Mechatronics Technician

Exam preparation Documentation

Part 1

2026

Test Taker first and last name:

Test Taker number:

Test Taker company:

AHK German American Chambers of Commerce Deutsch-Amerikanische Handelskammern

German American Chamber of Commerce of the Midwest, Inc.
150 North Michigan Avenue, 35th Floor
Chicago, Illinois 60601
Phone: +1 (312) 644-2662 | Fax: +1 (312) 644-0738
www.gaccmidwest.org

Atlanta | Chicago | Detroit | Houston | New York | San Francisco | Washinton DC

General information

In Part 1 of the final examination, the test taker must complete a practical assignment.

For the practical assignment, including situational technical discussions, the apprenticeship organization is to provide the testing equipment listed in this booklet and the booklet "Standard Material Staging List".

This test equipment and both booklets must be available to the test taker in due time before the date of the final examination part 1 to ensure that the test taker can check the test equipment for completeness and functionality.

The test taker must bring this booklet and the booklet "Standard Material Staging List" to the planning phase to the written and practical exam.

The mechatronic subsystem described in this booklet must be implemented and checked in accordance with applicable guidelines and safety specifications.

Standard tools and operating equipment from the company are permitted.

The apprenticeship organization must ensure that the test taker admitted for the examination has received safety instruction and applicable work safety regulations.

The test taker confirms with his or her signature prior to the start of the practical exam that he or she has received safety instruction and will observe and comply with regulations.

Test preparation information:

This booklet contains the technical documents necessary for preparing the work task. The documents have been created to be as neutral as possible and must be adapted as necessary for the actual components used.

The following must be provided on the title page of this booklet:

– The test-taker number assigned (at test)
– First and last name of the test taker

The standard provisioning documents and preparation material can be accessed and downloaded from the ICATT apprentice resource pages

This test was resolved by a committee composed of members from different regions in the United States. It has been developed for implementation and acceptance of examinations as part of training examinations. Neither the test nor products based on it are intended for reproduction or free trade.

Final Examination Overview - ICATT Mechatronics Technician

Final examination: Part 1

Weighting: 40 %

Areas of examination

Practical task with professional, situation-based discussions

Weighting: 50 %

Total time permitted: 6.5 h

– Planning*
Weighting: 20 %
Time suggested: 30 min

– Execution including tech discussion
Weighting: 40 %
Time suggested: 4 h

–Commissioning
Weighting: 35 %
Time suggested: 2 h

Professional, situation-based discussions

Weighting: 5 %
Time permitted: 10 min

- The duration of the discussions is included in the examination time.
- The discussions can last up to 10 min within the scope of the examination and can be held continuously or in stages.

*The planning phase takes place after the written assignments. If the planning time is exceeded or not used in full, the relevant deviation is compensated for in the execution and review phases to ensure that the total permitted time of 6 h 30 min is not exceeded.

Written examination

Weighting: 50 %

Total time permitted: 1 h 30 min

– Part A (50%):
23 multiple choice questions
3 of which can be deselected

– Part B (50%):
8 short answer questions
No deselection possible

Final examination: Part 2

Weighting: 60 %

Areas of examination

Practical task with professional, situation-based discussions

Weighting: 50 %

Total time: 14 h

– Preparation for the practical task
Time allotted: 8 h In company

– Execution of the practical task
Time allotted: 6 h At exam site

Including **technical discussion**
Time allotted: 20 min

Phases:

- Information
- Planning
- Execution
- Review

The practical task is assessed by means of:

- Task-specific documents
- Professional, situation-based discussions
- Observations by the board of examiners

Written examination

– Work planning
– Functional analysis
– OSHA and Workers Rights

Weighting: 50 %

Total time permitted: 4 h 15 min

– Work Planning
Time permitted: 105 min
Weighting: 40 %

Part A (50%):
28 multiple choice questions – 3 of which can be deselected

Part B (50%):
8 short answer questions
No deselection possible

– Functional analysis
Time permitted: 105 min
Weighting: 40 %

Part A (50%):
28 multiple choice questions
3 of which can be deselected

Part B (50%):
8 short answer questions
No deselection possible

– OSHA and Workers Rights

Time permitted: 45 min
Weighting: 20 %

20 multiple choice questions
5 of which can be deselected

4 short answer questions
1 of which can be deselected

AHK-USA Chicago

Final Examination Part 1 - 2026

General Information	Mechatronics Technician

General information

The mechatronic subsystem to be completed on the day of the exam is to be prepared according to the specifications of this booklet, commissioned and put into operation in compliance with the valid safety regulations.

The required control cabinet with the control unit is to be prewired according to the documents in this booklet and connected to the mechanical subassembly via the plug connector.

208V – Connection to the main is made by a 208VAC cable with NEMA L21-20P plug 3-poles +N+PE (5 wires)

6mm outer diameter (OD) pneumatic push to connect hose fitting for the pressure regulator

This booklet and the "Standard material staging list" found on the ICATT apprentice resource page provided by the program administrating organization lists more items of equipment than are required to prepare for this examination. Bring everything listed to the examination even if it was not used during the preparation (unused material may be required to complete the in-person examination). Be sure that all equipment is functioning properly.

The finished model of the final examination Part 1 is the basis for subsequent exams.

AHK-USA Chicago

Final Examination Part 1 - 2026

Work assignment **Training tools, extras and** **Exam Day Equipment**	**Mechatronics Technician**

The following items are required for the companies to properly train and prepare an apprentice for the examination. The following equipment must be accessible to each apprentice at his/her training facility and should therefore also be available for use in preparation of the equipment for a mechatronics examination and during the examination. Not all items will be needed but should be provided by the training company.

If your examination is not taking place at your training company, you are expected to bring all tools listed to the testing site. If the exam is taking place at the training company all material listed should be available during the exam.

I Quality measuring equipment that the company must provide and each test taker must bring to the examination:

1. 1 caliper	min. 135mm	DIN 862
2. 1 flat square	100x70mm	
3. 1 wide base square	100x70mm	
4. 1 beveled edge square	100x70mm	
5. 1 two-pin voltage tester (optional)		

II Tools the company must provide and each test taker must bring to the examination:

1. 1 scriber		
2. 1 center punch		
3. 1 engineer's hammer	ca. 300 g	DIN 1041
4. 1 mallet		
5. 1 hacksaw for metal	300 mm	DIN 6473
6. 1 flat file	150-1 150-3 250-1	DIN 7261
7. 1 triangular file	150-1 150-3	DIN 7261
8. 1 round file	150-1 150-3	DIN 7261
9. 1 square file	150-1 150-3	DIN 7261
10. 1 semi-round file	150-1 150-3	DIN 7261
11. 1 needle file H3	flat, triangular, round rectangular	
12. 1 file brush		
13. 1 triangular scraper		
14. 1 pin punch	4 5mm	DIN 6450
15. 1 allen wrench set	(WAF) 2, 2.5, 3, 4, 5 mm	ISO 2936
16. 1 screwdriver for slotted screws	A 0.5x3.0 A0.8x4.0 A 1.0x5.5 A1.2x6.5	DIN 5265
17. 1 screwdriver each for Phillip's head screws	size 0 size 1 size 2	DIN 5262
18. 2 parallel C-clamps	40 to 100 mm span or similar	
19. 1 side cutter		
20. 1 combination pliers		
21. 1 angled telephone plier		DIN 5745 B
22. 1 wire stripper		
23. 1 cable tie pliers (if necessary)		

24. 1 crimper for fire-end ferrules	0.14-2.5 mm^2	
25. 1 cable stripping knife		
26. 1 tubing cutter to shorten pneumatic hoses		
27. Open end wrench of appropriate sizes for mounting of push-in pneumatic fittings and silencers		
28. 1 external snap ring pliers	range approx. 3 to 10mm	DIN 5254

III Test equipment that the company must provide and each test taker must bring to the examination:

1. 1 universal protractor		
2. 1 set of radius gauges	1-7 (concave and convex)	
3. 1 steel ruler	300mm	
4. 1 set of feeler gauges	0.05 to 0.5mm	
5. 1 caliper	300mm	DIN 862
6. 1 plug gauge H7	4, 5, 6mm	
7. 1 outside micrometer	0-25mm 25-50mm	
8. 1 VDE-test device VDE 0413/installation tester (i.e.Fluke Megger)	to check protective measures according to VDE 0100-600 (insulation and isolation resistance, PE conductor resistance, etc.)	
9. 1 RCD-tester VDE 0413	if not included in Item No. 8	
10. 1 multi-meter with probs		
11. 1 watch/timer with second hand		
12. 1 rotary field test instrument		
13. 1 crimper	for cable terminals 1.5mm^2 to 4mm^2 or crimp contacts	

IV Tools and equipment that the company must provide and each test taker must bring to the examination:

1. 1 divider/compass	150mm leg length	
2. 1 set of marking stamps (Arabic numbers)	3mm	
3. Open-ended wrench of each size	WAF 6x7, 8x9, 10x11, 12x13, 17x19, 24x27	DIN 3110
4. 1 set of taps (with tap wrench) or machine taps	M3 M4 M5 M6 M12 (standard pitch) M12x1	
5. 1 center drill of each size	Each A 1.6 A2.5	DIN 333
6. 1 twist drill of each size	Each Ø 2.5, 3.3, 3.4, 3.8, 4.2, 4.5, 4.8, 5.0, 5.5, 5.8, 6.0, 6.6, 8.0, 9.0, 10.5, 11, 12.5	
7. 1 counter bore of each size	Each 6.5x3.4, 8x4.5, 10x5.5	DIN 373
8. 1 tapered countersink 90° of each size	Each 1-5 5-10 10-15	DIN 335
9. 1 machine reamer H7 of each size	4 5 6	DIN 212
10. 1 appropriate tool to assemble control panel and switches		
11. 1 hand reamer H7	4 5 6	
12. 1 bending aid (block)	ca. 100mm long, ca. 10-40mm wide, and high, radius *r*=4mm	

V The following are <u>provided during the examination in the testing center</u> in collaboration with the Board of Examiners for 1 to 5 test takers:

1. 1 surface plate with general accessories such as height marker, prism, angle
2. 1 floor drill press to 13mm drill power with machine vice and general accessories

VI Test equipment that the company must provide and each test taker must bring to the examination:

1. 1 cleaning cloth
2. 1 whisk broom
3. 1 file cleaner
4. 1 permanent pen/marker for labeling

VII The following are <u>provided during the examination in the testing center</u> in collaboration with the Board of Examiners for each test taker:

1. Parallel vice (with protective jaws)
2. 1 compressed air connection, with on/off switch, 6 bar and corresponding pneumatic hoses, coupling boxes and plug
3. 1 three-phase socket for electro-technical work. 3P/N/PE L21-20/208V, 60hz

VIII Equipment/resources that the company must provide and each test taker must bring to the examination:

1. Mechanical and Metal Trades Handbook and Electrical Engineering Handbook
2. One sided 3x5 note card with a collection of quick reference formulas
3. 1 writing material with drawing tools
4. 1 non-programmable, solar or battery powered calculator without third-party communication possibilities
5. 1 set of personal protection equipment
6. 1 appropriate voltage extension cable to connect the control cabinet

IX Programming device that the company must provide and each test taker must bring to the examination:

1. Programming device for the PLC system used

AHK-USA Chicago

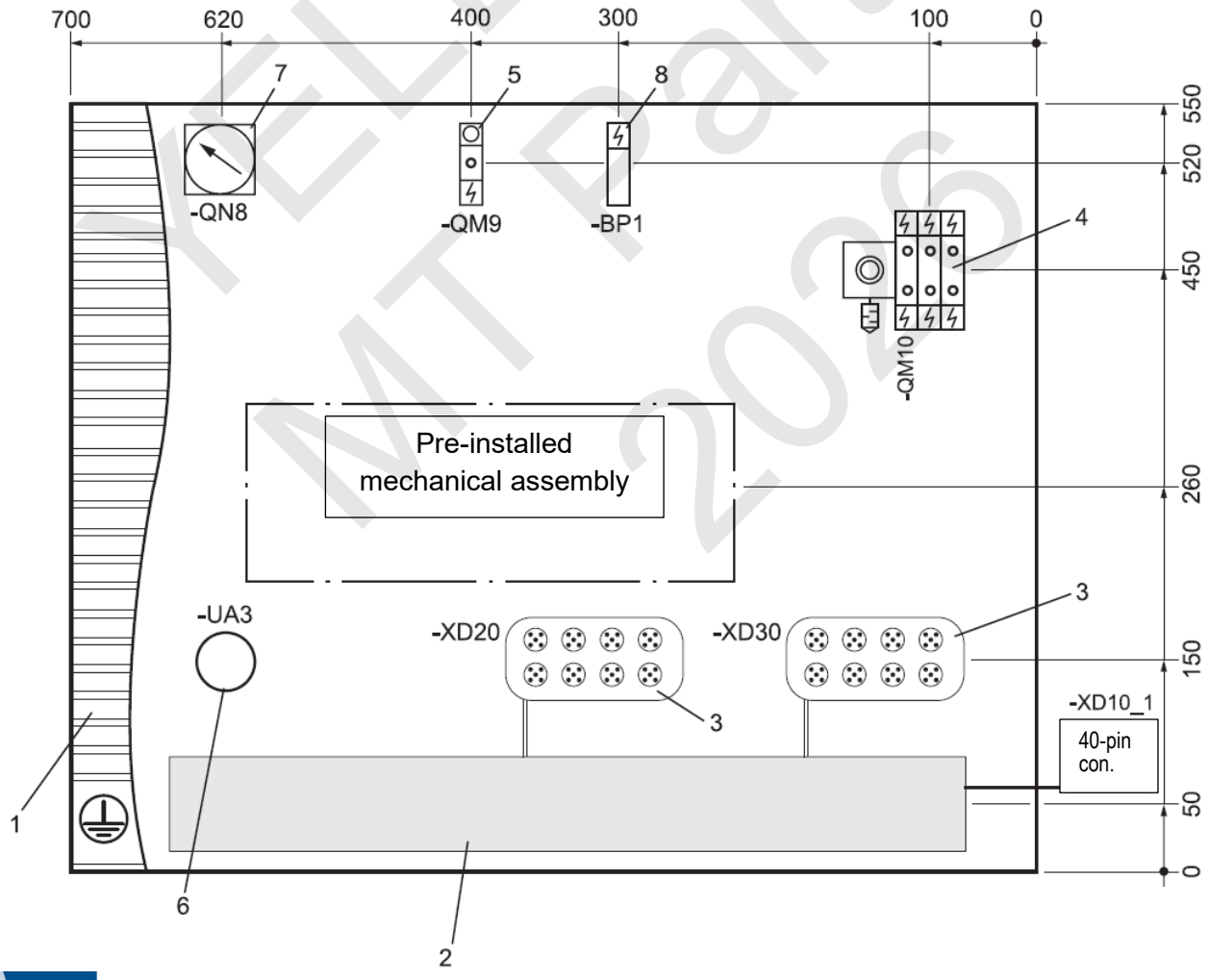
Final Examination Part 1 - 2026

Preparation of the practical assignment Pre-assembly drawing | **Mechatronics Technician**

Item No.	Quantity	Identification	Description	Comments
8	1	-BP1	Pressure Switch	Stand. Mat. List page 3
7	1	-QN8	Pressure regulator with gage	Stand. Mat. List page 3
6	1	-UA3	Stack light	Stand. Mat. List page 4
5	1	-QM9	3/2-way valve	Stand. Mat. List page 3
4	1	-QM10	Valve manifold	Stand. Mat. List page 3
3	2	-XD20,-XD30	Actuator/sensor distributor system	Stand. Mat. List page 4
2	1		Wiring duct	Stand. Mat. List page 3
1	1		Mounting plate	Stand. Mat. List page 3

Please note:

- The drawing is not to scale!
- Pre-wiring and placement of hoses is carried out in accordance with the diagrams/information in this booklet
- The plumbing of the pneumatic system is part of the execution or test phase of the examination. No pneumatic hosing should be connected when you arrive at the examination.
-
- **Only mount Item No. 1-8 which are shown in the diagram, do not add any other hoses for preparation. If you added any hoses to check functionality, they must be removed for the day of the examination. Only items 1-8 should be set up as shown in the diagram below.**



AHK-USA Chicago

Final Examination Part 1 - 2026

Assignment **Electrical and Pneumatic** **Material Provision List**	**Mechatronics Technician**

General information

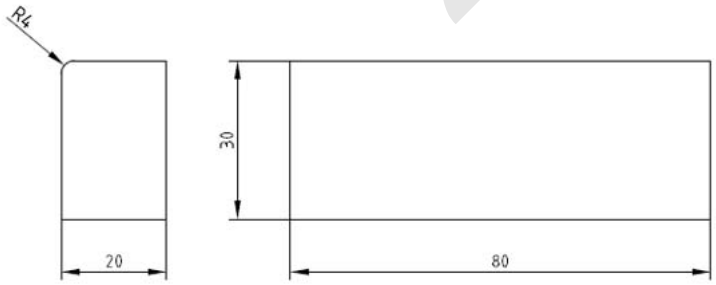
In addition to the listed test equipment from the standard provision documents for the training center, the following equipment must be brought in <u>on the day of the test</u>.

The components must correspond to the accident prevention regulations for electrical systems and operating equipment. For components, the required fastening material must be provided. It is mandatory to comply with the technical data of the components (including modular dimensions). The connection diagrams and data sheets for the electronic components may be brought in where required.

All materials should be checked before the test to ensure proper functionality.

I Parts that the company must provide and each test taker must bring to the examination:

1.	5 m	Plastic-sheathed multi-lead cable, H07V-K 0.5 mm^2, dark blue
2.	3 m	Plastic-sheathed multi-lead cable, H07V-K 1.5 mm^2, green/yellow
3.	5 m	Plastic-sheathed multi-lead cable, H07V-K 1.5 mm^2, black
4.	3 m	Plastic-sheathed multi-lead cable, H07V-K 1.5 mm^2, light blue
5.	5 m	Plastic-sheathed multi-lead cable, H07V-K 2.5 mm^2, black
6.	30	Insulated wire-end ferrules 0.5 mm^2, dependent on the terminal blocks in use
7.	30	Insulated wire-end ferrules 1.5 mm^2, dependent on the terminal blocks in use
8.	30	Insulated wire-end ferrules 2.5 mm^2, dependent on the terminal blocks in use
9.	50	Self-adhesive label to identify the components
10.	5 m	Plastic tube, preferably: inner diameter 2 mm, outer diameter 4 mm Optionally: inner diameter 4 mm, outer diameter 6 mm, compatible with the components and resources specified in the standard material staging documents
11.		Light fixture, 1 x RED, 24 V, compatible with the components on page 4/**V** of the standard material staging documents
12.		The capacitive sensor should not exceed a sensing distance or range of 100mm, including the connection cable. Alternatively, the following sensor/actuator cable can be provided: 1.5m sensor/actuator cable (M12x1) 4-pin, 1 angled connection socket for sensor, connection in distribution system.
13.		Flat steel bending aid 30x20x80 EN 10278 for bending sheet metal, see drawing below.



AHK-USA Chicago

Final Examination Part 1 - 2026

Assignment **Mechanical** **Material Provision List**	**Mechatronics Technician**

General information

In addition to the listed test equipment and tools from the standard provision documents for the training center, the following listed testing equipment and material must be brought in on the day of the test.

