

# Mechatronics Technician

## Exam Preparation Documentation

# Part 2 Phase 2

# 2023

Test Taker first and last name:

Test Taker number:

Test Taker company:



German American  
Chambers of Commerce  
Deutsch-Amerikanische  
Handelskammern

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<b>AHK-USA Chicago</b>	
Final Examination Part 2, <b>PHASE 2</b> - 2023	
<b>Preparation for the practical assignment</b>	<b>Mechatronics Technician</b>
<b>General information</b>	

### General information

#### **DO NOT DO PHASE 2 until you have completed PHASE 1.**

Your starting point or foundation for this subassembly is what you should have already assembled according to your initial “yellow” PHASE 1 preparation documentation. NOW you will make modifications by completing the PHASE 2 of the preparation. On the day of examination, the test taker must bring in the mechatronics subsystem assembled as described in this PHASE 2 packet. Do not do more modifications than is described in the “yellow PHASE 1” and “yellow PHASE 2” packet.

**To your completed PHASE 1, only add to the mechatronics assembly as specified in numbers 1-8 on the “Preparation for the practical assignment – work assignment- Task description” found in the following documents. Do not add more than what is explicitly stated in steps 1-8. As part of step 8 you are to draw these additions or modifications into the “yellow” drawings and schematics that are included in the PHASE 1 packet. Changes should be noted and initialed - including the date the change was made (i.e.GS 01/APR/22)- on schematics and blueprints!**

**All equipment should also be tested for functionality prior to the exam. Read all steps before starting. Anything you may have added or connected to test a function but is not listed in steps 1-7 should be removed before the day of the examination.**

The following “4 phases” are meant to guide you through the proper set up and mechatronics testing process:

- I Information phase
- II Planning phase
- III Execution phase
- IV Check phase

Consider each as you create and test a modification (work assignment steps 1-8) according to the attached documentation “Preparation for the practical assignment - work assignment -Task description”. After set up you will submit relevant documentation for evaluation on exam day.

Complete all “4 phases” as you prepare the system described in the attached documentation. **Take notes and document your steps!** You must bring in your preparation work and supporting materials as described below to demonstrate your ability to properly prepare and set up a mechatronics system.

**Use the diagrams, drawings and schematics already provided from your “yellow” preparation booklet for additions/expansions. As part of step 8, draft or add to drawings, schematics and diagrams, to show what was completed in steps 1-7. Use proper symbols in your drawings. Changes should be noted and initialed - including the date the change was made (i.e.GS 01/APR/22)- on schematics and blueprints! You will bring this to the exam for review and further modification.**

Write your first and last name and your test taker number on all documents, even your internal documents and those you have created yourself for the specific assignment, **and place in a folder to bring to the examination.**

**The working mechatronics system and your folder/binder containing your documents and other self-created documentation must be presented on the day of the examination. Please do not include photos.**

**Any further required modification work will be performed during the examination time!** Unused components listed in the standard material staging list in your “yellow” documentation that are not required to complete the system described below are to be brought in on the day of the examination.

### I Information phase

In the information phase, you should demonstrate the ability to do the following:

- Work through the documents and gather information
- Read all steps and documentation before beginning any planning or execution
- Perform the work assignment on the basis of the documents and gathered information while still maintaining applicable standards and regulations and following the requirements set forth by the contractor (i.e. certification, documentation, controlling)

### I Planning phase

In the planning phase, you should be able to demonstrate the following:

- You can create a work schedule from the guidelines in the following assignment while taking into account the information given.
- You can completely and properly draft supplement drawings (circuit diagrams, terminal connection diagrams, technical drawings...) and documentation (programs, parameter lists,...) to reflect the work that was done.
- You can compile test and measurement information for the component inspection and commissioning reports.

### II Implementation phase

In the implementation phase, you should be able to demonstrate the following:

- The ability to complete the assignment according to the workflow you created.
- **Prepare the mechatronics assembly according to numbers 1-8 on the “Preparation for the practical assignment – work assignment- Task description.”**
- The ability to visually check work and make corrections.

### III Check phase

In the check phase, you should be able to demonstrate the following:

- You can carry out tests of preassembled components according to your test protocol and documentation and evaluate results.
- You can carry out safety checks, commissioning and functional checks according to test reports and document and evaluate results.

### IV Submission

Mark all documents with your first and last name as well as your test taker number.

**Put what you believe to be the most important examination documents together and place these in a logical order in a folder to bring to the examination. Prepare a table of contents and a cover sheet for all of your documentation from your preparation to present to the exam board. Check the work performed and correct any mistakes. Please do not include photos in your folder.**

### Examination day (executing the assignment)

On examination day, plan to bring the following to the testing center:

- The remaining material from the material provisioning lists from Phase 1
- Consumables, auxiliary equipment, test material and tools as per the standard material staging list documents as well as the necessary equipment to modify the control program (documentation can be handwritten)
- The functioning axis model as well as the functioning controller in accordance with the preparation assignment
- Yellow preparation documentation and other informational and planning documentation in an organized binder. No photos please.

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Final Examination Part 2, PHASE 2- 2023

**Preparation for the practical assignment  
– work assignment**

**Mechatronics Technician**

**Task description**

## 1 General information

You have been tasked with retrofitting the system. You have been assigned to implement the requested information. Of course, in doing so you must adhere to and take into account standards and regulations.

