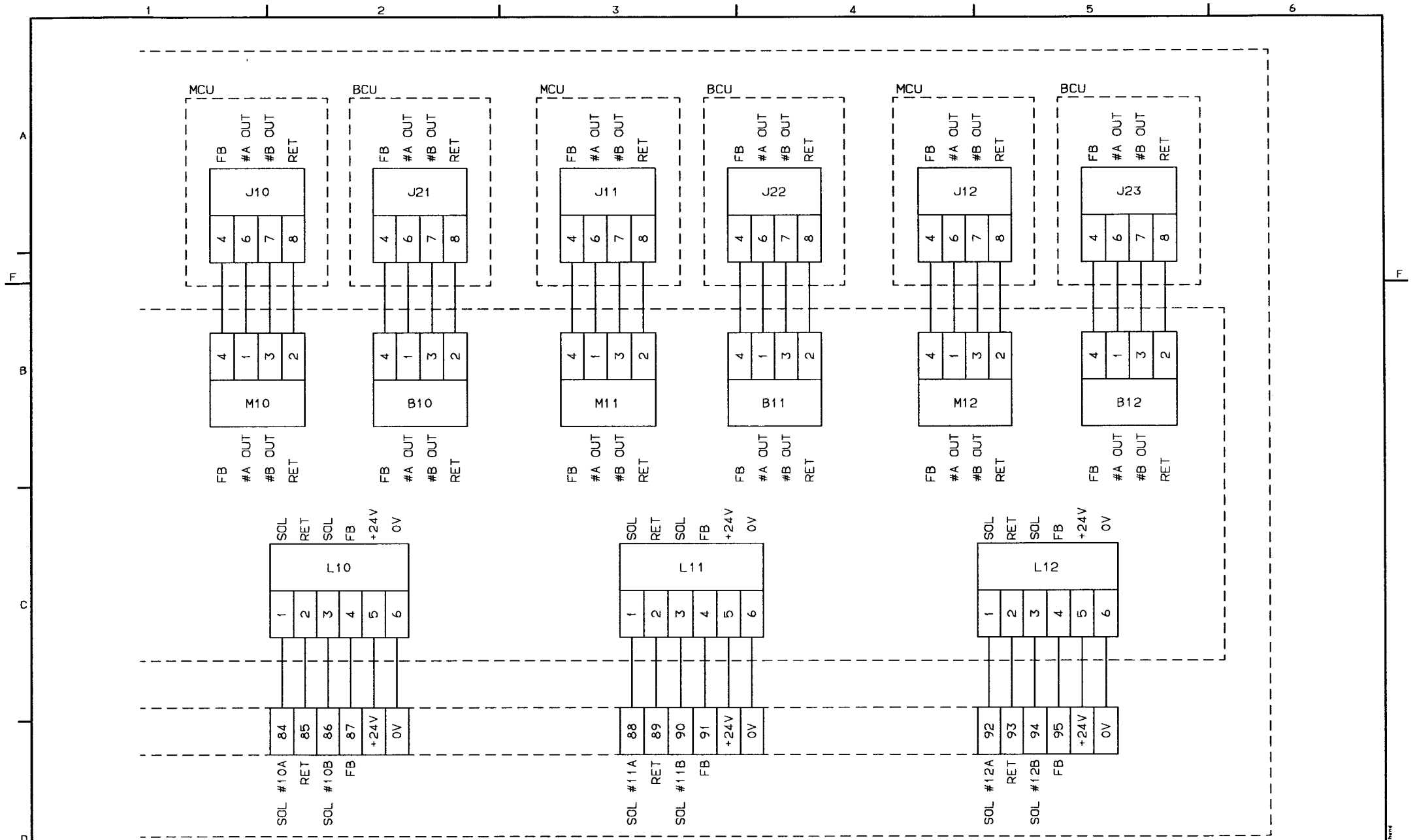


Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	C.No.
20030204	DFA	JHV	JHV	Z4	Page 9 Wire on encoder J20 corr.	2

Scale:	Size: A2	Type: INTERNAL CONN. 2 LUB.	Page No.: 12 (13)
Intra. No.: 363160		Description: CABLING OF EL. LUBRICATOR	Ident. No.: 0794607-6
Final User Intra. No.		Final User Description:	Final User Ident. No.:

MAN B&W Diesel A/S

CAD Drawing - do not correct by hand

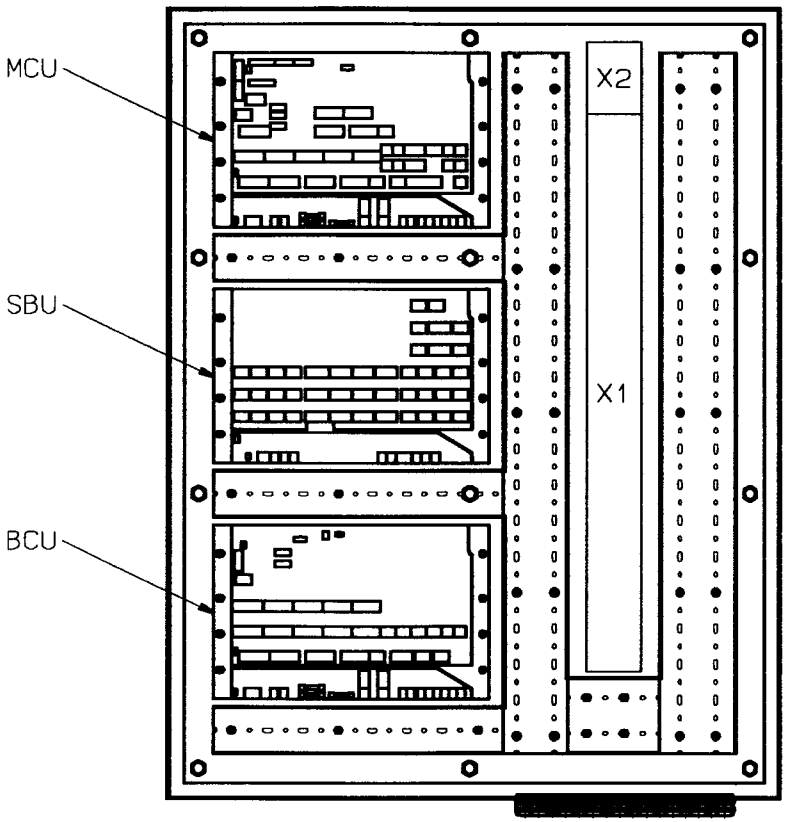


Date	Des.	Chk	Appd	A.C.	Change / Replacement	C. No.
20030204	DFA	JHV	JHV	Z4	Page 9. Wire on encoder J20 corr.	2

Scale:	Size: A2	Type: INTERNAL CONN. 2 LUB.	Page No. 13 (13)
Info. No.: 363160		Description: CABLING OF EL. LUBRICATOR	Ident. No.: 0794607-6
Final User Info. No.:		Final User Description:	Final User Ident No.:

MAN B&W Diesel A/S

CAD Drawing - do not correct by hand



- Wires 0.75² blue
- Wire marking labels Phoenix Contact PABA-15 HW
- All wire ends are fitted with cable Ferulre

