



**Politecnico
di Torino**

Politecnico di Torino

Corso di Laurea Mechanical Engineering
A.a. 2020/2021
Sessione di Laurea Ottobre 2021

Design of a test bench for the flow ripple determination in positive- displacement hydraulic pumps

ANNEX

DRAWINGS

Relatori:

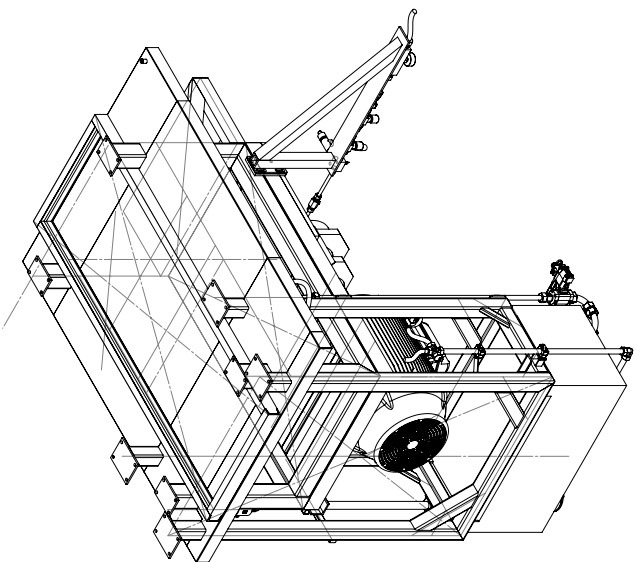
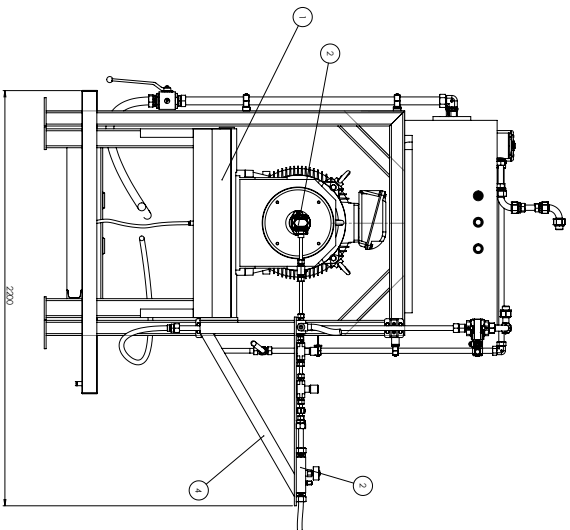
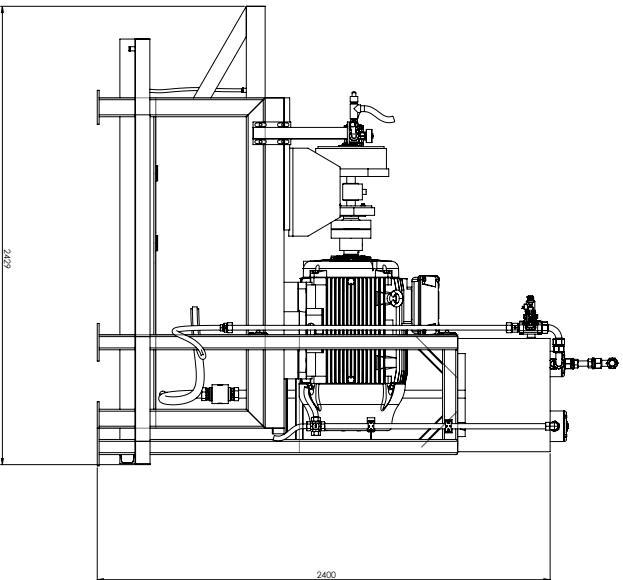
Daniela Misul
Miquel Torrent Gelrà

Candidato:

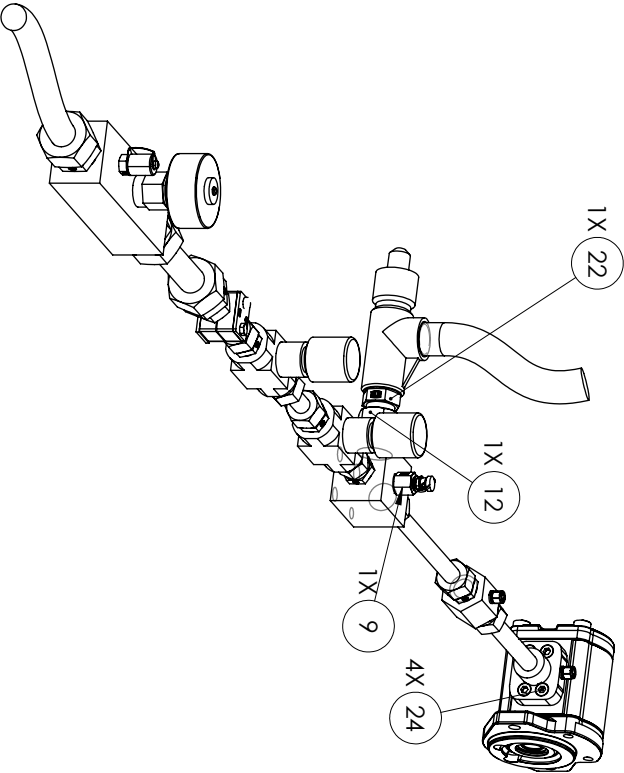
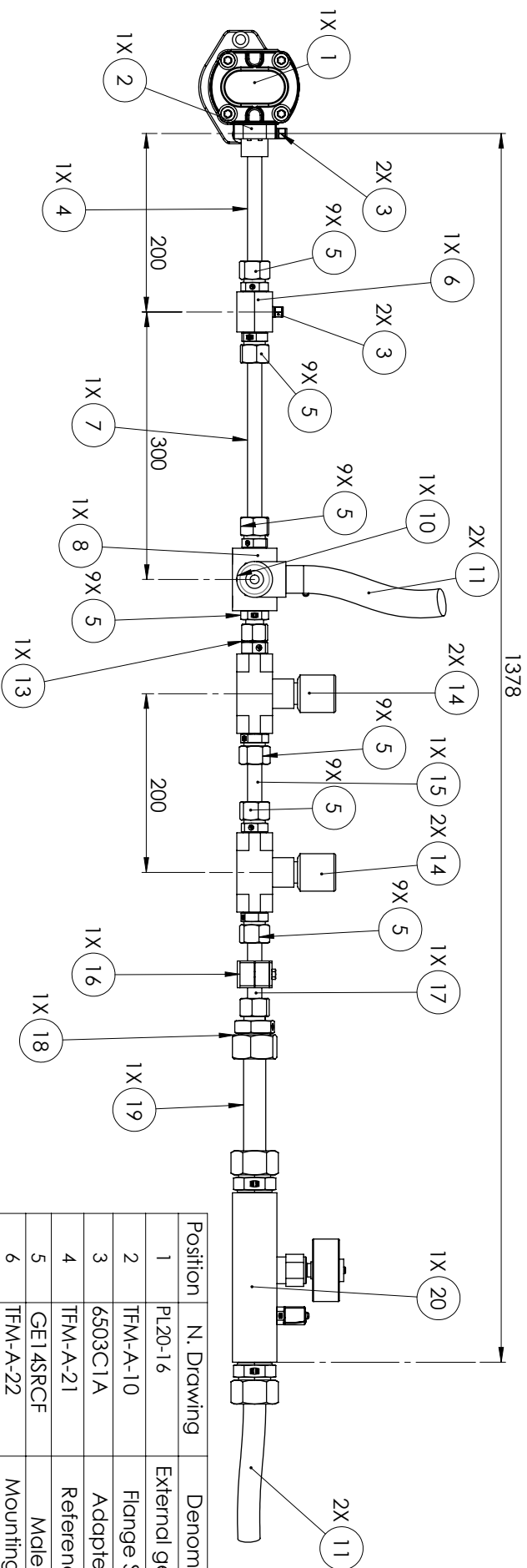
Andrea Gallo

1. List of Drawings

1. TFM-A-1 TEST BENCH KIT A
2. TFM-A-10 KIT A
3. TFM-A-20 FLANGE
4. TFM-A-21 REFERENCE PIPE
5. TFM-A-22 MOUNTING BLOCK 1
6. TFM-A-23 CONNECTING PIPE
7. TFM-A-24 MOUNTING BLOCK 2
8. TFM-A-25 EXTENSION PIPE
9. TFM-A-26 STEEL PIPE
10. TFM-B-1 TEST BENCH KIT B
11. TFM-B-10 KIT B
12. TFM-B-20 FLANGE
13. TFM-B-21 REFERENCE PIPE
14. TFM-B-22 MOUNTING BLOCK 1
15. TFM-B-23 CONNECTING PIPE
16. TFM-B-24 MOUNTING BLOCK 2
17. TFM-B-25 EXTENSION PIPE
18. TFM-B-26 STEEL PIPE
19. TFM-C-1 TEST BENCH KIT C
20. TFM-C-10 KIT C
21. TFM-C-20 FLANGE
22. TFM-C-21 REFERENCE PIPE
23. TFM-C-22 MOUNTING BLOCK 1
24. TFM-C-23 CONNECTING PIPE
25. TFM-C-24 MOUNTING BLOCK 2
26. TFM-C-25 EXTENSION PIPE
27. TFM-A-8 HYDRAULIC SCHEME KIT A
28. TFM-B-8 HYDRAULIC SCHEME KIT B
29. TFM-C-8 HYDRAULIC SCHEME KIT C
30. TFM-9 ELECTRIC SCHEME

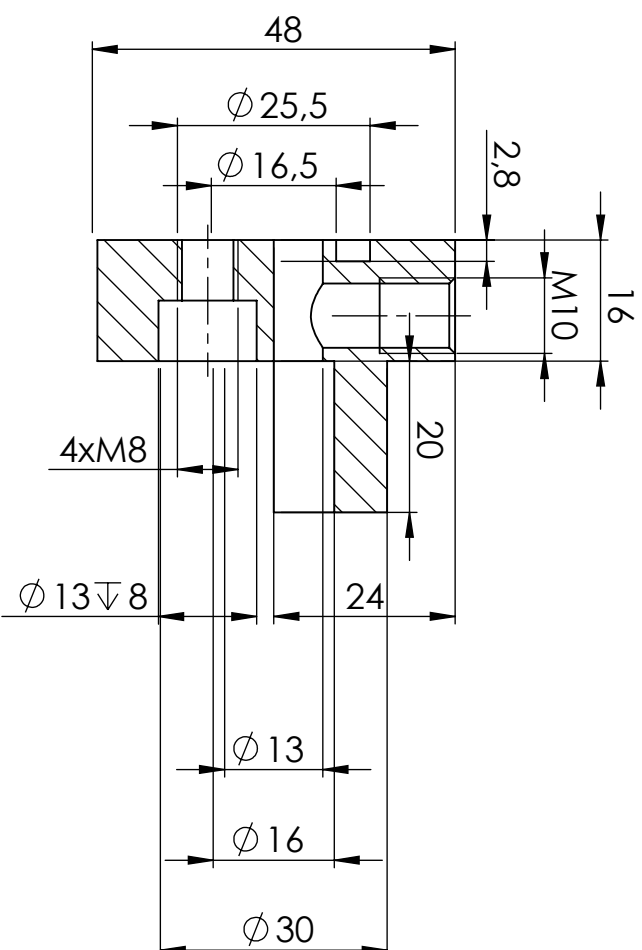
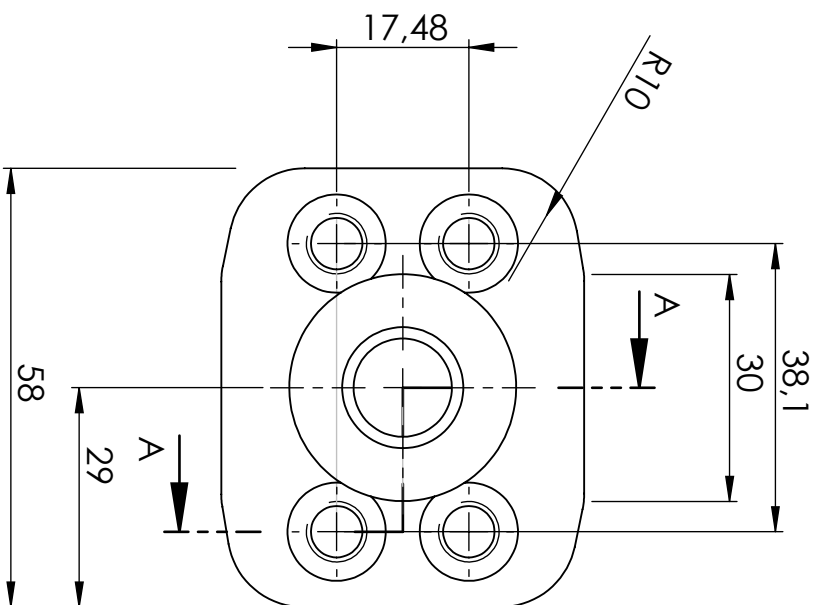