## 2 Description of the preparation task (Steps 1-8)

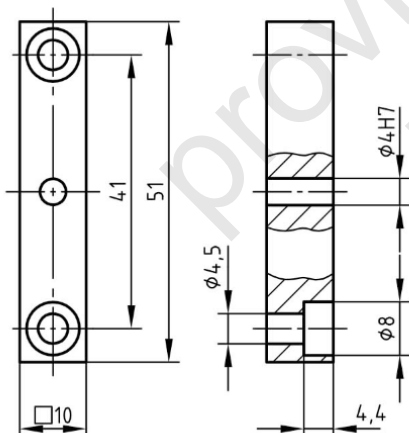
In addition to the drawings already received, the following points must be observed for the retrofit then completed and added to/drawn into your "yellow" phase 1 drawings in your binder. Use the sheet included in this packet to write out your work plan for completing these steps and include it in your binder to be reviewed prior to your examination start:

- 1 Fabricate guide rails 1, 2, 3 and the tabletop in accordance with the drawings provided and assemble them.
- 2 Integrate illuminated pushbuttons -S10 and -S11 into the system.
  - a. -S10 actuates cylinder -M40. The Home position is at the front. When the illuminated pushbutton is released, the cylinder moves forward again.
  - b. -P12 indicates the "retracted" end position of -M40.
  - c. -S11 deactivates magnet -Q61 via -Q60. This is indicated by -P13.

*For the installation positions, refer to the excerpt from the display and control panel on the following pages of Phase 2 and draw the modifications into your original documentation.*
- 3 Wire the power unit in accordance with the partial circuit diagram provided in the following pages and draw the modifications into your original documentation.
- 4 Integrate the signal contact of -F7 "Motor starter overload fault" (I23) with display (-P5) into the system.
- 5 Motor supply line -M10 is damaged and must be reconnected to -X13\_1 (NEMA plug).
- 6 Complete the program according to the functional description which includes the changes in steps 1-5 above and then modify the Grafcet on the following pages to match. Do not forget about the I/O lists and any other element of the Yellow Phase 1 drawings that needs to reflect the functional description or other additions made in steps 1-5.
- 7 Test the retrofitted system for safety and partial function.
- 8 In your binder, document all necessary changes for the retrofit with the planning page included in Phase 2 (Changes should be noted and initialed - including the date the change was made (i.e.GS 01/APR/22)- on schematics and blueprints!) On your own commissioning sheet, document all measured values for each step of the commissioning to check for safety before and after testing for function.

