



UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH

Escola Superior d'Enginyeries Industrial,
Aeroespacial i Audiovisual de Terrassa

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

Document:

Drawings

Author:

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Director /Co-director:

Miquel Torrent Gelrà

/ Pedro Javier Gamez Montero

Degree:

Master in Industrial Engineering

Examination session:

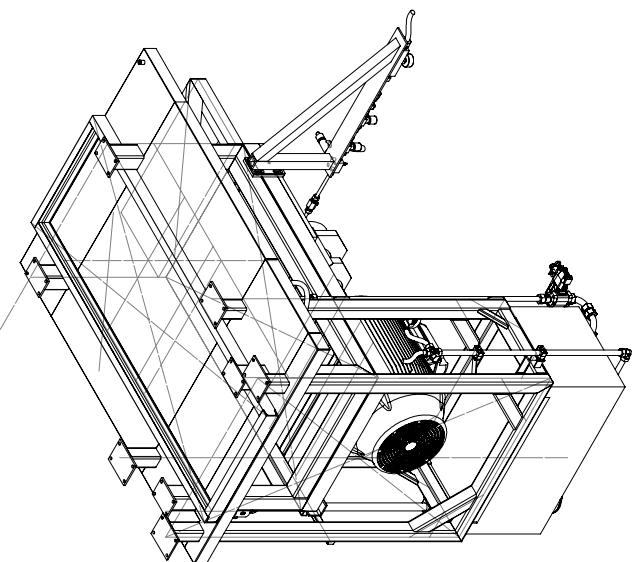
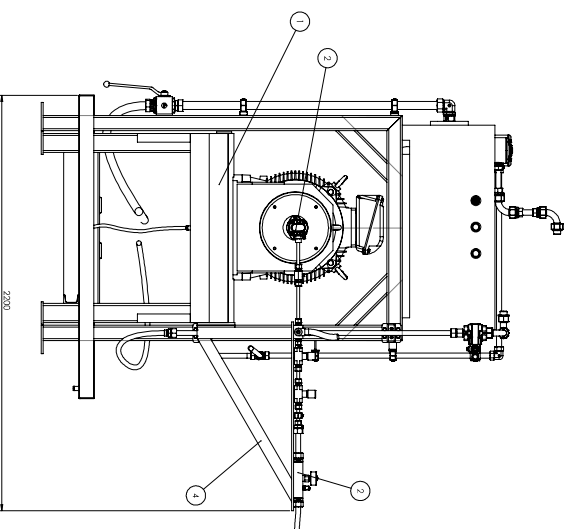
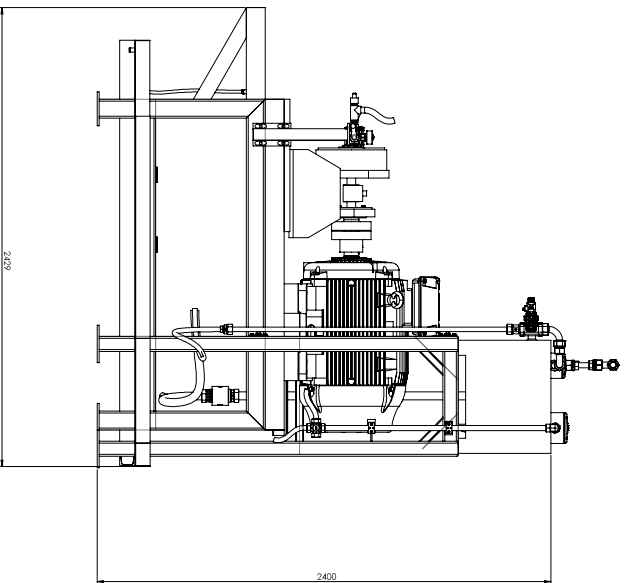
Spring, 2021

MASTER FINAL THESIS



LIST OF DRAWINGS

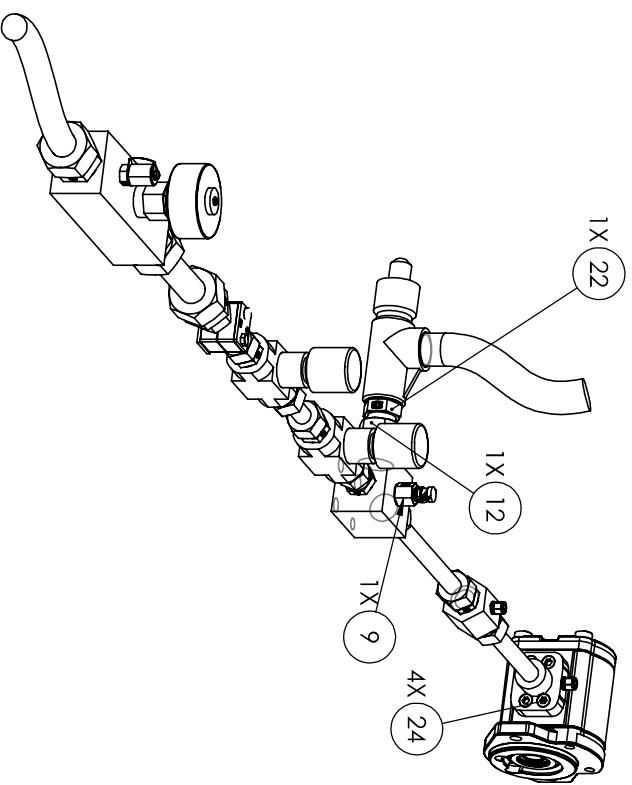
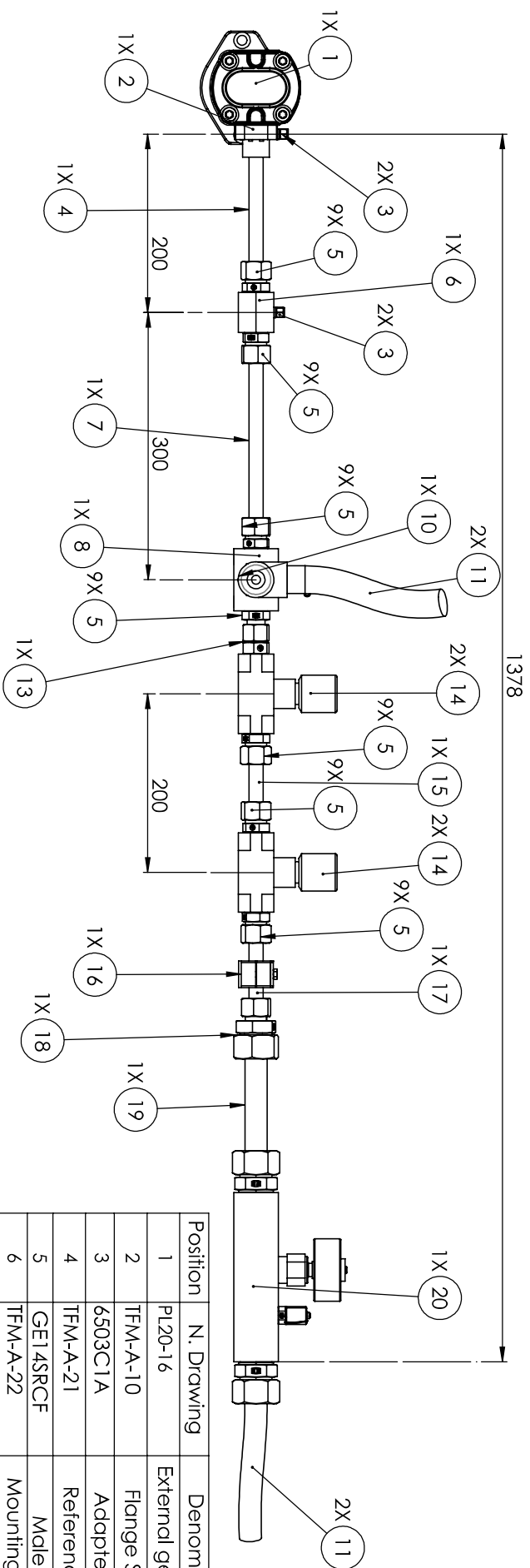
1. TFM-A-1 TEST BENCH KIT A
2. TFM-A-10 KIT A
3. TFM-A-20 FLANGE
4. TFM-A-21 REFERENCE PIPE
5. TFM-A-22 MOUNTING BLOCK 1
6. TFM-A-23 CONNECTING PIPE
7. TFM-A-24 MOUNTING BLOCK 2
8. TFM-A-25 EXTENSION PIPE
9. TFM-A-26 STEEL PIPE
10. TFM-B-1 TEST BENCH KIT B
11. TFM-B-10 KIT B
12. TFM-B-20 FLANGE
13. TFM-B-21 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