Position	Accessories	Description	Quantity
1	PL-201.6	HYDRAULIC PUMP	1
2	TRMA-A-10	KIT A	1
3	TRMA-J	SUPPORT	1
4	09/04/2021	TRMA-A-1	1
Version: A-0100			
A-0100			
Test bench			
A-01			

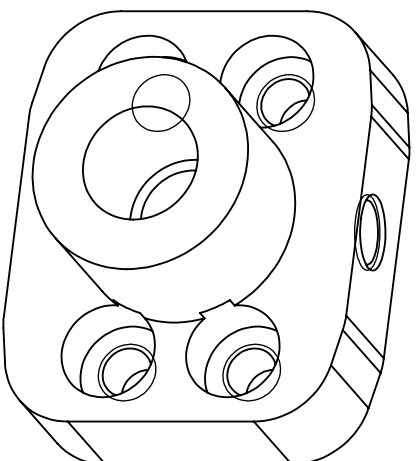


Position	N. Drawing	Denomination	Quantity
1	PL20-16	External gear pump	1
2	TFM-A-10	Flange SAE MA	1
3	6503C1A	Adapter Kistler	2
4	TFM-A-21	Reference pipe	1
5	GEL4SRCF	Male stud	9
6	TFM-A-22	Mounting block 1	1
7	TFM-A-23	Connecting pipe	1
8	TFM-A-24	Mounting block 2	1
9	EMA1/1/4CF	Pressure transducer	1
10	SGRA06	Relief valve	1
11	VOSS SP3	Flexible hose	2
12	EGE20SREDCF	Swivel connector	1
13	EGE16SREDCF	Swivel connector	1
14	VRFU9003	Needle valve	2
15	TFM-A-25	Extension pipe	1
16	RAP3520	Clamp halves	1
17	TFM-A-26	Steel pipe	1
18	GR2016SCFX	Hydraulic Reducer	1
19	TFM-B-26	Steel pipe	1
20	SCFT-300	Flowmeter	1
22	GE25SRCF	Male stud	1
24	ISO 4762 M8 x 20 - 20N	Allen Screw Bolts 10.9	4

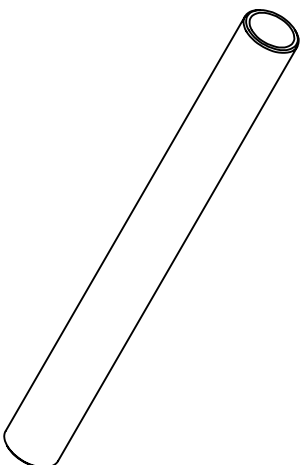
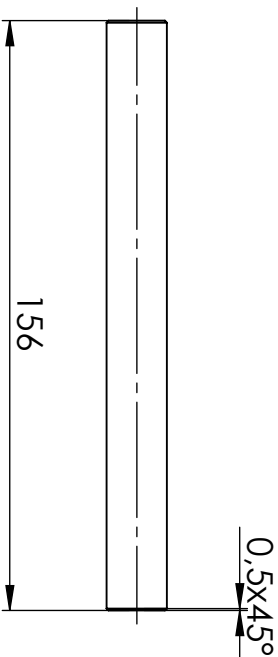
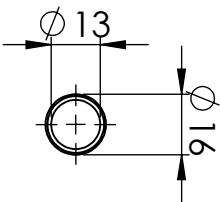
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DRAWN BY	A.Gallo				
SURFACE FINISH		REFERENCE	ISO 10767 SAE A		A3



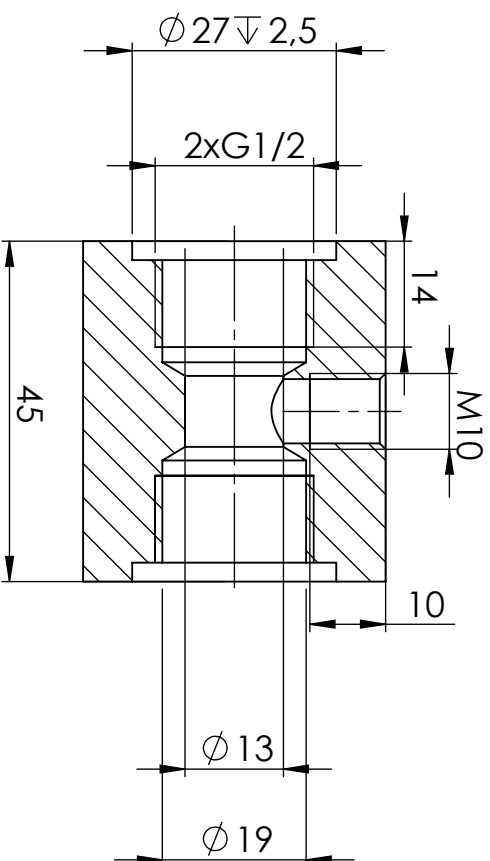
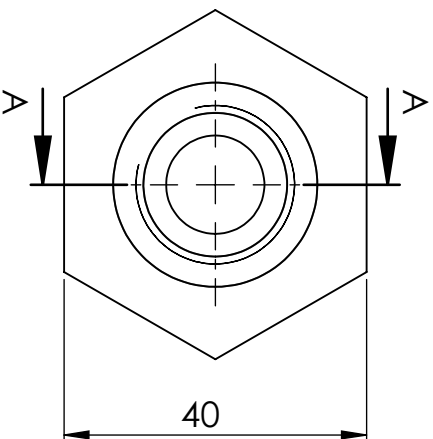
SECTION A-A



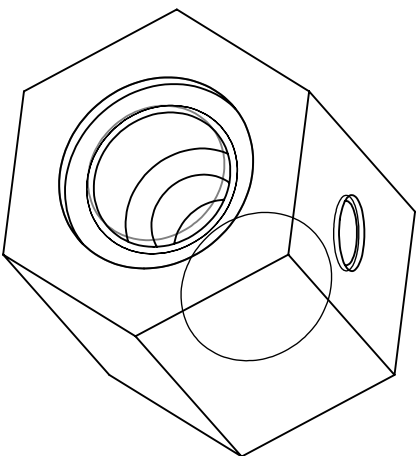
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DRAWN BY	A.Gallo	1:1	TFM-A-10
SURFACE FINISH	N 7	REFERENCE	FLANGE SAE MA
MATERIAL	ST52.3		A4



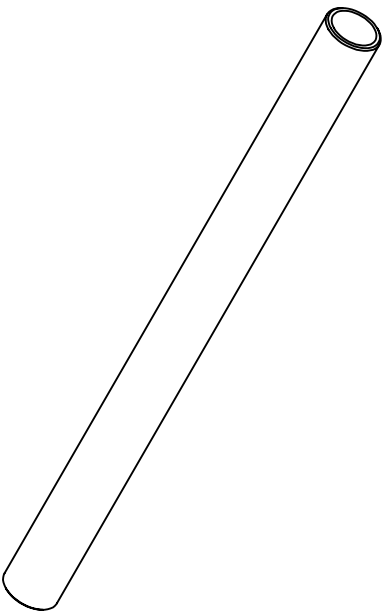
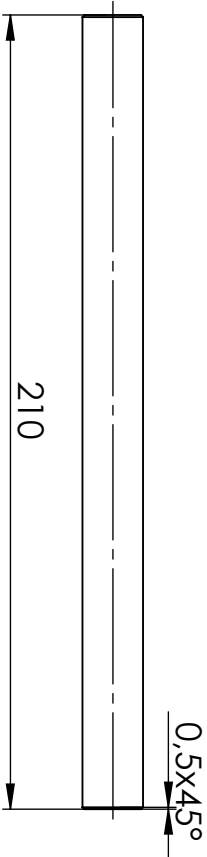
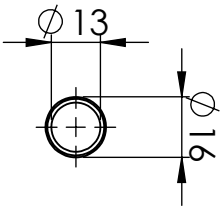
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DRAWN BY	A.Gallo		1:2	TFM-A-21	
SURFACE FINISH	N 7		REFERENCE	Reference pipe	
MATERIAL	ST 37				
		A4			



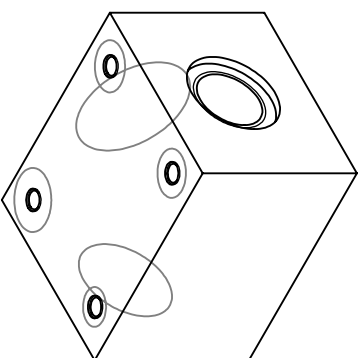
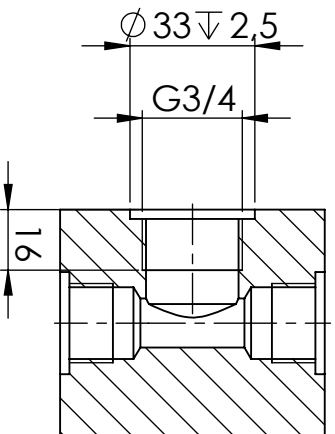
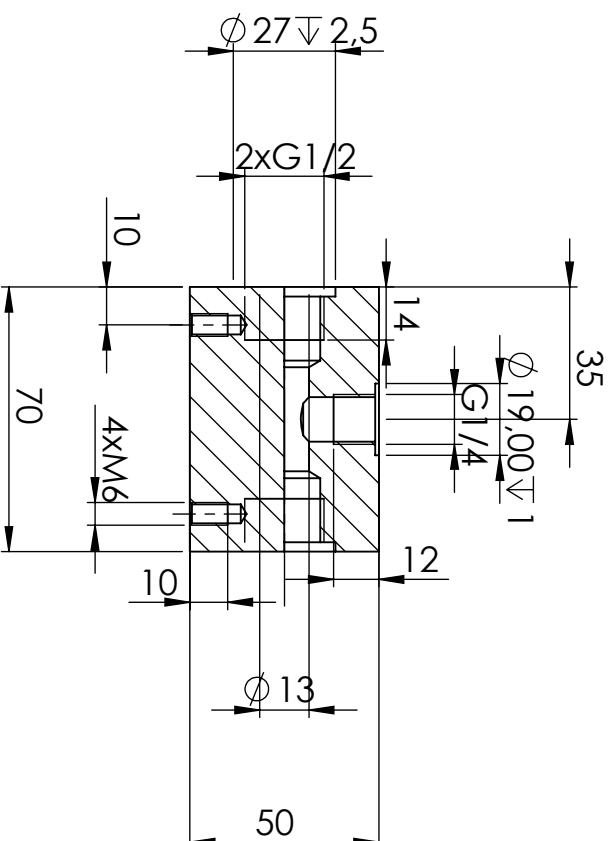
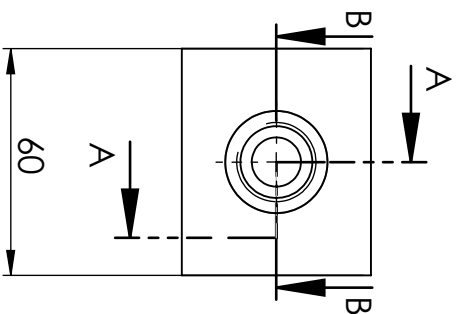
SECTION A-A



DATE	09/06/2021	SCALE	N. DRAWING
DRAWN BY	A. Gallo	1:1	TFM-A-22
SURFACE FINISH	N 7	REFERENCE Mounting block 1	
MATERIAL	F1-S235JR		
			A4



DATE	09/06/2021	SCALE	N.DRAWING	
DRAWN BY	A. Gallo	1:2	TFM-A-23	
SURFACE FINISH	N 7	REFERENCE	Connecting pipe	
MATERIAL	ST 37			A4