The semi-finished products must correspond to the specified **standards** [1].

During the preparation, the general tolerances to the right must be adhered to. Even when tolerances are adhered to, function and fit must be considered for final assembly. Unless the dimension is underlined, all dimensions should be treated as finished dimensions (surface $\nabla Rz16$). For the surfaces marked with an asterisk *∇, applies First angle projection applies to all drawings ( ).

General tolerances per ISO 2768

Tolerance class	from 0.5 up to 3	over 3 up to 6	over 6 up to 30	over 30 up to 120	over 120 up to 400
Average	±0.1	±0.1	±0.2	±0.3	±0.5

General tolerances in accordance with ISO 2768

[1] EN 10278 permissible width and thickness deviations for flat steel in accordance with ISO tolerance field h11;
EN 10278 permissible nominal diameter deviations for round steel in accordance with ISO tolerance field h11;
EN 10278 permissible width and thickness deviations for square steel in accordance with ISO tolerance field h11

While you may use parts from a previous exam, DO NOT assume that you have all parts. Check all material required and check all blueprints provided to ensure that you have all pieces according to dimensions and that they are prefabricated according to the provided drawings! You must order and/or fabricate anything that you do not already have. Parts 8.2, 8.3, 15, 16 on the product list below will be modified on exam day and evaluated for accuracy, therefore each test taker needs his or her own material cut to size and prefabricated according to the corresponding drawings. Numbers 8.2, 8.3, 15, and 16 below cannot be shared or reused on exam day. NOTE: The numbers below do not always coincide with the item numbers on the BOM.

I Semi-finished products that must be provided for every test taker:

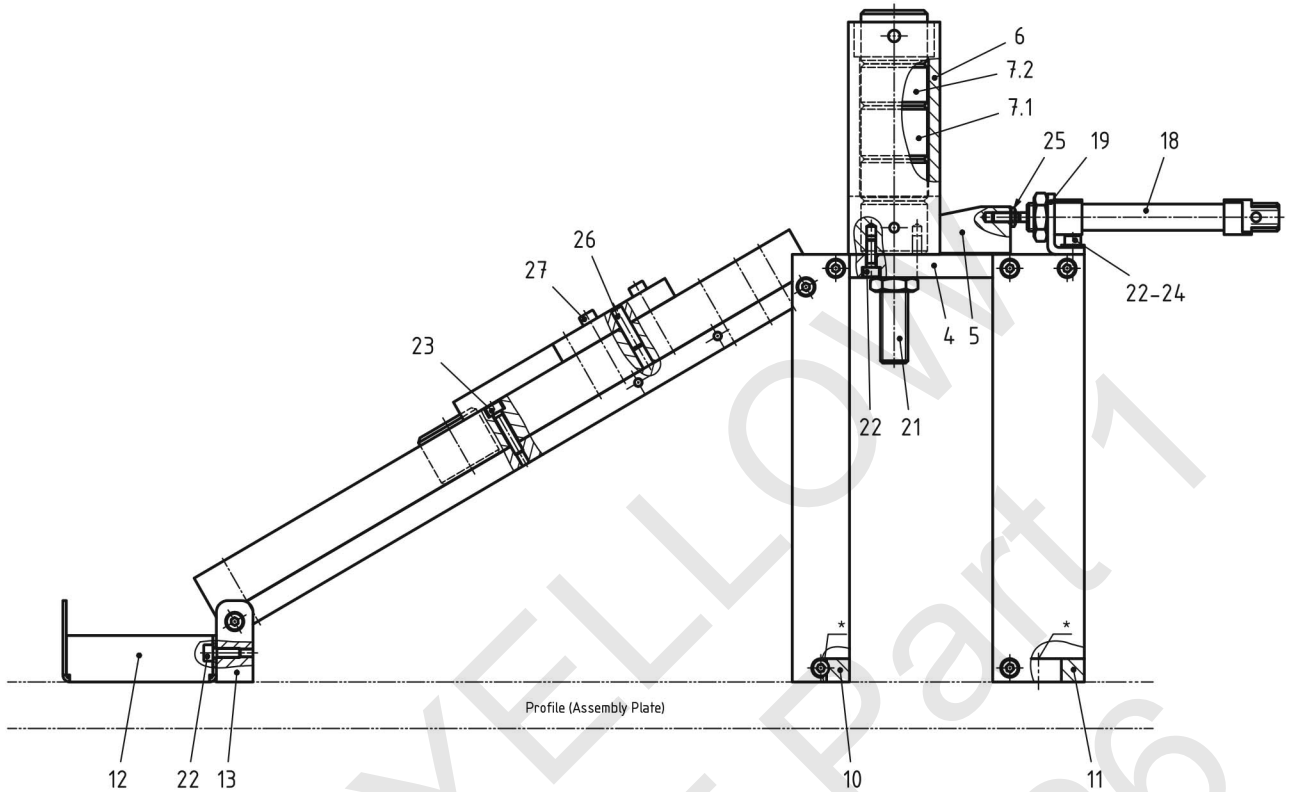
1.	1	Flat steel	25 x 10 x 184	EN 10278	S235JRC+C	prefab. acc. to drawing 1
2.	1	Flat steel	25 x 10 x 184	EN 10278	S235JRC+C	prefab. acc. to drawing 2
3.	2	Flat steel	40 x 10 x 184	EN 10278	S235JRC+C	prefab. acc. to drawing 3
4.	1	Flat steel	50 x 10 x 114	EN 10278	S235JRC+C	prefab. acc. to drawing 4
5.	1	Plastic	35 x 25 x 20		PVC	prefab. acc. to drawing 5
6.	1	Flat steel	40 x 50 x 100	EN 10278	S235JRC+C	prefab. acc. to drawing 6
7.1	3	Round steel	29 x 23	EN 10278	11SMn30+C	prefab. acc. to drawing 7.1
7.2	2	Round steel	29 x 18	EN 10278	11SMn30+C	prefab. acc. to drawing 7.2
8.1	1	Flat steel	20 x 10 x 300	EN 10278	S235JRC+C	prefab. acc. to drawing 8.1
8.2	1	Flat steel	20 x 10 x 200	EN 10278	S235JRC+C	prefab. acc. to drawing 8.2
8.3	1	Flat steel	20 x 10 x 280	EN 10278	S235JRC+C	prefab. acc. to drawing 8.3
8.4	1	Flat steel	20 x 10 x 60	EN 10278	S235JRC+C	prefab. acc. to drawing 8.4
9.	1	Flat steel	90 x 10 x 300	EN 10278	S235JRC+C	prefab. acc. to drawing 9
10.	1	Flat steel	25 x 10 x 50	EN 10278	S235JRC+C	prefab. acc. to drawing 10
11.	1	Flat steel	40 x 10 x 50	EN 10278	S235JRC+C	prefab. acc. to drawing 11
12.	1	Sheet Metal	1.5 x 120 x 165	EN 10131	DC01A(FeP01A)	prefab acc. to drawing 12
13.	2	Flat steel	35 x 10 x 16	EN 10278	S235JRC+C	prefab acc. to drawing 13
14.	1	Flat steel	50 x 10 x 108	EN 10278	S235JRC+C	prefab acc. to drawing 14
15.	1	Flat steel	30 x 4 x 98	EN 10278	S235JRC+C	prefab acc. to drawing 15
16.	3	Alu Sheet*	2 x 30 x 70	EN AW1060	Al, 1060	prefab. acc. to drawing 16
17.	1	Round steel	8 x 50	EN 10278	11SMn30+C	prefab. acc. to drawing 17

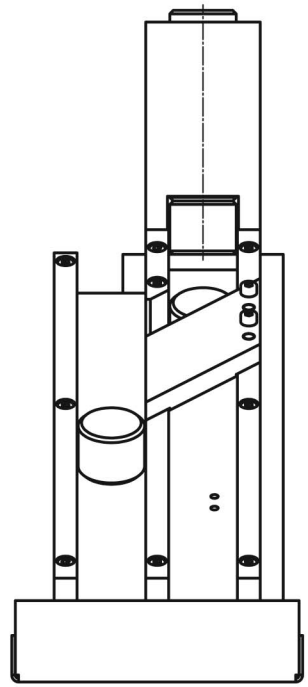
II Standard hardware that must be provided for every test taker:

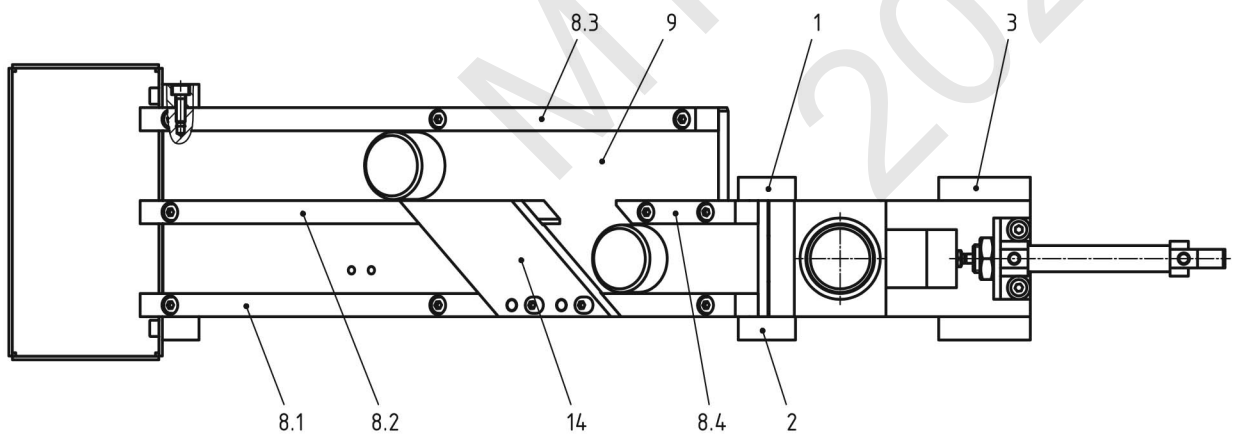
1.	28	Cap screws	M4 x 12	DIN EN ISO 4762	5.8
2.	10	Cap screws	M4 x 16	DIN EN ISO 4762	5.8
3.	15	Cap screws	M4 x 20	DIN EN ISO 4762	5.8
4.	6	Washer	4	DIN EN ISO 7091	200 HV
5.	2	Hex Thin Nut	M4	DIN EN ISO 4035	5
6.	7	Hex Nut	M4	DIN EN ISO 4032	5
7.	2	Dowel pin	5 x 20 – A	DIN EN ISO 8734	

Note: You will need additional fasteners to attach the mechanical subassembly on the assembly plate

*Recommended aluminum equivalent: McMaster-Carr MMC# 2471T87 1100







* Depends on the mounting plate used.

Test-taker no.

First and last name

Please note: drawing is not to scale

AHK Final Examination Part 1 - 2026

Scale —

Mechatronics Technician

Page 11 of 47

Chute Assembly Drawing

Sheet: 1(2)

Item no.	Qty.	Designation	Standard	Material	Semi-finished products (as per material preparation)
27	2	Cap screw M4 x 16	ISO 4762	5.8	
26	2	Dowel pin 5 x 20 - A	ISO 8734	St	
25	1	Hex thin nut M4	ISO 4035	5	
24	2	Washer 4	ISO 7091	200 HV	
23	10	Cap screw M4 x 20	ISO 4762	5.8	
22	24	Cap screw M4 x 12	ISO 4762	5.8	
21	1	Inductive sensor			
20	–	–		–	–
19	1	Cylinder mount			
18	1	Pneumatic cylinder			Stroke 40, Diameter 10
17	–	–		–	–
16	–	–		–	–
15	–	–		–	–
14	1	Diverter		S235JR	Fl 50 × 10 × 106,6 EN 10278
13	2	Chute Holder		S235JR	Fl 35 × 10 × 16 EN 10278
12	1	Collection container		DC01-A	SM1,5 × 120 × 165 EN 10131
11	1	Base plate		S235JR	Fl 40 × 10 × 50 EN 10278
10	1	Base plate		S235JR	Fl 25 × 10 × 50 EN 10278
9	1	Chute		S235JR	Fl 90 × 10 × 300 EN 10278
8.4	1	Guide rail		S235JR	Fl 20 × 10 × 60 EN 10278
8.3	1	Guide rail		S235JR	Fl 20 × 10 × 280 EN 10278
8.2	1	Guide rail		S235JR	Fl 20 × 10 × 200 EN 10278
8.1	1	Guide rail		S235JR	Fl 20 × 10 × 300 EN 10278
7.2	2	Sorting block		11SMn30+C	Rd 29 × 18 EN 10278
7.1	3	Sorting block		11SMn30+C	Rd 29 × 23 EN 10278
6	1	Magazine		S235JR	Fl 40 × 50 × 100 EN 10278
5	1	Pusher		PVC	Fl 33 × 25 × 20
4	1	Upper base plate		S235JR	Fl 50 × 10 × 114 EN 10278
3	2	Back stilt		S235JR	Fl 40 × 10 × 184 EN 10278
2	1	Front left stilt		S235JR	Fl 25 × 10 × 184 EN 10278
1	1	Front right stilt		S235JR	Fl 25 × 10 × 184 EN 10278

AHK Final Examination Part 1 - 2026

Scale

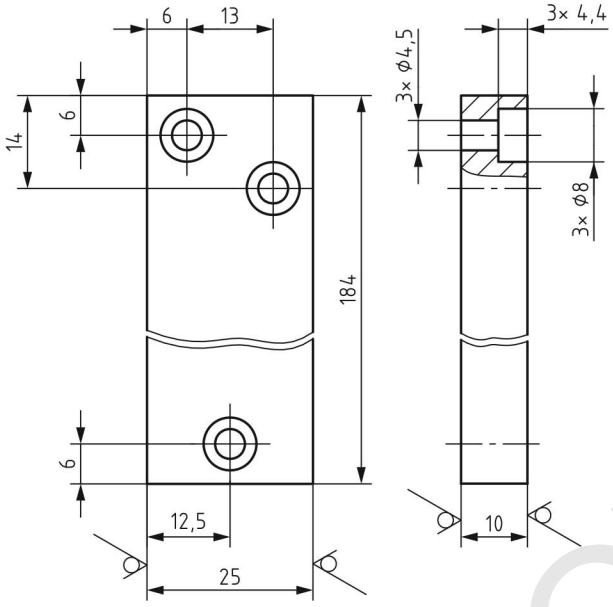
Mechatronics Technician

Page: 2(2)