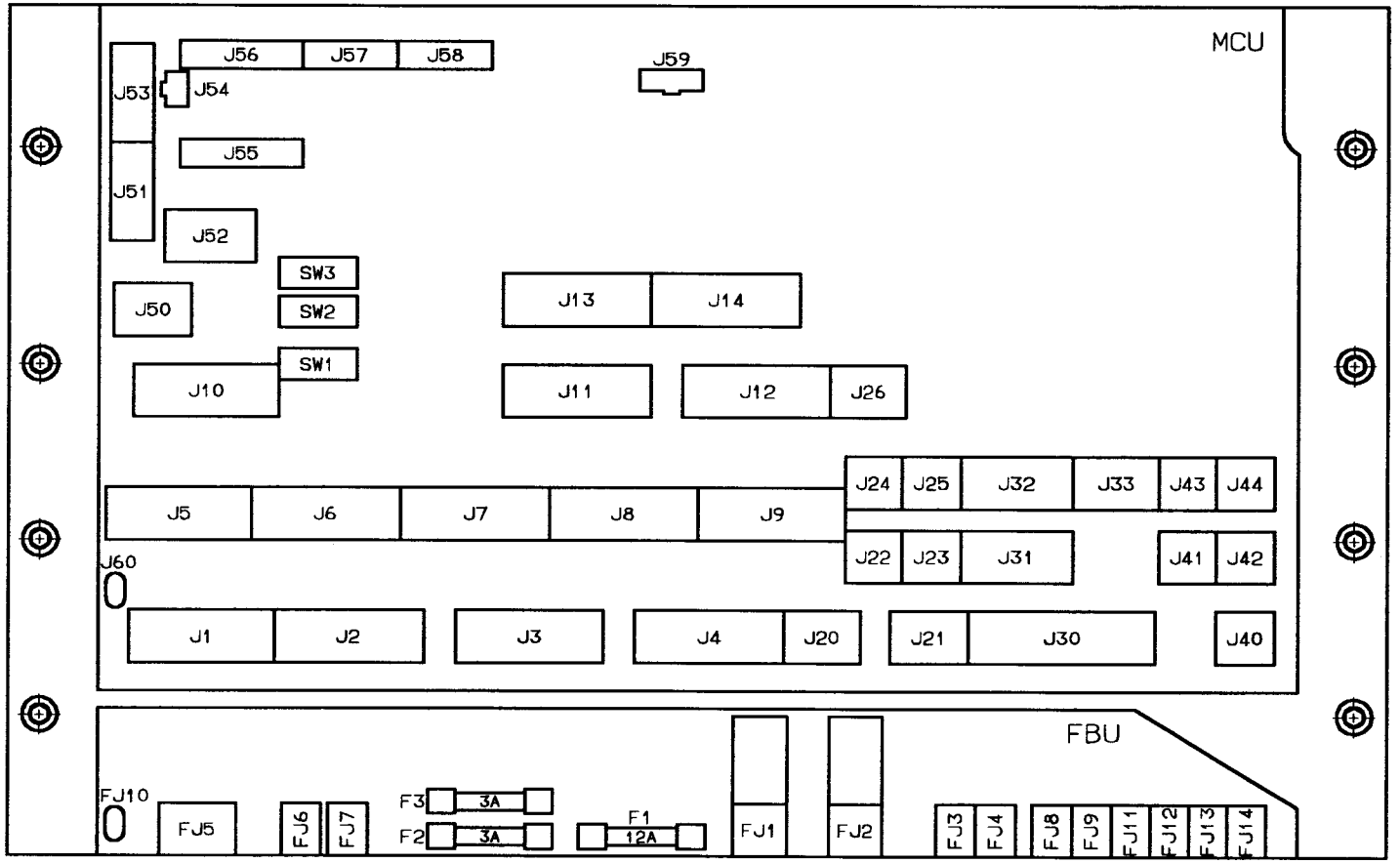
ALCU

Basic Standards (MBD 88) & Suppl. Drawing No.	EN21C Surf. roughness	Projection	Material / Blank
	EN21F-h Tolerances	Mass (kg)	Final User Material

Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	C.No
				*	Replaced by Ident. No.	9
				*		8
				*		7
				*		6
				*		5
				*		4
				*		3
				*		2
20030204	DFA	JHV	JHV	Z4	Page 9 Wire on encoder J20 corr.	1
20020517	IBB	JHV	JHV	*		0

Similar Drawing No.: Replacement for Ident. No.:

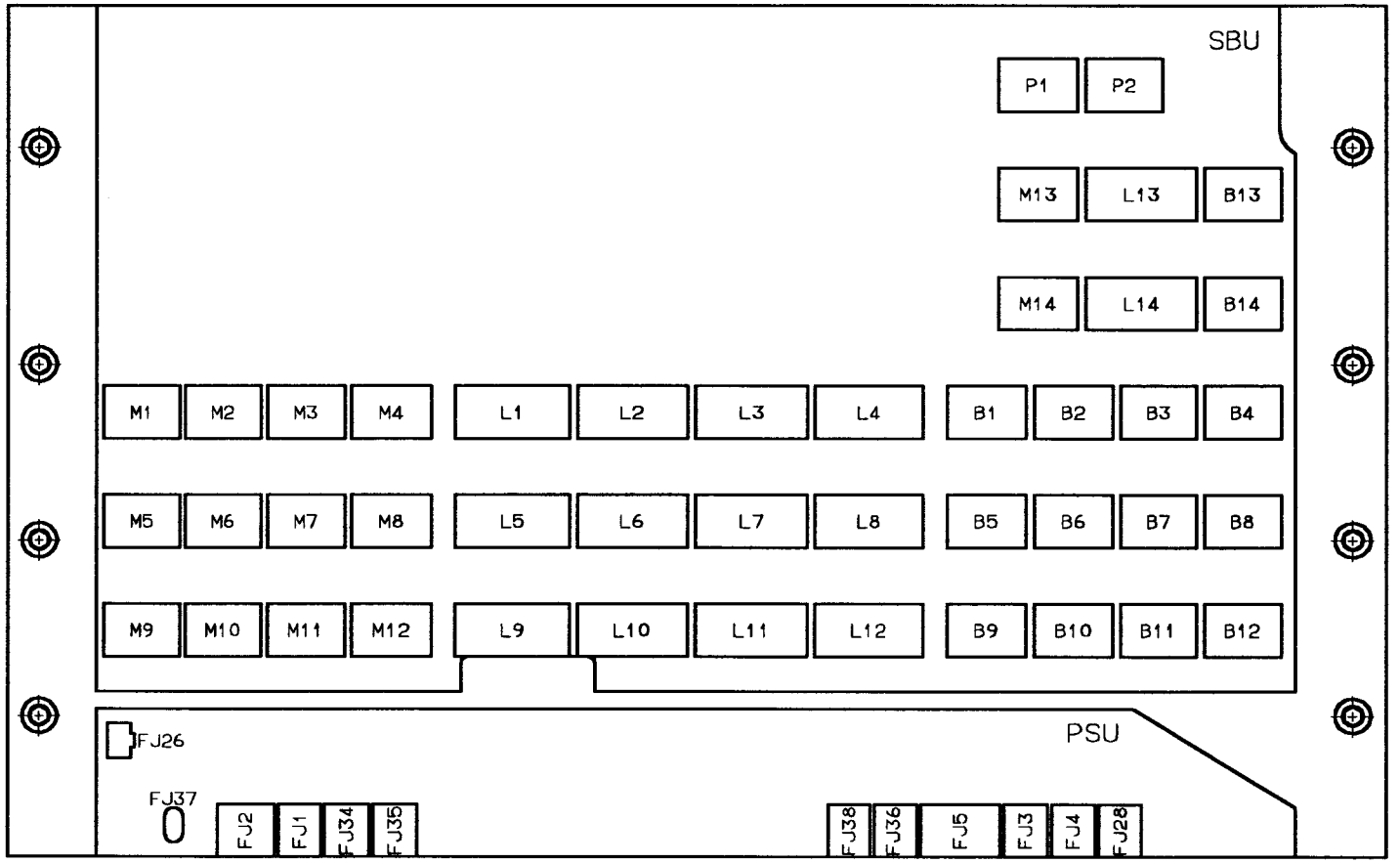
Scale:	Size:	Type:	Page No.:	
	A2	INTERNAL CONN. 1 LUB.	01 (13)	MAN B&W Diesel A/S
Info. No.: 363160	Description: CABLING OF EL. LUBRICATOR		Ident. No.: 0794608-8	
Final User Info. No.	Final User Description:		Final User Ident. No.	



Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	C.No
20030204	DFA	JHV	JHV	Z4	Page 9: Wire on encoder J20 corr.	1

Scale:	Size:	Type:	Page No:	
	A2	INTERNAL CONN. 1 LUB.	02 (13)	MAN B&W Diesel A/S
Intra. No.:		Description:		Ident. No.:
363160		CABLING OF EL. LUBRICATOR		0794608-8
Final User Intra. No.:		Final User Description:		Final User Ident No.:

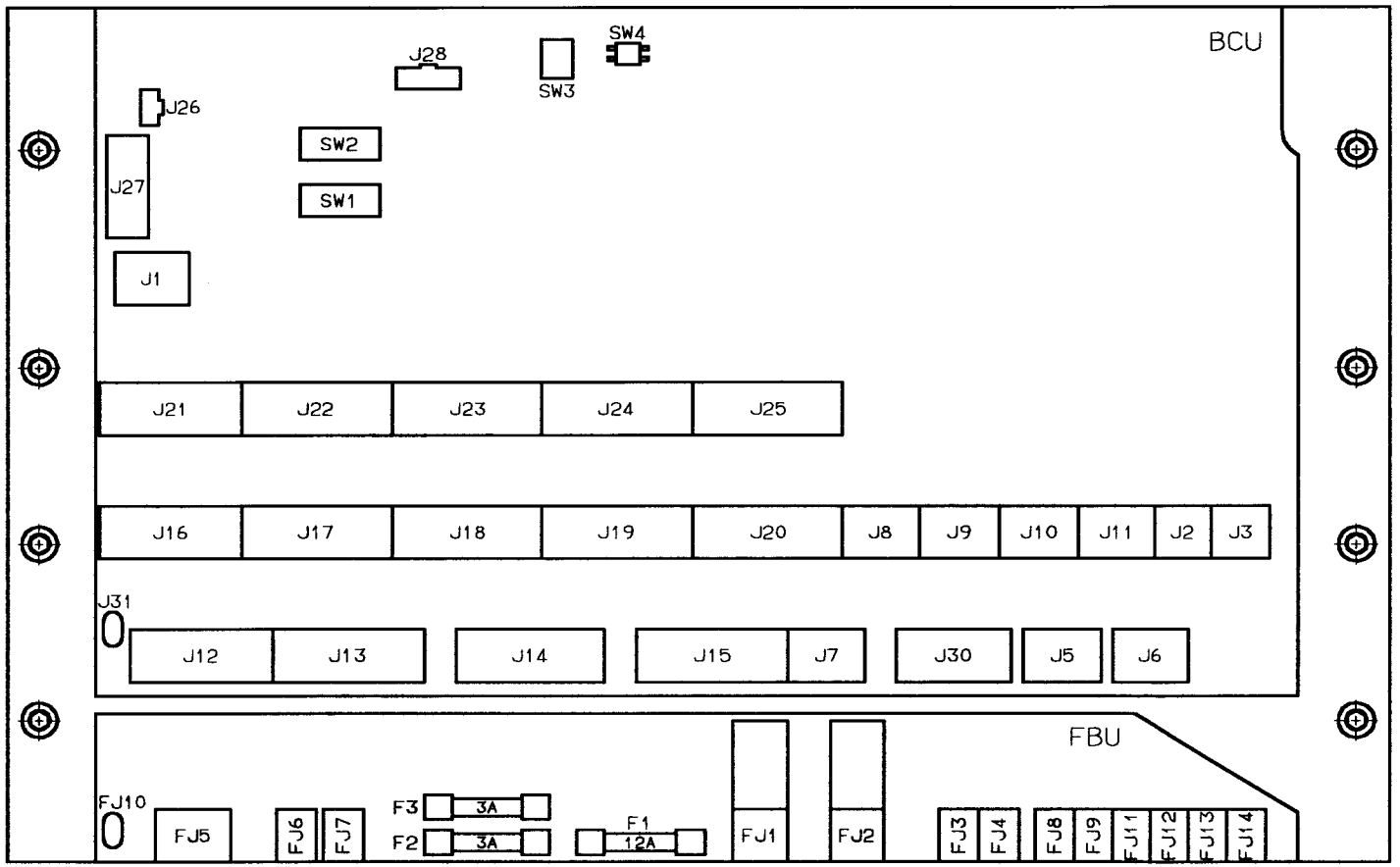
CAD Drawing - do not correct by hand



Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	C. No.
20030204	DFA	JHV	JHV	Z4	Page 9. Wire on encoder J20 corr.	1