SECTION B-B

SECTION A-A

DATE	09/06/2021	SCALE	NDRAWING
DRAWN BY	A.Gallo	1:1	TFM-A-24
SURFACE FINISH	N 7	REFERENCE	Mounting block 2
MATERIAL	F1-S235JR		A4

6

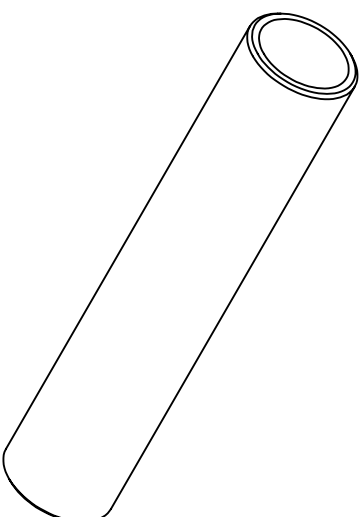
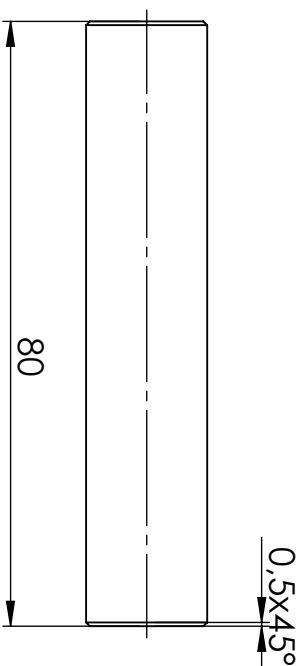
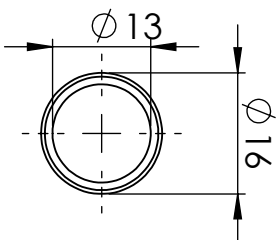
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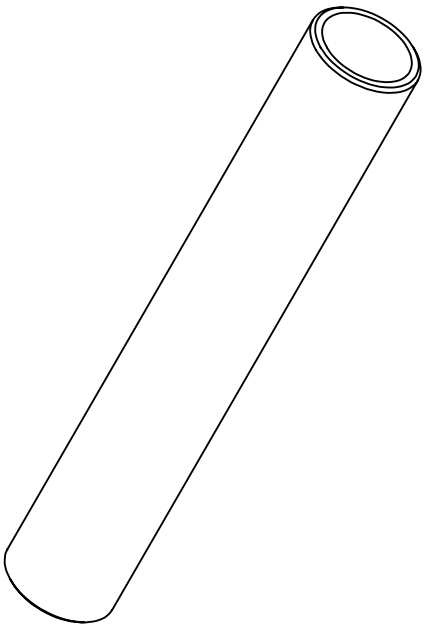
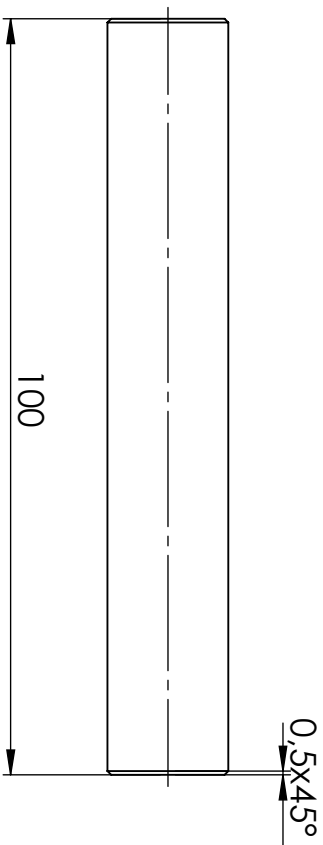
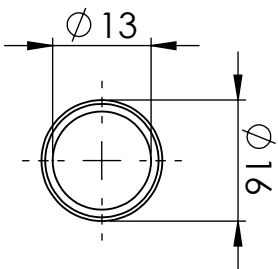
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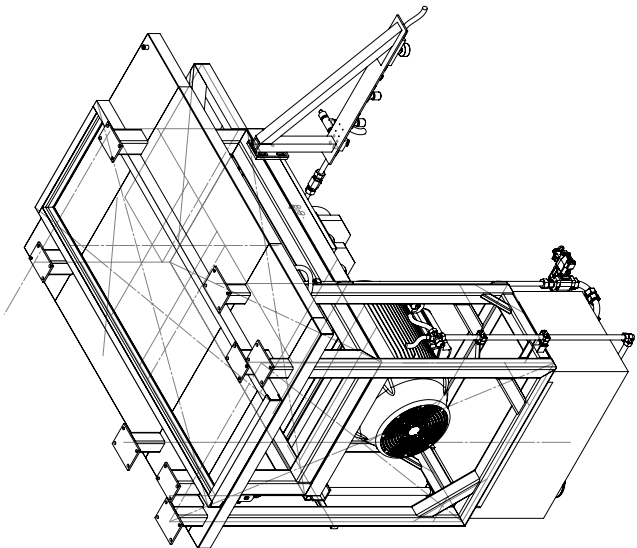
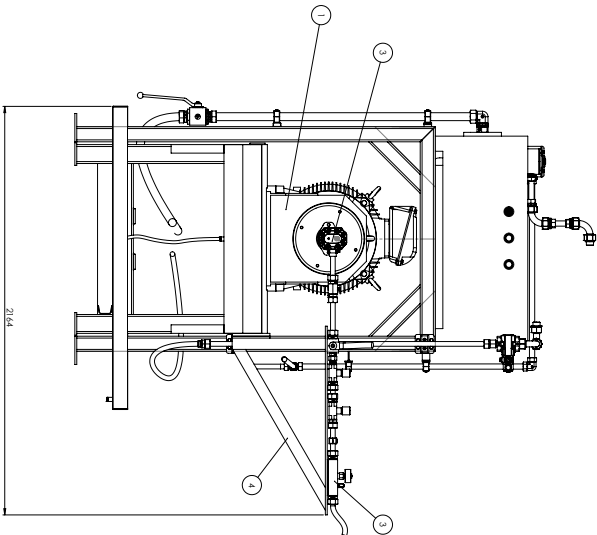
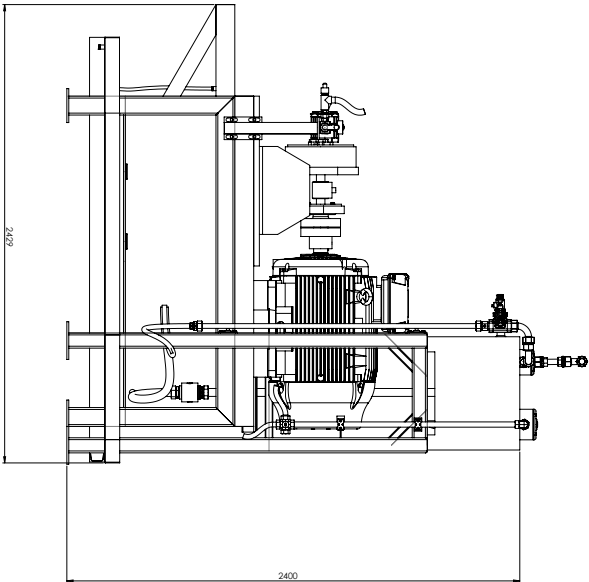
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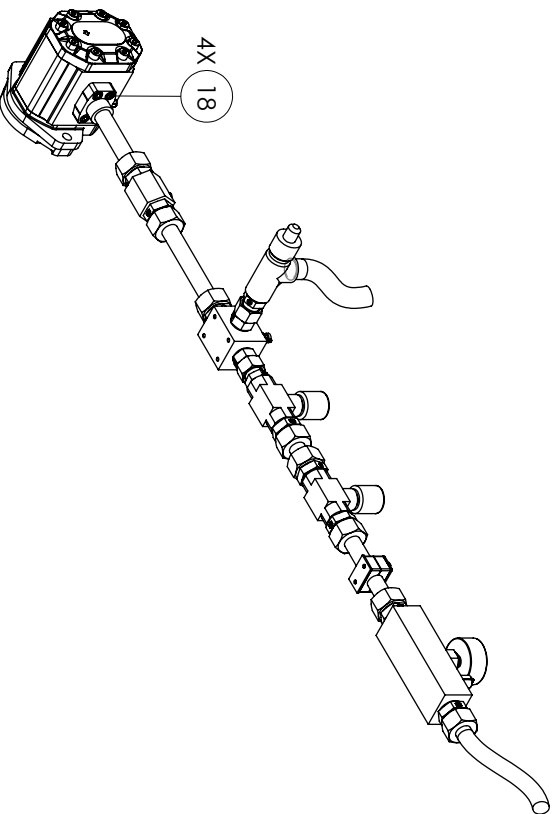
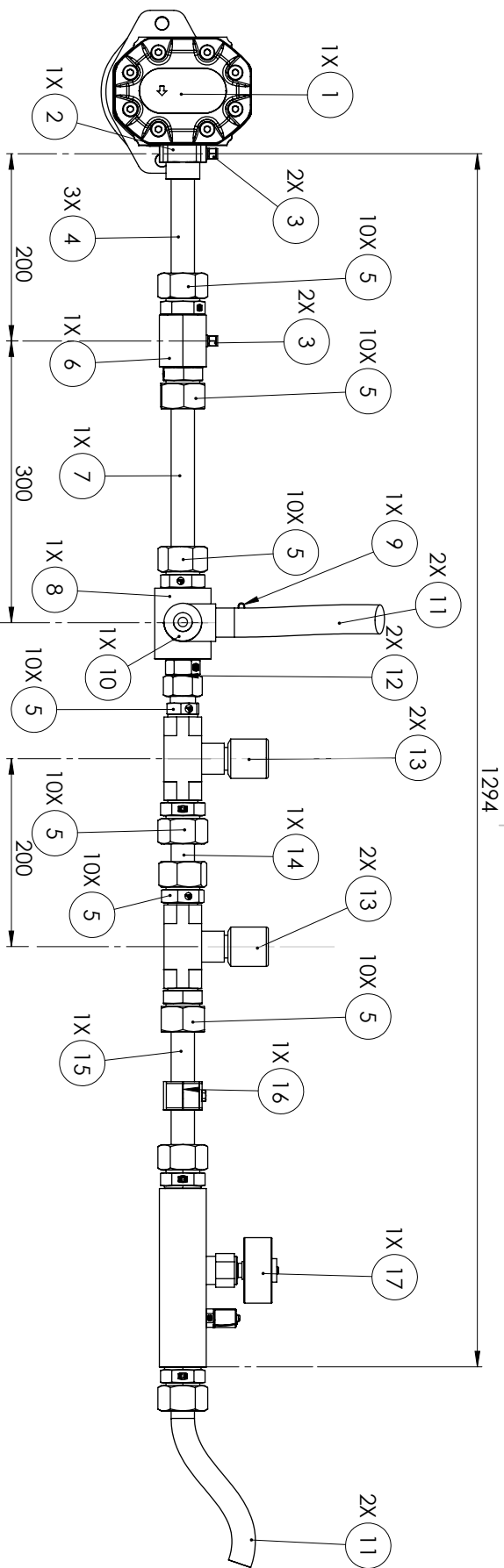
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DRAWN BY	A. Gallo	1:1	TFM-A-25	
SURFACE FINISH	N 7	REFERENCE	Extension pipe	
MATERIAL	ST 37			A 4



DATE	09/06/2021	SCALE	N.DRAWING	
DRAWN BY	A.Gallo	1:1	TFM-A-26	
SURFACE FINISH	N 7	REFERENCE	Steel pipe	
MATERIAL	ST 37			A4



Position		NT drawing	Description	Quantity
1	TPM-B-1	TPM-B-1	Test bench	1
2	TPM-B-10	TPM-B-10	Hydraulic pump	1
3	TPM-B-10	TPM-B-10	Support	1
4	TPM-A-1	TPM-A-1	Support	1
Date		09/04/2021	Project	TPM-B-1
Version		A-0000	Scale	1:10
Author		A-0000	Test bench	10