Posizione	Descrizione	Quantità
1	Struttura	1
2	Pistone	1
3	Barile	1
4	Supporto	1

Prodotto da	TRAKA
Disegnato da	TRAKA
Verificato da	TRAKA
Approvato da	TRAKA

TRAKA



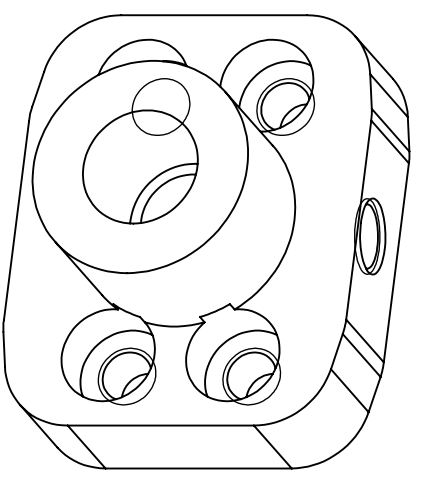
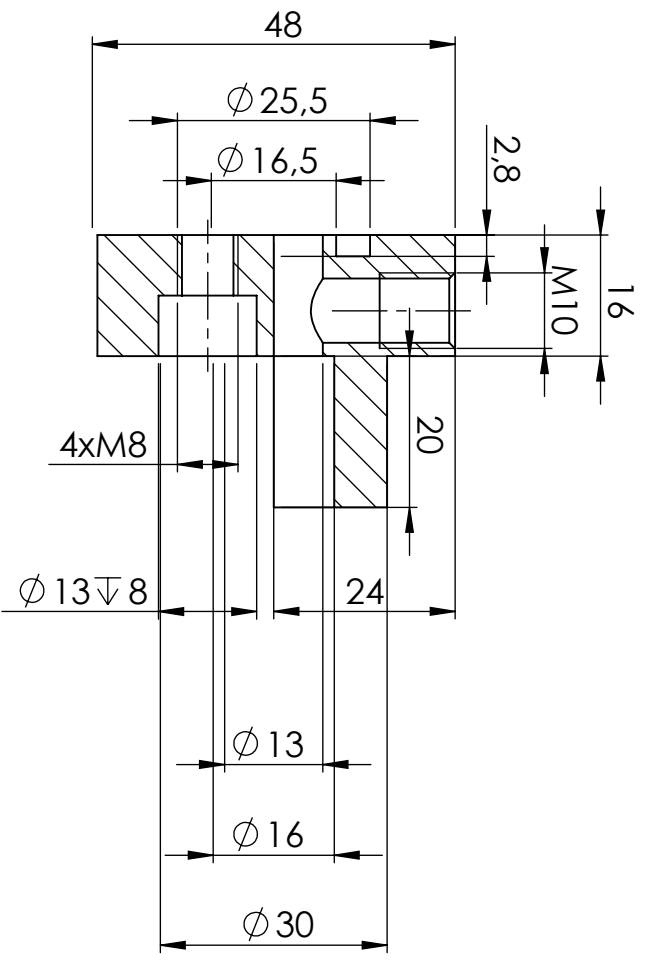
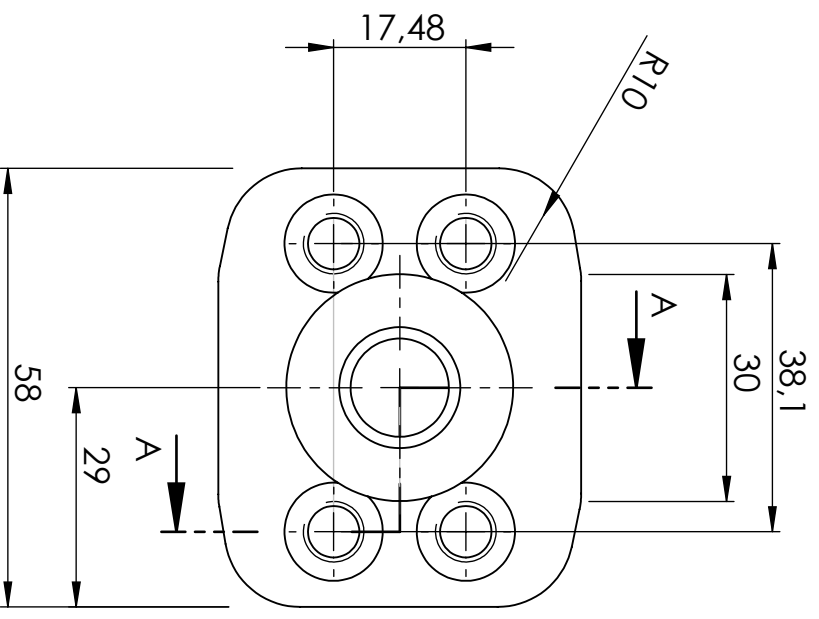
Position	N. Drawing	Denomination	Quantity
1	PL20-16	External gear pump	1
2	TFM-A-10	Flange SAE MA	1
3	6503C1A	Adapter Kistler	2
4	TFM-A-21	Reference pipe	1
5	GEL4SRCF	Male stud	9
6	TFM-A-22	Mounting block 1	1
7	TFM-A-23	Connecting pipe	1
8	TFM-A-24	Mounting block 2	1
9	EMA1/1/4CF	Pressure transducer	1
10	SGRA06	Relief valve	1
11	VOSS SP3	Flexible hose	2
12	EGE20SRREDCF	Swivel connector	1
13	EGE16SRREDCF	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

DATE 09/06/2021
SCALE 1:5
DRAWN BY A.Gallo




DATE 09/06/2021
SCALE 1:5
DRAWN BY A.Gallo
REFERENCE ISO 10767 SAE A

6 5 4 3 2 1

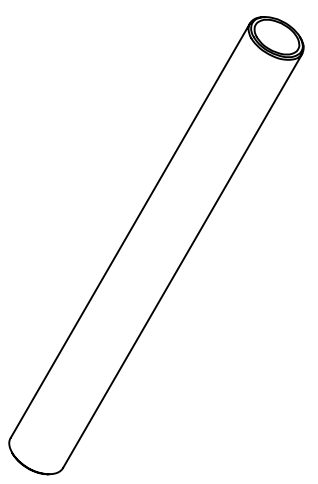
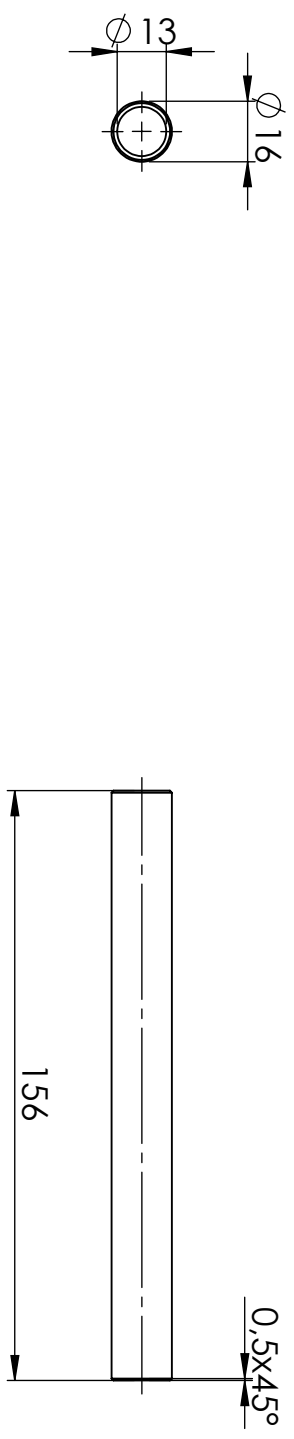



SECTION A-A

DATE	09/06/2021	SCALE	1:1	N.DRAWING	TFM-A-10	
DRAWN BY	A. Gallo	REFERENCE	FLANGE SAE MA			
SURFACE FINISH	N 7					A4
MATERIAL	ST52.3					

6 5 4 3 2 1

D D

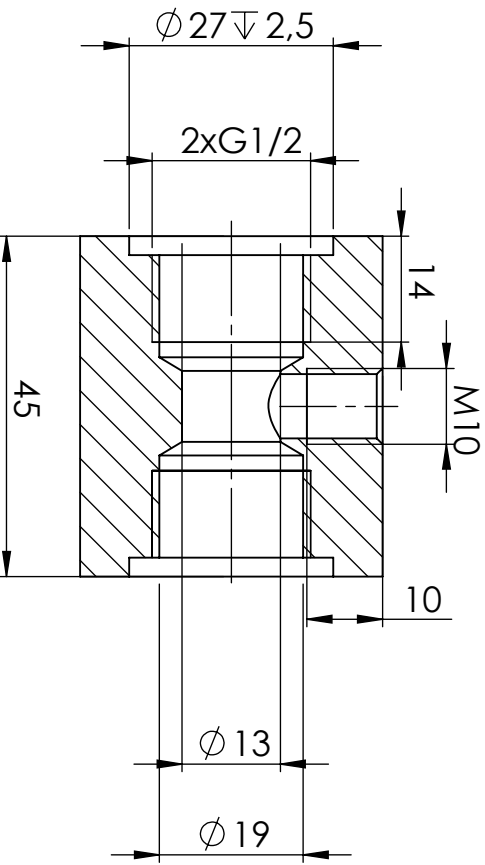
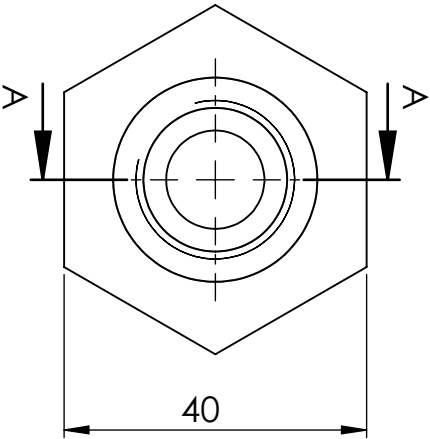


DATE	09/06/2021	SCALE	1:2	DRAWING	TFM-A-21	
DRAWN BY	A.Gallo	REFERENCE	Reference pipe			
SURFACE FINISH	N 7					A4
MATERIAL	ST 37					

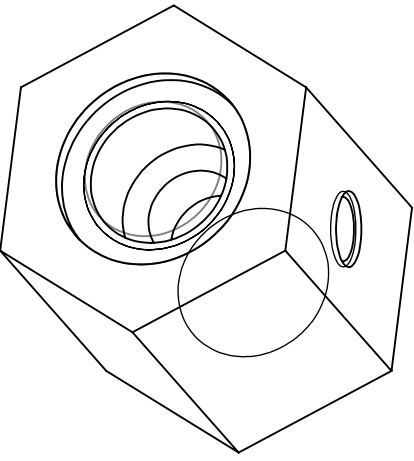
4 3 2 1


A A

6 5 4 3 2 1



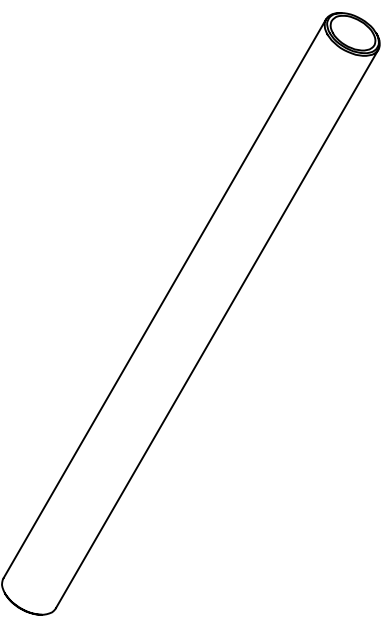
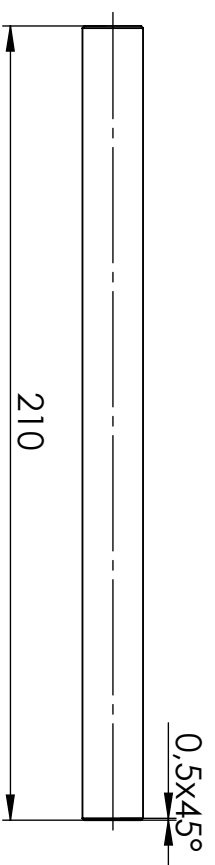
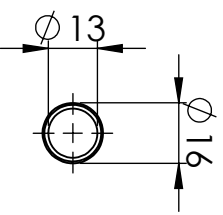
SECTION A-A