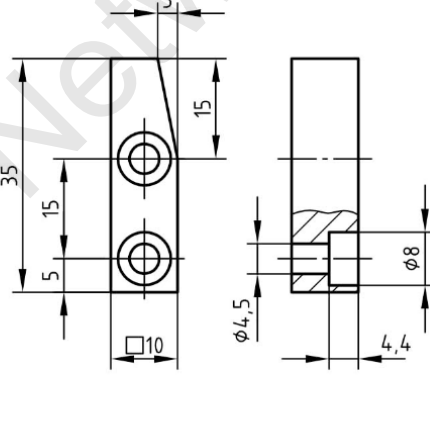
Guide rail 1

S235JR+C



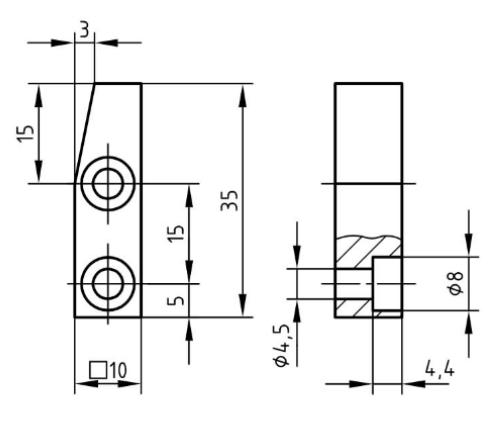
Guide rail 2

S235JR+C



Guide rail 3

S235JR+C



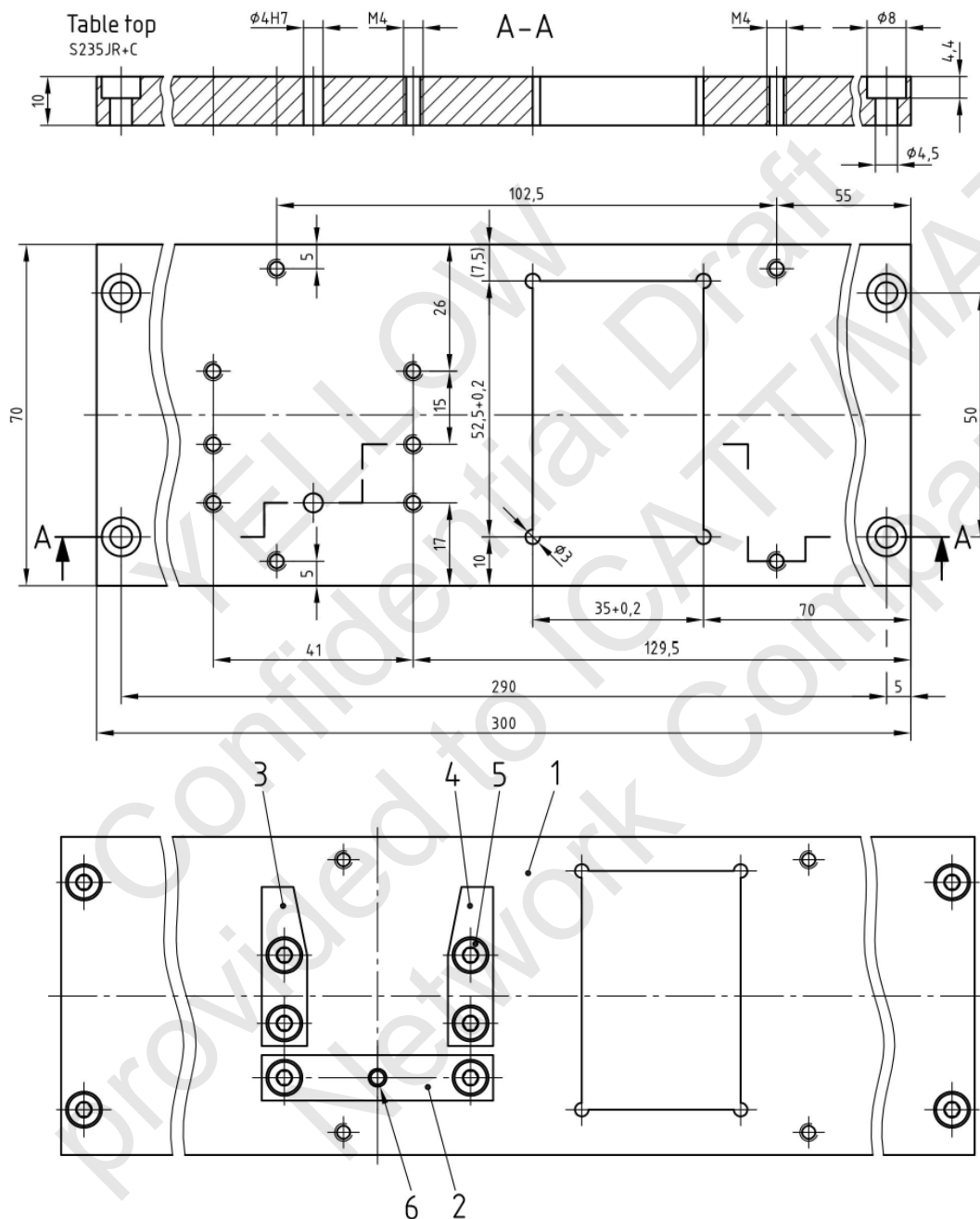
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Final Examination Part 2, PHASE 2- 2023

**Preparation for the practical assignment  
- work assignment - modifications**

**Mechatronics Technician**

Note: Mount the pneumatic cylinder for the trap door (Item No. 15) to the bottom of the table top as shown in Phase 1 page 25. Positioning (not displayed) is determined by the thread length of cylinder used, for proper function of the trap door. Phase 1 page 12 and 25 also indicate a reference point for the sensor, if needed adjust the reference point for proper function.



Item-no.	Qty.	Designation	Standard	Material	
6	1	Dowel pin 4 x 18 -A	ISO 8734	St	
5	6	Cap screw M4 x 12	ISO 4762	8.8	
4	1	Guide rail 3		S235JR+C	4 sq 10 x 35 EN 10278
3	1	Guide rail 2		S235JR+C	4 sq 10 x 35 EN 10278
2	1	Guide rail 1		S235JR+C	4 sq 10 x 51 EN 10278
1	1	Table top		S235JR+C	Fl 70 x 10 x 300 EN 10278
					Semi-finished products (as per material preparation list)



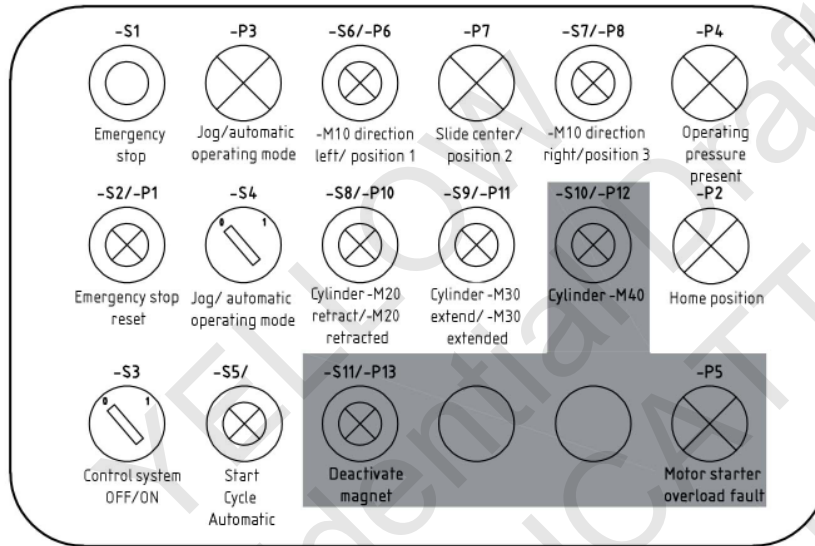
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<h1>AHK-USA Chicago</h1> <p>Final Examination Part 2, <b>PHASE 2</b>- 2023</p>	
<p><b>Preparation for the practical assignment – work assignment - modifications</b></p>	<p><b>Mechatronics Technician</b></p>