Position	N. Drawing	Denomination	Quantity
1	HD 30-38	External gear pump	1
2	TFM-C-20	Flange SAE MB	1
3	6503C1A	Adapter Kistler	2
4	TFM-02-21	Reference pipe	1
5	GE20SR71	Male stud	10
6	TFM-B-22	Mounting block 1	1
7	TFM-B-23	Connecting pipe	1
8	TFM-B-24	Mounting block 2	1
9	EMA1/1/4CF	Pressure transducer	1
10	SGRA06	Relief valve	1
11	VOSS SP3	Flexible hose	2
12	EGE20SREDCF	Swivel connector	2
13	VRFU9004	Needle valve	2
14	TFM-B-25	Extension pipe	1
15	TFM-B-26	Steel pipe	1
16	RAP3525	Clamp halves	1
17	SCFT-300	Flowmeter	1
18	ISO 4762 M12	Allen Screw Bolts 10,9	4

DATE 09/06/2021

SCALE N. DRAWING

DRAWN BY

A.Gollo

1:5

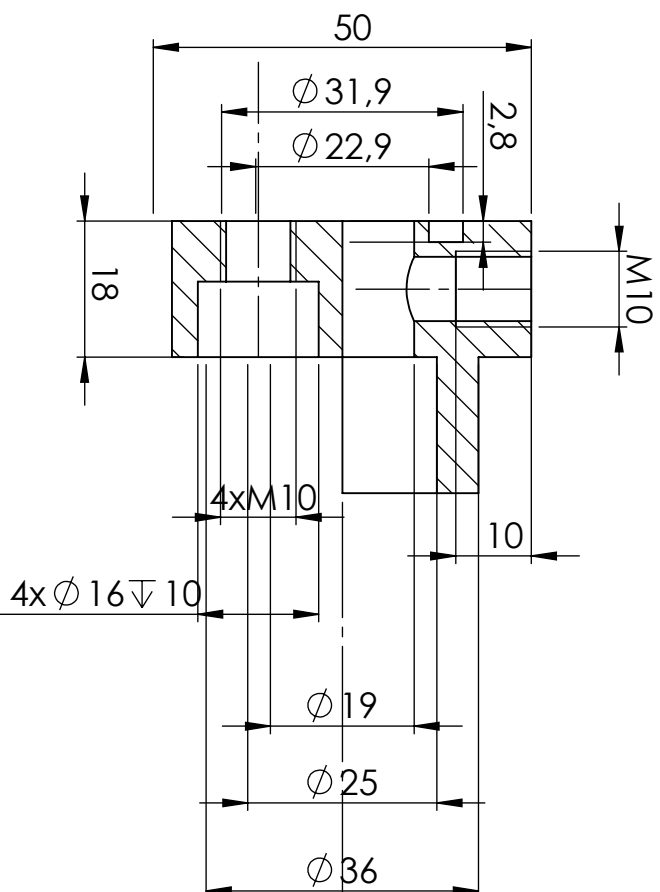
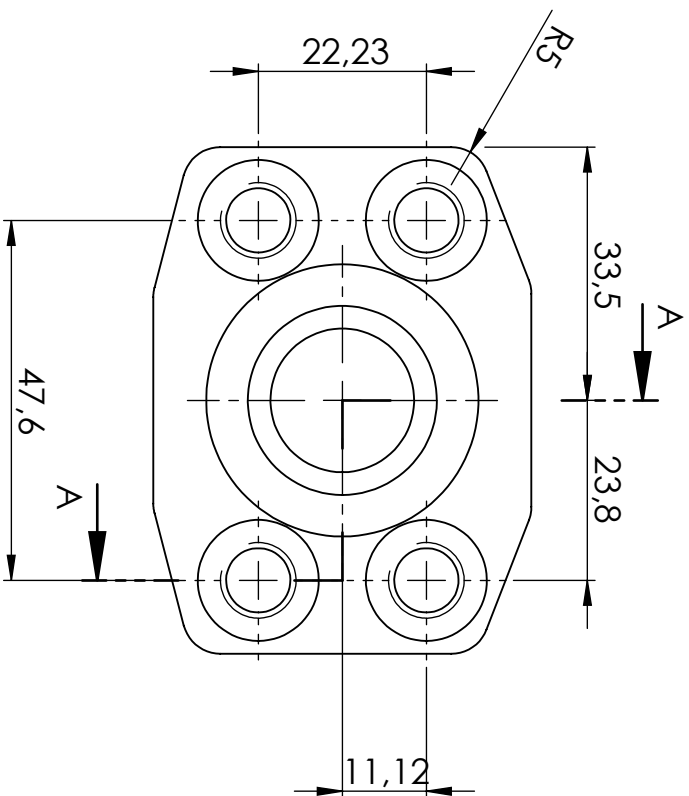
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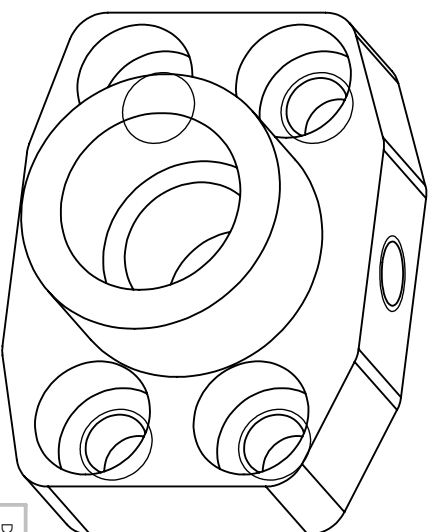
REFERENCE

ISO 10767/6 SAE B

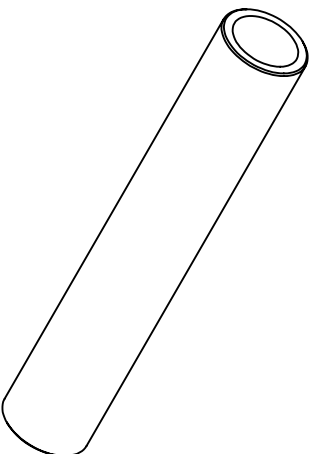
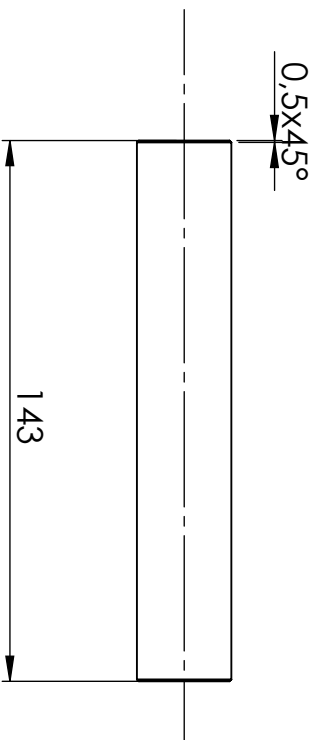
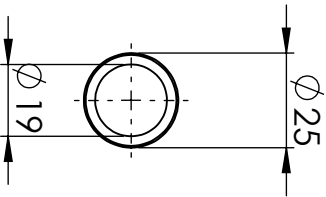
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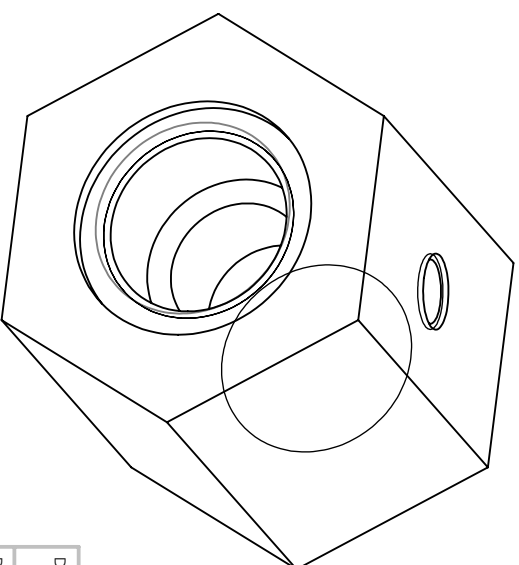
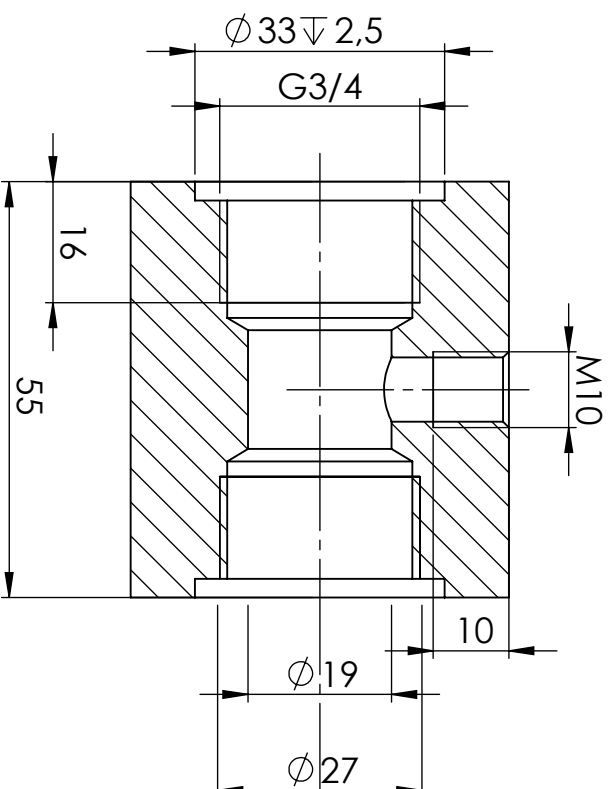
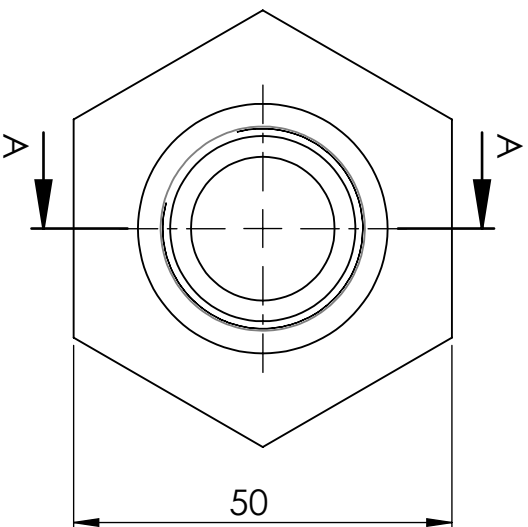
SECTION A-A



DATE	09/06/2021	SCALE	1:1	N.DRAWING	TFM-B-20
DRAWN BY	A.Gallo	REFERENCE	Flange SAE MB		
SURFACE FINISH	N 7				A4
MATERIAL	ST52.3				



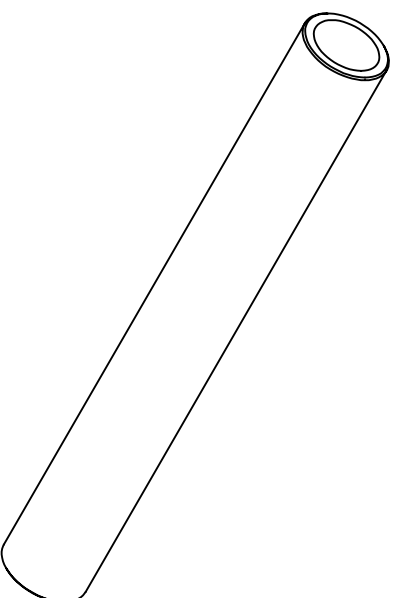
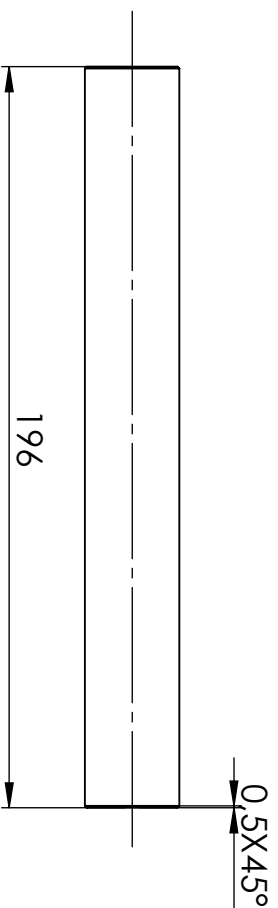
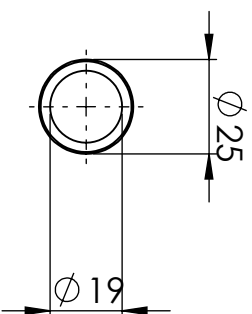
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DRAWN BY		A.Gallo	
SURFACE FINISH		N 7	
MATERIAL		ST-37	
SCALE		N. DRAWING	
1:2		TFM-B-21	
REFERENCE		Reference pipe	
		A4	