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

4 3 2 1

6 5 4 3 2 1

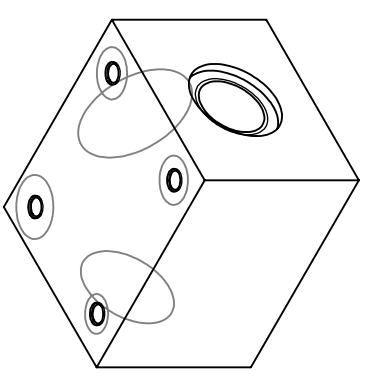
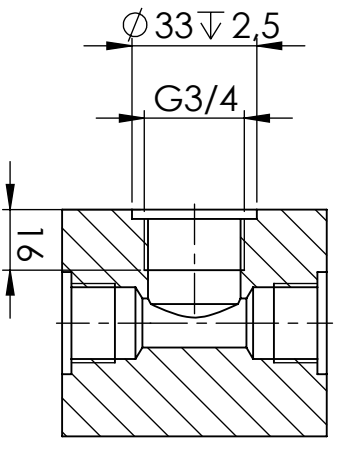
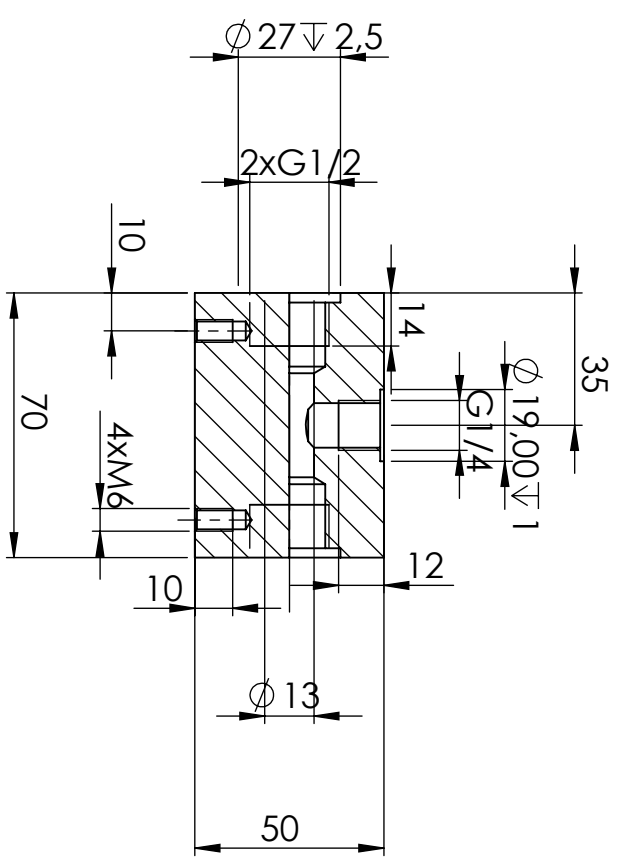
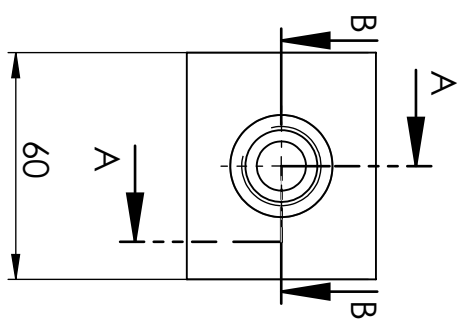


DATE	09/06/2021	SCALE	1:2	NDRAWING	TFM-A-23	
DRAWN BY	A. Gallo	REFERENCE	Connecting pipe			
SURFACE FINISH	N 7					A4
MATERIAL	ST 37					

4 3 2 1


A B C D

6 5 4 3 2 1



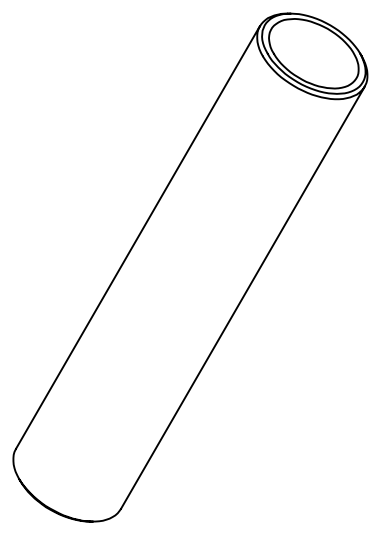
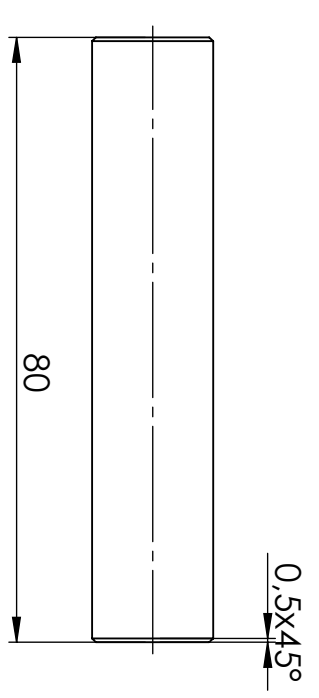
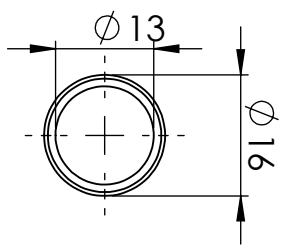
SECTION B-B


SECTION A-A

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

A B C D

6 5 4 3 2 1

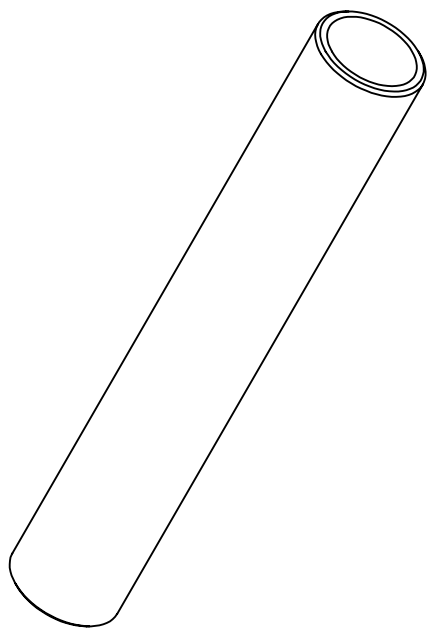
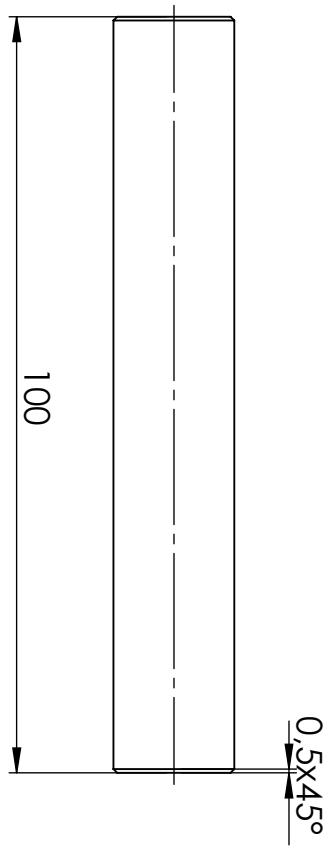
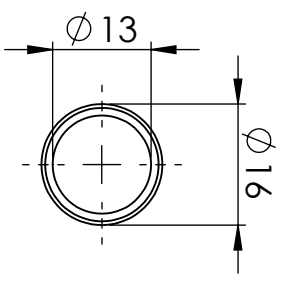



DATE	09/06/2021	SCALE	1:1	N.DRAWING	TFM-A-25	
DRAWN BY	A. Gallo	REFERENCE	Extension pipe			
SURFACE FINISH	N 7					A4
MATERIAL	ST 37					

4 3 2 1

A B C D

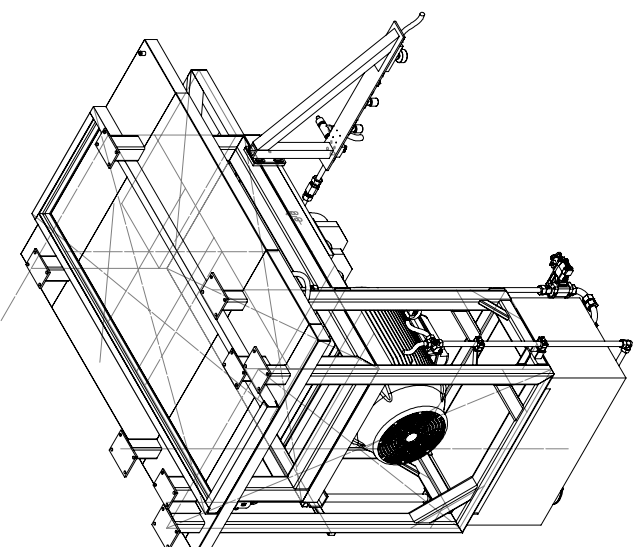
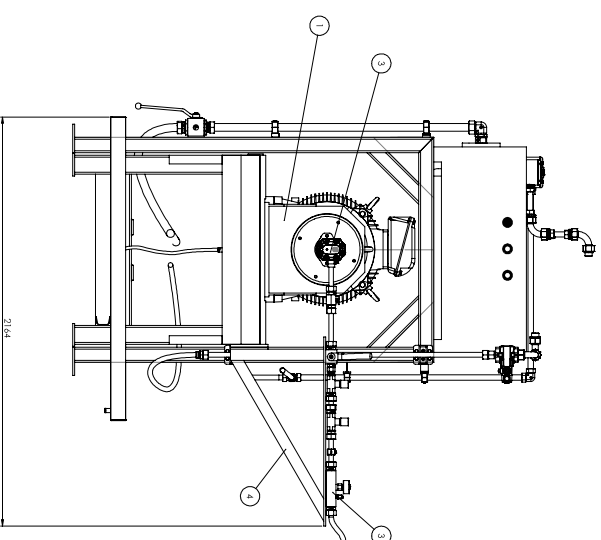
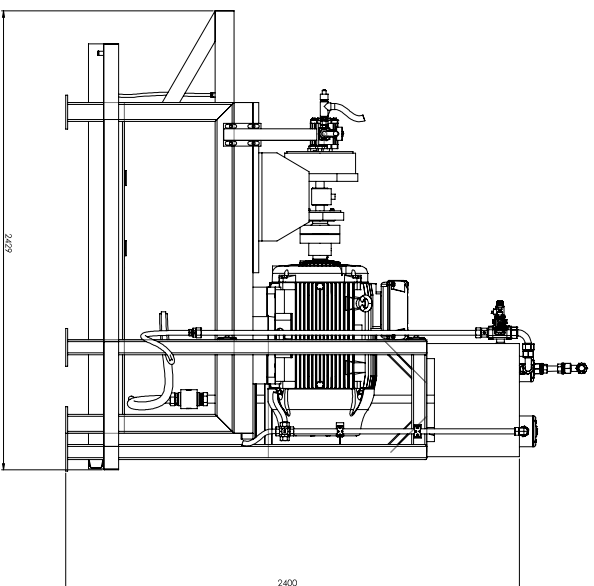
6 5 4 3 2 1