Chute Parts List - Bill of Materials

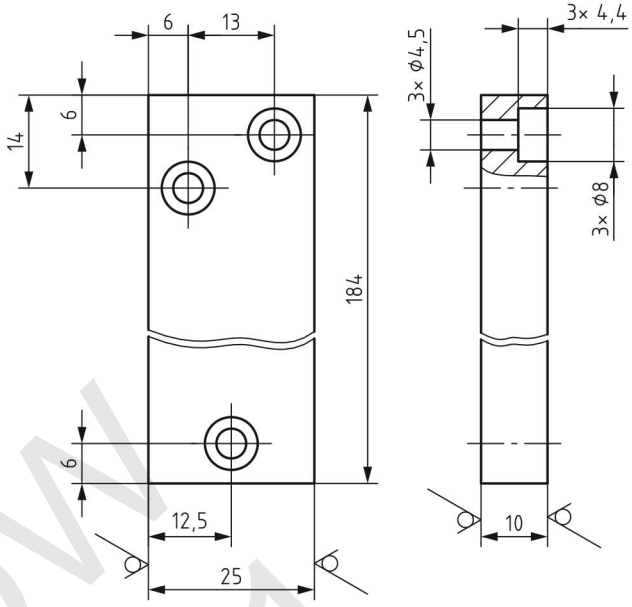
Drawing 1

Rz 16



Drawing 2

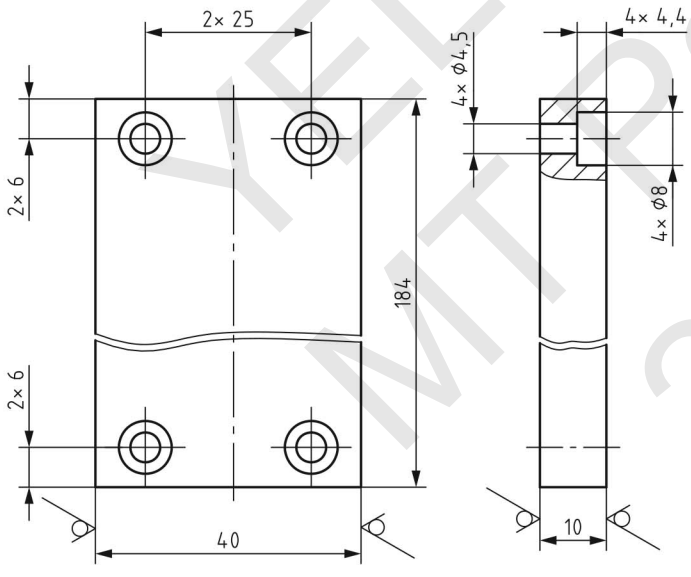
Rz 16



Drawing 3

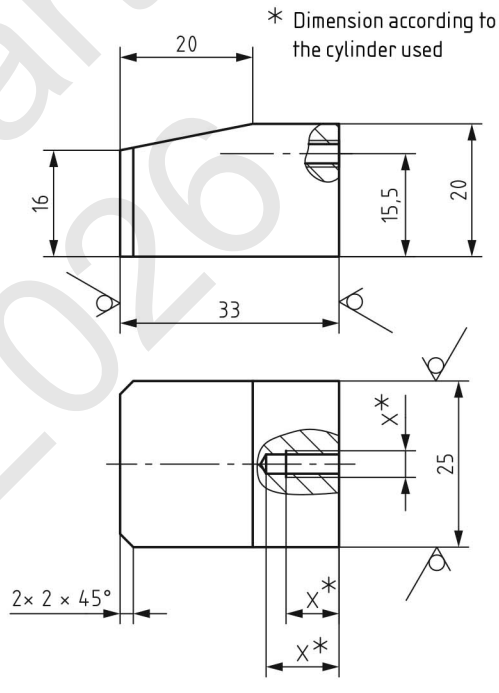
Rz 16

2 pieces

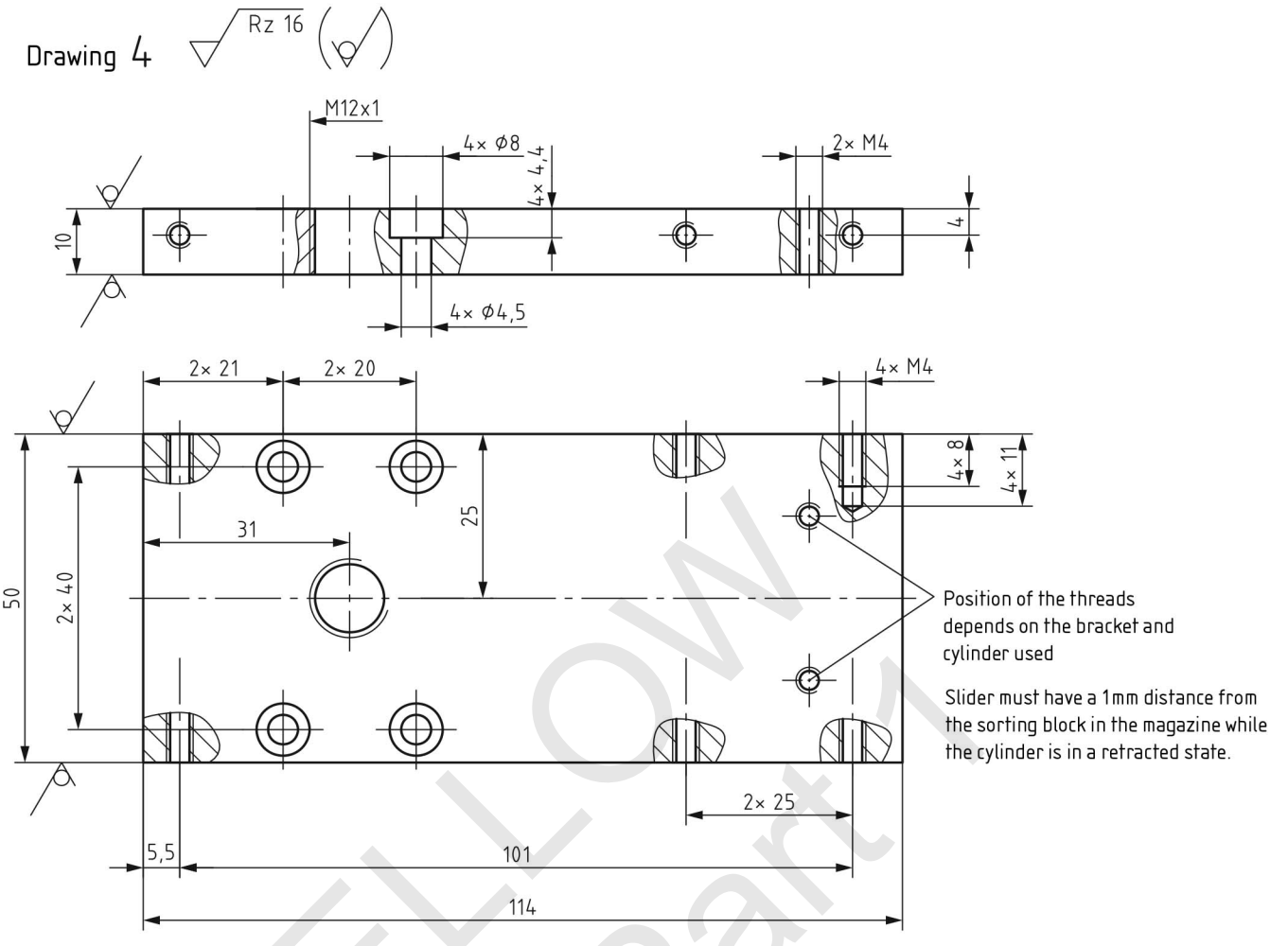


Drawing 5

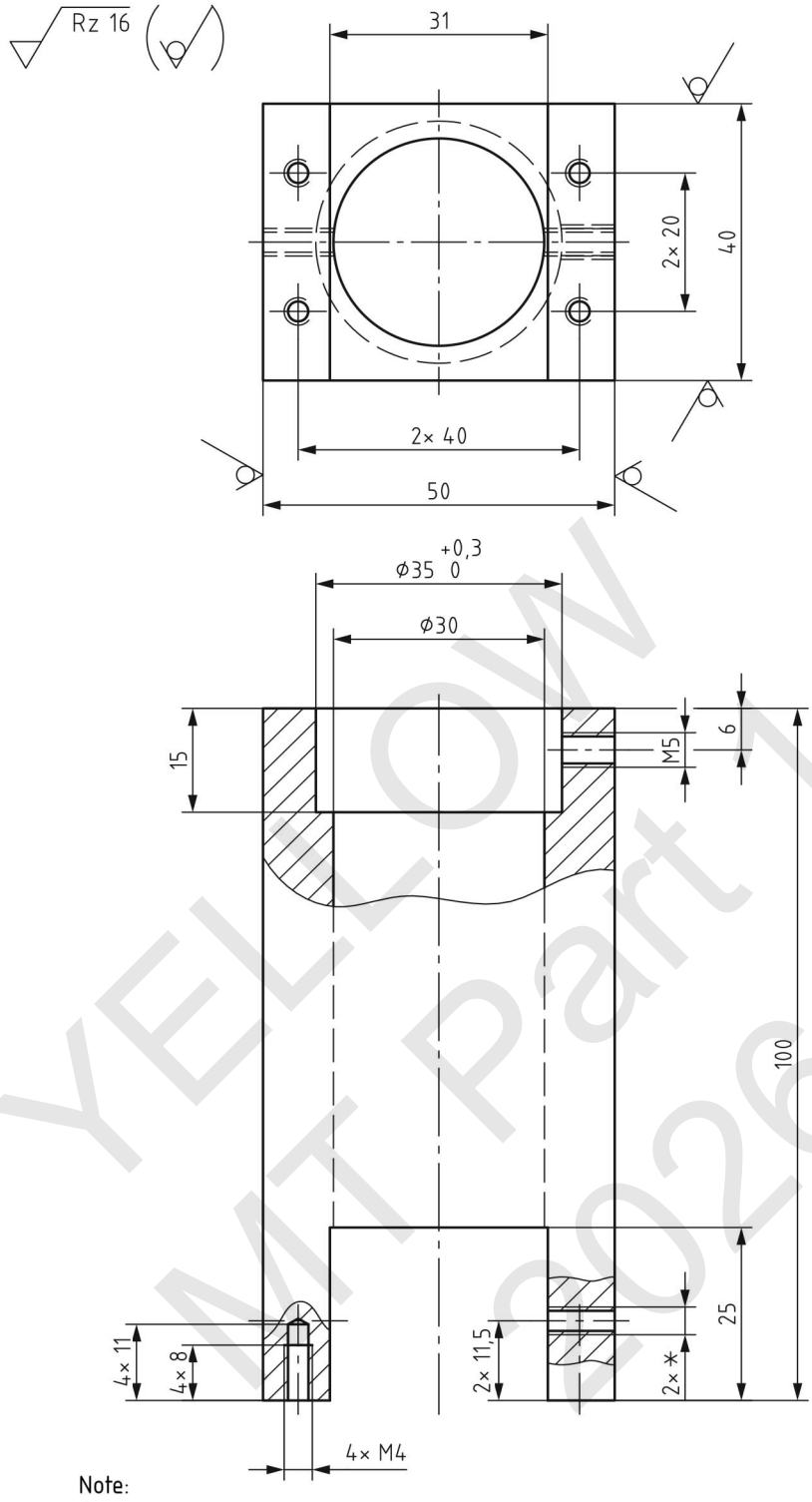
Rz 16



Drawing 4



Drawing 6

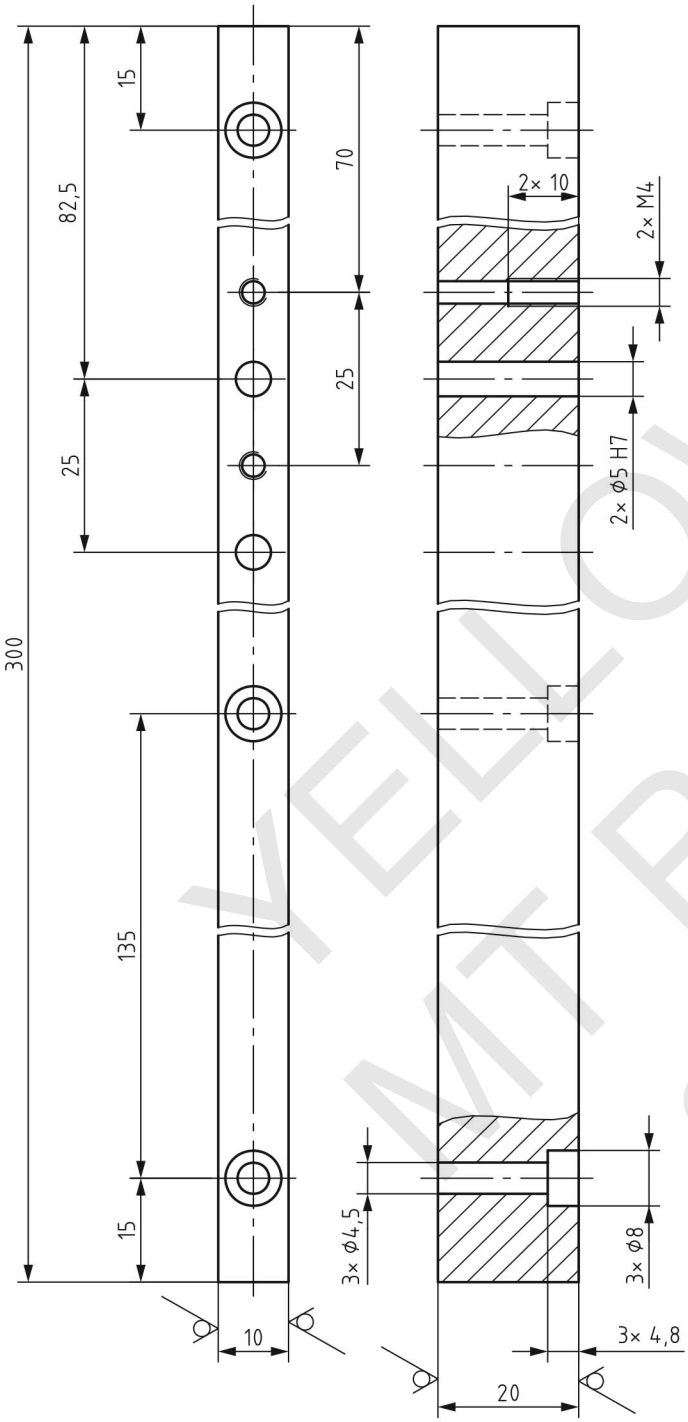


Note:

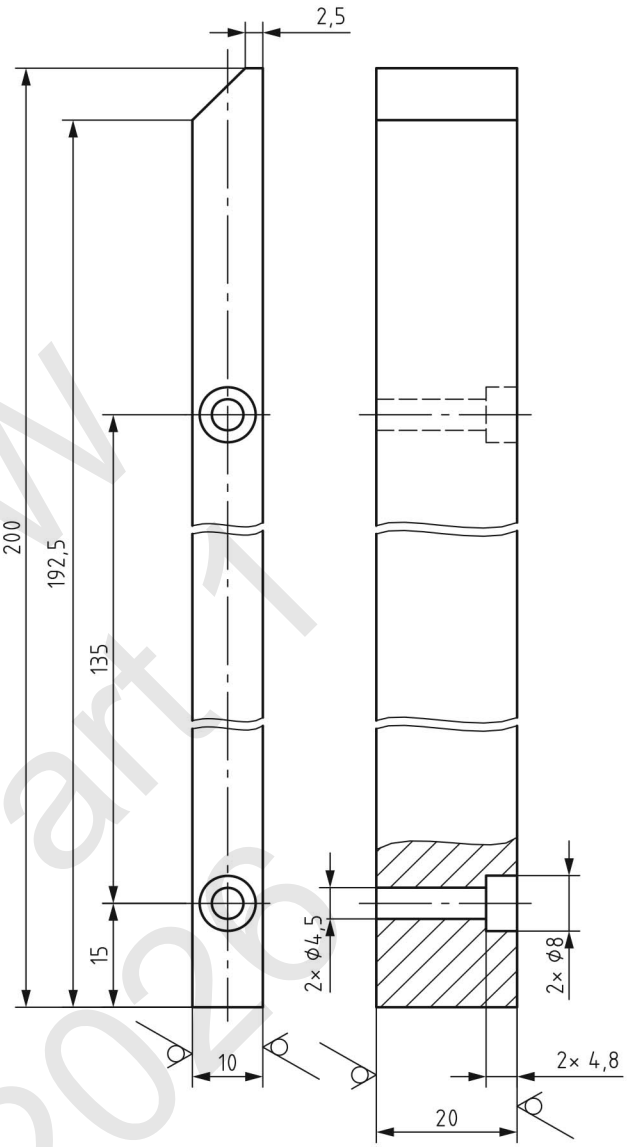
*M4 thread or the corresponding size for both fiber optic cables

Drawing 8.1 Rz 16

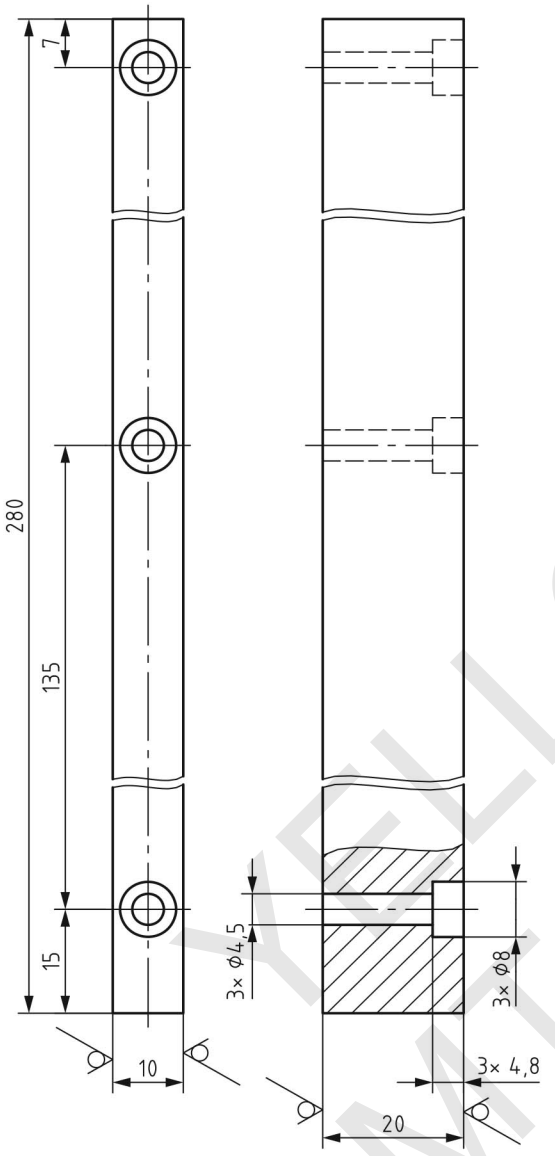
ø5 H7 to be drilled and reamed together with diverter (Drawing No. 14)



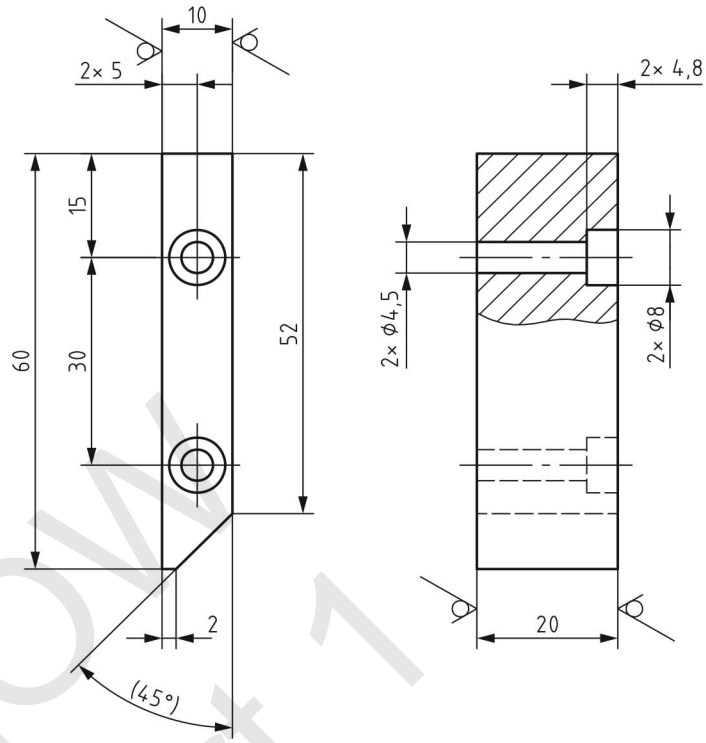
Drawing 8.2 Rz 16



Drawing 8.3 Rz 16

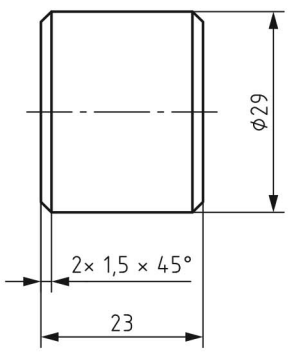


Drawing 8.4 Rz 16



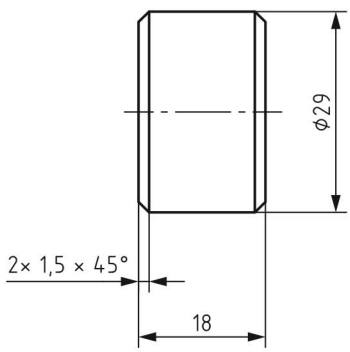
Drawing 7.1 Rz 16

3 pieces



Drawing 7.2 Rz 16

2 pieces

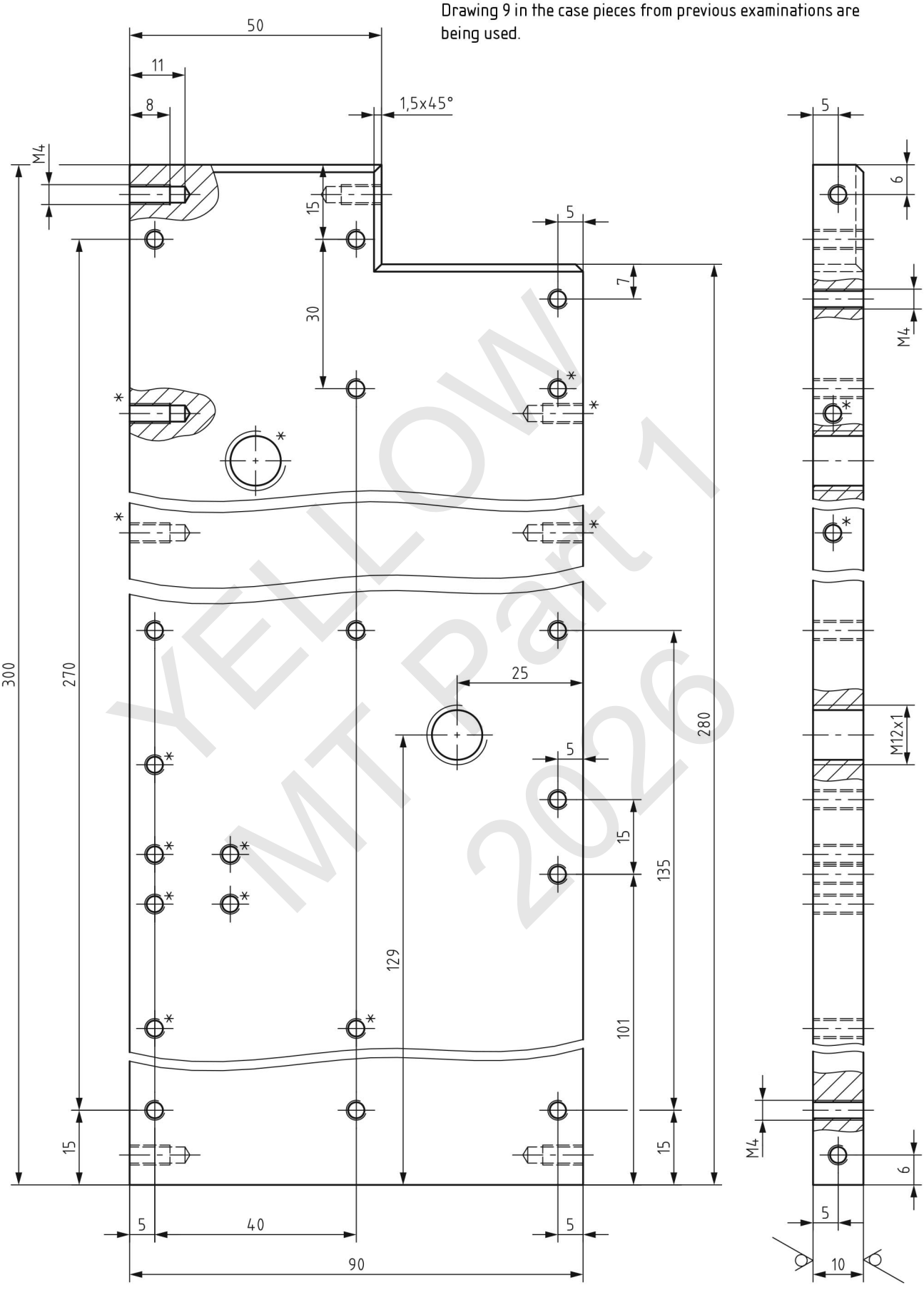


Drawing 9

Rz 16

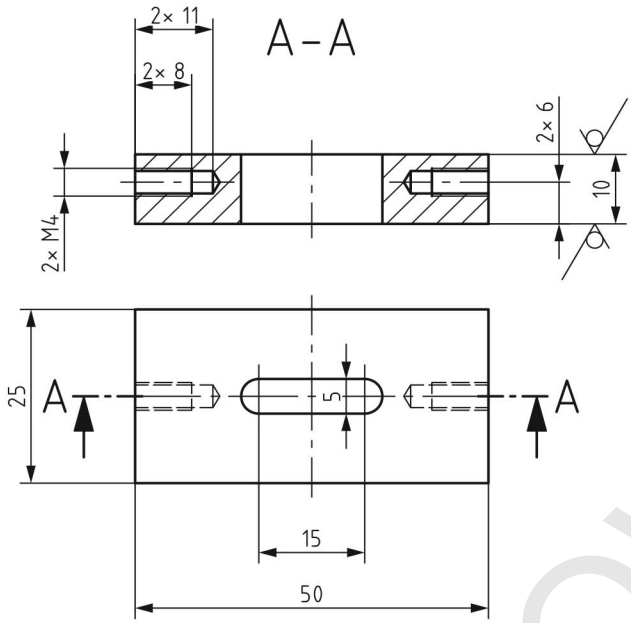
Note:

* Threads are not necessary for this exam but may be present in Drawing 9 in the case pieces from previous examinations are being used.