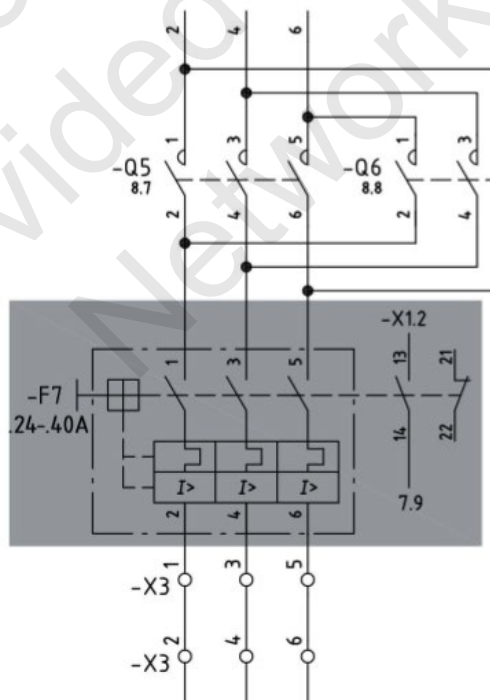
Partial circuit diagram for the display and control panel (for step 2 of work assignment)

Display and Control Panel

-A2



Partial circuit diagram for the power unit (for step 3 of work assignment)



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Final Examination Part 2, PHASE 2- 2023

**Work Assignment:  
Functional description**

**Mechatronics Technician**

## 1 General information

- Program the control system according to the functional description. Modify the Grafcet to reflect the following functional description.
- Bring the programmed control system into operation and test it.
- **On examination day, bring your own program capable of all functions listed on the I/O list. Modify your I/O list to reflect the changes you made in Phase 2.**
- The I/O assignment lists are meant to assist in allocation of the system-related operands. Insert your own operands.

## 2 Functional description

The mechatronic subsystem is switched on by the main switch -Q1.

### EMERGENCY STOP fault "-F5 off"

- Main valve "off"/"locked"
- -P1 and -P31 "on"
- System locked
- -S3 "on", display of the conditions present during malfunction
- -S3 "off", no display of momentary conditions

### EMERGENCY STOP without fault "-F5 on"

- Switches the main valve "on" via auxiliary contacts of -Q2 and -Q3
- -P1 and -P31 "off"

### Enabling the system

- Enable condition:
- EMERGENCY STOP -F5 "on"
- Motor starter overload fault -F7 "on"
- Home position from -S4 to -S12

### I Toggle switch -S3

The system can be switched on and off using -S3 if the enable conditions have been fulfilled. For -S3 "on", the current state of the system (jog mode) is shown by the indicator lamps. If the operating pressure is present, the system switches to jog mode.

### II The jog and automatic mode operating states

Switch -S4 can be used to select between jog and automatic mode.

If switch -S4 is in the "0" position, the system is in jog mode and indicator lamp -P3 is illuminated. If switch -S4 is in the "1" position, the system is in automatic mode and indicator lamp -P3 flashes at a frequency of 1 Hz.

### III Functional sequence in jog mode (-S4 = 0)

After activation of illuminated button -S6 or -S7, the slide can be moved to the right and left (depending on the end switches). The respective end position of the slide is indicated by indicator lamps -P6 and -P8. If the end position of a direction of travel has not yet been reached, the movement is indicated by the flashing of the respective indicator lamp. The center position is indicated by -P7.

Pressing -S6 and -S7 simultaneously results in the motor being stopped ( $G\_T\_Lock = 1$ ). For unlocking, -S6 and -S7 are not activated ( $G\_T\_Lock = 0$ ).

After activation of illuminated button "-S8" or "not -S8", the piston rod of cylinder -M20 can be retracted and extended. The "retracted" end position is indicated by indicator lamp -P10. In the Home position, the cylinder is extended.

After activation of illuminated button "-S9" or "not -S9", the piston rod of cylinder -M30 can be retracted and

extended. The "retracted" end position is indicated by indicator lamp -P11. In the Home position, the cylinder is retracted.

After activation of illuminated button "-S10" or "not -S10", the piston rod of cylinder -M40 can be retracted and extended. The "retracted" end position is indicated by indicator lamp -P12 (modify Grafcet accordingly). In the Home position, the cylinder is extended.

After activation of illuminated button "-S11" or "not -S11", magnet -Q61 is deactivated via Q60. The deactivated status is indicated by indicator lamp -P13 (modify Grafcet accordingly). In the Home position, the magnet is activated. Make sure the magnet has the correct polarity!