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

4 3 2 1

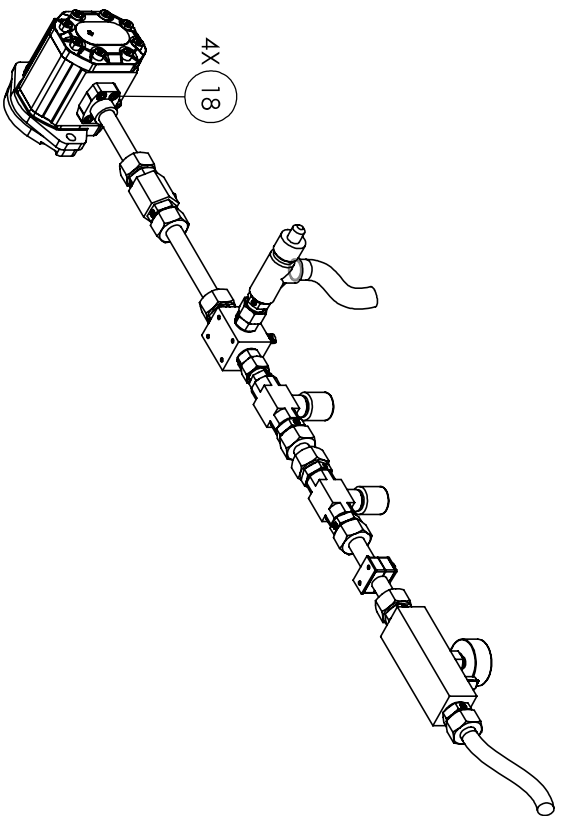
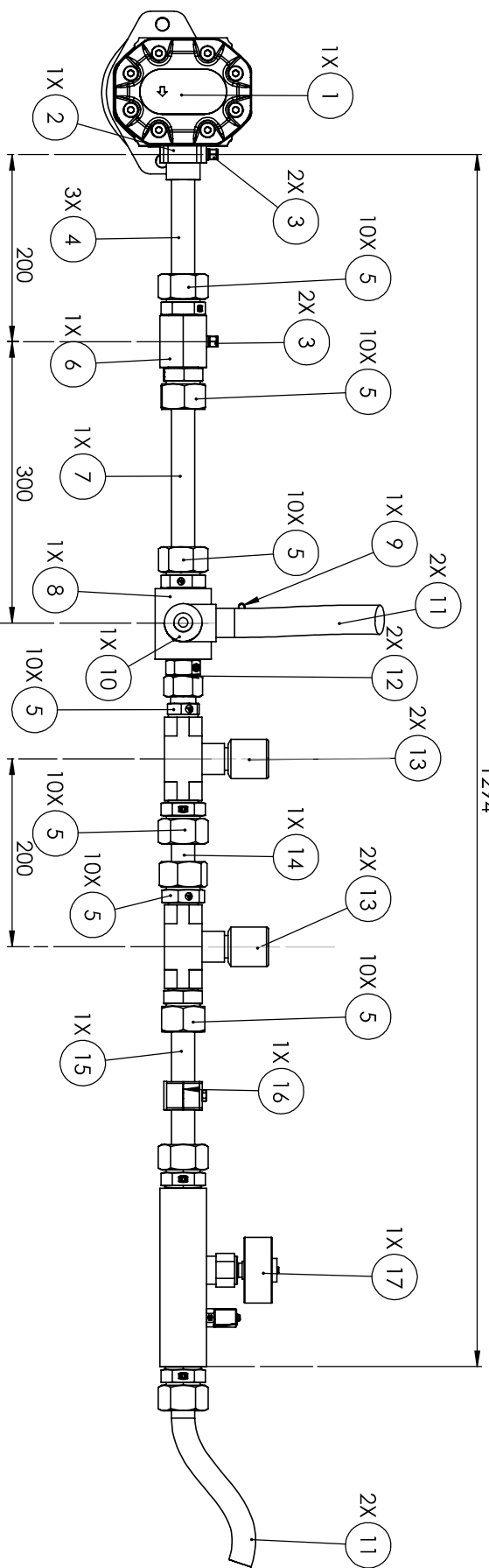
A B C D



Position	Numbering	Designation	Quantity
1	TRUCK	TRUCK	1
2	TRUCK	TRUCK	1
3	TRUCK	TRUCK	1
4	TRUCK	TRUCK	1

Order No.	09/10/2021	Scale	1:10	Project	TRUCK
Customer	A.G. S.p.A.	Sheet	1/10	Revision	

Author	101
Check	101
Draw	101
Rev.	101



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.Gallo

1:5

TFM-B-10

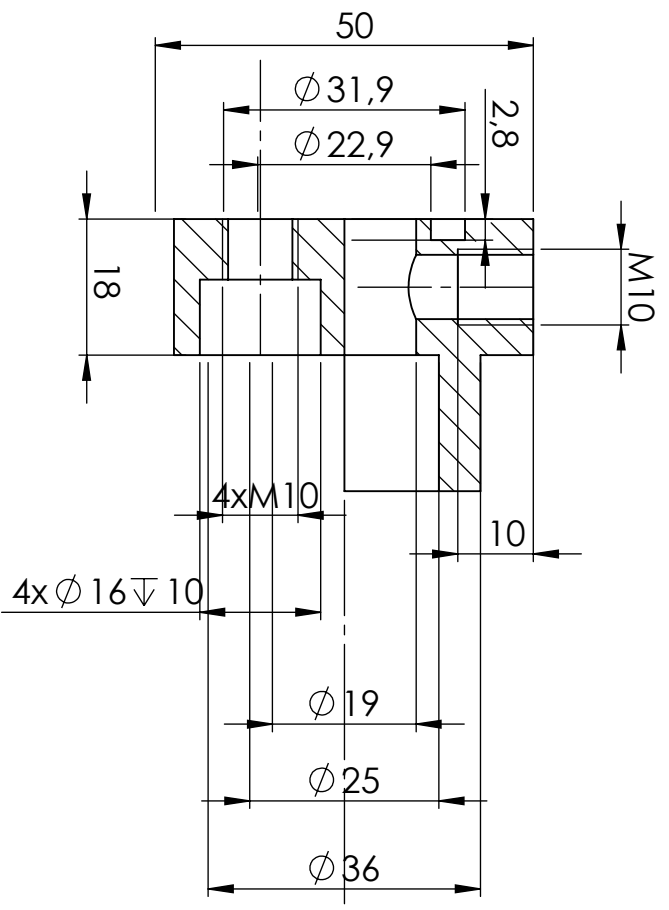
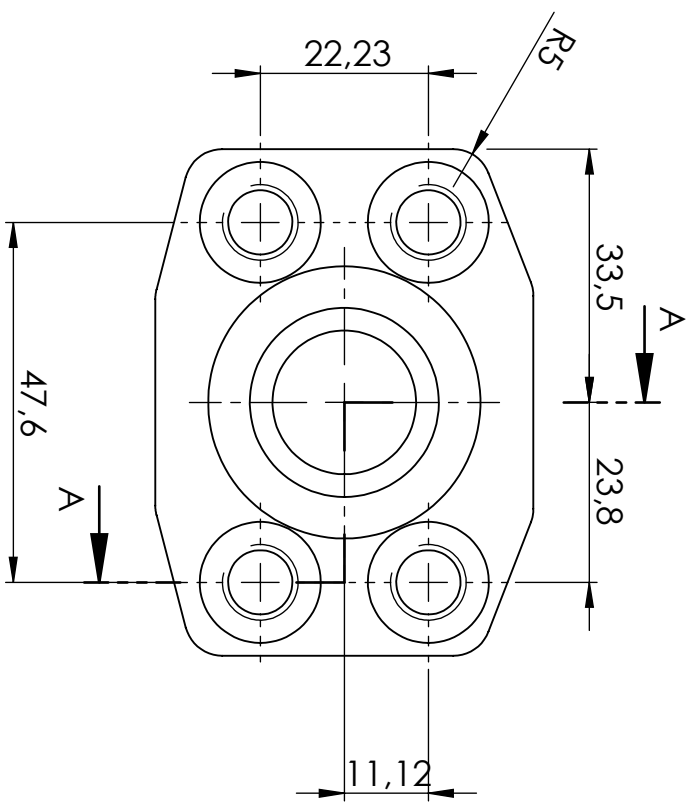


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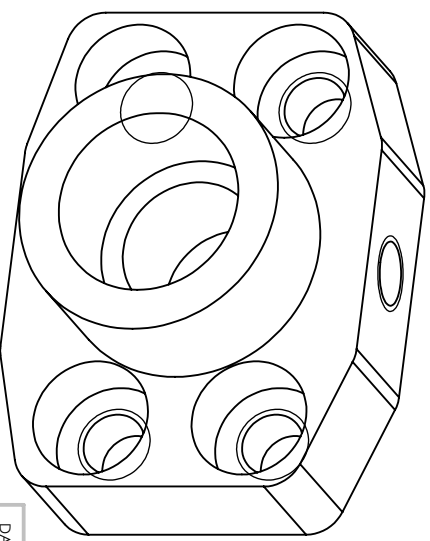
REFERENCE


ISO 107676 SAE B

A3

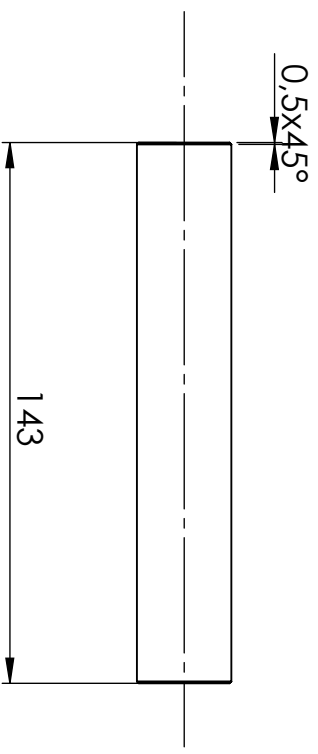
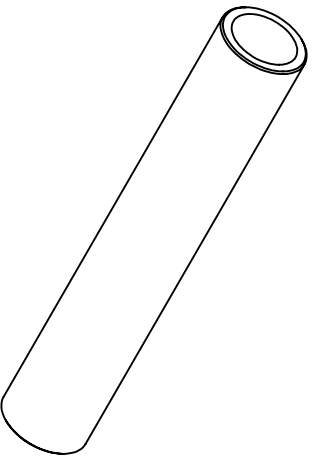
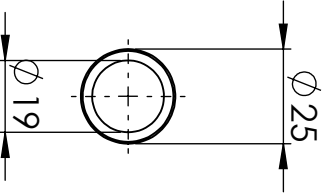