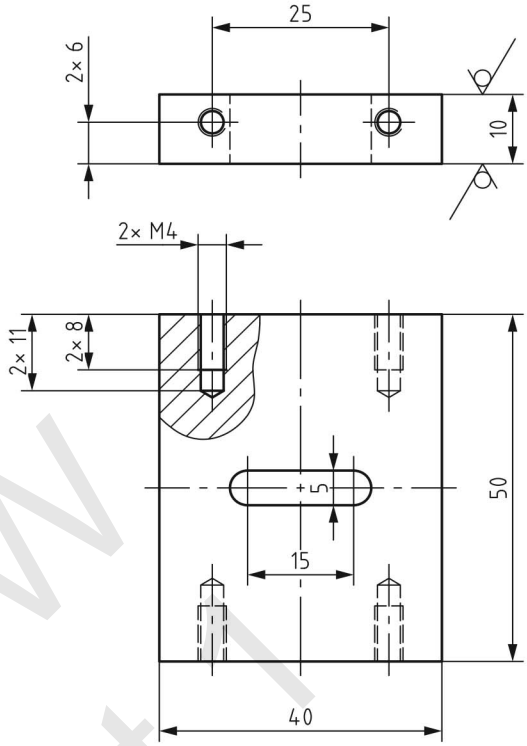
Drawing 10

Rz 16



Drawing 11

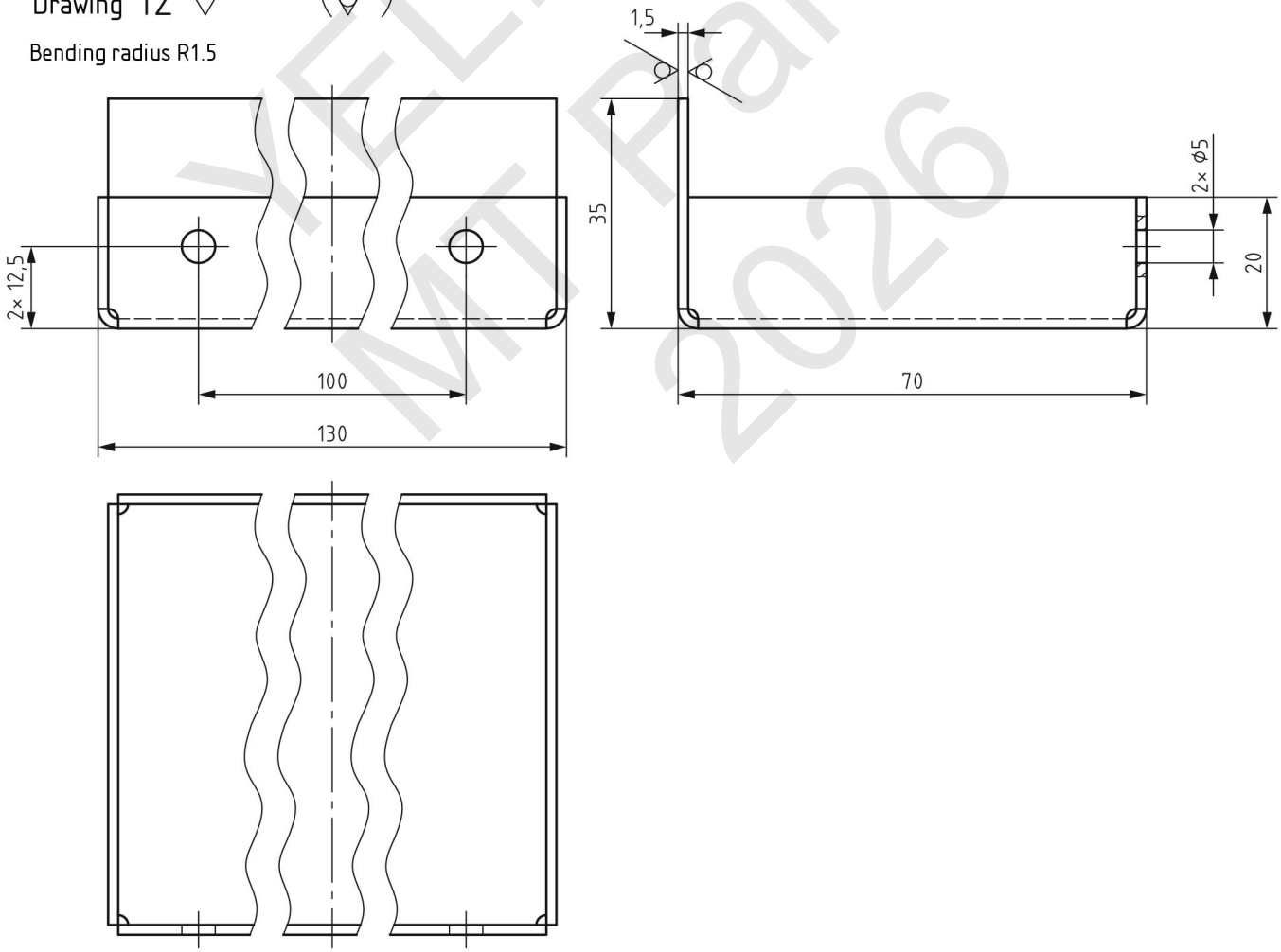
Rz 16



Drawing 12

Rz 16

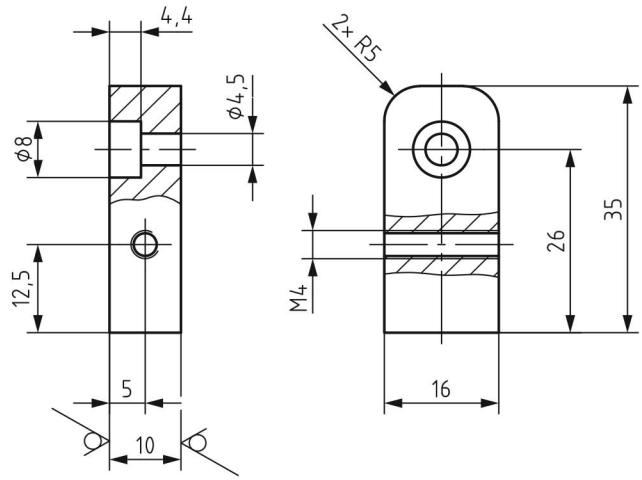
Bending radius R1.5



Drawing 13

Rz 16

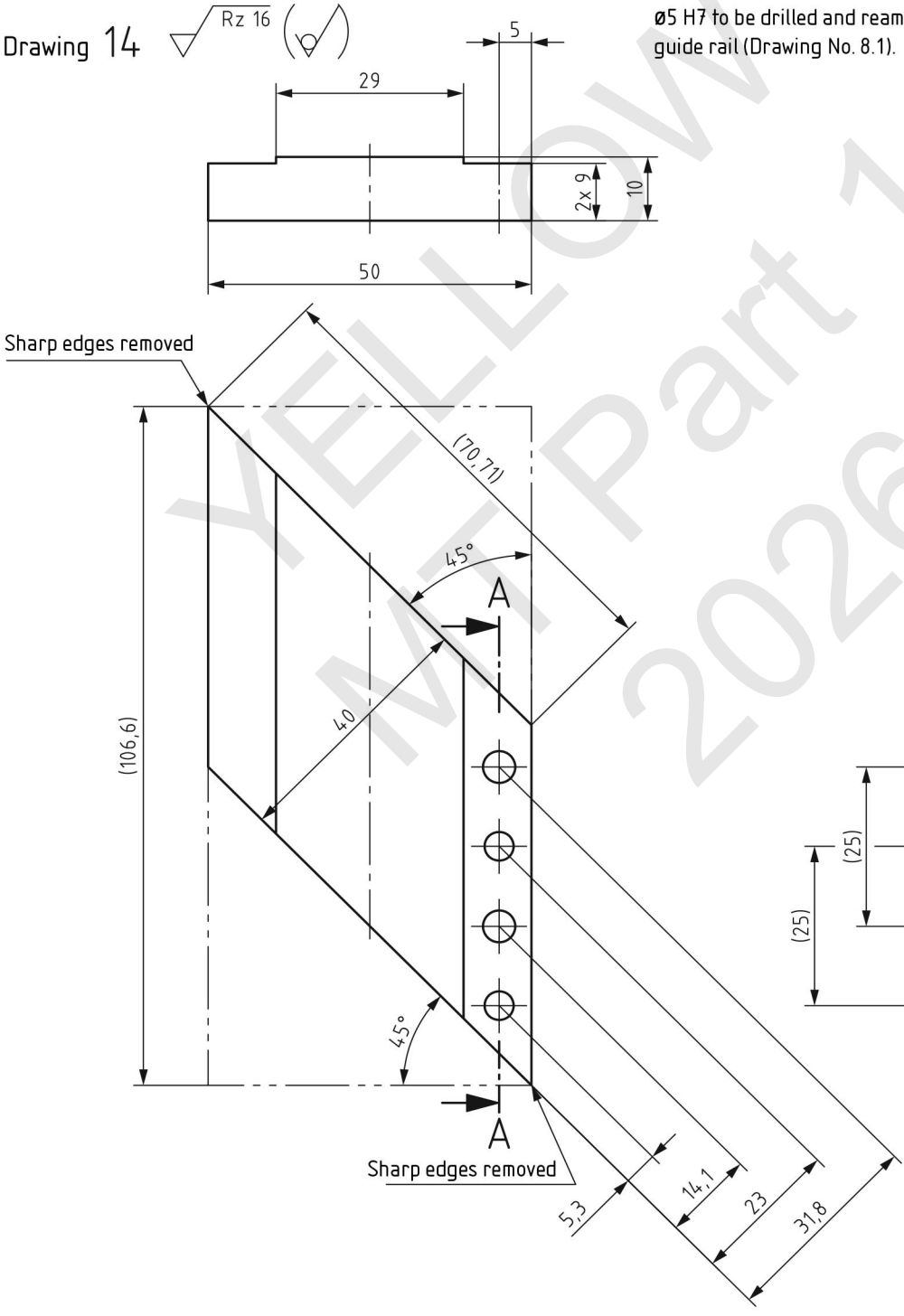
2 pieces



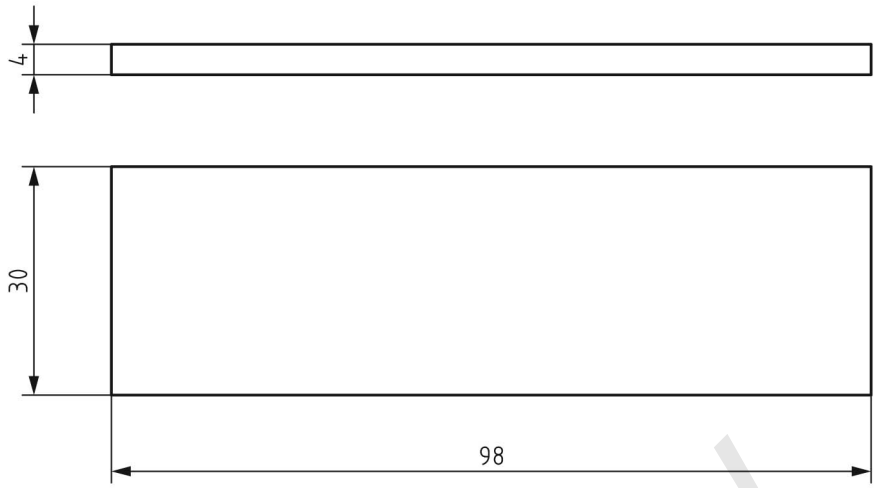
Drawing 14

Rz 16

ø5 H7 to be drilled and reamed together with the guide rail (Drawing No. 8.1).



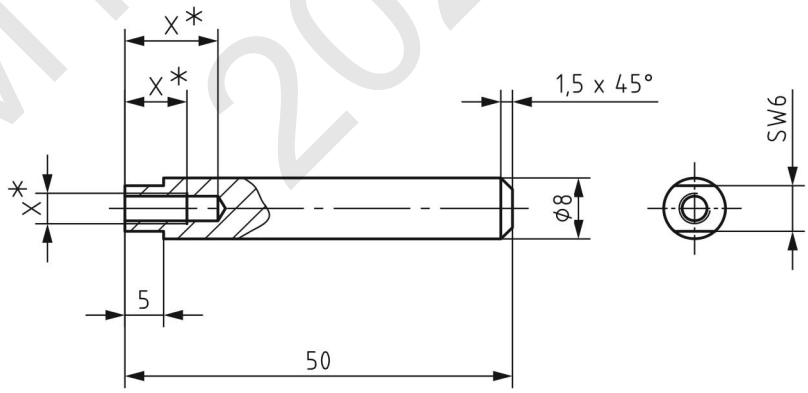
Drawing 15



Drawing 16 *

3 pieces

Drawing 17



* Dimension X depends on cylinder used (Stroke 40 ø10)

*SW=WAF

AHK-USA Chicago

Final Examination Part 1 - 2026

Assignment **Switch cabinet, control panel and circuit diagrams**	**Mechatronics Technician**

General information

The control cabinet and the control panel are pre-wired according to the following documents and connected to the mechanical subassembly using electrical connectors.

The following page shows one possible structure of the control cabinet (without depicting the wiring). Install components on the control cabinet back panel following the structural drawing. Depending on what materials/components are used, the positioning of this plate may need to be adjusted.

Minor modifications are acceptable as long as they remain in compliance with industry standards. Changes should be noted and initialed - including the date the change was made (i.e.GS 01/APR/24)- on schematics and blueprints!

Do not install any parts or wiring that are not shown in the schematics. Remove anything additional that may have been used for testing system functionality, but is not depicted on the drawings or schematics.

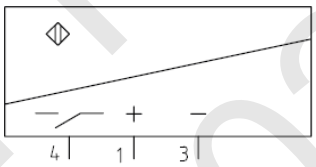
Note: The standard electrical connector (M12) for the actuator/sensor distributor system should have the following assignment:

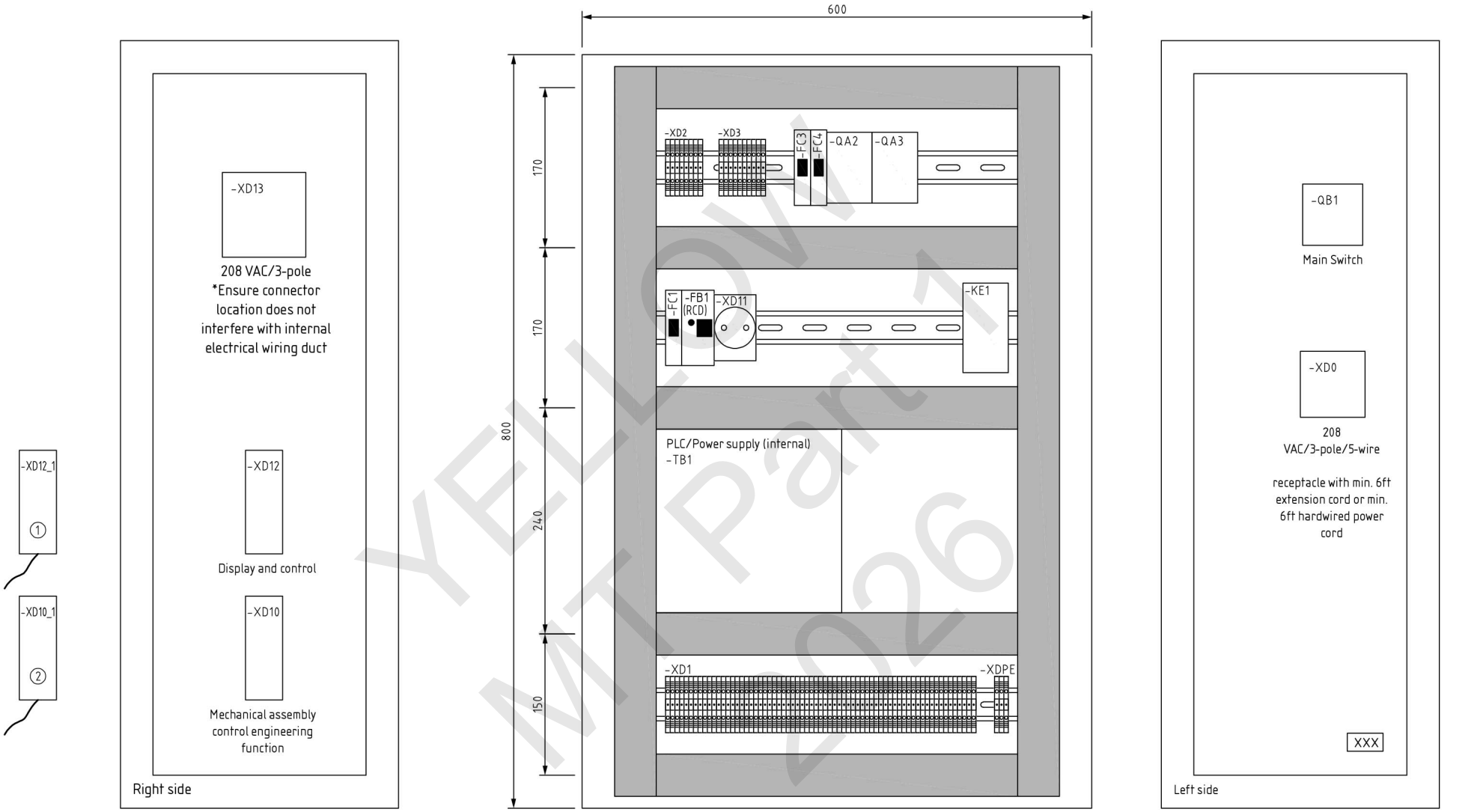
Pin 1: +24V

Pin 2: (not used)