#### IV Functional sequence in automatic mode (-S4 = 1)

##### **Caution: Home position is reached using jog mode!**

The Home position is indicated by signal lamp -P2

##### **Home position:**

- Carriage/slide to Pos. 2
- Cylinder -M20 extended
- Cylinder -M30 retracted
- Cylinder -M40 extended
- Magnet -Q61 activated
- P2 = "1"
- Inserting 2 metal and 2 plastic cubes

For start position, see Grafcet

After -S5 is pressed, automatic mode is started

Query of whether material is present/if not: Jump back to Step 301

##### **Metal present:**

- Cube cylinder -M20 retract
- Cube cylinder -M20 extend
- Z-axis down, when magnet deactivated
- > Detection of the next material in the magazine <
- Z-axis up, when magnet activated
- Carriage/slide to Pos. 3
- Z-axis down, when magnet activated
- Z-axis up, when magnet deactivated
- Trap door cylinder -M40 retract
- Trap door cylinder -M40 extend
- Carriage/slide to Pos. 2
- Jump back to Step 302

If magazine "empty": Jump back to Step 301

Restart

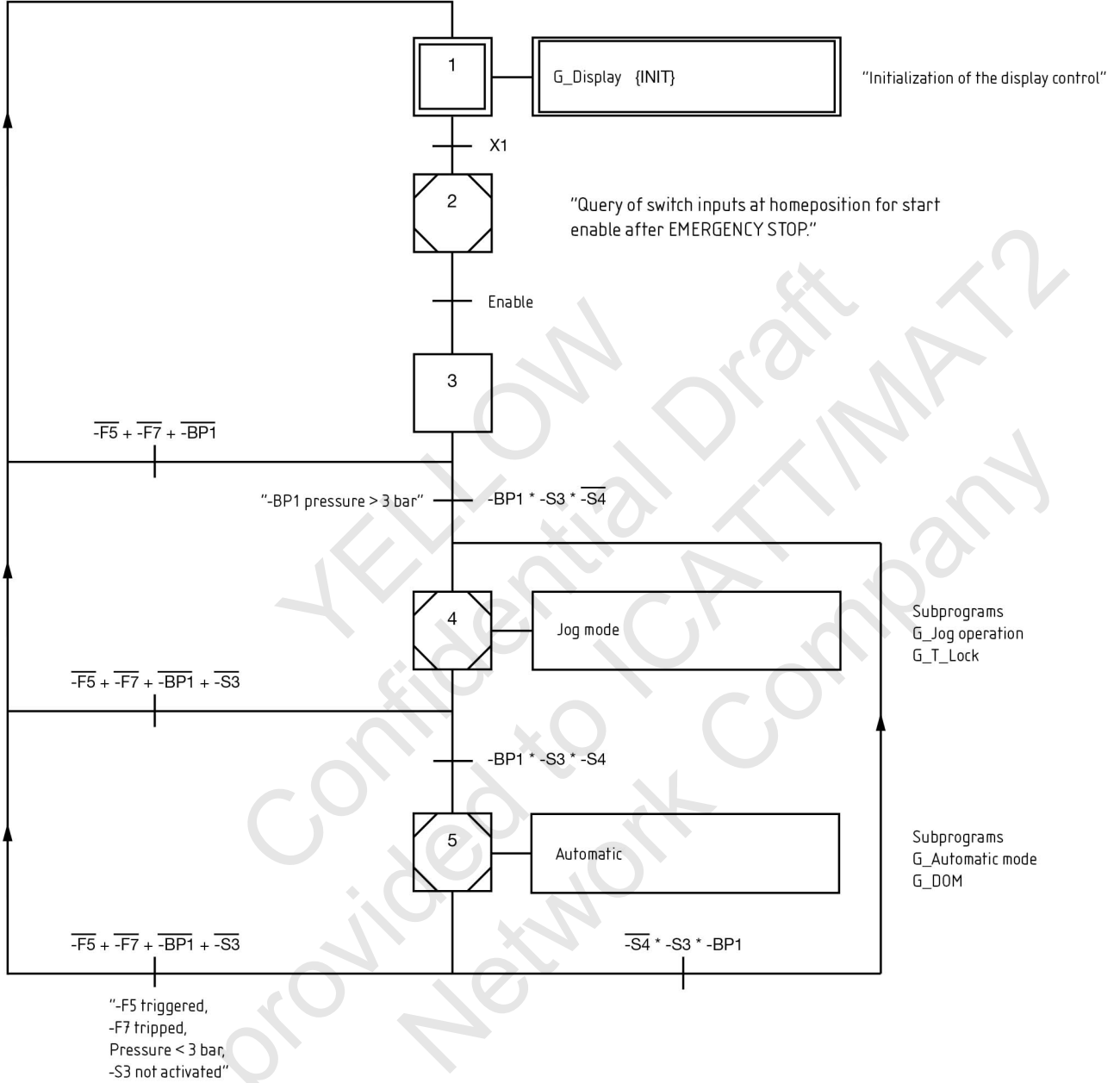
#### V Emergency stop while the system is switched on (-S3 = 1)

- Independently of the control system, indicator lamps -P1 and -P31 are "on"
- Main valve -Q10 is "off"
- All valves and motor slides are "off"
- Indicator lamps indicate the momentary value on the system
- System restart; all operating elements in Home position