SECTION A-A



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

6 5 4 3 2 1



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

4

3

2

1

A

B

C

D

A

B

C

D

6

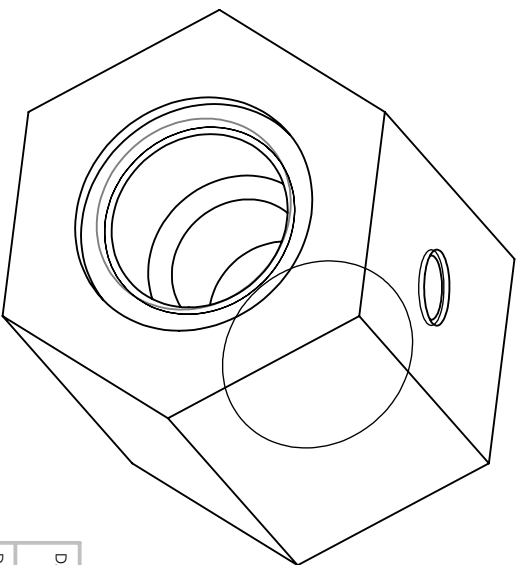
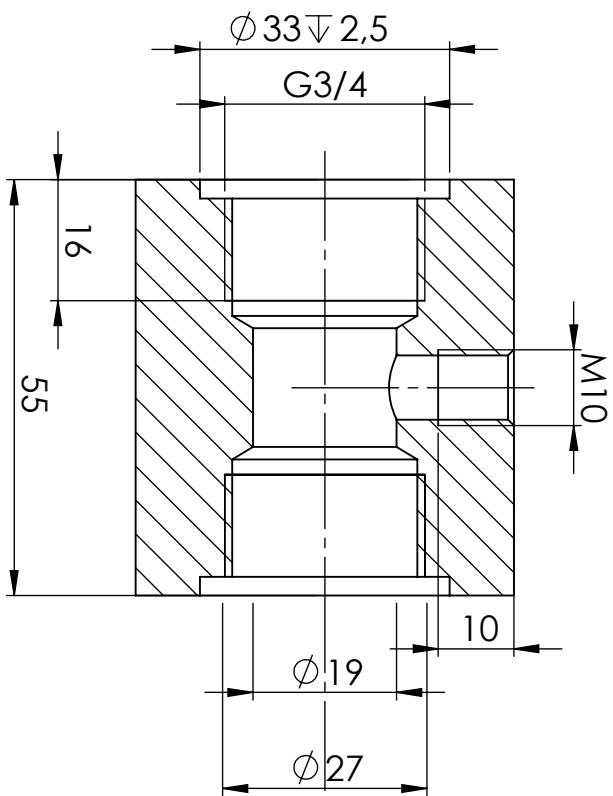
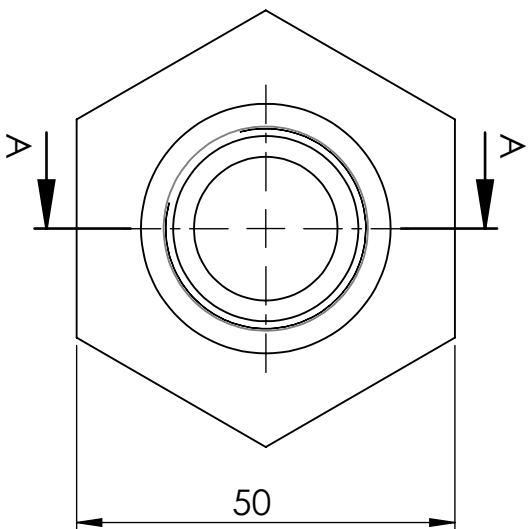
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4


3

2

1



SECTION A-A

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

A

B

C

D

A

B

C

D

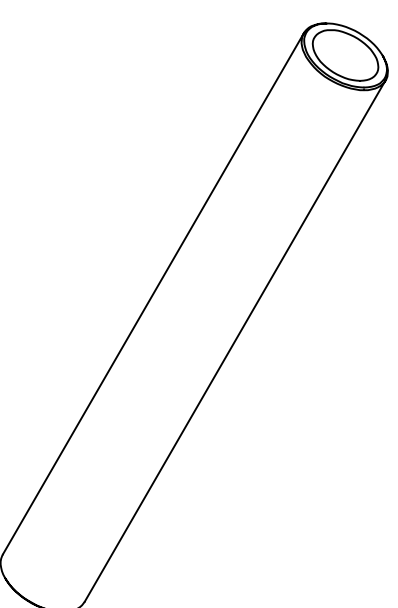
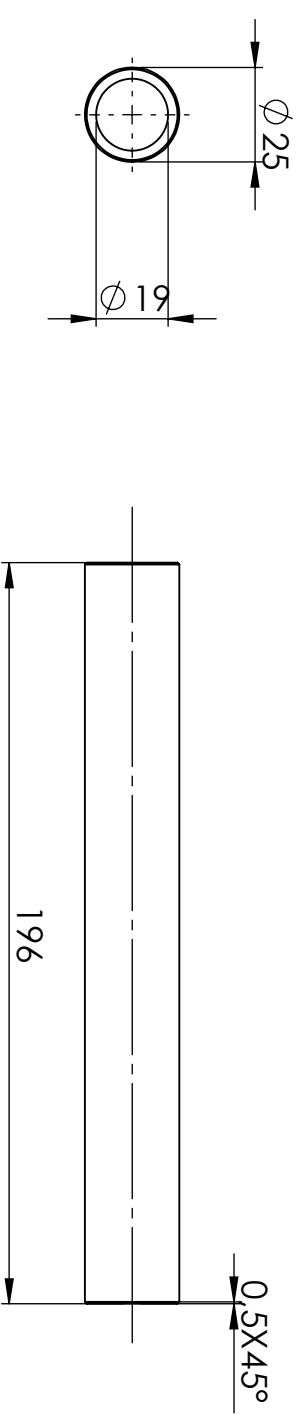
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3

2

1

6 5 4 3 2 1

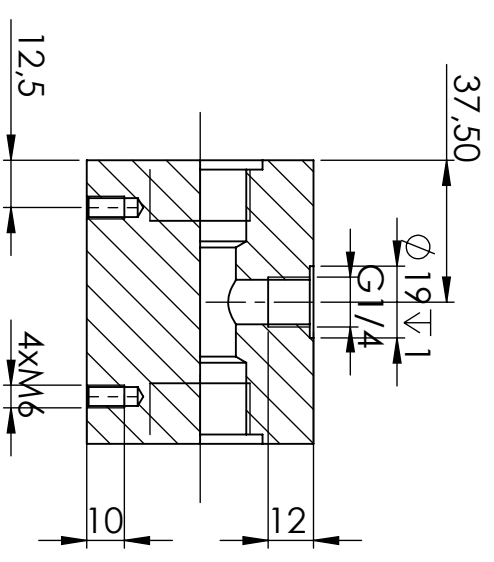
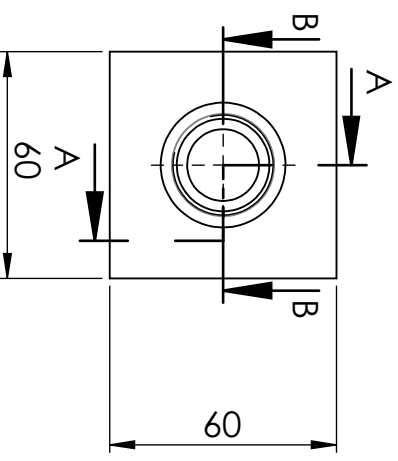


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DRAWN BY	A.Gallo	REFERENCE	Connecting pipe		A4	
SURFACE FINISH	N 7					
MATERIAL	ST-37					

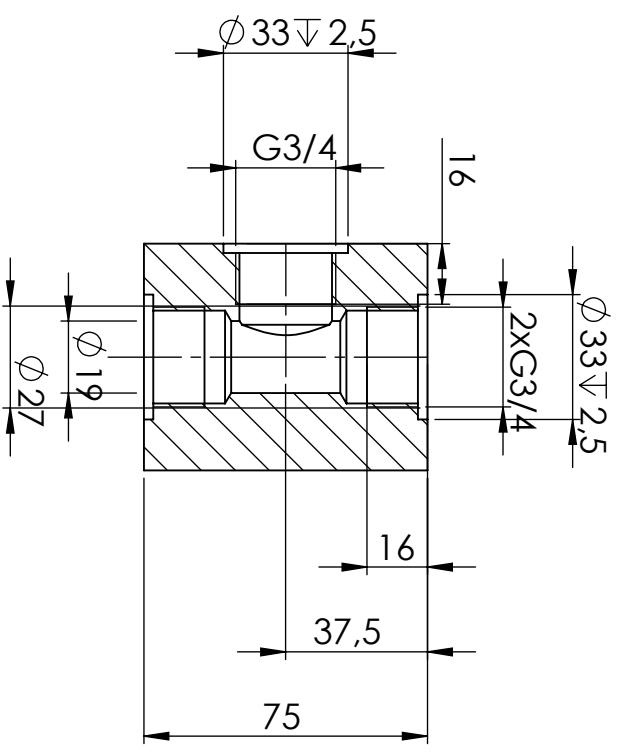
4 3 2 1

A B C D

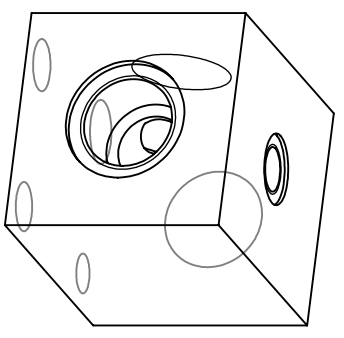
6 5 4 4 3 2 1



SECTION A-A



SECTION B-B



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

A

B

C

D

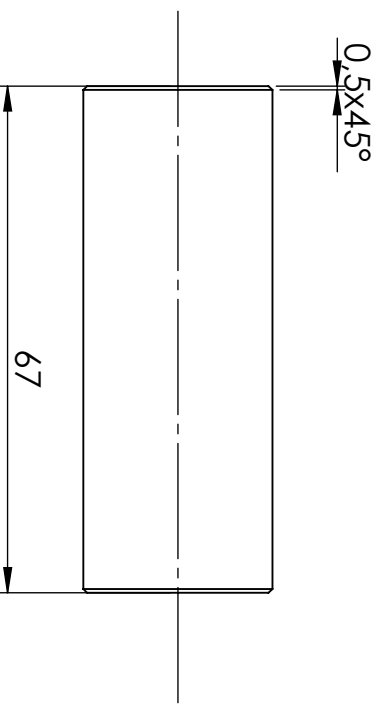
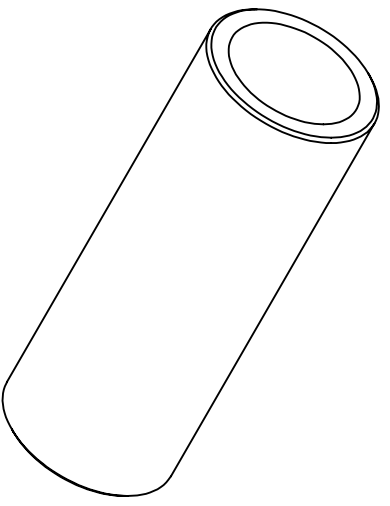
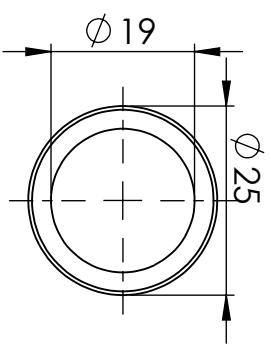
A