Pin 3: 0 V

Pin 4: Signal

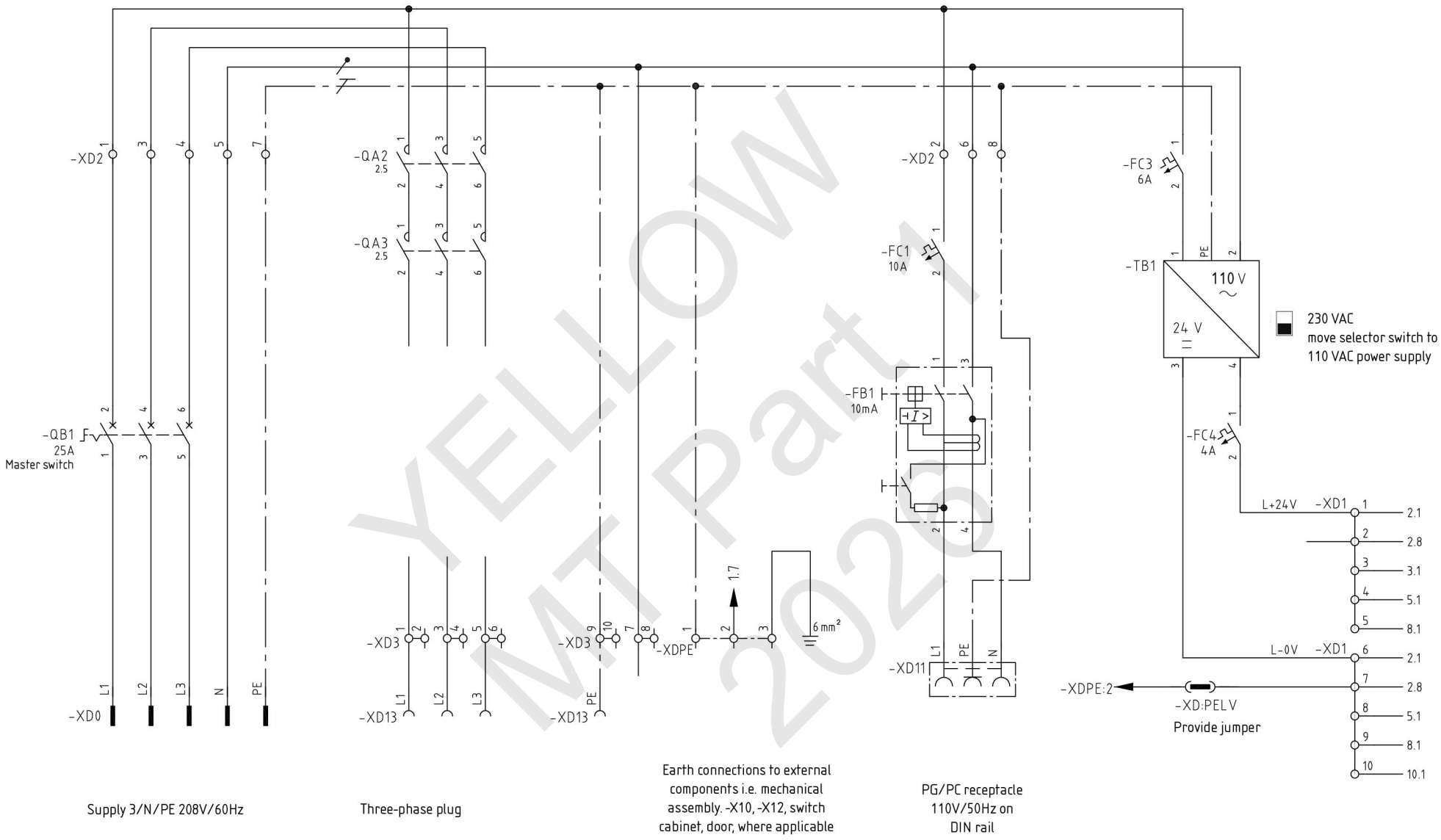


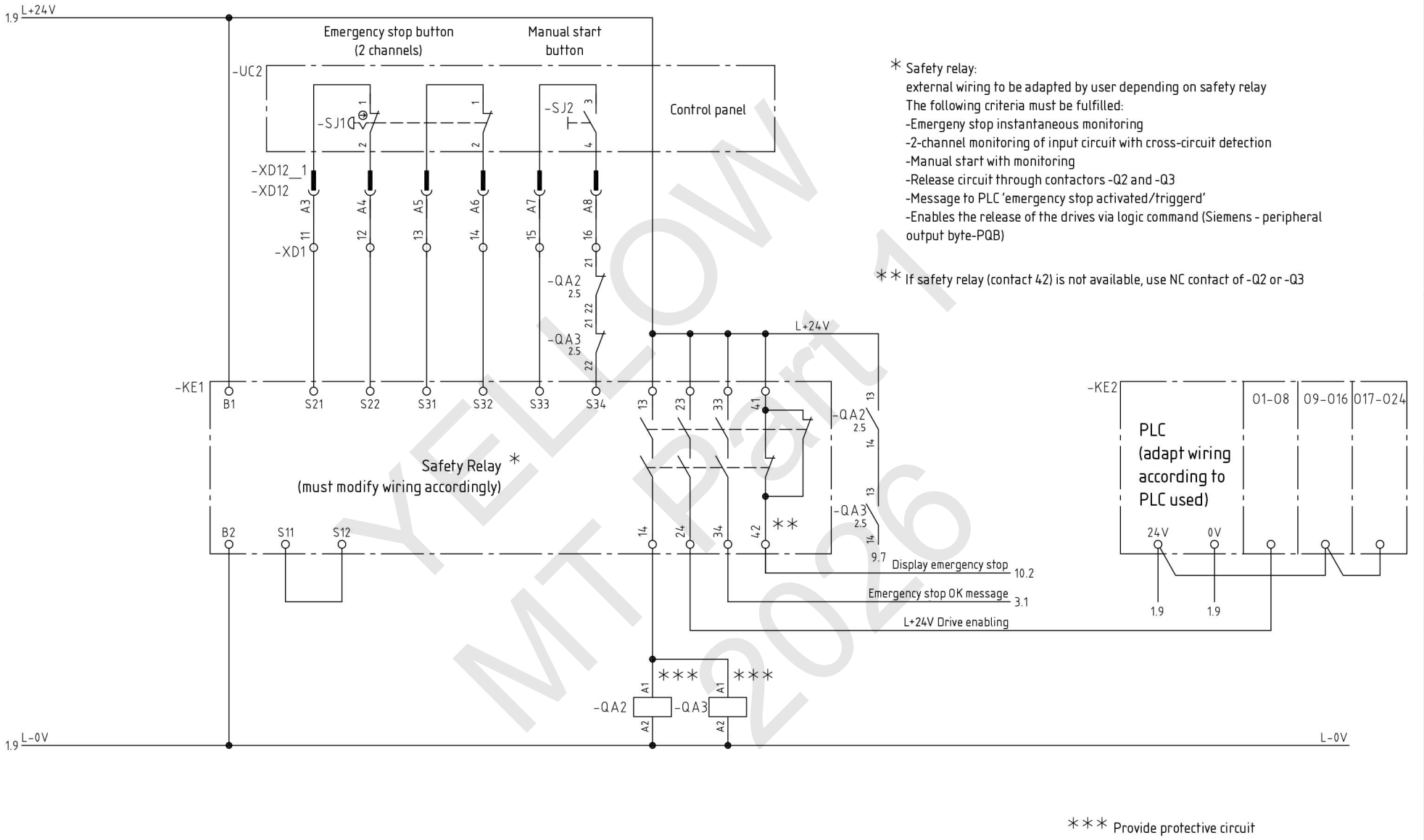


Note: - the image above shows a possible configuration of the switch cabinet
- adjust the positioning as needed

① plug connector - control/display unit (make sure not to mix these up)
② plug connector - mechanical assembly with control engineering function (make sure no to mix these up)

AHK	Final Examination Part 1 - 2026	Assembly Drawing			Sheet: 1(1)
	Mechatronics Technician				Page 23 of 47

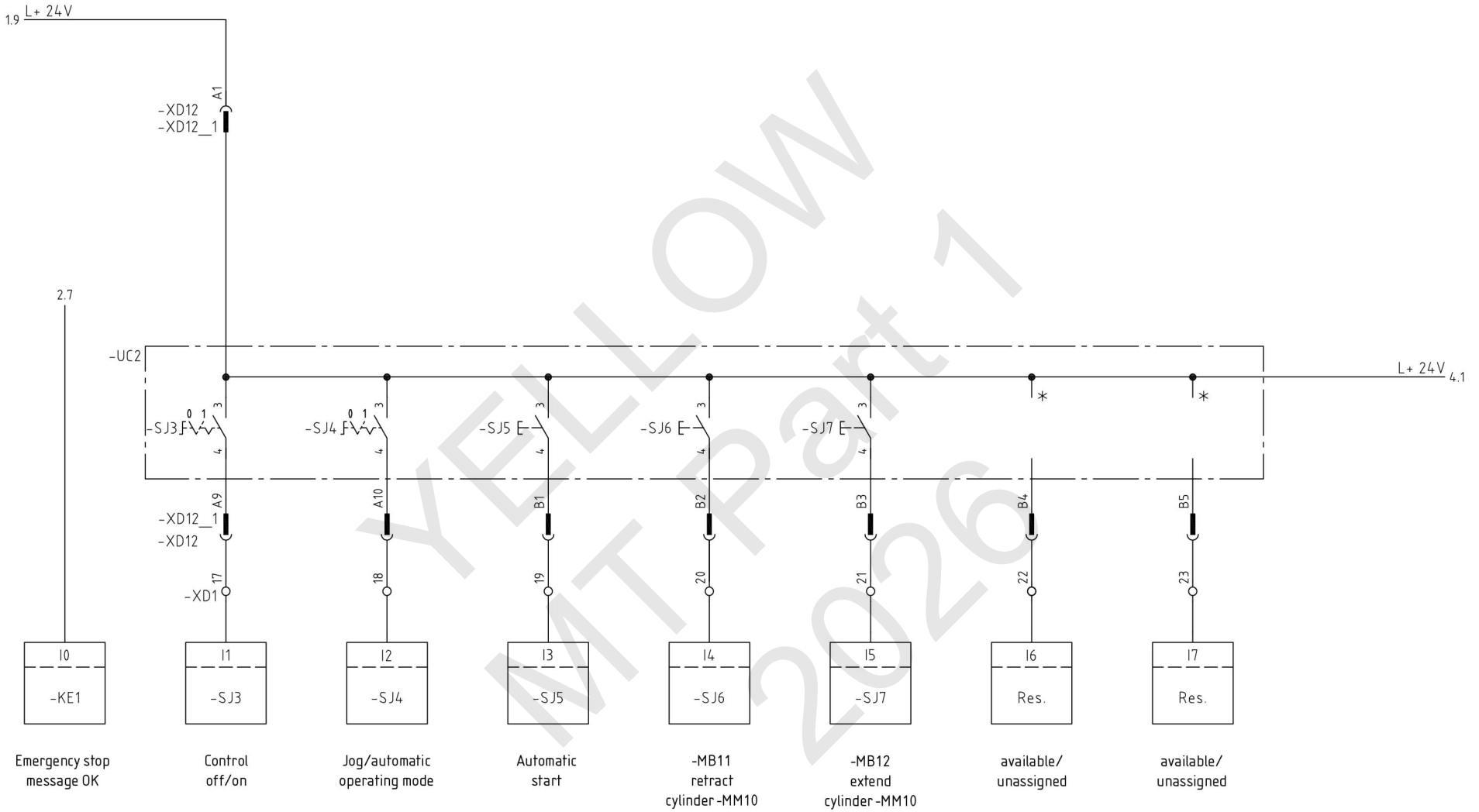


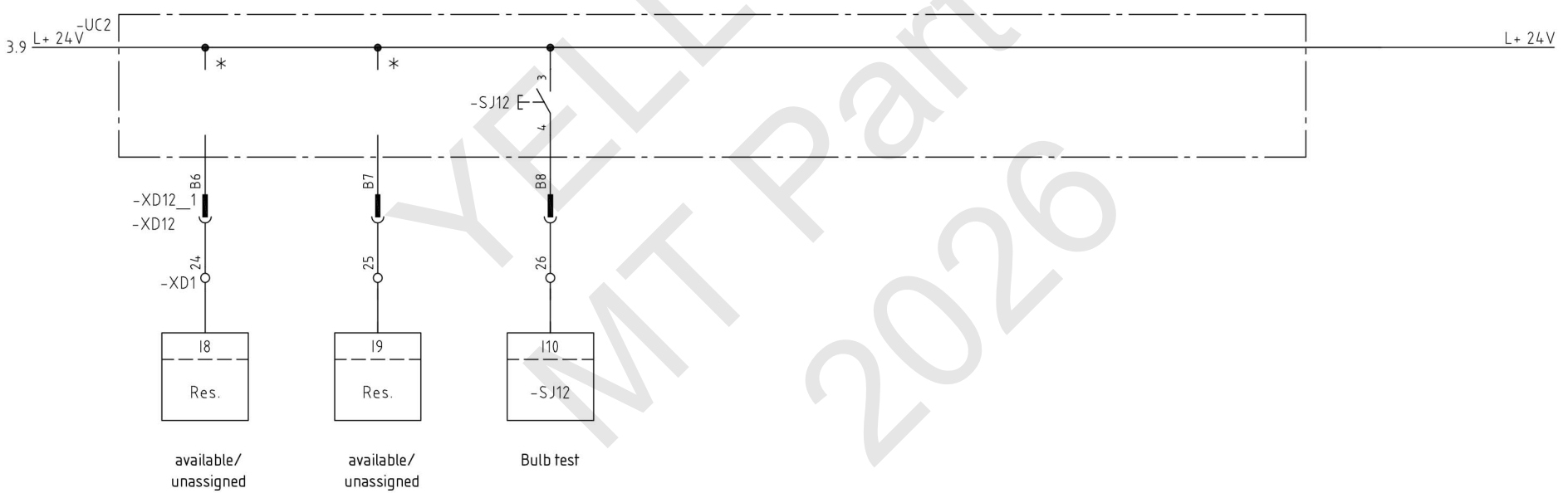


* Safety relay:
external wiring to be adapted by user depending on safety relay
The following criteria must be fulfilled:
-Emergeny stop instantaneous monitoring
-2-channel monitoring of input circuit with cross-circuit detection
-Manual start with monitoring
-Release circuit through contactors -Q2 and -Q3
-Message to PLC 'emergency stop activated/triggerd'
-Enables the release of the drives via logic command (Siemens - peripheral output byte-PQB)

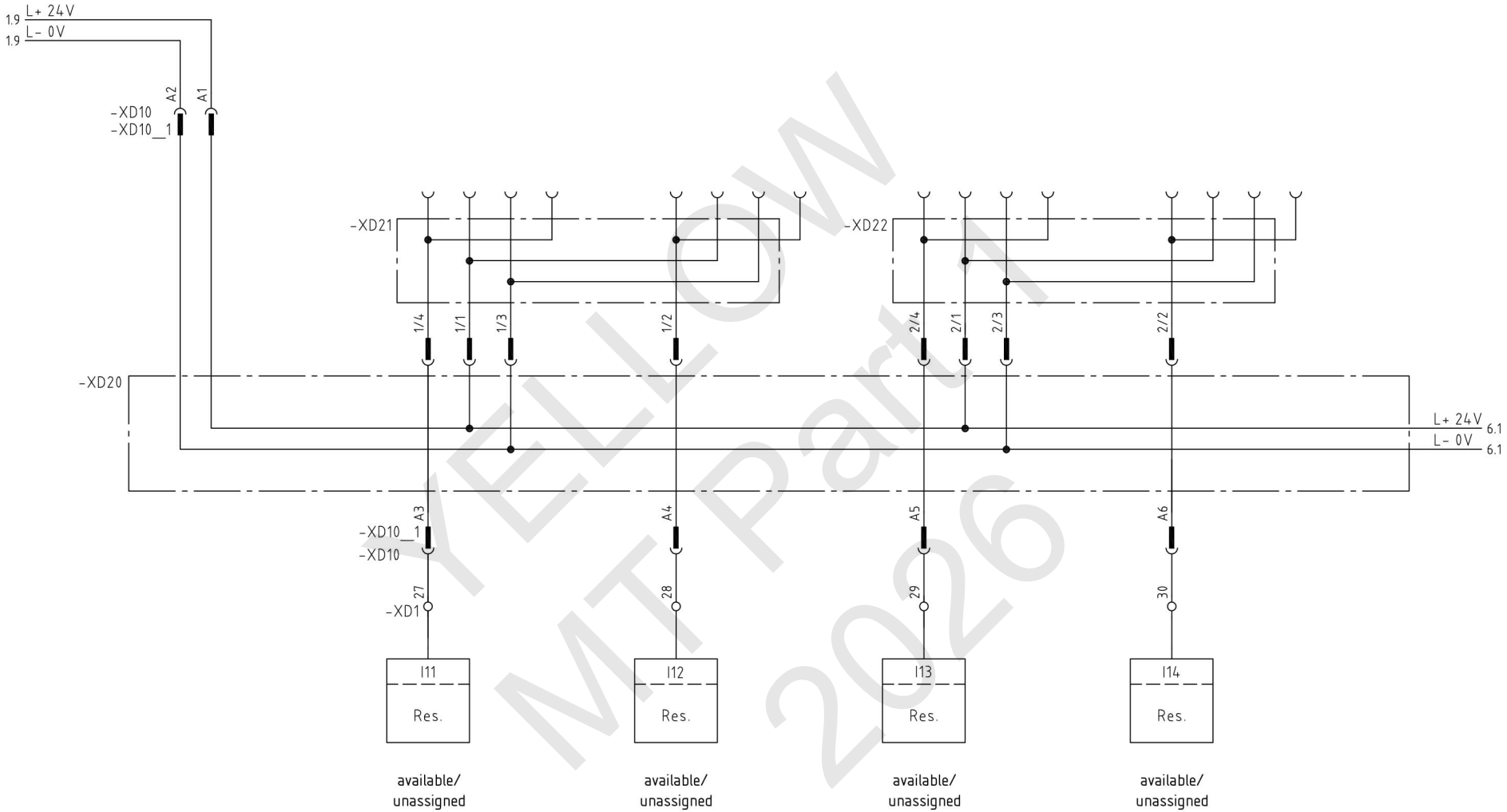
** If safety relay (contact 42) is not available, use NC contact of -Q2 or -Q3