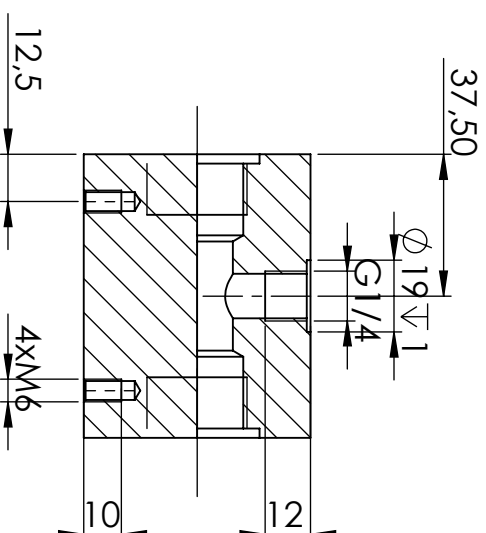
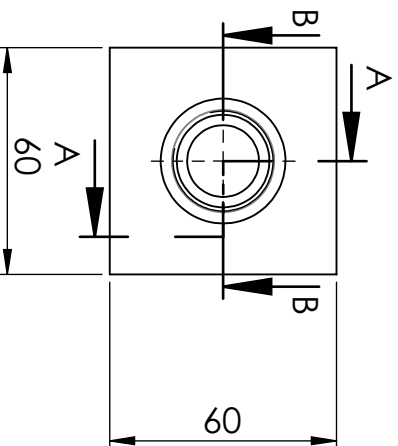
SECTION A-A

DATE	09/06/2021	SCALE	N	DRAWING	TFM-B-22
DRAWN BY	A.Gallo	1:1			
SURFACE FINISH	N 7	REFERENCE	Mounting block 1		
MATERIAL	F1-S235JR				

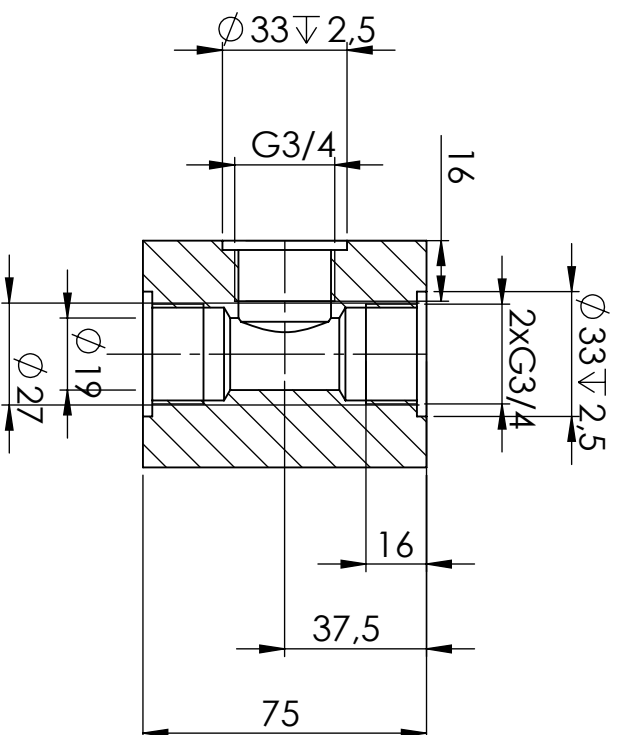
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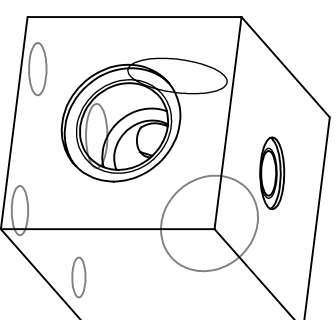
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SURFACE FINISH		N 7	
MATERIAL		ST-37	
SCALE		1:2	
N.DRAWING		TFM-B-23	
REFERENCE		Connecting pipe	
		A4	



SECTION A-A



SECTION B-B



DATA	09/06/2021	SCALE	1:2	N.DRAWING	TFM-B-24
DRAWN BY	A.Gallo	SURFACE FINISH	N7	REFERENCE	Mounting block 2
MATERIAL	F1-S235JR				A4

6

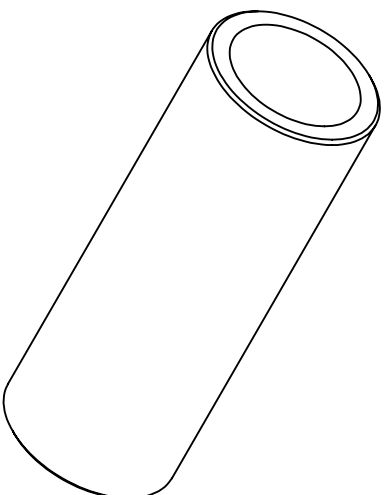
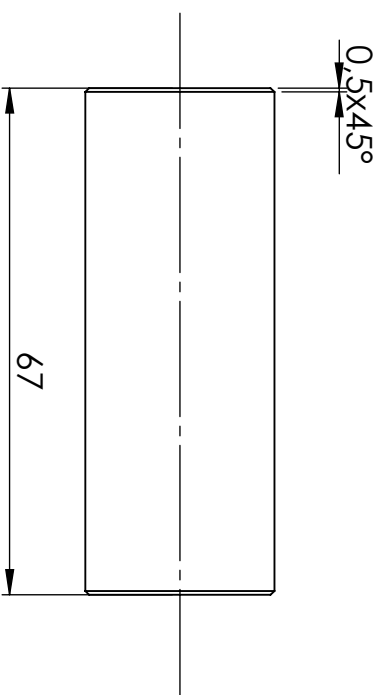
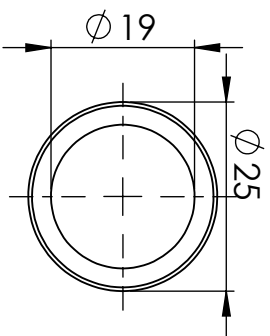
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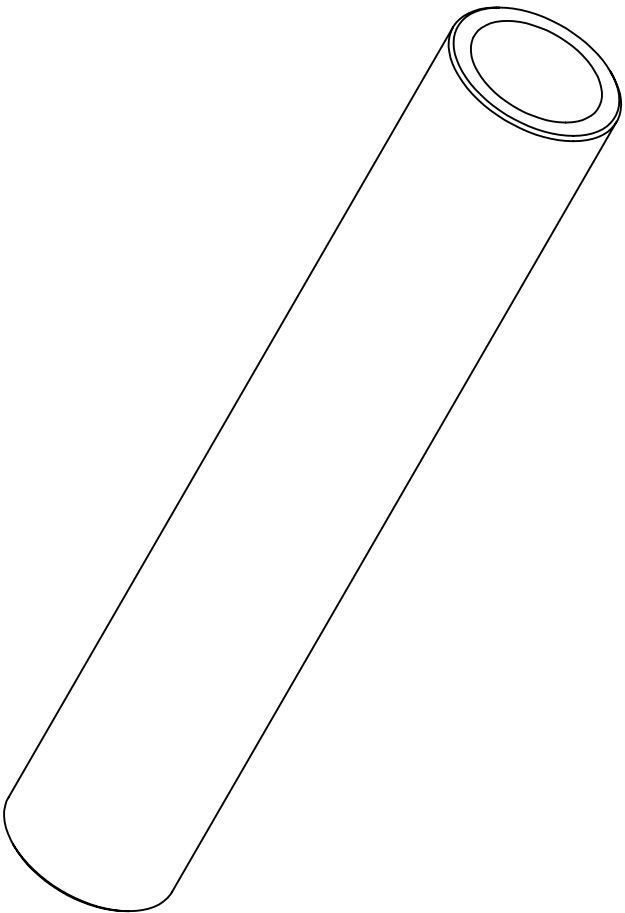
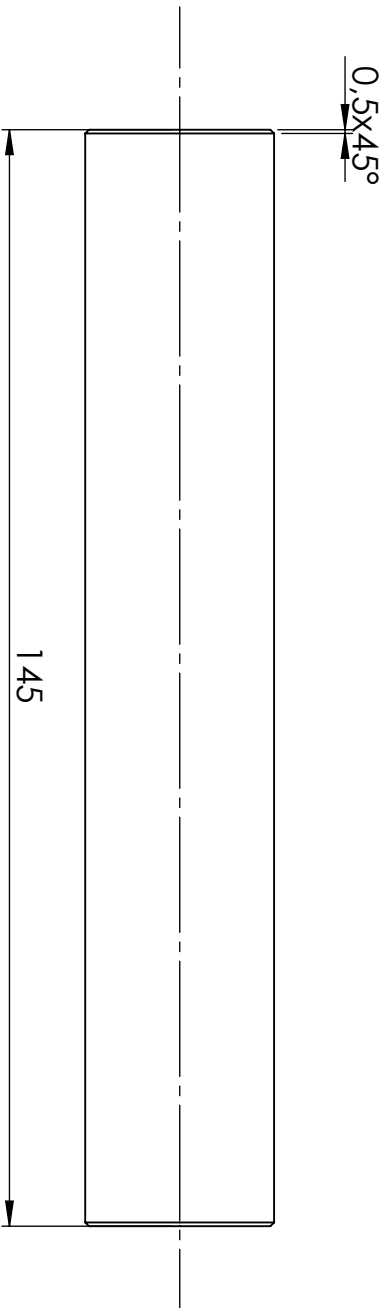
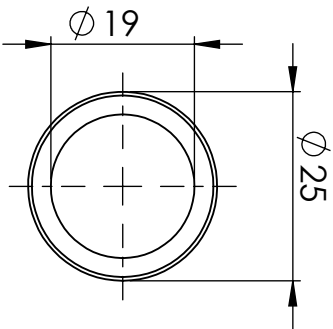
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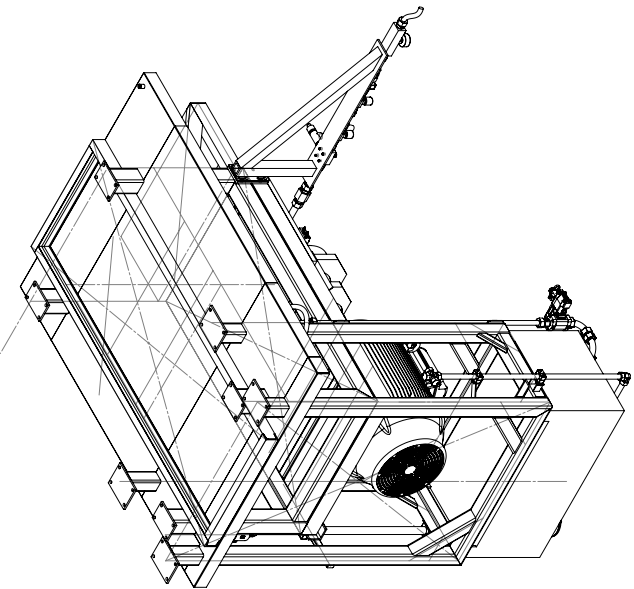
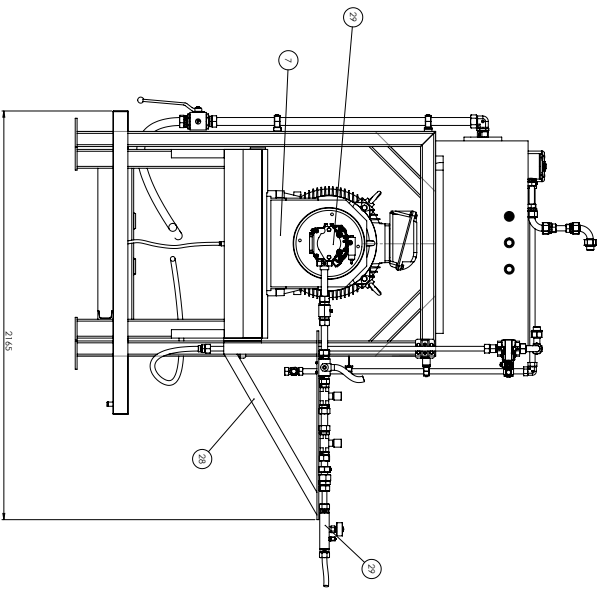
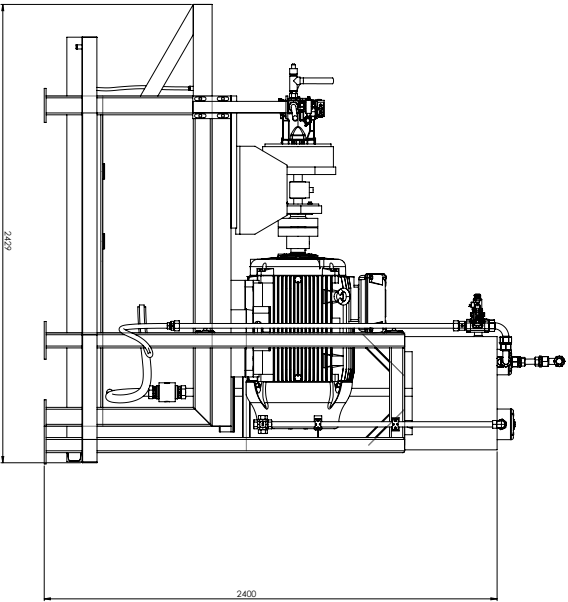
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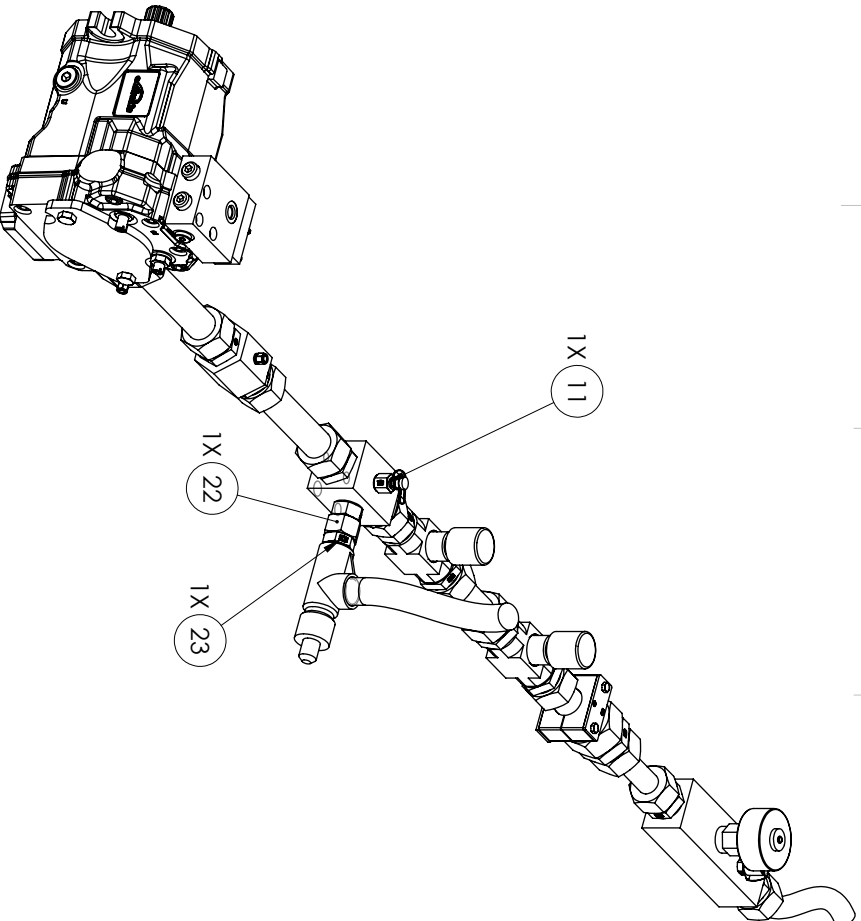
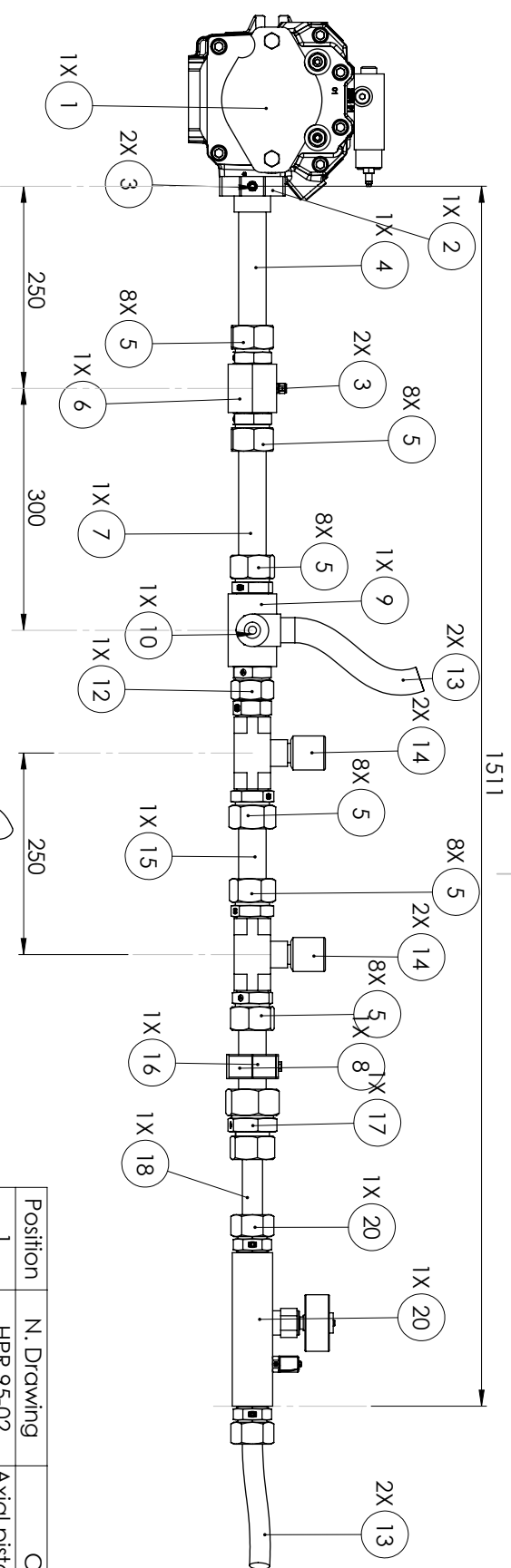
DATE	09/06/2021	SCALE	N. DRAWING	
DRAWN BY	A. Gallo	1:1	TFM-B-25	
SURFACE FINISH	N 7	REFERENCE		Extension pipe
MATERIAL	ST-37			
				A4