B

C

D

6 5 4 3 2 1



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

4

3

2

1

A

B

C

D

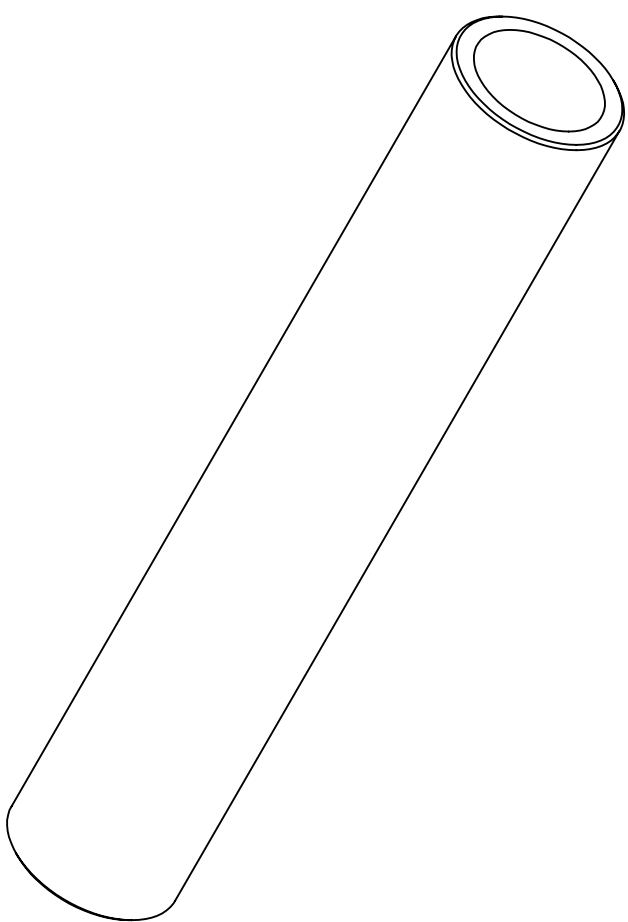
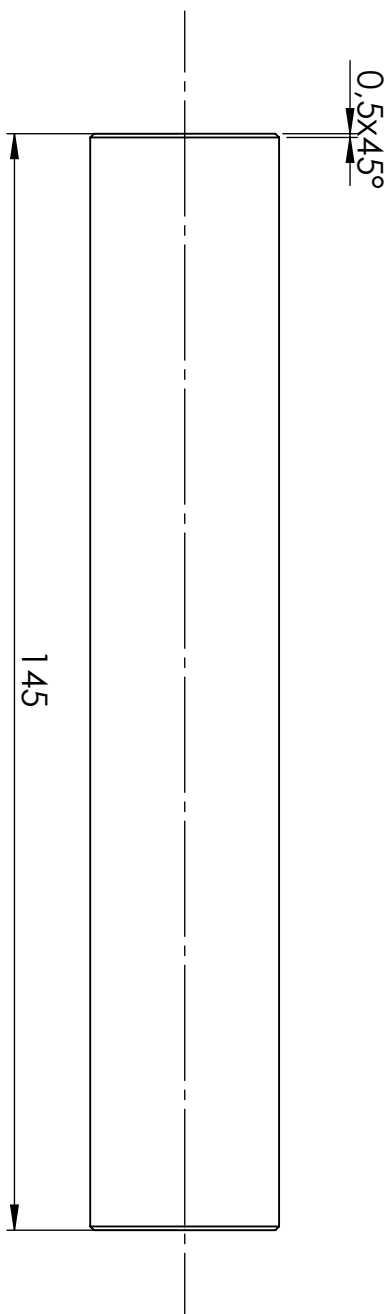
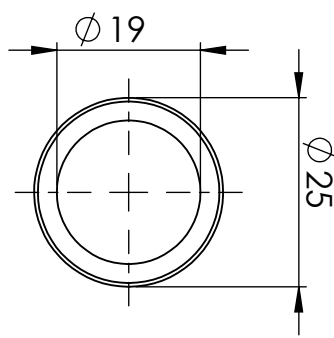
A

B

C

D

6 5 4 3 2 1



A

B

C

D

A

B

C


D

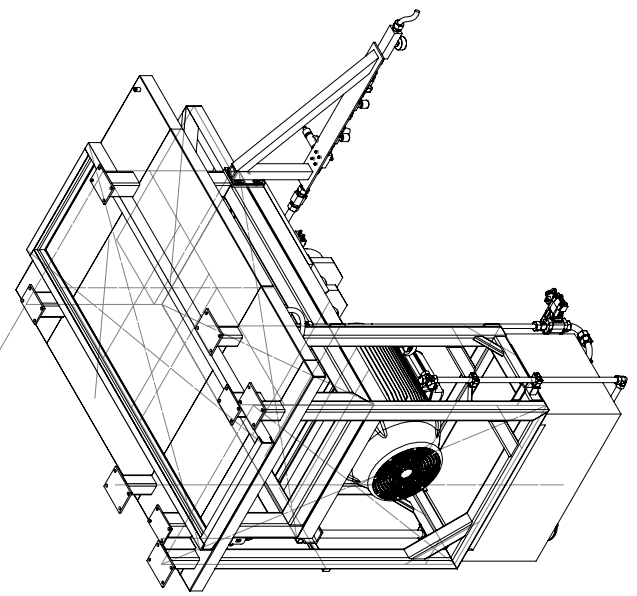
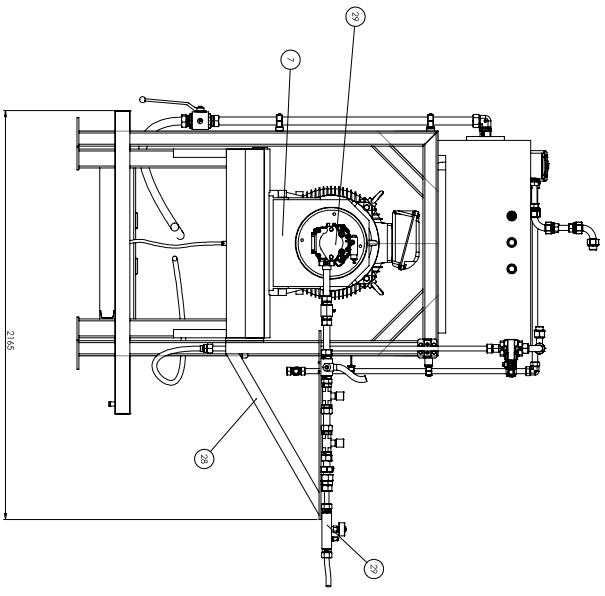
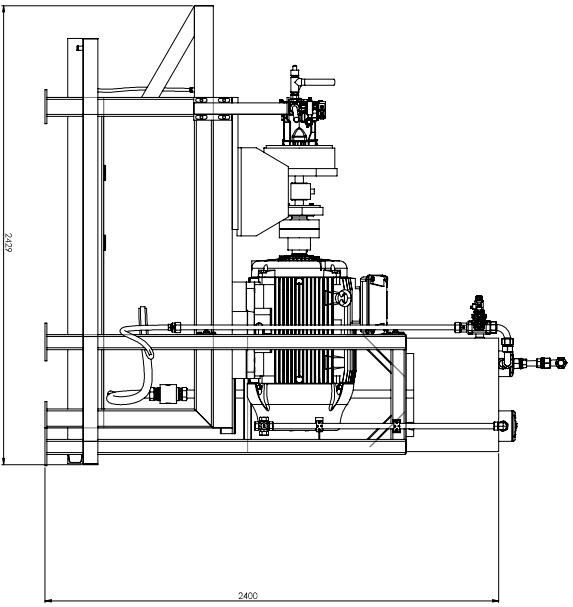
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3

2

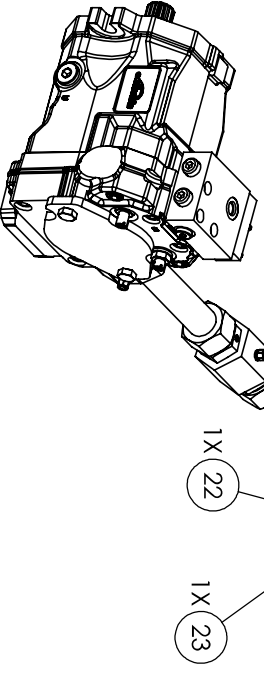
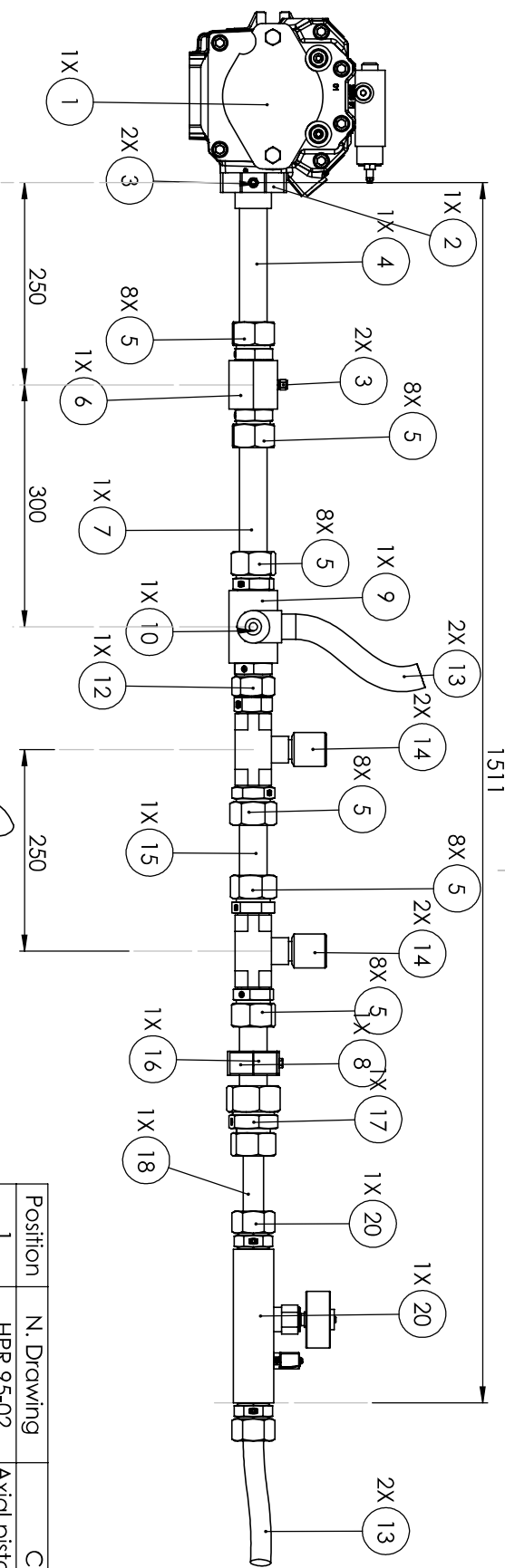
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DATE	09/06/2021	SCALE	1:1	N. DRAWING	TFM-B-26	
DRAWN BY	A. Gallo	REFERENCE	Steel pipe			
SURFACE FINISH	N 7					
MATERIAL	ST-37					A4