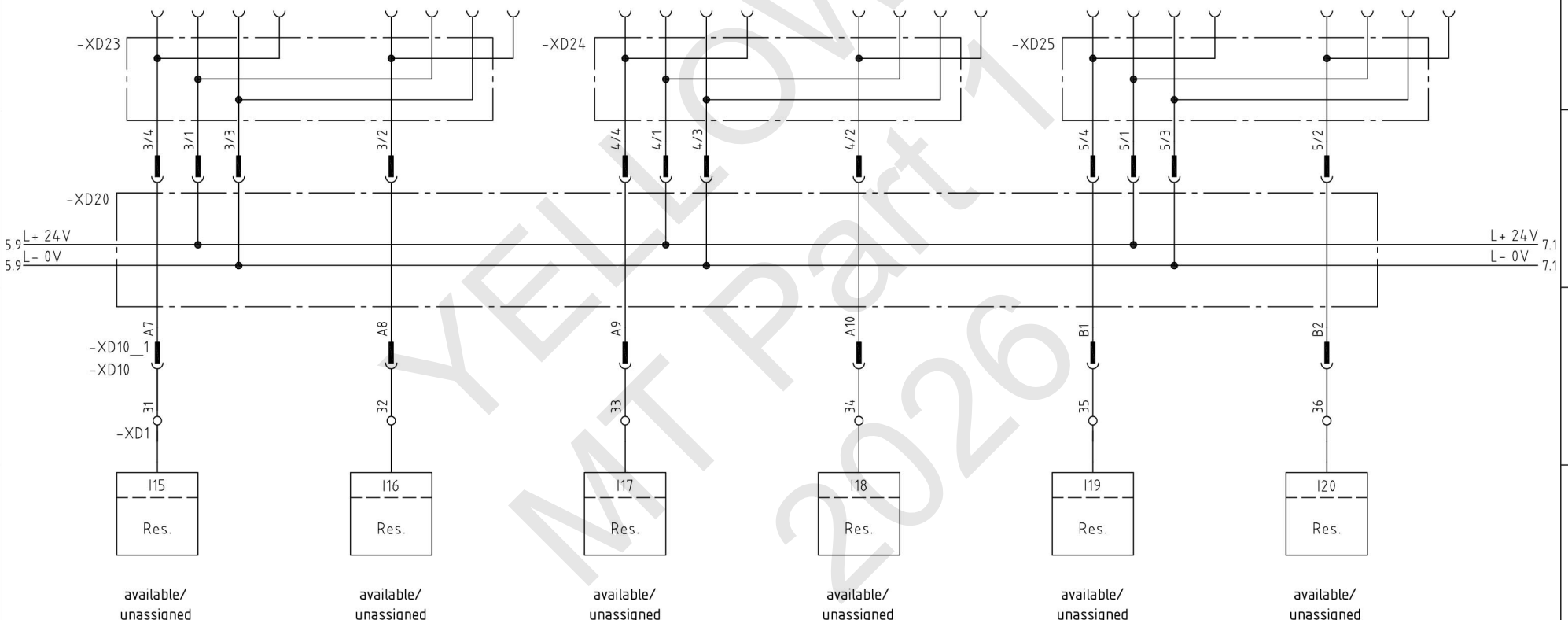
*** Provide protective circuit

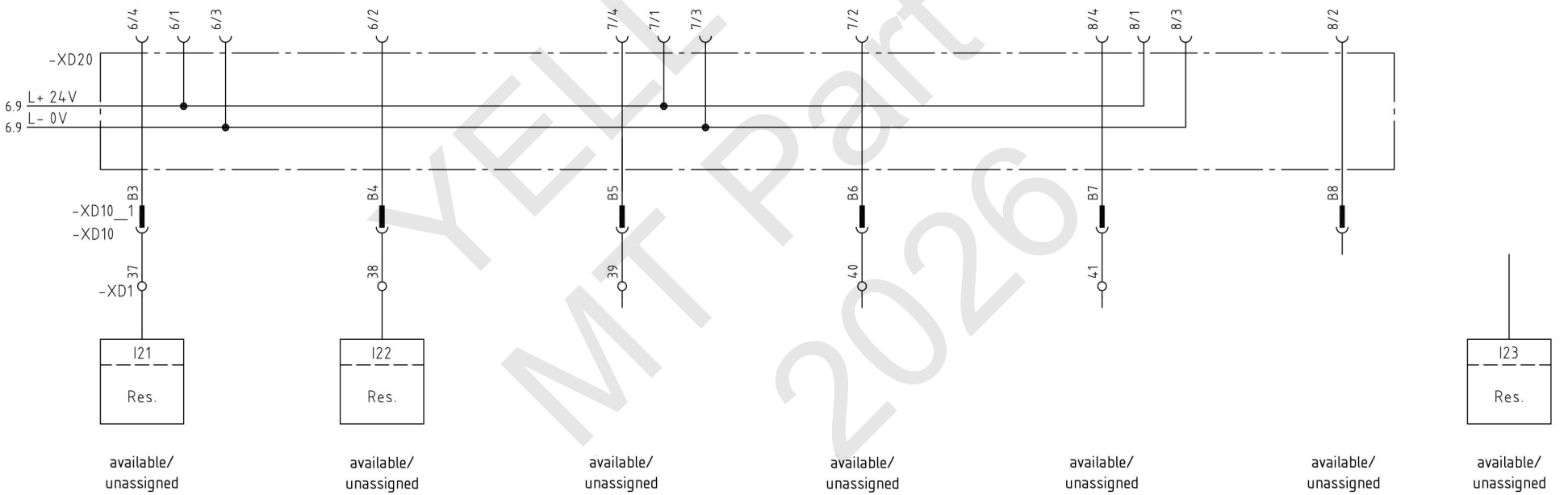


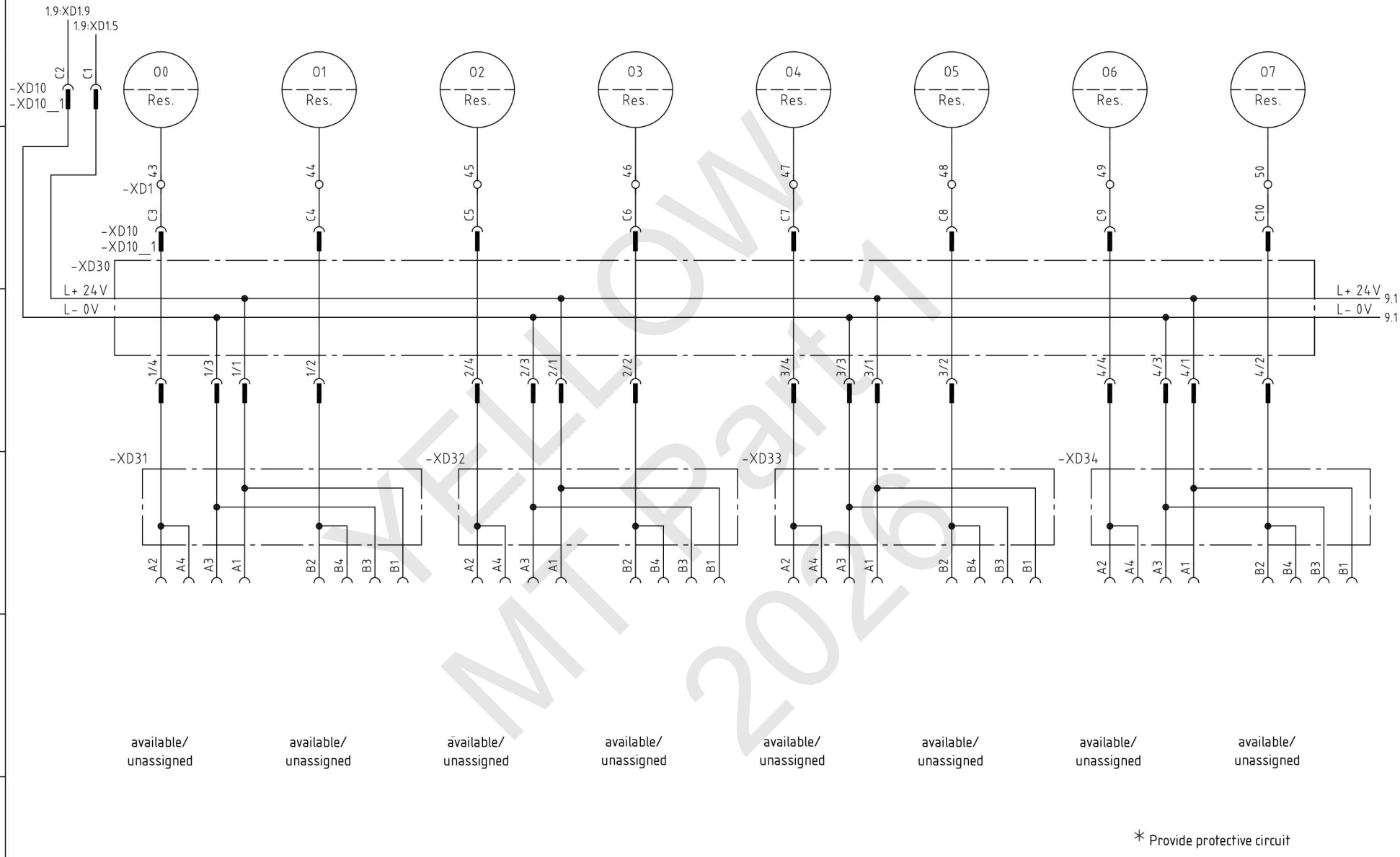


*Isolate end of wire

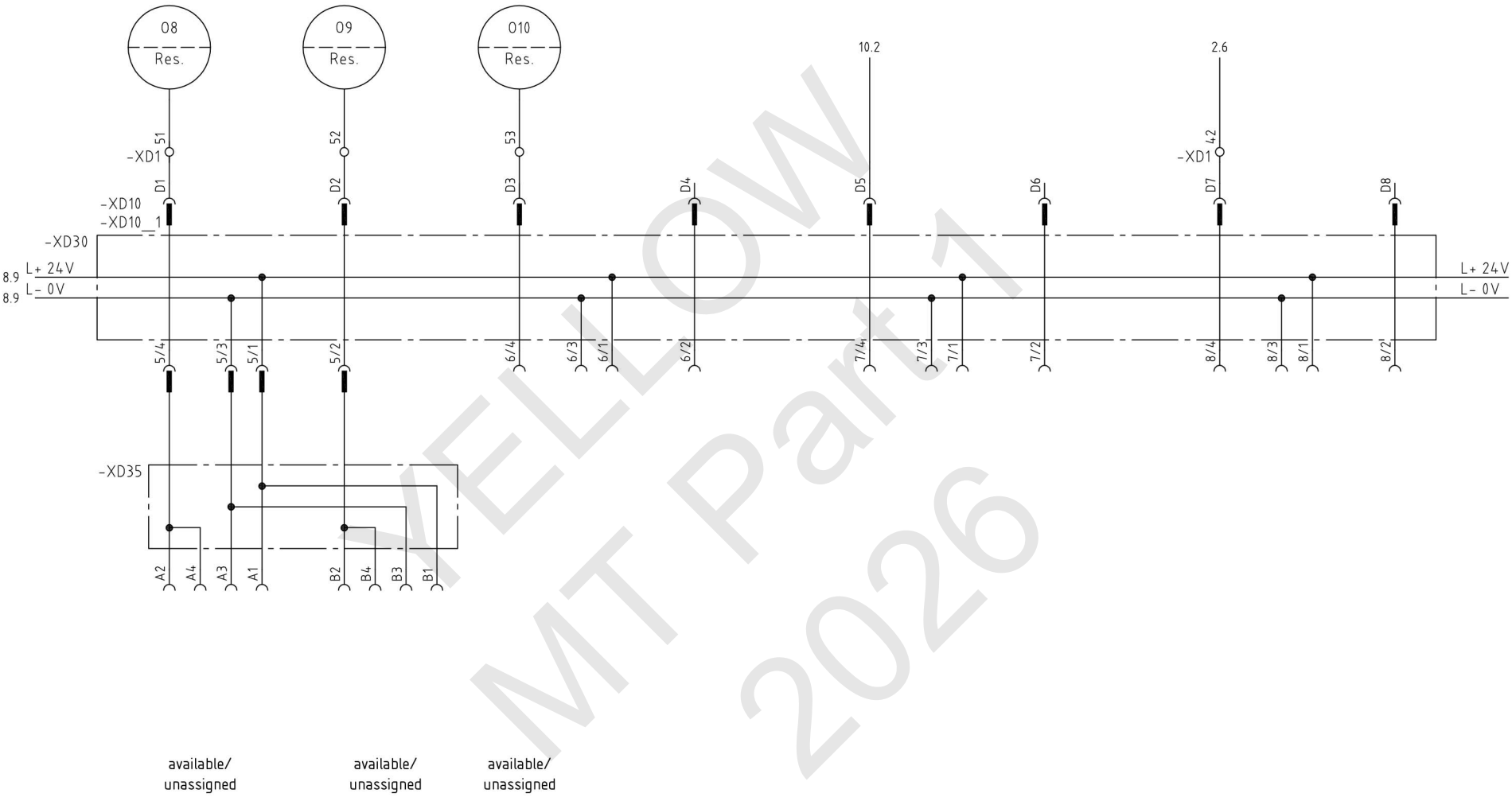


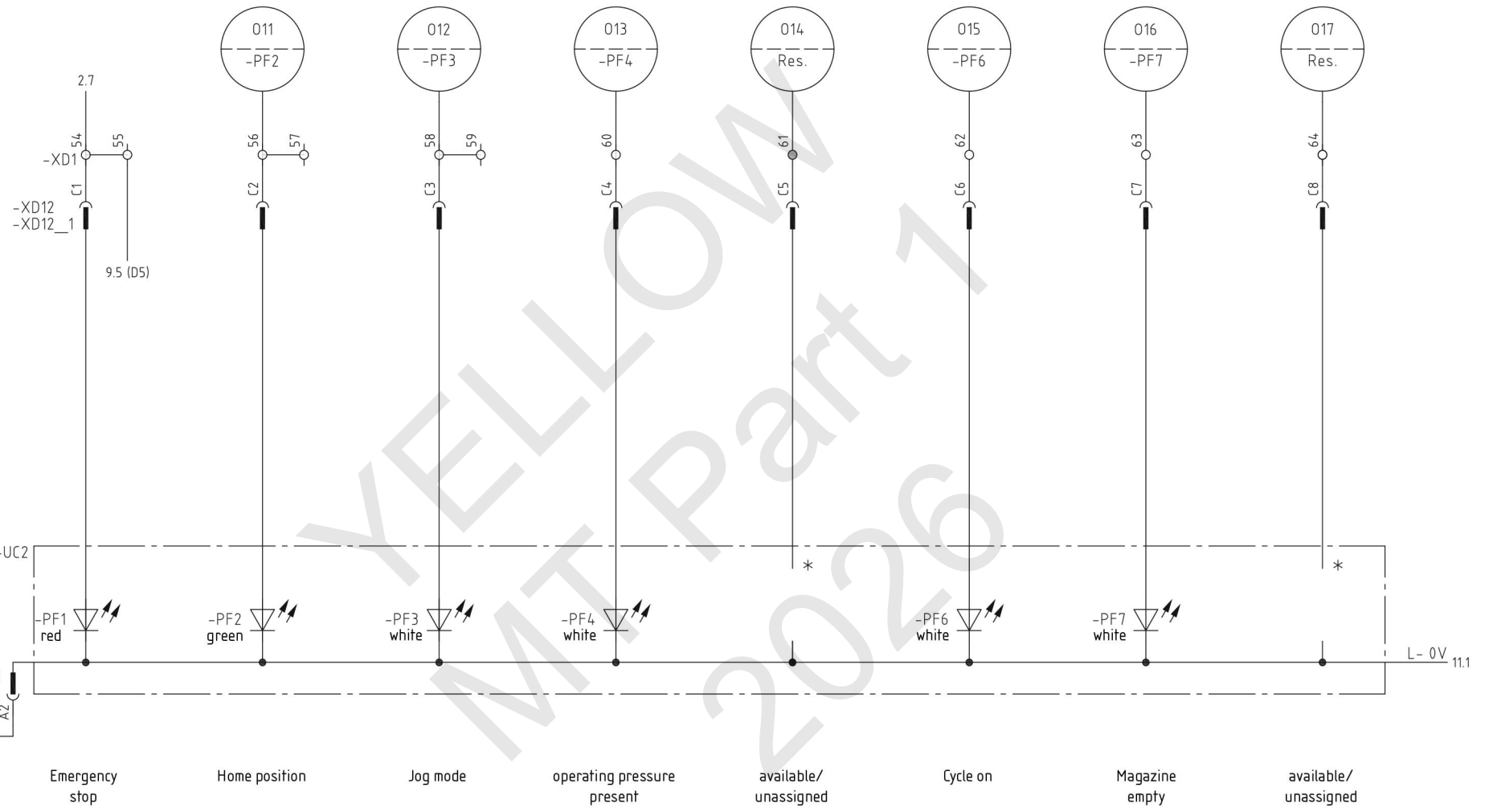




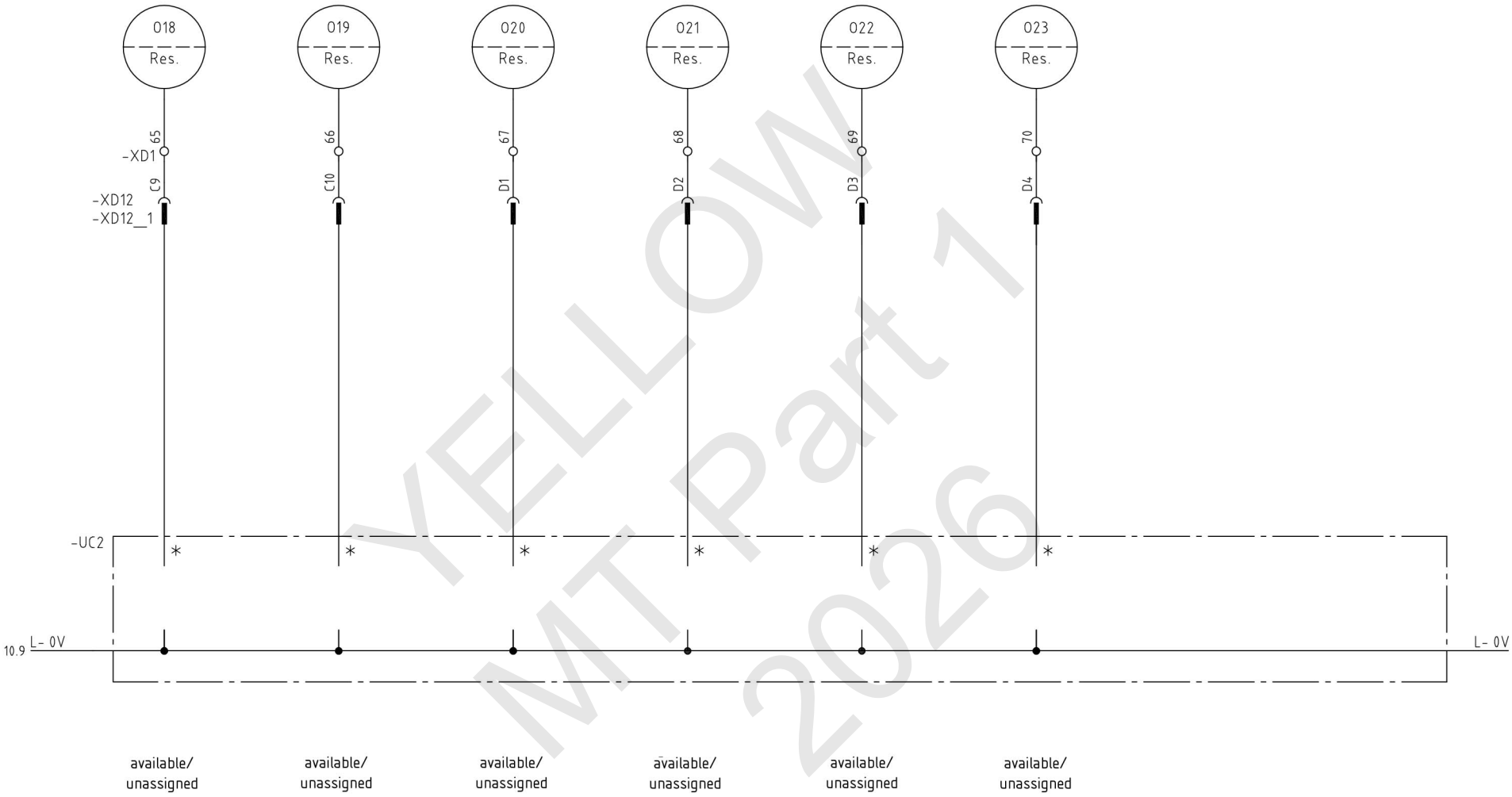


AHK	Final Examination Part 1 - 2026	Preparation		Sheet: 8(14)
	Mechatronics Technician			