DATE	09/06/2021	SCALE	N. DRAWING
DRAWN BY	A. Gallo	1:1	TFM-B-26
SURFACE FINISH	N 7	REFERENCE	
MATERIAL	ST-37		
Steel pipe		A4	



Position	Notation	Description	Quantity
1	TRAC-1	Test Bench	1
2	TRAC-2	Test Bench	1
3	TRAC-10	TRAC-10	1
4	TRAC-7	Support	1
Date: 09/04/2021			
Version: 1.10			
Author: AGM			
Title: Test Bench			
MO			

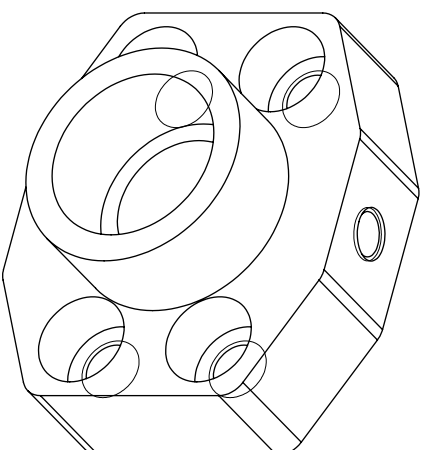


Position	N. Drawing	Code	Quantity
1	HPR 95-02	Axial piston pump	1
2	TFM-C-20	Flange SAE 1"	1
3	6503C1A	Adapter Kistler	2
4	TFM-C-21	Reference pipe	1
5	GE25SRCF	Male stud	8
6	TFM-C-22	Mounting block 1	1
7	TFM-C-23	Connecting pipe	1
8	RAP3535	Clamp halves	1
9	TFM-C-24	Mounting block 2	1
10	SGRA06	Relief valve	1
11	EMA11/4CF	Pressure transducer	1
12	EGE25SRECD	Swivel connector	1
13	VOSS SP3	Flexible hose	2
14	VRUJ9005	Needle valve	2
16	TFM-C-25	Steel pipe	1
17	GR2520SCFX	Hydraulic reducer	1
18	TFM-B-25	Steel pipe	1
20	SCFT-300	Flow meter	1
22	EGE20SREDCF	Swivel connector	1
23	GE20SR71	Male stud	1
24	ISO 4762 M12	Allen Screw Bolts 10.9	4

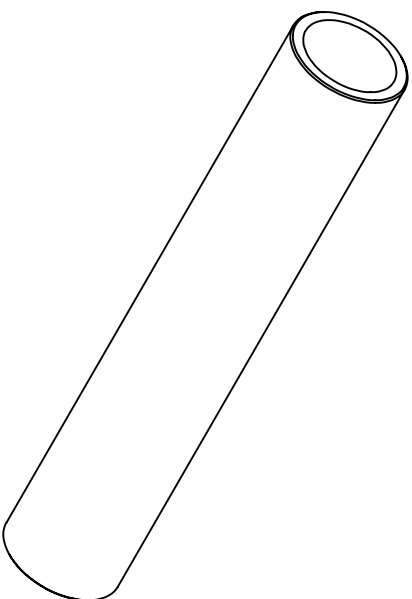
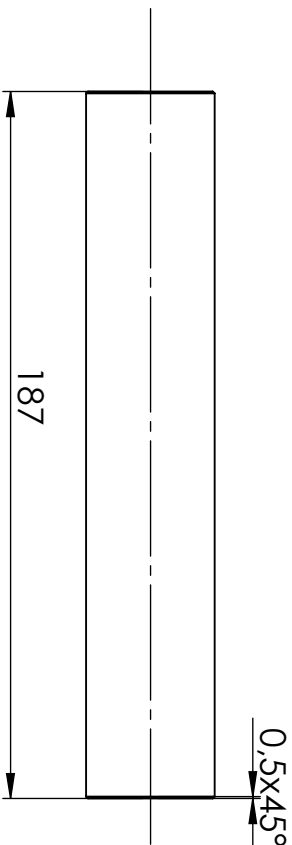
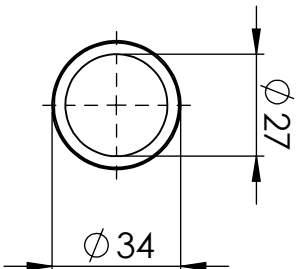
DATE 21/05/2021
SCALE 1:6
N. DRAWING TFM-C-10

DRAWN BY A. Gallo
REFERENCE ISO 10767 SAE C

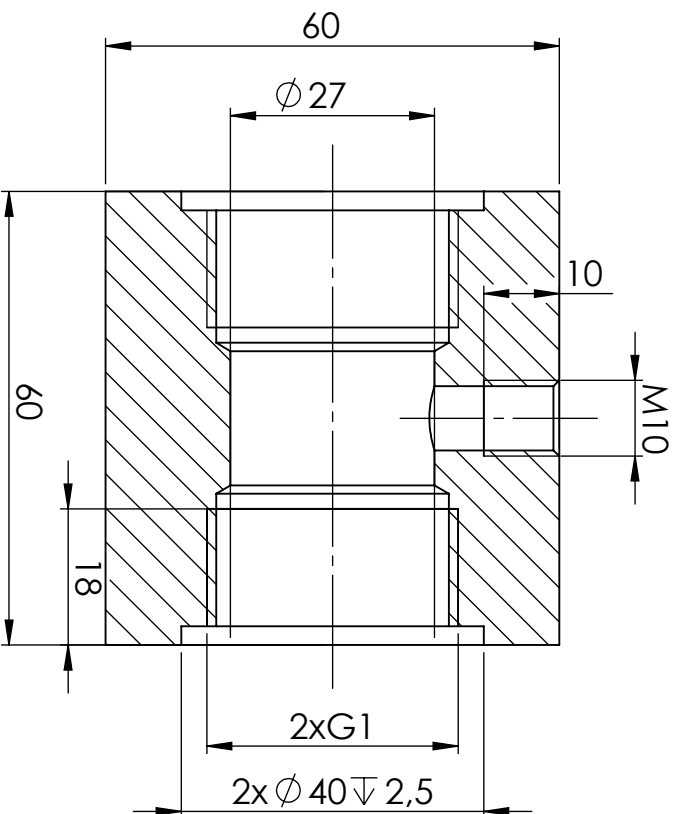
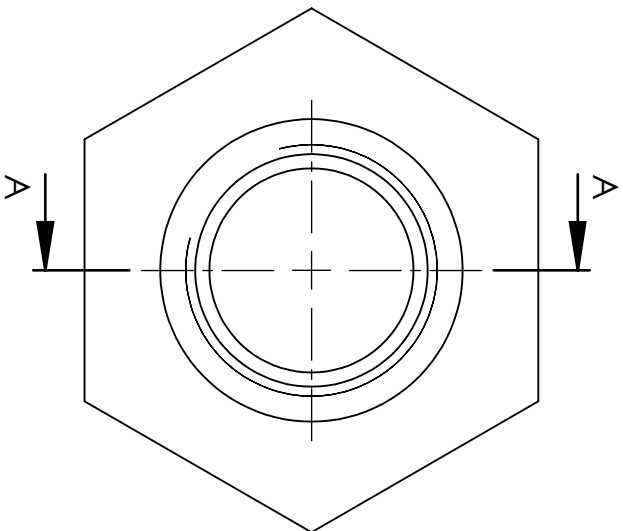
IF NOT SPECIFIED SURFACE FINISH: A3