POSITION	NOME/NUMERO	DESCRIZIONE	QUANTITÀ
1	TRM-C10	TRM-C10	1
2	TRM-C10	TRM-C10	1
3	TRM-C10	TRM-C10	1
4	TRM-C10	TRM-C10	1

Scale:	1:10	TRM-C10
Author:	A. Gallo	
Reviser:		



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	EMAI1/1/4CF	Pressure transducer	1
12	EGE25SRCD	Swivel connector	1
13	VOSS SP3	Flexible hose	2
14	VRFU9005	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	EGE20SRDCF	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

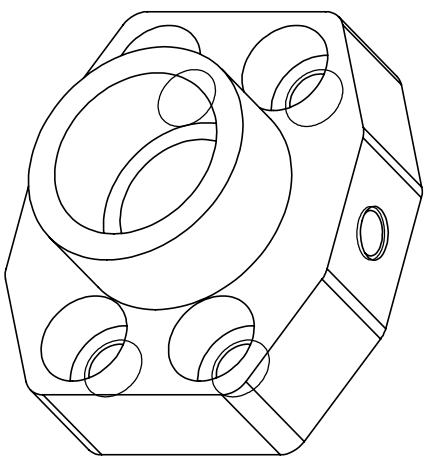
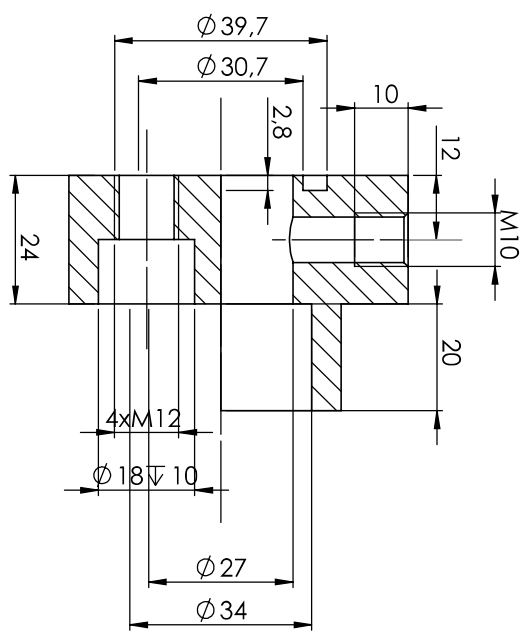
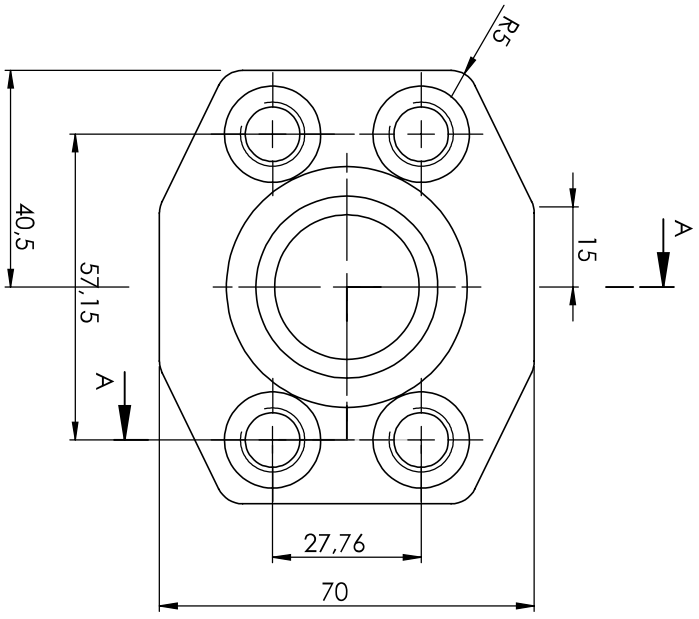
DRAWN BY
A. Gallo

REFERENCE
ISO 10767 SAE C




IF NOT SPECIFIED SURFACE FINISH:

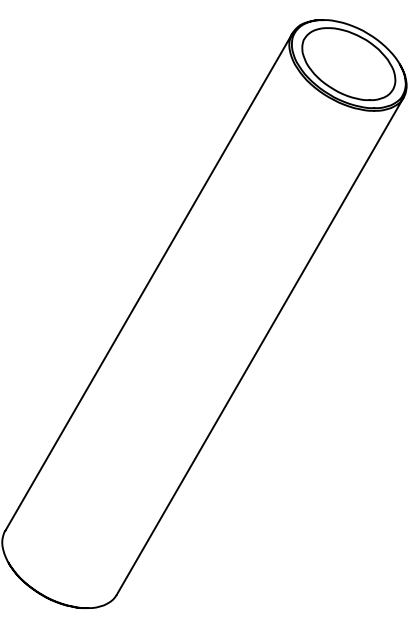
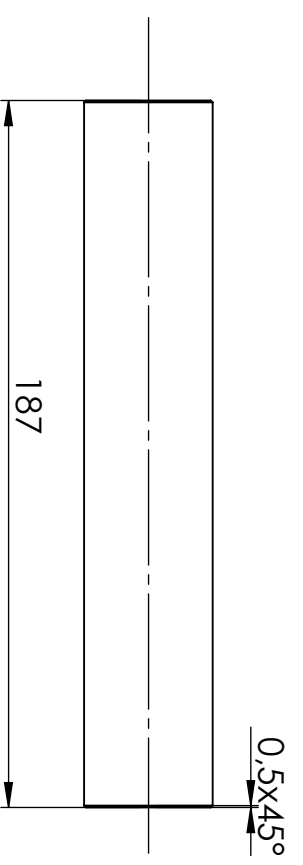
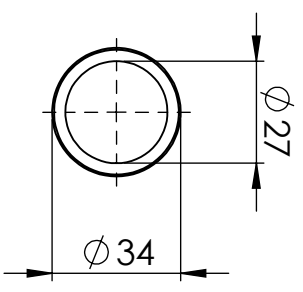
A3




SECTION A-A

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

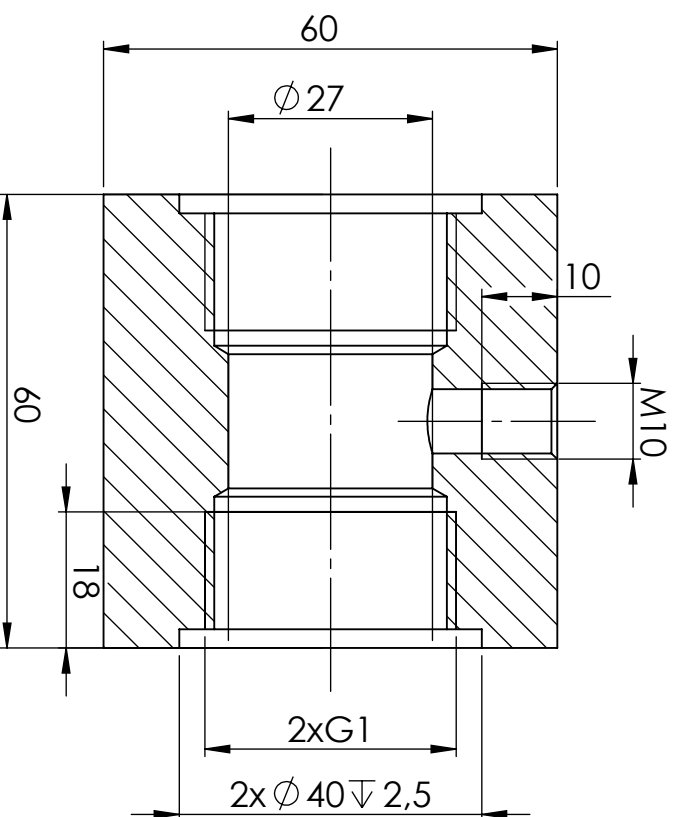
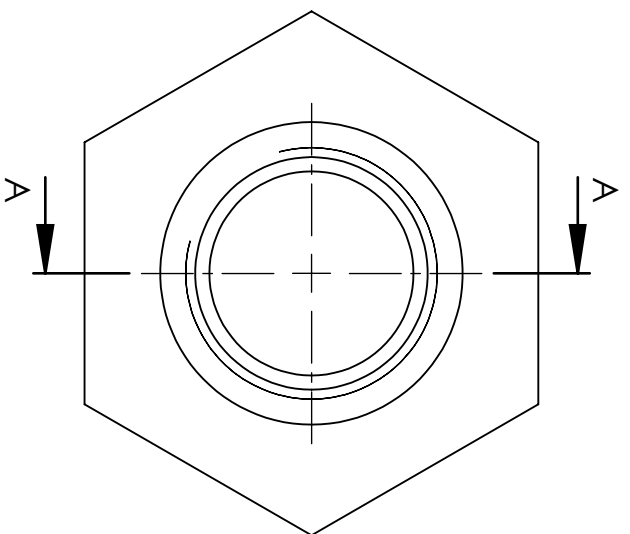
6 5 4 3 2 1



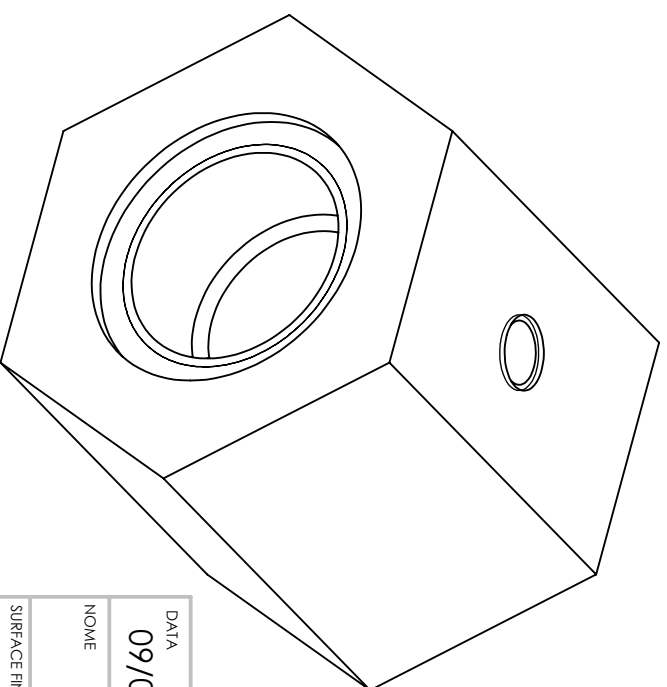
DATE	09/06/2021	SCALE	1:2	TITOLO:	TFM-C-21	
DRAWN BY	A.Gallo	REFERENCE	Reference pipe			
SURFACE FINISH	N 7					A4
MATERIAL	ST-37					