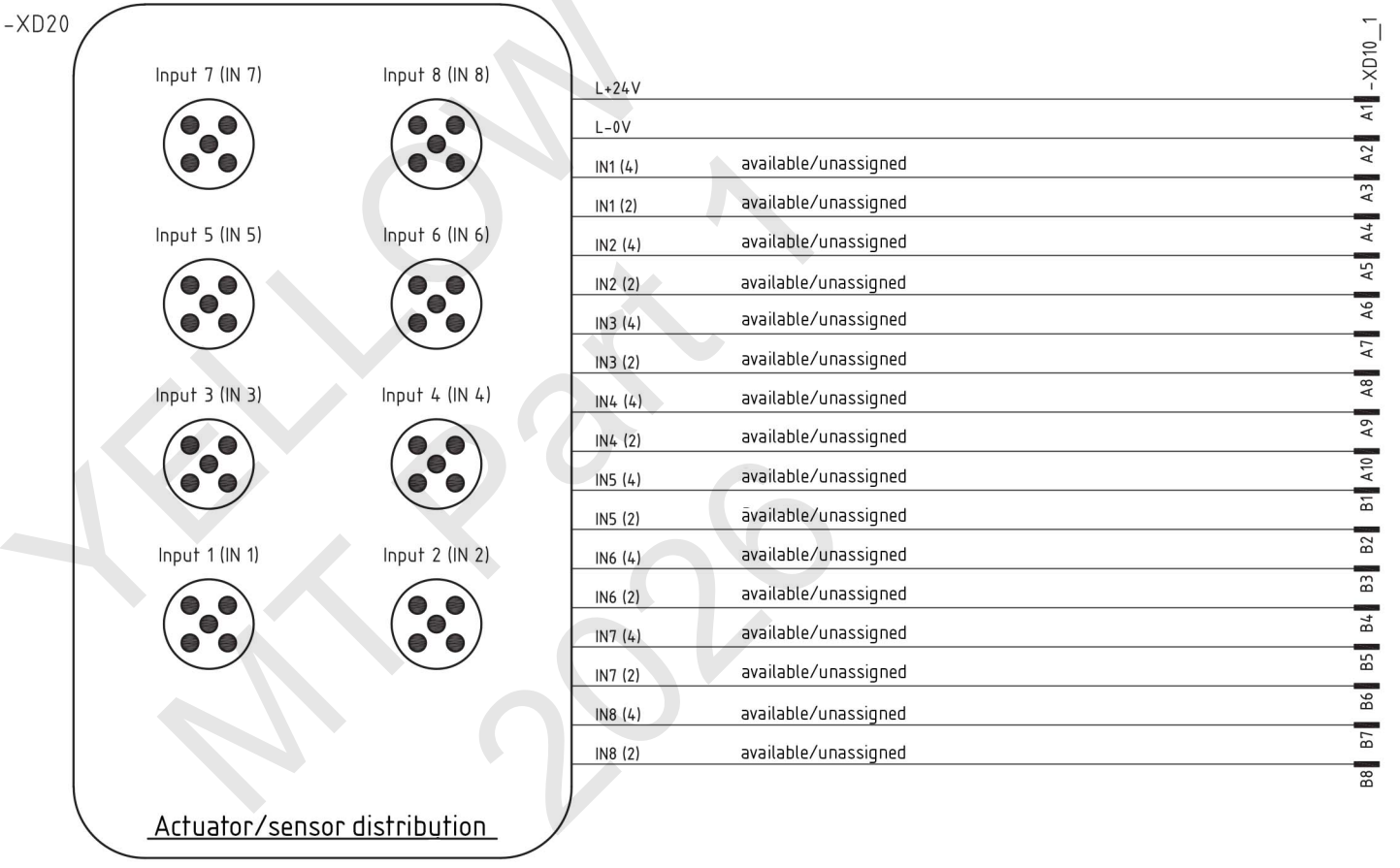


AHK	Final Examination Part 1 - 2026 Mechatronics Technician	Preparation		Sheet: 10 (14)

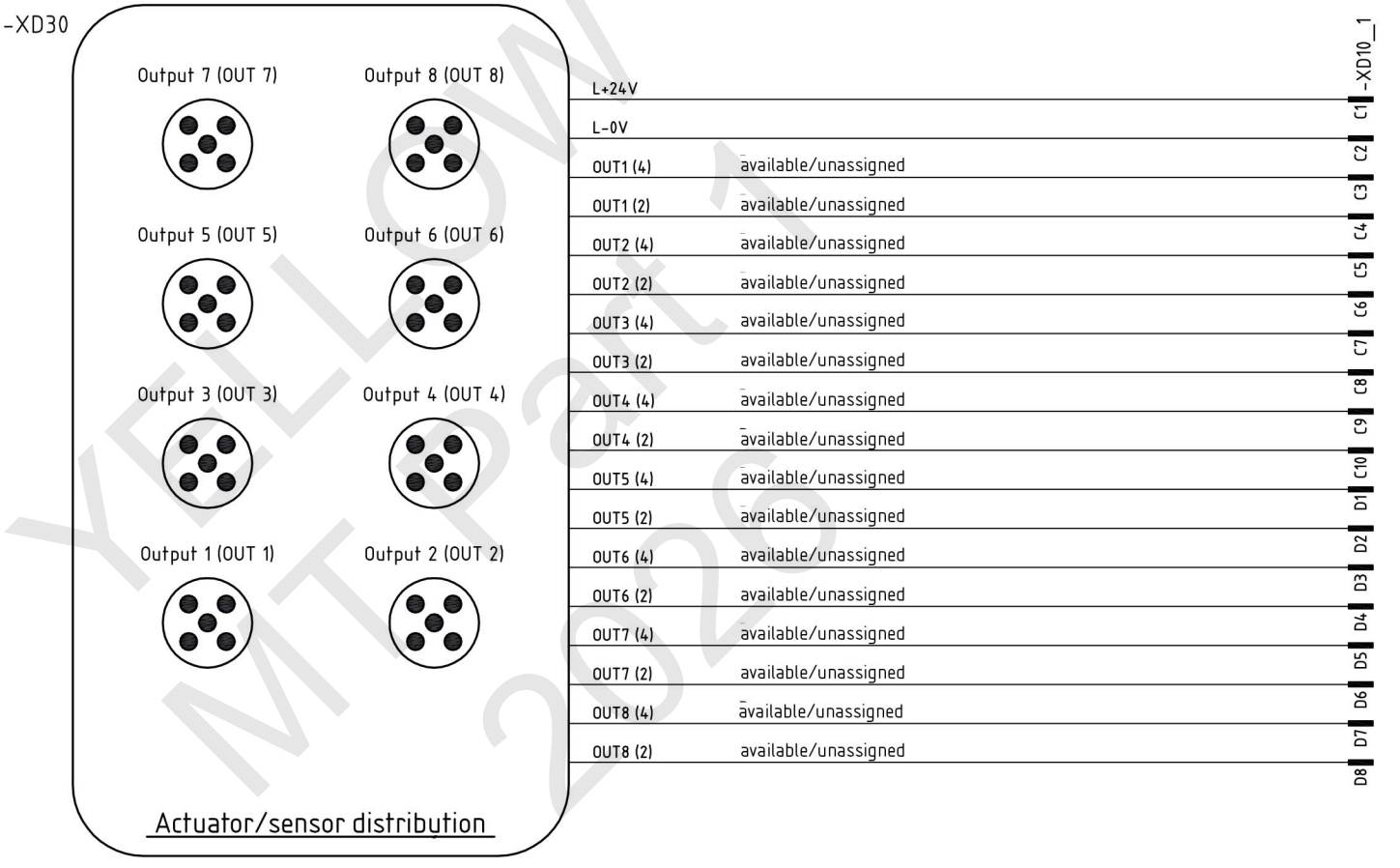


AHK	Final Examination Part 1 - 2026	Preparation		Sheet:11(14)
	Mechatronics Technician			

Sensors → mechanical subassembly



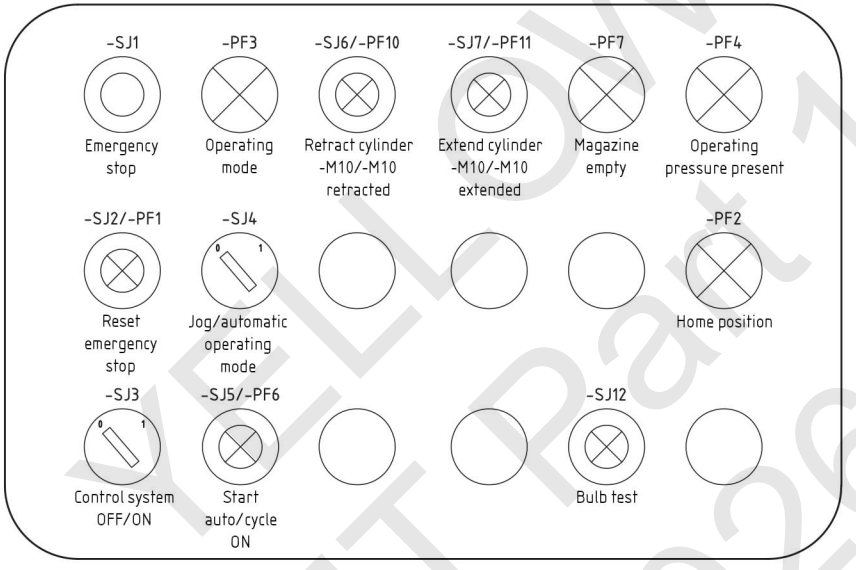
Actuators → mechanical subassembly



AHK	Final Examination Part 1 - 2026 Mechatronics Technician	Actuator/sensor distribution system			Sheet 13(14)

Display and control panel

-UC2



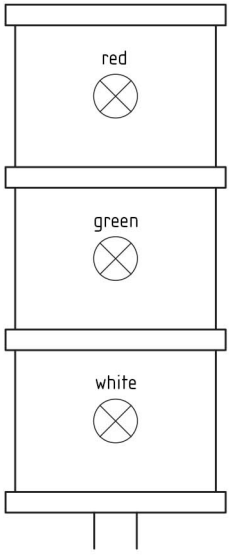
Note: Electical wiring is not shown!

Legend:

- Dummy plug
- Installation toggle
- Installation indicator lamp
- Installation illuminated
- Emergency stop

Stack light

-UA3



Note: The electrical connections are not shown!

AHK-USA Chicago

Final Examination Part 1 - 2026

Assignment **Functional Description**	**Mechatronics Technician**

1 General information

- Program the control system as described in the Grafcet and functional description
- Put the programmed control system into operation and test the function.
- If you added components not shown in the schematics or diagrams to test for functionality, remove them prior to exam day.
- The PLC assignment lists are meant to assist in allocation of the system-related operands. The operands will not be provided for you.
- **On examination day, bring your own program capable of all functions listed on the I/O list. No program will be provided.**

Functional description

I The mechatronics system, is turned “ON” by the main switch -QB1. If there is no fault in the emergency stop (-KE1=1) the main valve –MB9 is activated. Also all Flags, Counter and indicator lights will be reset. If the emergency stop is activated, the main valve -MB9 is not activated and -PF1 and -PF31 light up independently without the use of the PLC.

Using the toggle switch -SJ3, the control system is turned on, and all indicator lights show the current status of the system.

If pressure is present (-BP1>3.5 bar), switch -SJ4 is set to the "0" position, and motor starter overload fault -FC7=1 the system is in jog mode then indicator lights -PF3 and -PF32 light up.

In jog mode, the actuators can be controlled via the operating and control panel. A bulb test of the control panel can be performed by pressing -SJ12. -SJ12 does not illuminate.

II In the home position, -MM10 is retracted and -MM20 is extended. The magazine is loaded with at least one sorting block.

Load your magazine with sorting blocks in the following order: 23mm – 18mm – 23mm – 18mm…etc.

If switch -SJ4 is in position “1”, the system is in automatic mode. The automatic cycle is started by pressing-SJ5 While in automatic mode, indicator lights -PF3 and -PF32 will flash at the frequency of 1Hz.

After ejection from the magazine, the system sorts the parts into different chute paths depending on the height of the sorting block. The 18mm sorting block slides straight down. The 23mm high sorting blocks are guided into the other chute path by the diverter.

The sorting blocks are counted throughout the cycle. Once a quantity of 5 sorting blocks is reached the automatic cycle is complete. Light -PF33 illuminates to indicate “Quantity reached” and light -PF7 illuminates to indicate magazine empty, ending the automatic cycle.

To restart the automatic cycle, the magazine must be refilled and activated by pressing -SJ5

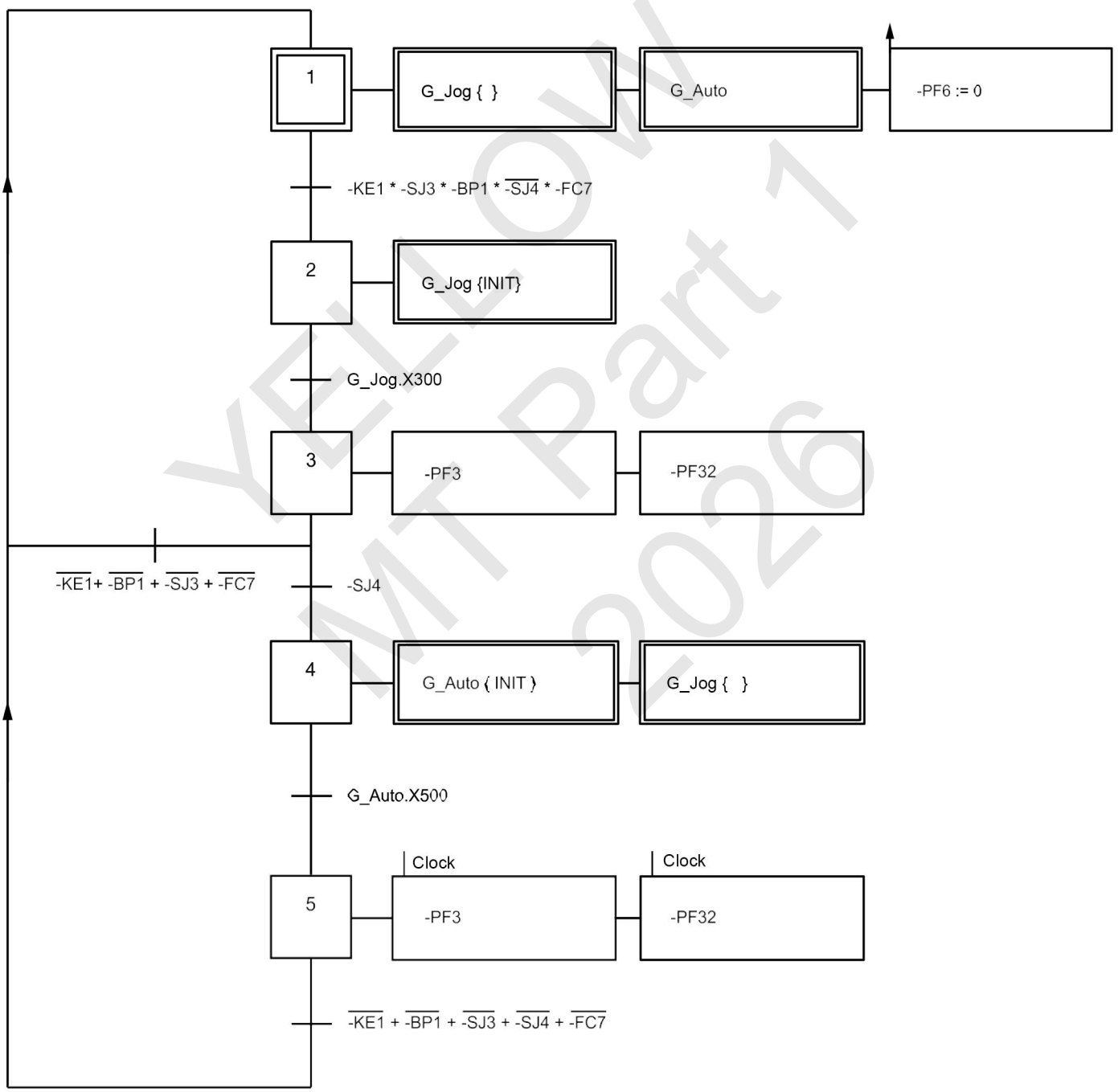
The system stops when the emergency stop button is activated, when there is a loss of compressed air, or when "motor starter overload fault" or “control off” is triggered.