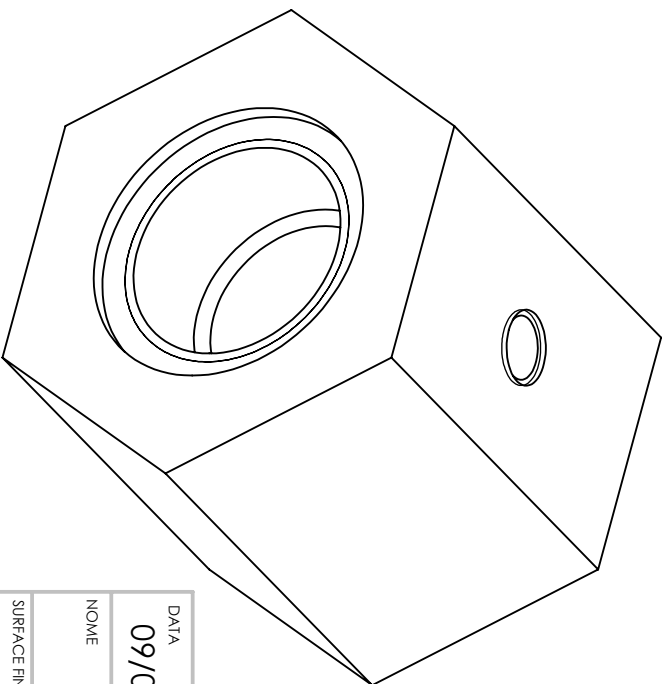
DATE	09/06/2021	SCALE	N/DRAWING
DRAWN BY	A.Gallo	1:1	TFM-C-20
SURFACE FINISH	N 7	REFERENCE	Flange SAE C
MATERIAL	ST52.3		A3



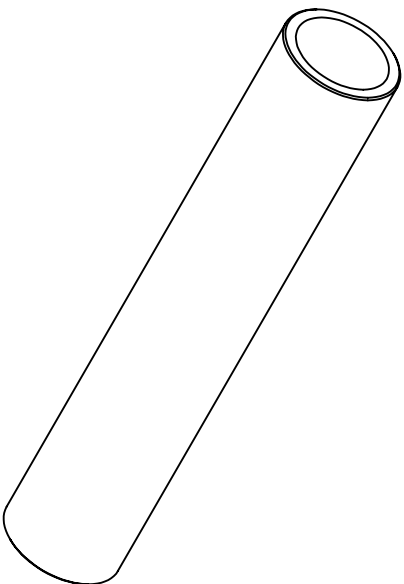
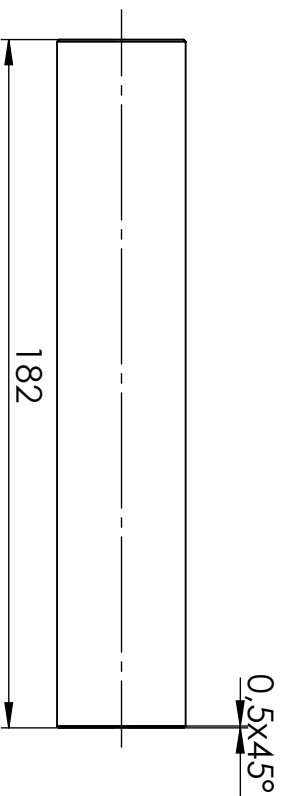
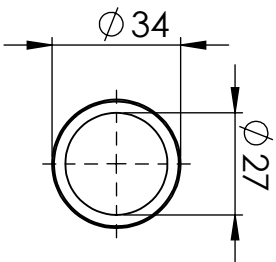
DATE	09/06/2021	SCALE	1:2	TITOLO:	TFM-C-21
DRAWN BY	A.Gallo	REFERENCE	Reference pipe		
SURFACE FINISH	N 7	REFERENCE		A4	
MATERIAL	ST-37				



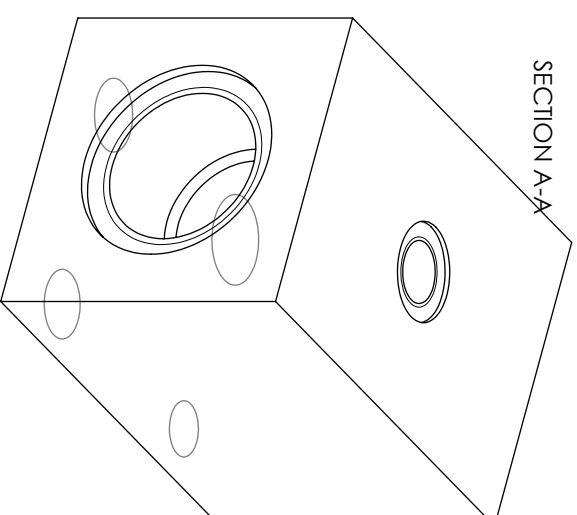
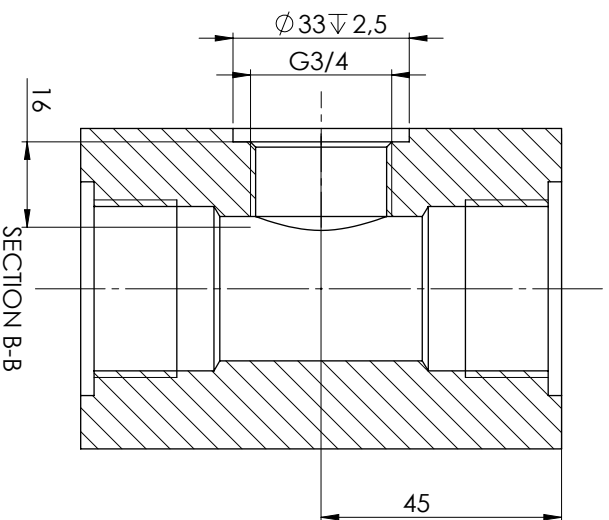
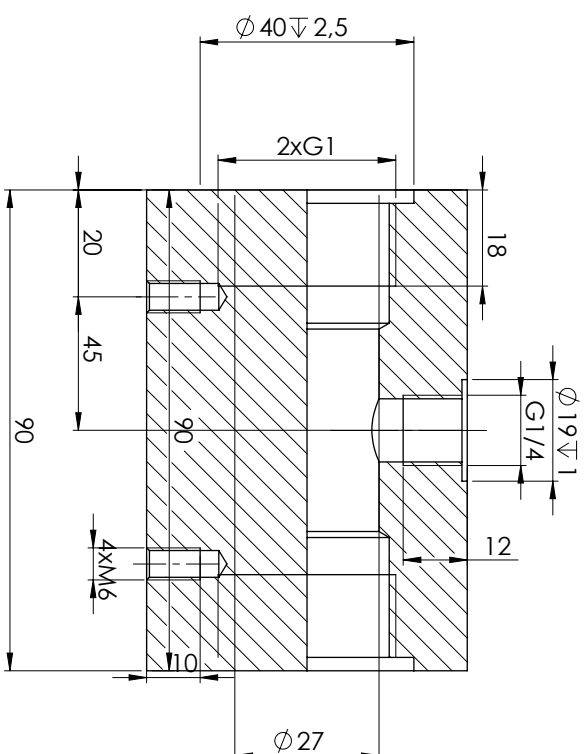
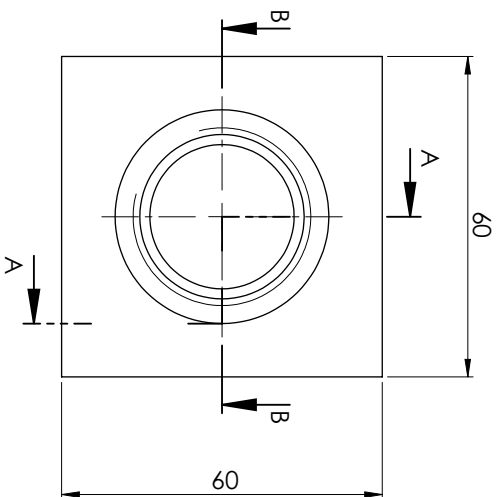
SECTION A-A



DATA		SCALE	TITOLO:	
09/06/2021		1:1	TFM-C-22	
NOME				
A. Gallo		REFERENCE		
SURFACE FINISH				
N 7				
MATERIAL				
F1-S235JR		Mounting block 1		
		A4		



DATA	09/06/2021	SCALE	N.DRAWING
DRAWN BY	A.Gallo	1:2	TFM-C-23
SURFACE FINISH	N 7	REFERENCE Connecting pipe	
MATERIALE:	ST-37		
			A4



DATE	09/06/2021		SCALE	N.DRAWING
DRAWN BY	A.Gallo		1:1	TFM-C-24
SURFACE FINISH	N 7		REFERENCE	MOUNTING BLOCK 2
MATERIAL	F1-S235JR			A3

6

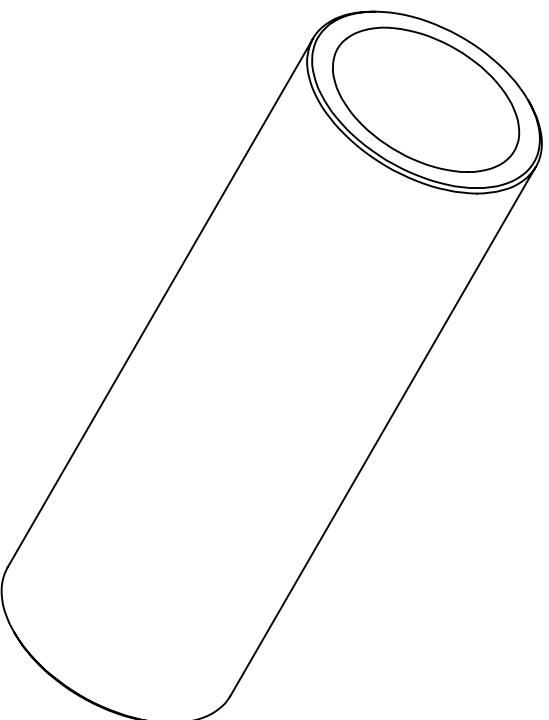
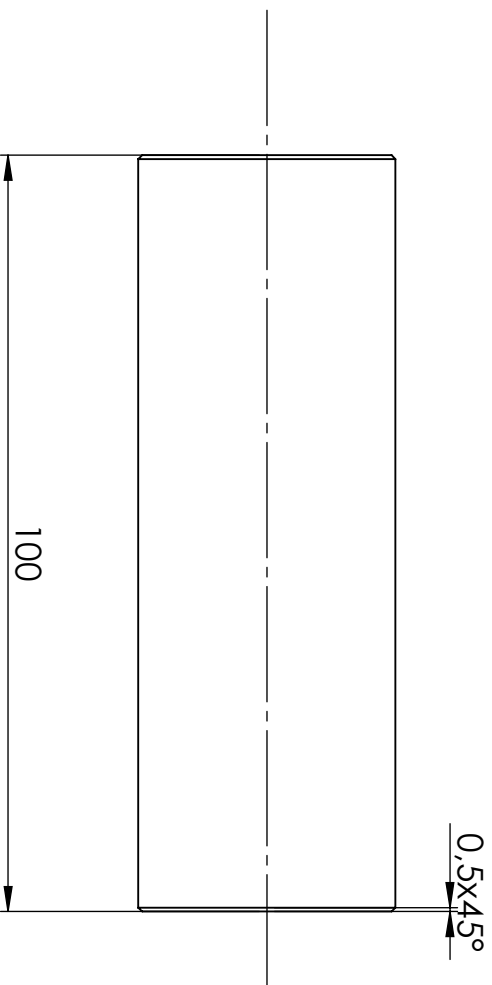
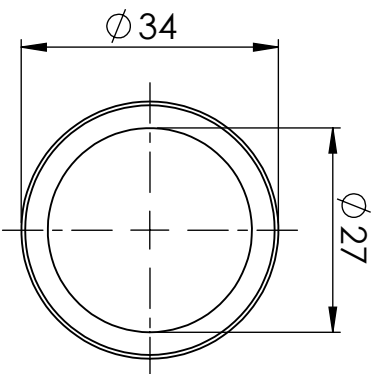
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4