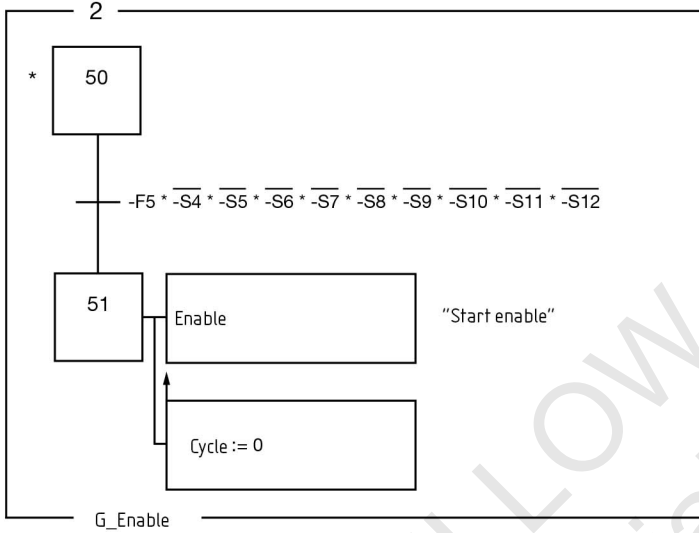
#### VI Off with -S3 while system is on

- Main valve -Q10 "on"
- All valves and motor slides are "off"
- All indicator lamps are "off"
- System restart; all operating elements in Home position

**Enable security of the jog/automatic mode**

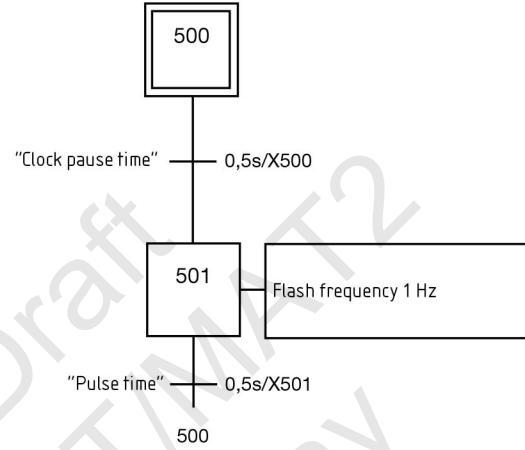


**Enable**

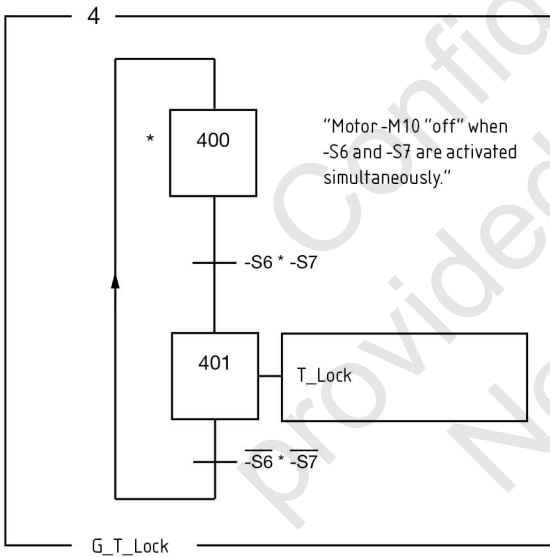


**Note:** Clock  $\triangleq$  Flashing clock or system clock

Clocking if no system clock is available



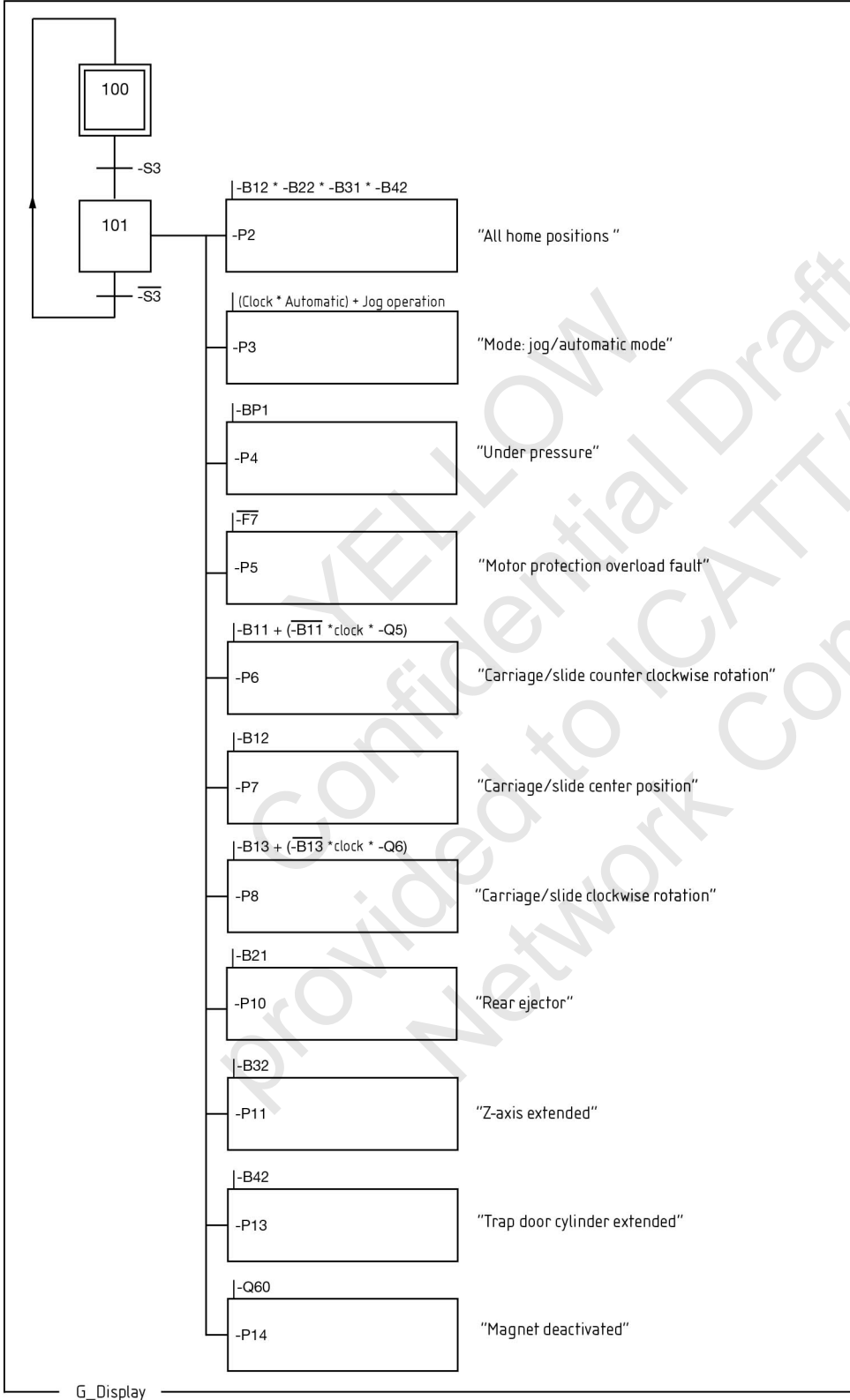
**Switch-on safety when -S6 and -S7 are activated simultaneously**