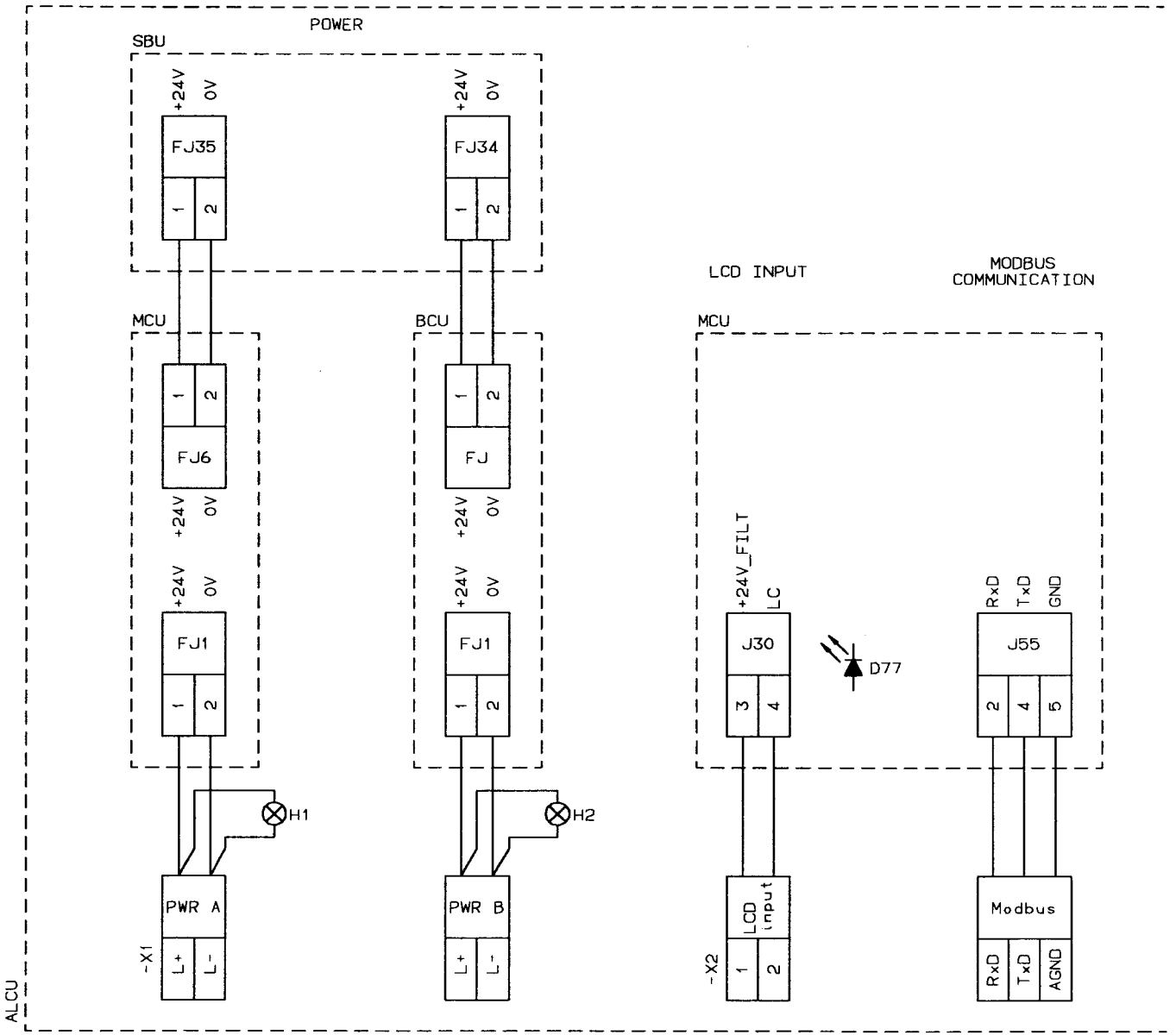
Scale:	Size:	Type:	Page No.:	
	A2	INTERNAL CONN. 1 LUB.	03 (13)	MAN B&W Diesel A/S
Info. No.:		Description:		Ident. No.:
363160		CABLING OF EL. LUBRICATOR		0794608-8
Final User Info. No.:		Final User Description:		Final User Ident. No.:

CAD Drawing - do not correct by hand



Date	Des	Chk	Appd	A.C.	Change / Replacement	C.No
20030204	DFA	JHV	JHV	Z4	Page 9. Wire on encoder J20 corr.	1

Scale:	Size: A2	Type: INTERNAL CONN. 1 LUB.	Page No.: 04 (13)	MAN B&W Diesel A/S
Intr. No.: 363160		Description: CABLING OF EL. LUBRICATOR		Ident. No.: 0794608-8
Final User Intr. No.:		Final User Description:		Final User Ident. No.:

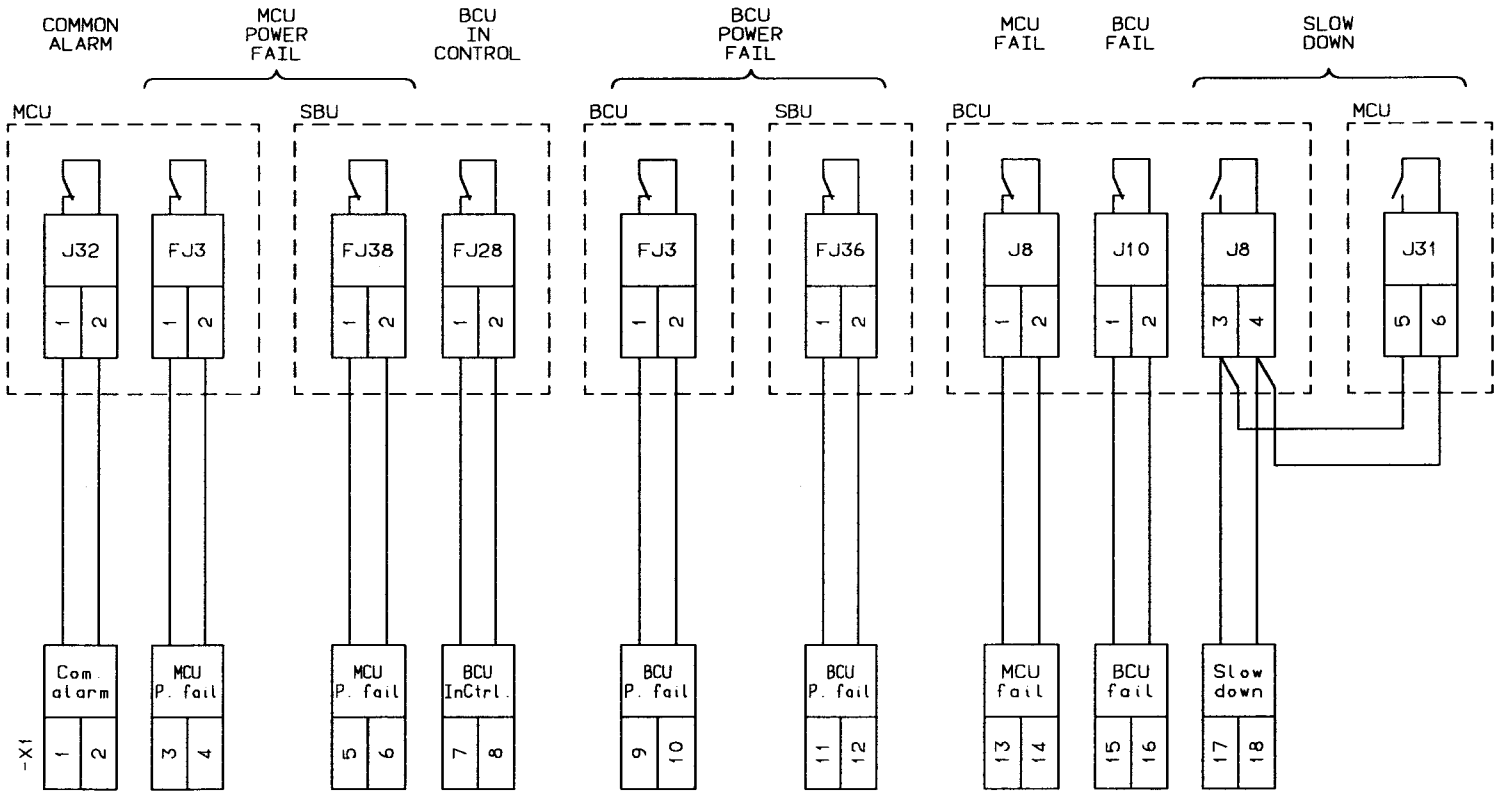


Date	Des.	Chk.	Appd	A.C	Change / Replacement	C No.
20030204	DFA	JHV	JHV	Z4	Page 9. Wire on encoder J20 corr.	1

Scale:	Size: A2	Type: INTERNAL CONN. 1 LUB.	Page No.: 05 (13)
Info. No.: 363160		Description: CABLING OF EL. LUBRICATOR	Ident. No.: 0794608-8
Final User Info. No.:		Final User Description:	Final User Ident. No.:

MAN B&W Diesel A/S

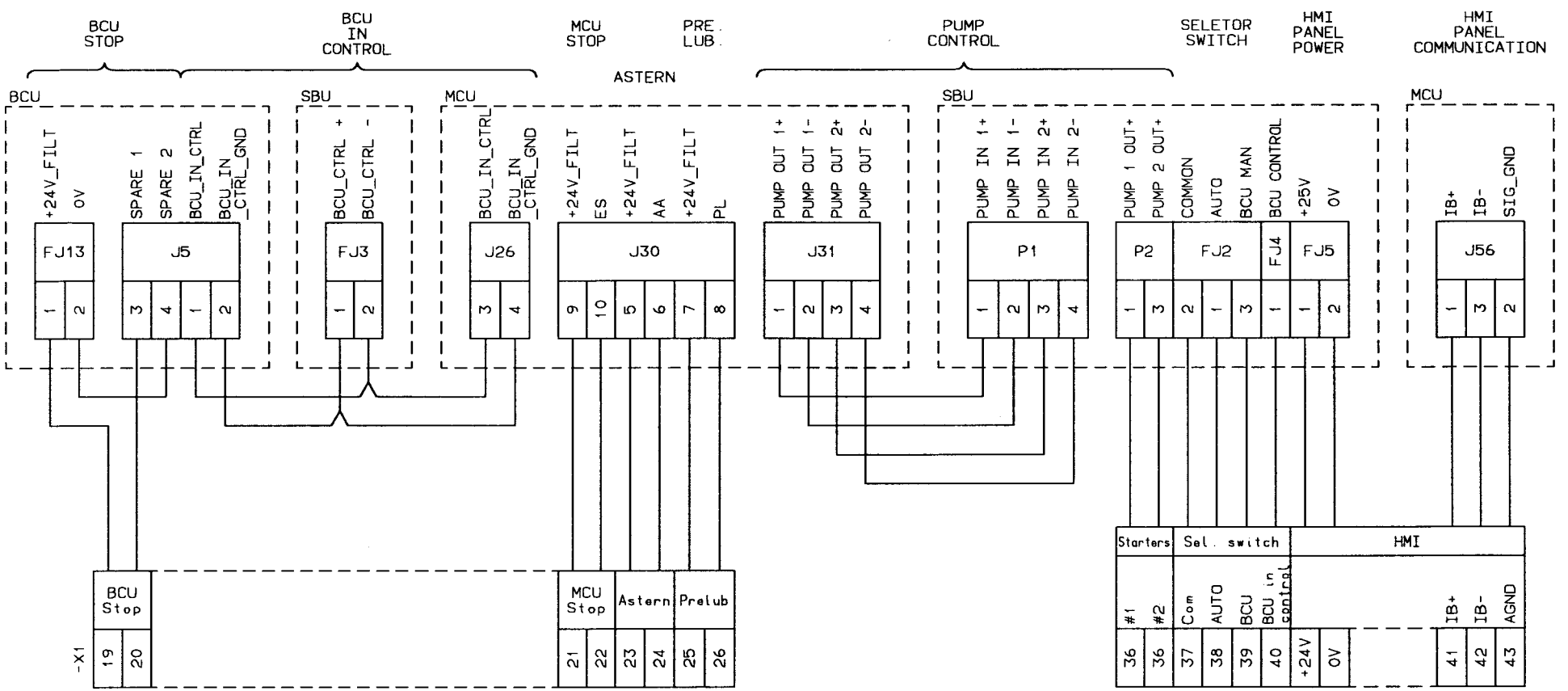
CAD Drawing - do not correct by hand



Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	C.No
20030204	DFA	JHV	JHV	Z4	Page 9. Wire on encoder J20 corr.	1

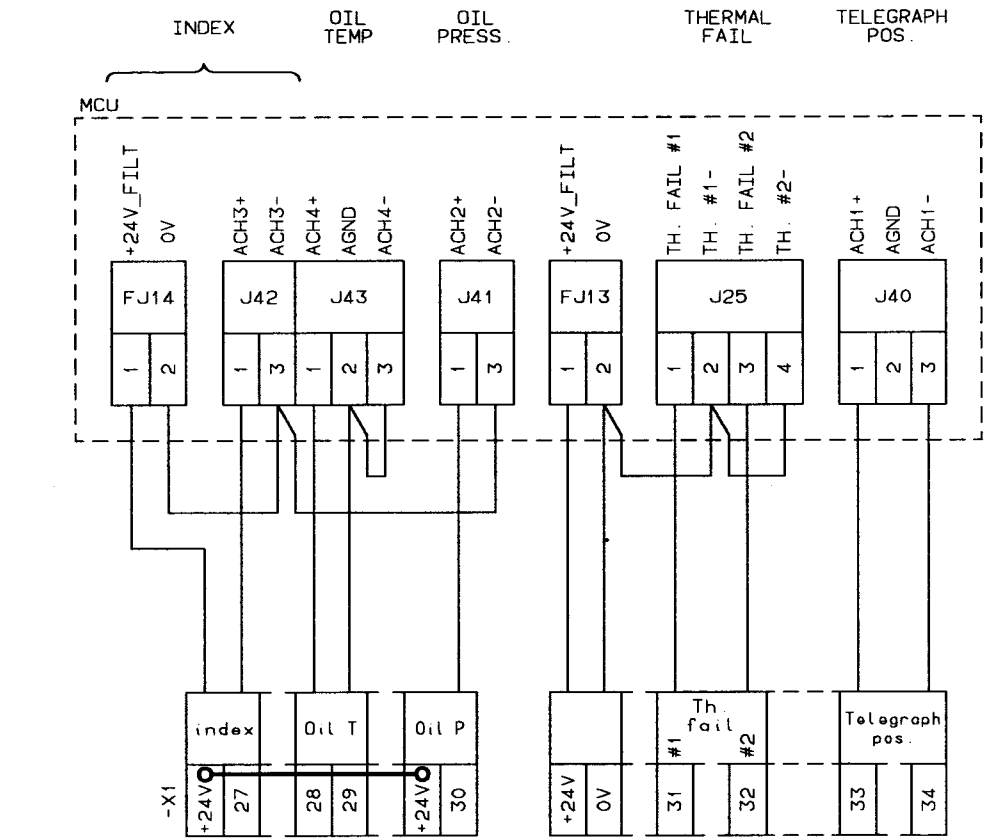
Scale:	Size:	Type:	Page No	
	A2	INTERNAL CONN. 1 LUB.	06 (13)	MAN B&W Diesel A/S
Info. No.:		Description:		Ident. No.:
363160		CABLING OF EL. LUBRICATOR		0794608-8
Final User Info. No.:		Final User Description:		Final User Ident. No.:

CAD Drawing - do not correct by hand



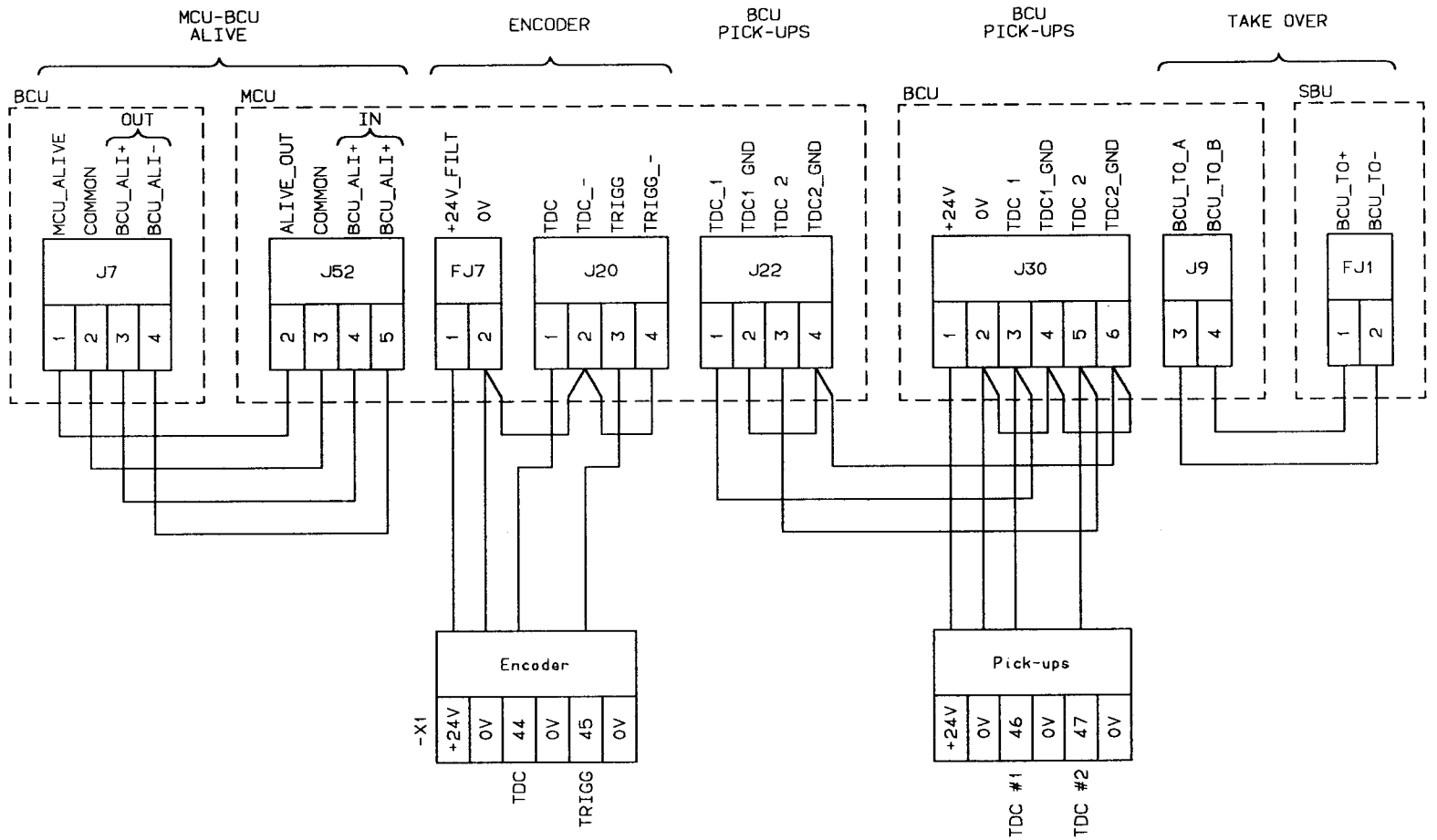
Date	Des	Chk	Appd.	A.C.	Change / Replacement	C.No
20030204	DFA	JHV	JHV	Z4	Page 9. Wire on encoder J20 corr.	1

Scale:	Size	Type	Page No.	
	A2	INTERNAL CONN. 1 LUB.	07 (13)	MAN B&W Diesel A/S
Info. No.		Description	Ident. No.	
363160		CABLING OF EL. LUBRICATOR	0794608-8	
Final User Info. No.		Final User Description	Final User Ident No.	



Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	C.No.
20030204	DFA	JHV	JHV	Z4	Page 9: Wire on encoder J20 corr.	1

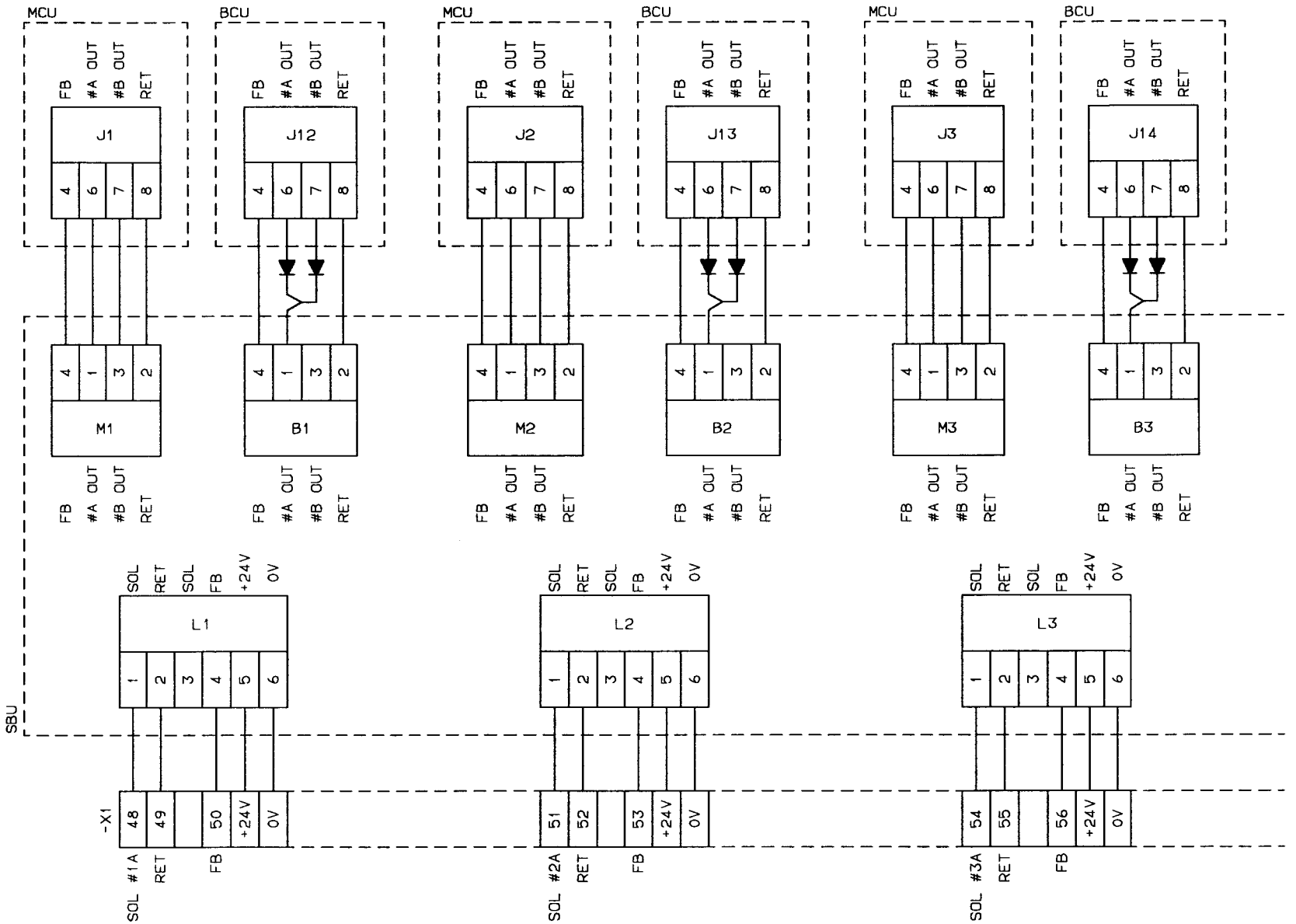
Scale:	Size	Type	Page No.	
	A2	INTERNAL CONN. 1 LUB.	08 (13)	MAN B&W Diesel A/S
Info. No.: 363160		Description: CABLING OF EL. LUBRICATOR		Ident. No.: 0794608-8
Final User Info. No.:		Final User Description:		Final User Ident. No.:



Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	C.No
20030204	DFA	JHV	JHV	Z4	Page 9: Wire on encoder J20 corr.	1

Scale:	Size	Type	Page No	
	A2	INTERNAL CONN. 1 LUB.	09 (13)	MAN B&W Diesel A/S
Info. No.: 363160		Description: CABLING OF EL. LUBRICATOR		Ident. No.: 0794608-8
Final User Info. No.:		Final User Description:		Final User Ident. No.:

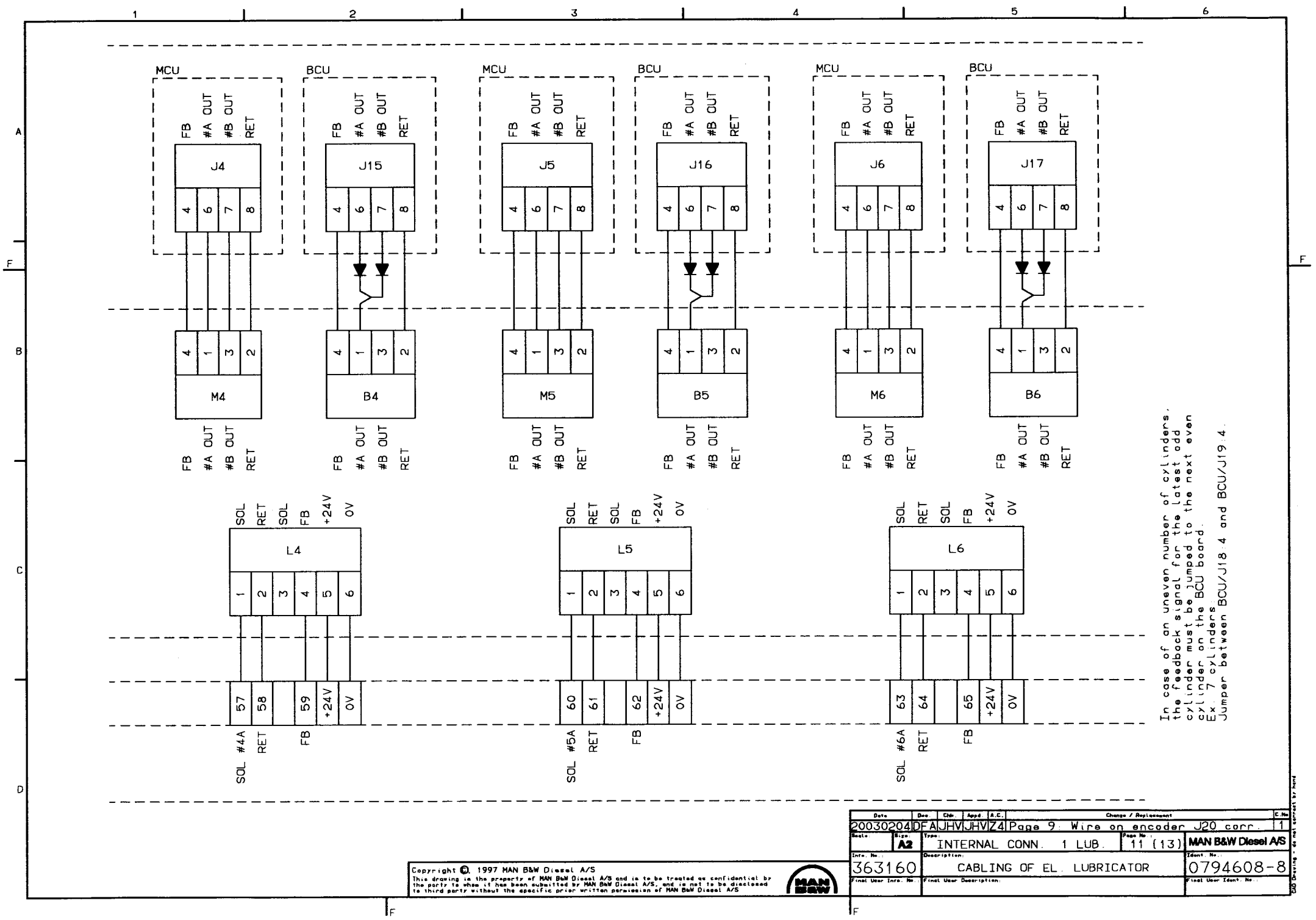
CAD Drawing - do not correct by hand



Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	C.No.
20030204	DFA	JHV	JHV	Z4	Page 9. Wire on encoder J20 corr.	1

Scale:	Size:	Type:	Page No.:	
	A2	INTERNAL CONN. 1 LUB.	10 (13)	MAN B&W Diesel A/S
Info. No.:		Description:		Ident No.:
363160		CABLING OF EL. LUBRICATOR		0794608-8
Final User Info. No.:		Final User Description:		Final User Ident. No.:

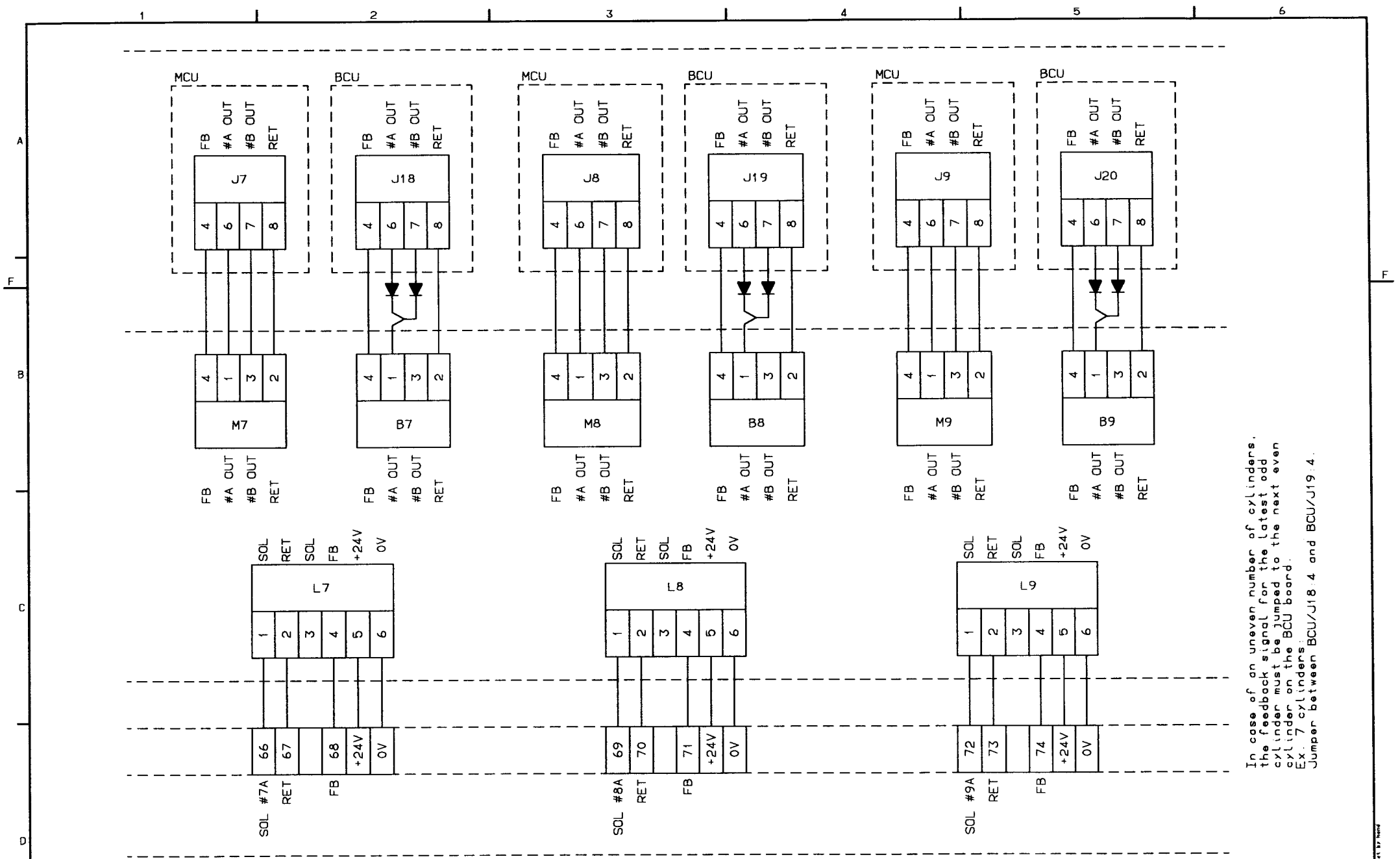
CAD Drawing - do not correct by hand



Date	Des.	Chk.	Appd.	A.C.	Change / Replacement	C.No.
20030204	DFA	JHV	JHV	Z4	Page 9: Wire on encoder J20 corr.	1

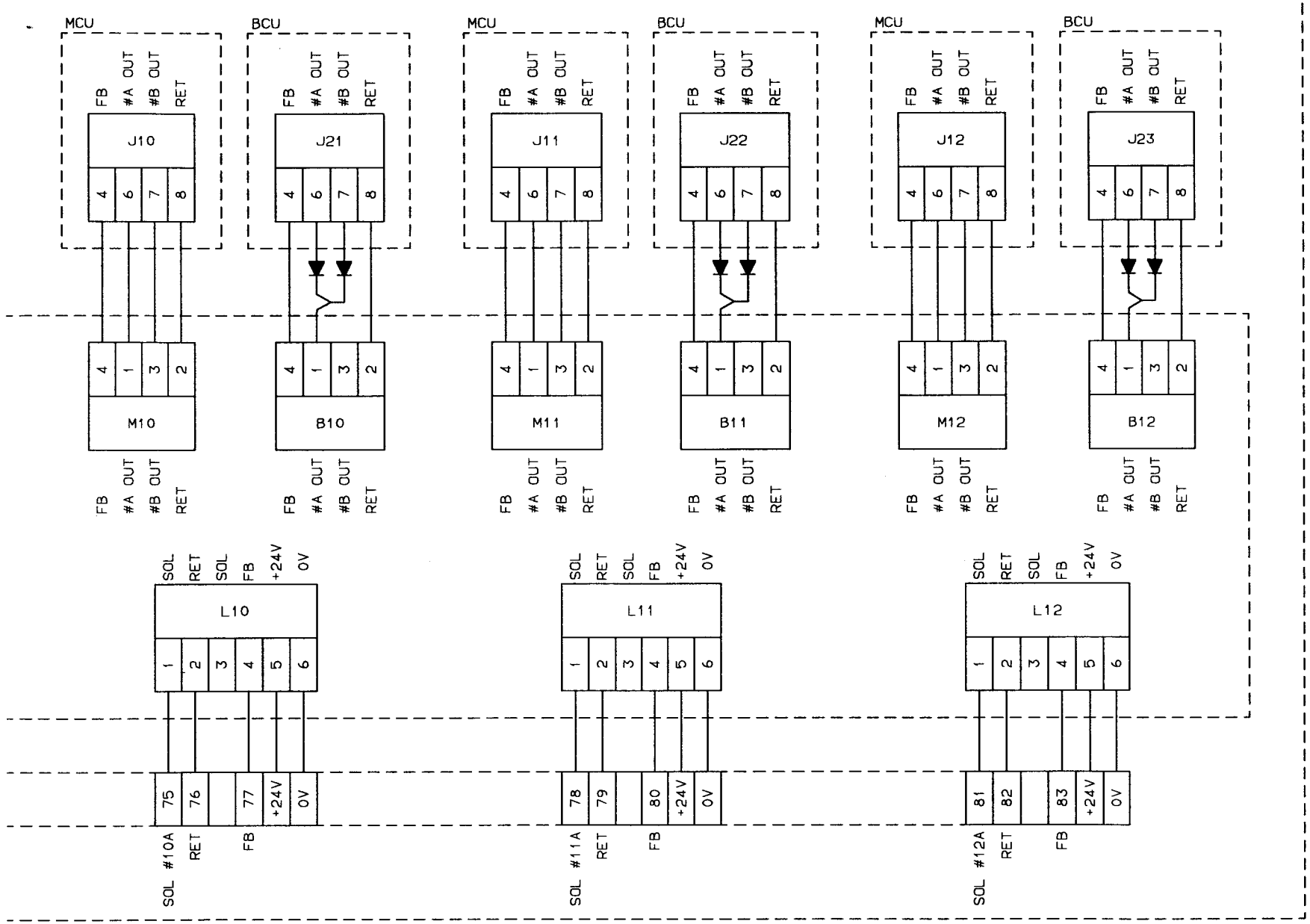
Scale:	Size	Type:	Page No.:	
	A2	INTERNAL CONN. 1 LUB.	11 (13)	MAN B&W Diesel A/S
Info. No.: 363160		Description: CABLING OF EL. LUBRICATOR		Ident. No.: 0794608-8
Final User Info. No.:		Final User Description:		Final User Ident. No.:

CAD Drawing - do not correct by hand



Date	Des.	Chk	Appd	A.C.	Change / Replacement	C.No.
20030204	DFA	JHV	JHV	Z4	Page 9. Wire on encoder J20 corr.	1

Scale:	Size	Type	Page No.	
	A2	INTERNAL CONN. 1 LUB.	12 (13)	MAN B&W Diesel A/S
Info. No.:		Description:		Ident No.:
363160		CABLING OF EL. LUBRICATOR		0794608-8
Final User Info. No.:		Final User Description:		Final User Ident. No.:



Date	Doc.	Chk.	Appd.	A.C.	Change / Replacement	C.No.
20030204	DFA	JHV	JHV	Z4	Page 9. Wire on encoder J20 corr.	1

Scale:	Size:	Type	Page No.	
	A2	INTERNAL CONN. 1 LUB.	13 (13)	MAN B&W Diesel A/S
Info. No.		Description:		Ident. No.
363160		CABLING OF EL. LUBRICATOR		0794608-8
Final User Info. No.		Final User Description		Final User Ident. No.

CAD Drawing - do not correct by hand