3

2

1



DATE		SCALE		TITOLO:	
09/06/2021		1 : 1		TFM-C-25	
DRAWN BY		N. DISEGNO			
A. Gallo					
SURFACE FINISH		STEEL PIPE			
N 7					
MATERIAL				A4	
ST-37					

A

B

C

D

A

B

C

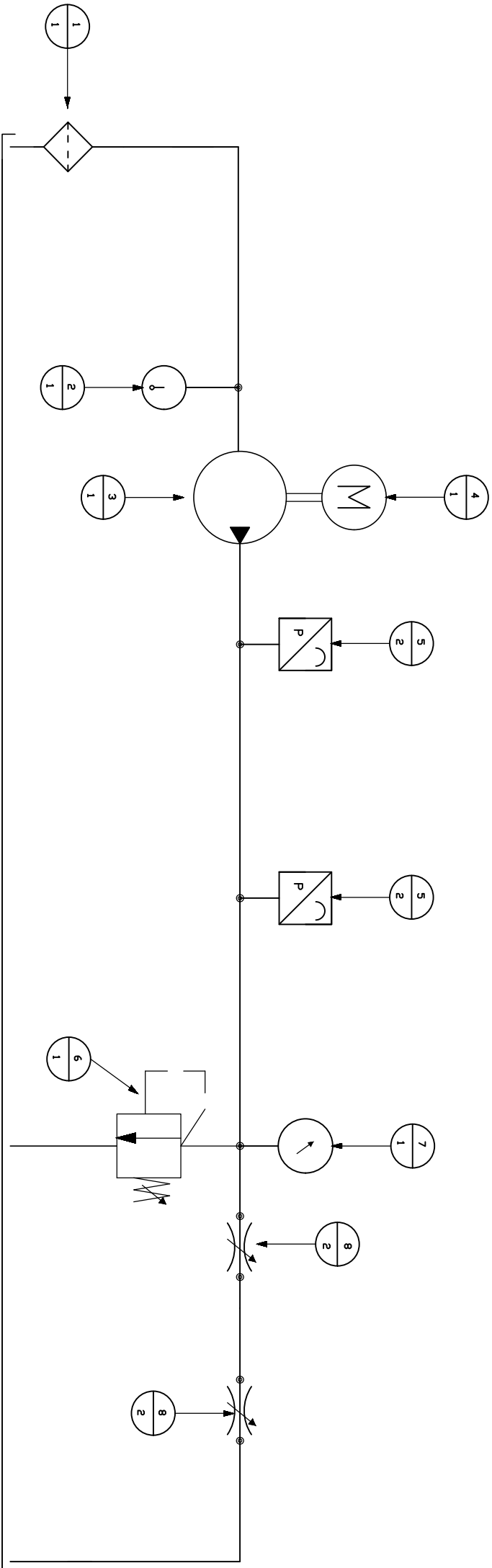
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4

3

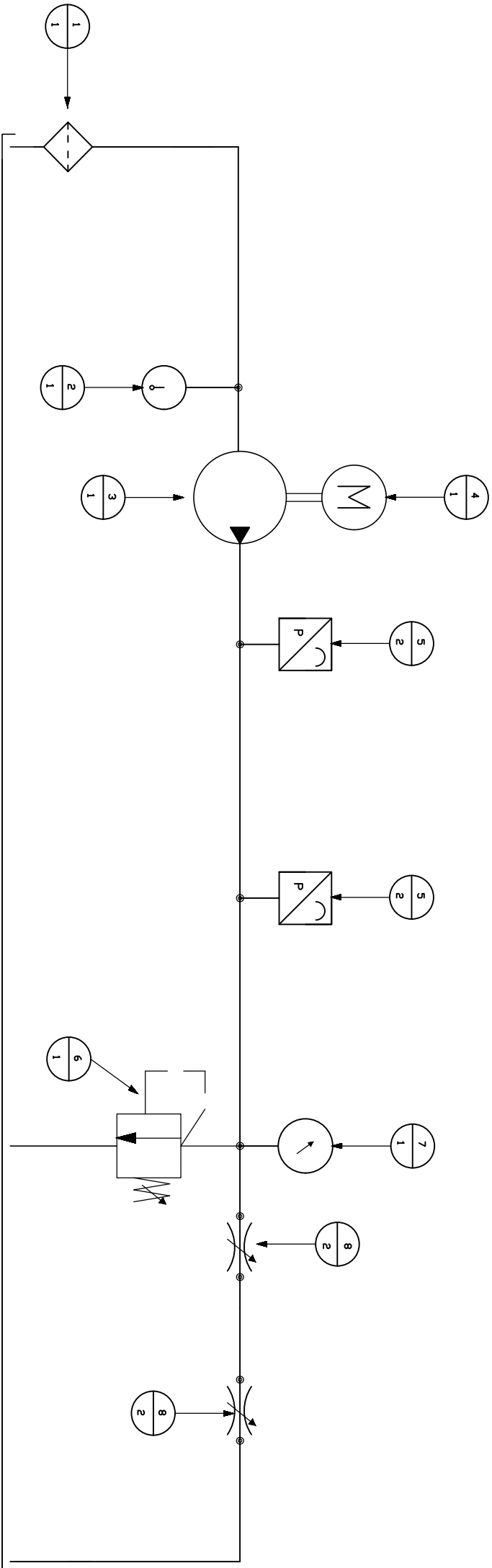
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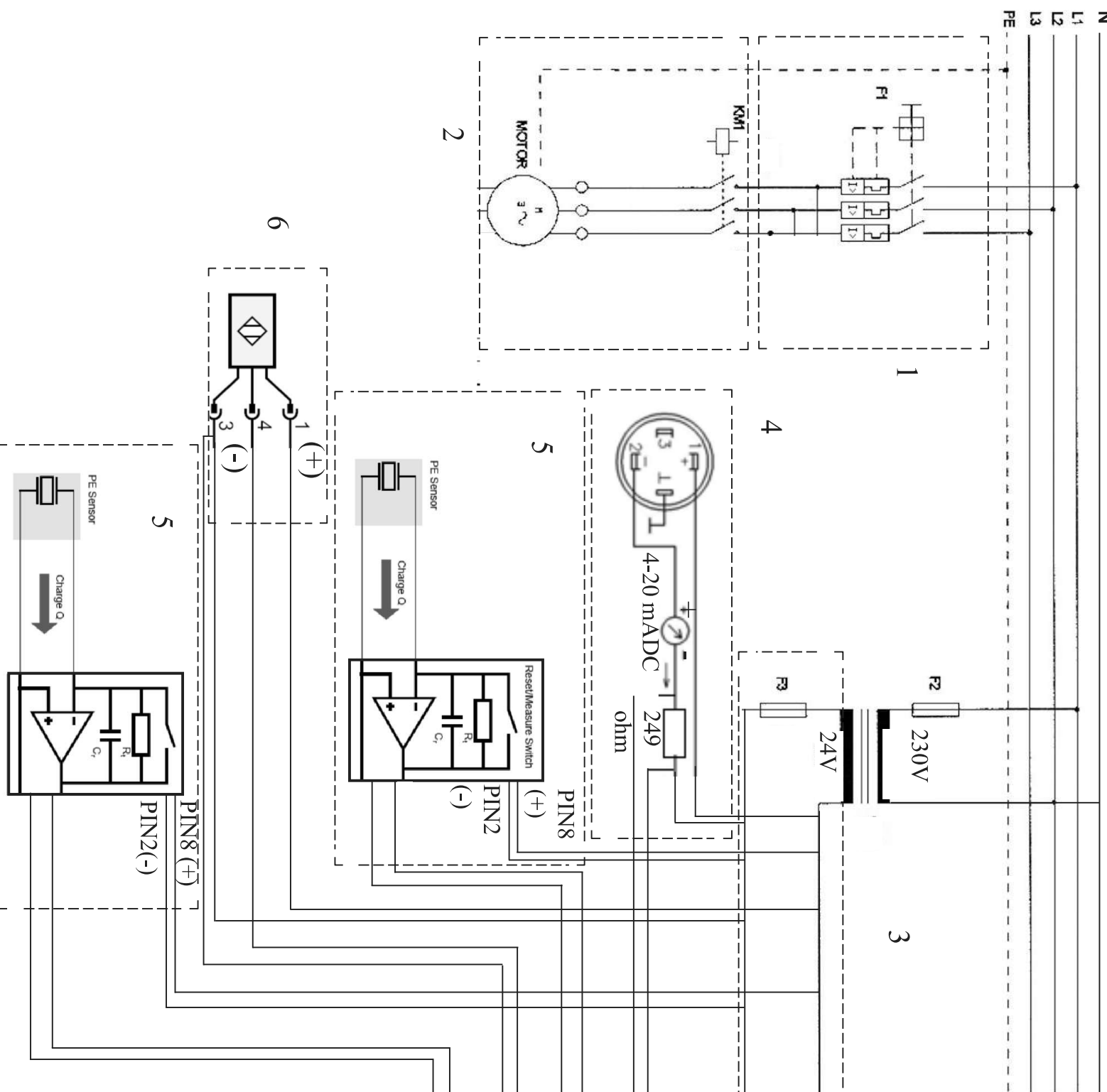
POSITION	QUANTITY	CODE	REFERENCE
1	1	RS 512-702	FILTER
2	1	TPM10	TEMPERATURE SENSOR
3	1	PL 20-16	HYDRAULIC PUMP
4	1	BFS 100L	ELECTRIC MOTOR
5	2	601 A	PIEZOELECTRIC SENSOR
6	1	SGRA06	RELIEF VALVE
7	1	MH-3	PIEZORESISTIVE SENSOR
8	2	VRFU9003	LOADING VALVE

DATE	REVISION
08/06/2021	TFM-A-8
DRAWN BY	AGALLO
A3	HYDRAULIC SCHEME



POSITION	QUANTITY	CODE	REFERENCE
1	1	RS 512-702	FILTER
2	1	TPM10	TEMPERATURE SENSOR
3	1	HPR 95-02	HYDRAULIC PUMP
4	1	BFS 100L	ELECTRIC MOTOR
5	2	601 A	PIEZOELECTRIC SENSOR
6	1	SGRA06	RELIEF VALVE
7	1	MH-3	PIEZORESISTIVE SENSOR
8	2	VRFU9005	LOADING VALVE

DATE	REVISION
08/06/2021	TFM-C-8
DRAWN BY	
AGALLO	
A3	
HYDRAULIC SCHEME	



POSITION	QUANTITY	CODE	DENOMINATION
1	1	IO60N SCHNEIDER	MAGNETOTHERMIC
2	1	MEB BF5 100L	ELECTRIC MOTOR
3	1	Mean well S-50-24	POWER SUPPLY
4	1	Wika MH-3	PIEZORESISTIVE SENSOR
5	2	Kistler 5093A	PIEZOELECTRIC SENSOR
6	1	IFM IFT200	INDUCTIVE SENSOR
7	1	YOOGOKAMA DL716 701830	DIGITAL SCOPE
DATE	07/06/2021		
DRAWN BY	ANDREA GALLO		
REFERENCE	ELECTRIC SCHEME		
TFM-9	A3		