Task  
Preparation of the practical work task  
Flow chart based on Grafcet

**Mechatronics Technician**

**Indicator lamp for end position detection and home position**



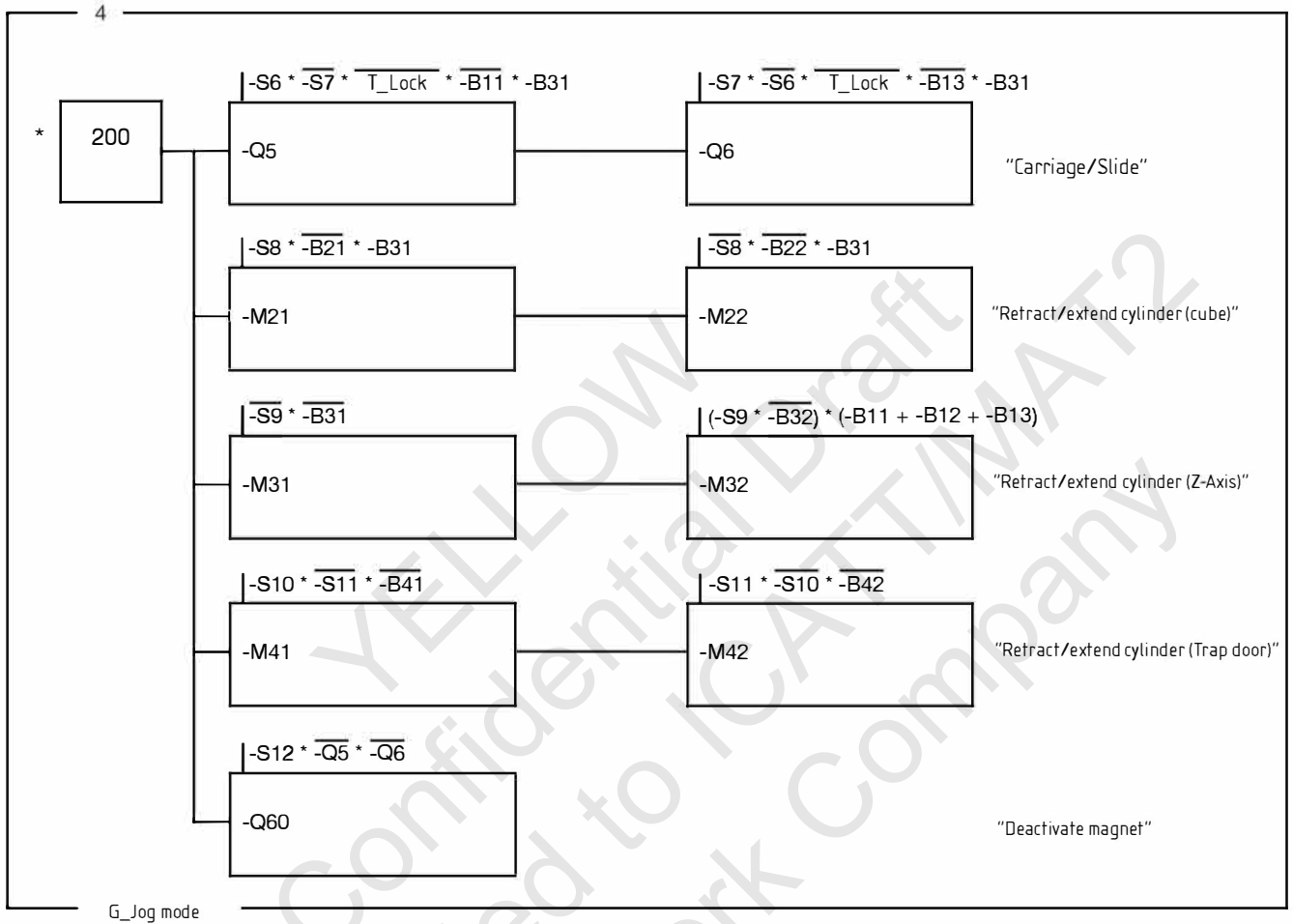
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## Final examination Part 2 - 2023