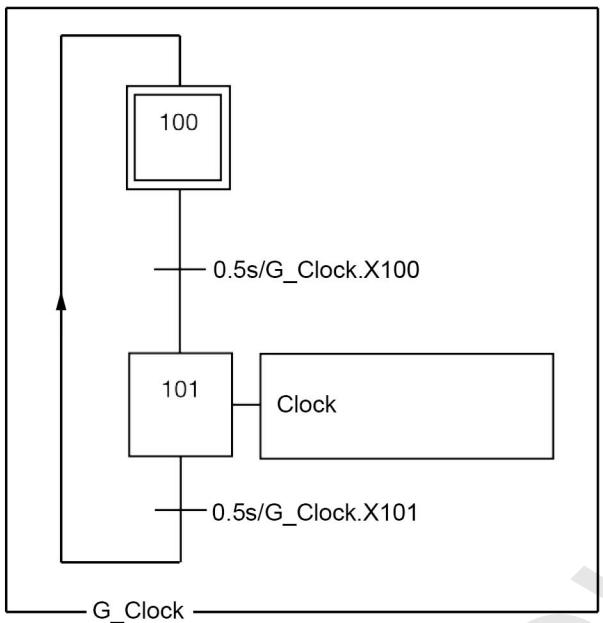
Work Task Function according to Grafcet	Mechatronics Technician

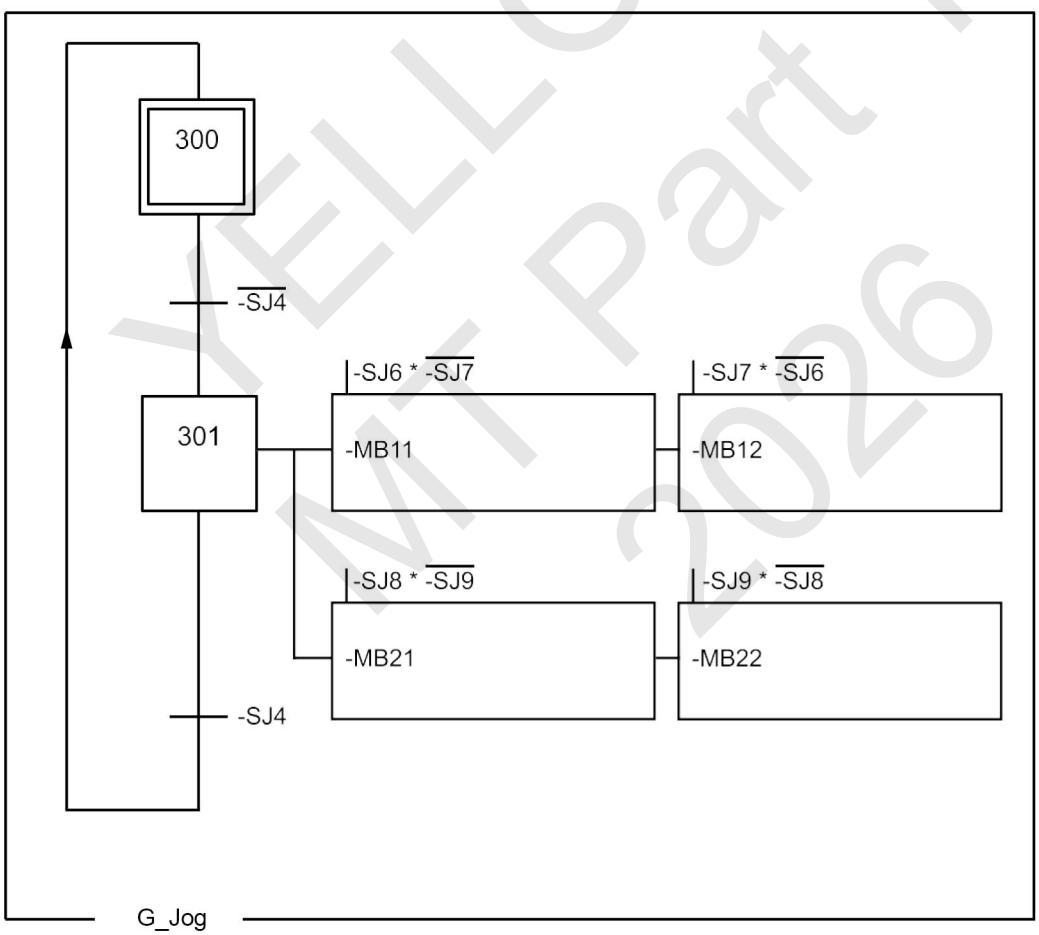
3 General

The process illustrated below is to be programmed into the control technology provided by the training company. This includes implementing the flow chart illustrated in 3.1 in the appropriate programming language. The program should be tested prior to the examination to ensure it is functioning correctly. No additions should need to be made on the day of the exam.

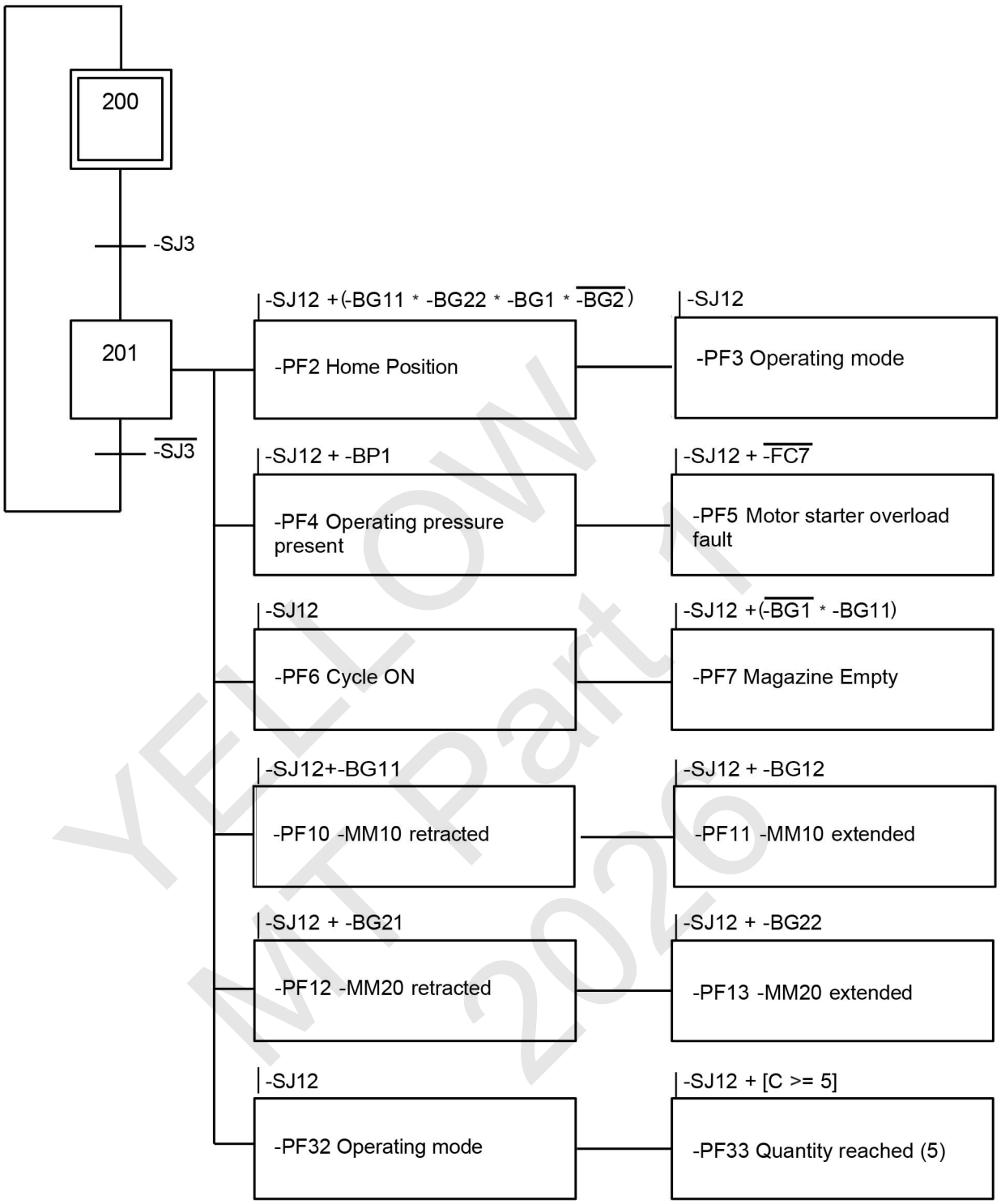
3.1 Flow chart based on GRAFCET

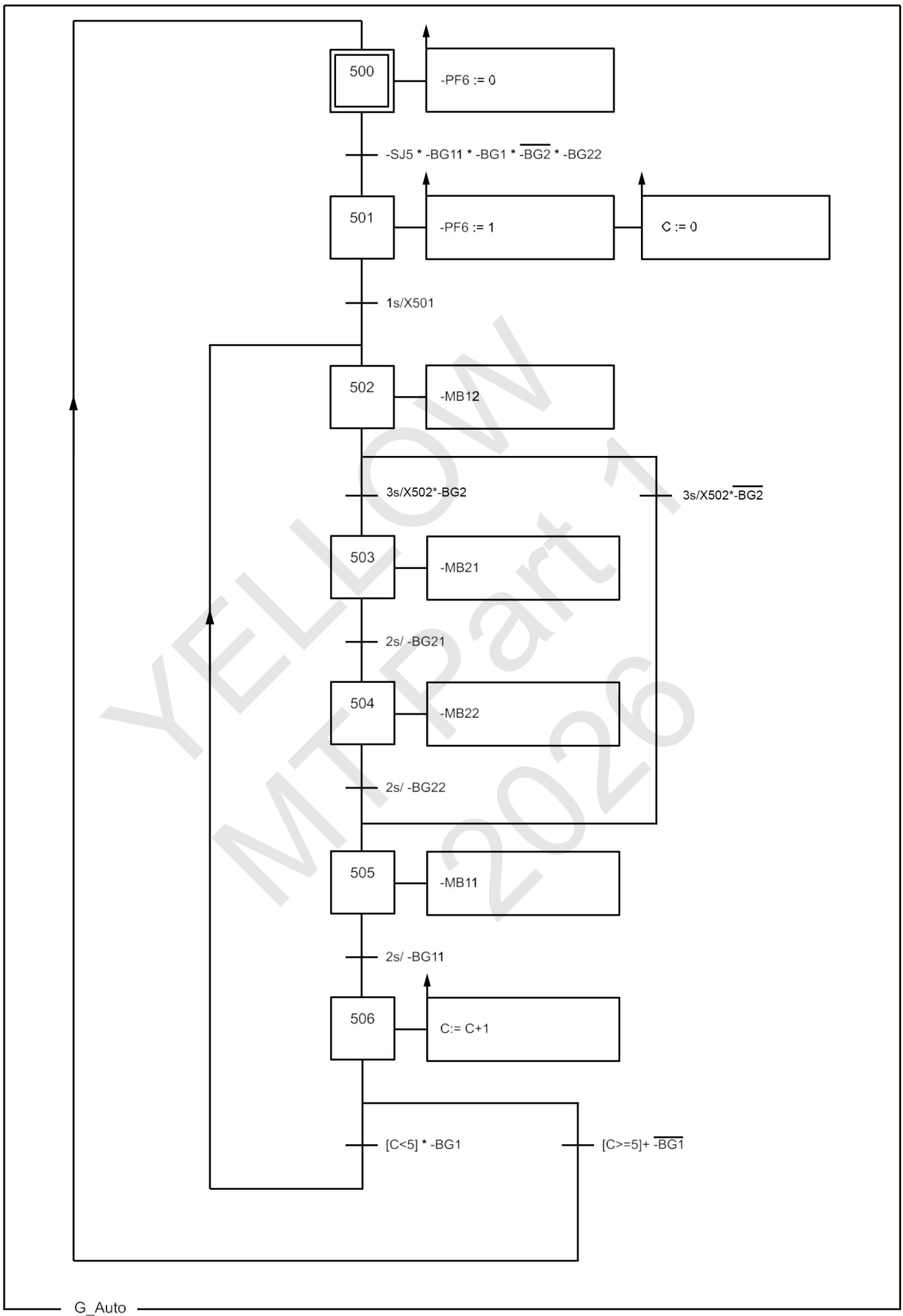






Continued on next page →





AHK-USA Chicago

Final Examination Part 1 - 2026

PLC **Input assignment list**	**Mechatronics Technician**

System related operands are to be entered here.

Inputs	Operand	Equipment identifier	Function
I0		-KE1	Emergency stop message ok
I1		-SJ3	Control system ON/OFF
I2		-SJ4	Mode: Jog/automatic mode
I3		-SJ5	Start automatic mode
I4		-SJ6	Cylinder -MM10 retract
I5		-SJ7	Cylinder -MM10 extend
I6		-SJ8	Cylinder -MM20 retract
I7		-SJ9	Cylinder -MM20 extend
I8		–	–
I9		–	–
I10		-SJ12	Bulb test
I11		-BP1	Operating pressure present
I12		-BG1	Material recognition Magazine
I13		-BG2	Material recognition Stopper
I14		–	–
I15		-BG11	Cylinder -MM10 retracted
I16		-BG12	Cylinder -MM10 extended
I17		-BG21	Cylinder -MM20 retracted
I18		-BG22	Cylinder -MM20 extended
I19		–	–
I20		–	–
I21		–	–
I22		–	–
I23		-FC7	Motor starter overload fault ok
I24		–	–
		-SJ1	Emergency Stop
		-SJ2	Manual start, emergency stop reset for -KE1
		–	–

AHK-USA Chicago

Final Examination Part 1 - 2026

PLC **Output assignment list**	**Mechatronics Technician**

System related operands are to be entered here.

Outputs	Operand	Equipment identifier	Function
O0		-MB11	Cylinder -MM10 retract
O1		-MB12	Cylinder -MM10 extend
O2		-MB21	Cylinder -MM20 retract
O3		-MB22	Cylinder -MM20 extend
O4		–	–
O5		–	–
O6		–	–
O7		–	–
O8		-PF32	Operating mode
O9		-PF33	Quantity reached (5)
O10		–	–
O11		-PF2	Home position
O12		-PF3	Operating mode
O13		-PF4	Operating pressure present
O14		-PF5	Motor starter overload fault
O15		-PF6	Cycle ON
O16		-PF7	Magazine empty
O17		–	–
O18		-PF10	Cylinder -MM10 retracted
O19		-PF11	Cylinder -MM10 extended
O20		-PF12	Cylinder -MM20 retracted
O21		-PF13	Cylinder -MM20 extended
O22		–	–
O23		–	–
O24		–	–
		-PF31	Emergency stop message (stack light)
		-MB9	Main Valve -QM9

AHK-USA Chicago

Final Examination Part 1 - 2026

Assignment **Evaluation of Protective Conductor for Safety**	**Mechatronics Technician**

To ensure the electrical safety of the equipment and plant, proper functionality of the protective measures must be be checked. In an electrical installation in the TN system, the overcurrent protection devices should in the case of a short circuit between active parts turn off as well as prevent the prolonged exposure of dangerous contact voltage in the case of contact with earth or a body. (pg 209/210)

If, in addition to the overcurrent protective devices, a residual current device (RCD) or GFCI is installed in the system, checking the protection by automatic shutdown is not mandatory, rather checking the continuity and low impedance of the protective conductor is required.

While preparing to commission the mechatronic subsystem during your exam, be ready to check the continuity and verify there is low impedance in the protective earth conductor.

Note:
According to the DIN VDE 0100-600 standard, after the installation, retrofit or repair of an electrotechnical system a PE conductor test must be carried out before start up of the system. This is carried out in a de-energized state. The measured values must be recorded.

The measured current must be at least 200 mA at 4-24 V. You will need to measure the resistance of conductive, touchable parts (e.g. assembly grid, control panel, protective conductor connection of a socket outlet) and the potential of a short (and the protective conductor connection at -X11 during the test).

In order to be able to make an assessment, the expected resistance values must be calculated.
To calculate the expected resistance, you can use the conductor resistance values according to Table 1 (next page). At each terminal point, a maximum contact resistance of 10 mΩ applies.

Example:
Calculation of the expected resistance of the protective conductor between the PE contact on the main power cord to outlet -X13:

Conductor cross-section	1.5 mm^2
Conductor length NEMA L21-20P plug to -X2	0.6 m
Conductor length -X2 to -X13	0.5 m
Terminal points (1 NEMA L21-20 plug, 2x -X2:7, 2x -X3:9, -X13:PE)	6

Conductor resistance:	R_1 = 1.1 m x 12.575 5 mΩ/m	= 13.833 mΩ
Terminal resistance:	R_2 = 6 x 10 mΩ	= 60 mΩ
Total resistance to ground:	R_{PE} = 13.833 mΩ + 60 mΩ	= 73.833 mΩ

AHK-USA Chicago

Final Examination Part 1 - 2026

Assignment **Evaluation of Protective Conductor for Safety**	**Mechatronics Technician**

Task:
To assess the low impedance of the protective conductor, you must compare the calculated resistance values with the measured values during the test and decide whether the measured value is safe.
Calculate the expected resistance of the protective conductor for the following. First determine the cable length and the number of terminal points. Remember at each terminal point, a maximum contact resistance of 10 mΩ applies and use Table 1 below for additional variable information.

Ground wire continuity	Conductor Length	Number of terminal points	Calculated Resistance Value
PE contact on main power cord to electrical cabinet			
PE contact on main power cord to assembly grid			
PE contact on main power cord to switch cabinet door			
PE contact on main power cord to outlet -X13			
PE contact on main power cord to power supply unit			
PE contact on main power cord to -X1.7 PELV			
PE contact on main power cord to control panel			
PE contact on main power cord to mechanical assembly			

TABLE 1:

Nominal Conductor cross section S mm^2	Conductor resistance R^I at 30 °C (86 °F) mΩ/m
1.5	12.575 5
2.5	7.566 1
4	4.739 2
6	3.149 1
10	1.881 1

The conductor resistance values refer to conductor temperatures of 30 °C (86 °F). For other temperatures of Θ the conductor resistances R_Θ can be calculated with the following equation:

$$R_\Theta = R_{30\,°C}\,[1 + \alpha \cdot (\Theta - 30\,°C)]$$

α temperature coefficient (for copper $\alpha = 0.003\,93\ K^{-1}$).

*Select conductor resistance loadings R^I for copper conductors at 30 °C depending on the nominal conductor cross-section S for a rough calculation of conductor resistances (source: VDE 0100-600 Table NA.4 - excerpt).

Important excerpts from the preparation material

Tools/Equipment:

If your examination is not taking place at your training company, you will receive a list of tools prior to the examination that must be brought to the testing site. If the exam is taking place at the training company all materials listed should be available during the exam.

This booklet and the "Standard material staging list" lists additional testing equipment that is required for test preparation**. Unused items in the standard material staging list must be brought in by the test taker in functional condition on the day of the exam.**

Pneumatics:

The plumbing of the pneumatic system is part of the execution or test phase of the examination.

Only prepare Item No. 1-8 which are shown in the diagram on page 8, do not add any other hoses for preparation. If you added any parts to check functionality, they must be removed before the day of the examination. Only items 1-8 should be set up as shown in the diagram.

Electronics:

Only wire what is shown in the schematics, do not add any parts that are not shown in the schematics.

Mechanical Assembly:

While you may use parts from a previous exam, DO NOT assume that you have all parts from a previous exam. Check all material required and check all blueprints provided to ensure that you have all pieces according to dimensions and that they are prefabricated according to the provided drawings! You must order and fabricate anything that you do not already have. Parts 8.2, 8.3, 15, 16 on the product list below will be modified on exam day and evaluated for accuracy, therefore each test taker needs his or her own material cut to size and prefabricated according to the corresponding drawings. Numbers 8.2, 8.3, 15, and 16 below cannot be shared or reused on exam day

PLC

The PLC assignment lists are meant to assist in allocation of the system-related operands. The operands will not be provided for you. On examination day, bring your own program capable of all functions listed on the I/O list. Complete your own program with the proper inputs and outputs and bring to the exam. No program will be provided. If you added components not shown in the schematics or diagrams to test function, remove them prior to exam day.