Task  
Preparation for the practical worktask  
Flow chart based on Grafcet

### Mechatronics Technician

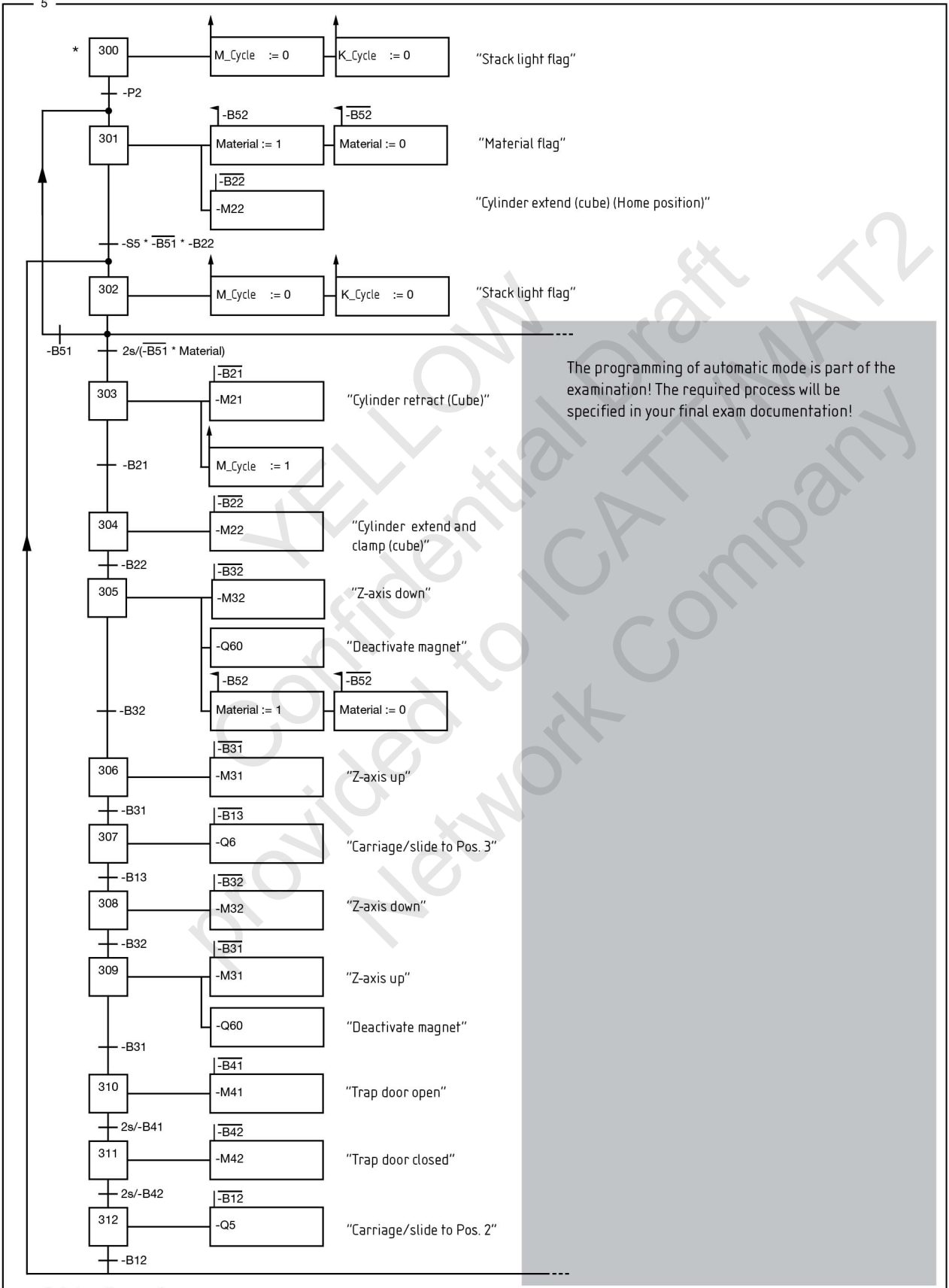
#### Jog mode control



Task  
Preparation of the practical work task  
Flow chart based on Grafset

### Mechatronics Technician

#### Automatic mode of sequence control



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Final Examination Part 2, PHASE 2 - 2023

**Preparation of the practical  
assignment  
Planning – workflow plan**

**Mechatronics Technician**

When preparing for the practical assignment, it is advisable to plan the work steps in a logical order. These steps along with your other preparation documentation are to be presented to the exam board in an organized folder on the day of the practical exam. Add pages if necessary.

Outline your work steps with key words or short sentences below:

YELLOW  
Confidential Draft  
provided to ICATT/MAT2  
Network Company