4 3 2 1

A B C D



SECTION A-A

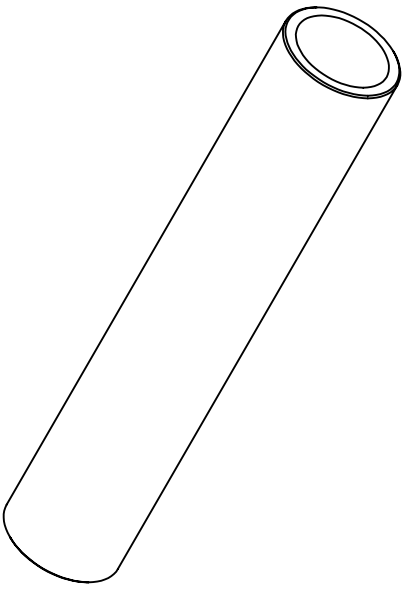
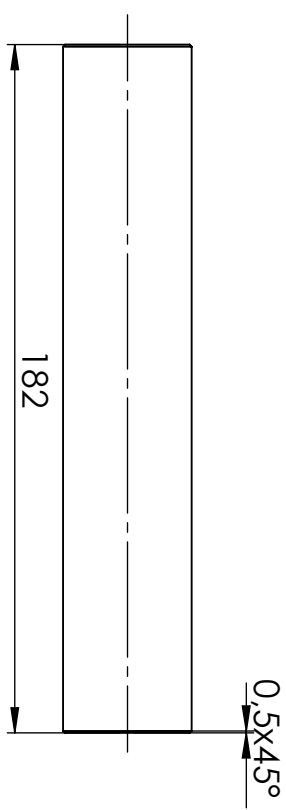
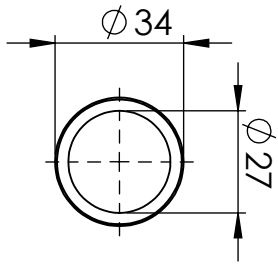



DATA		SCALE	TITOLO:	
09/06/2021		1:1	TFM-C-22	
NOME		REFERENCE		
A. Gallo		Mounting block 1		
SURFACE FINISH		MATERIAL		
N 7		F1-S235JR		
		A4		

6 5 4 3 2 1

A B C D A B C D A B C D

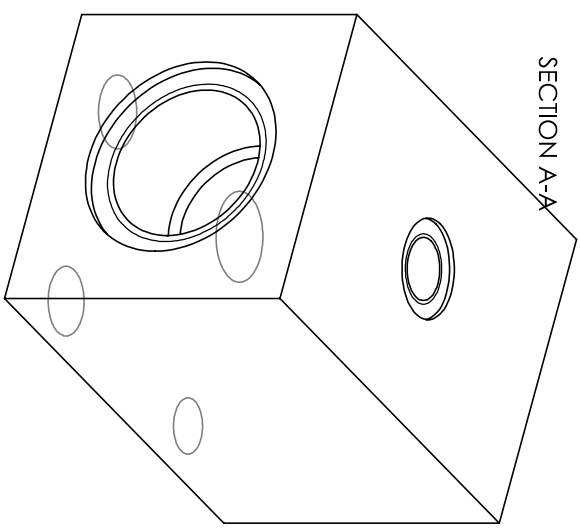
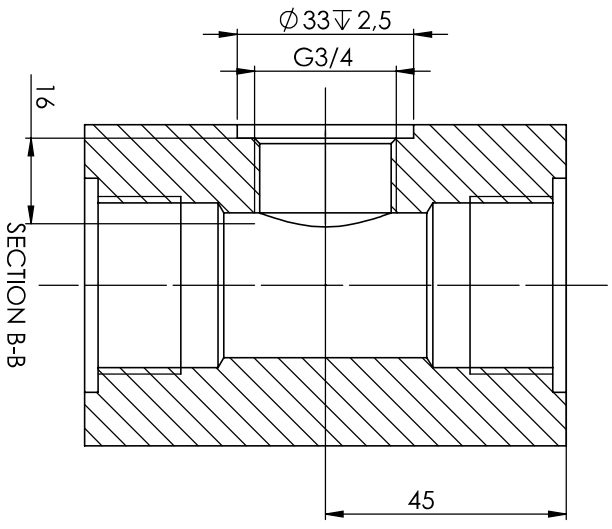
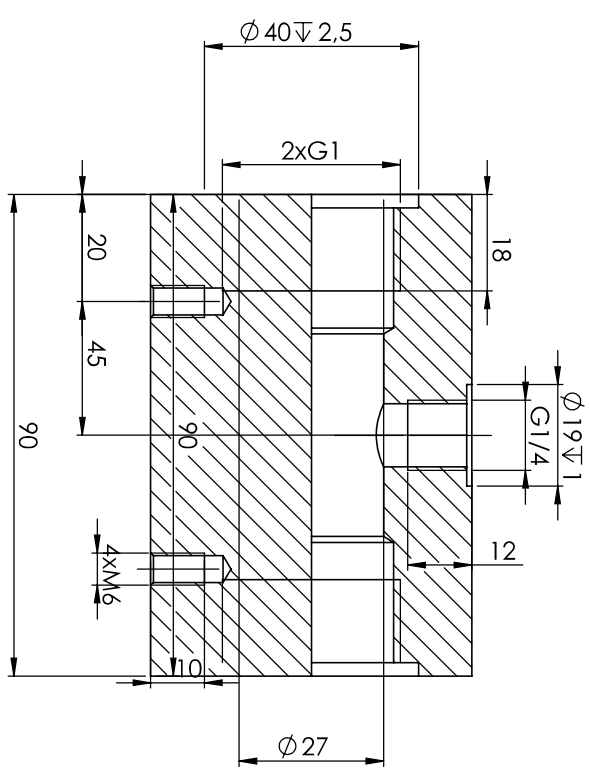
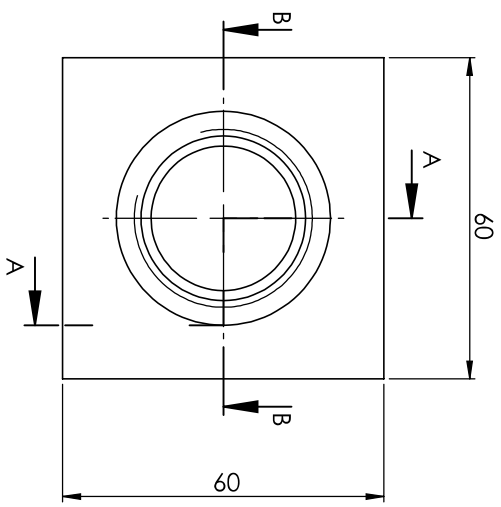
6 5 4 3 2 1




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

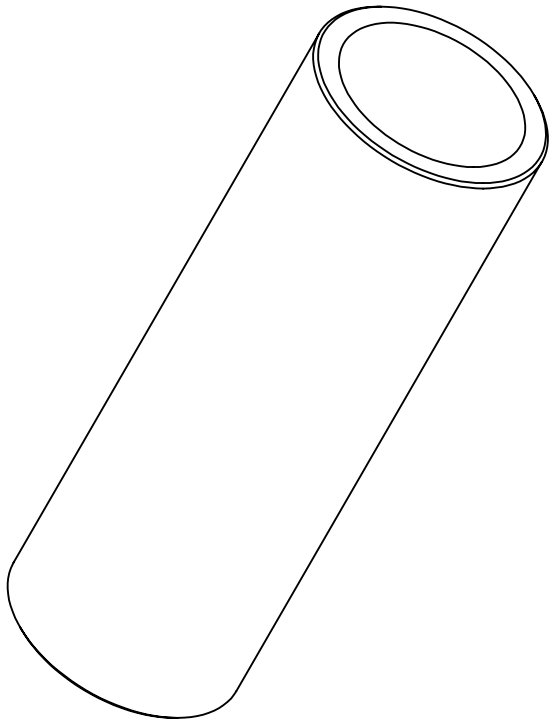
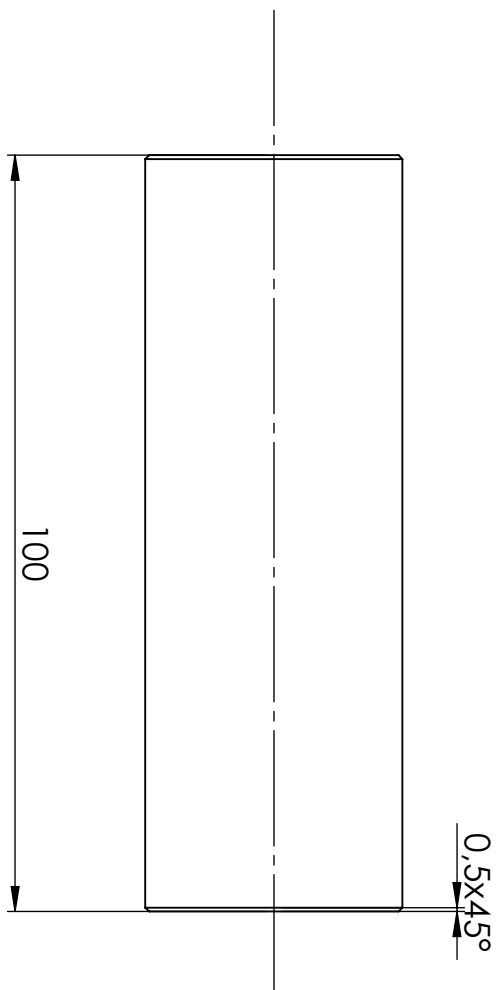
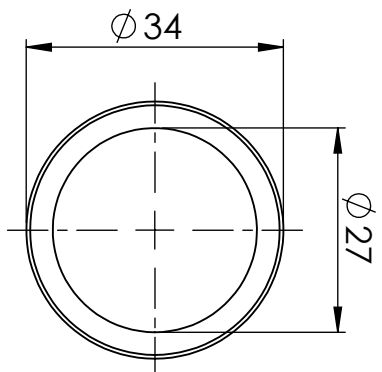
4 3 2 1


A B C D A B C D



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

6 5 4 3 2 1



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

4

3

2

1

A

B

C

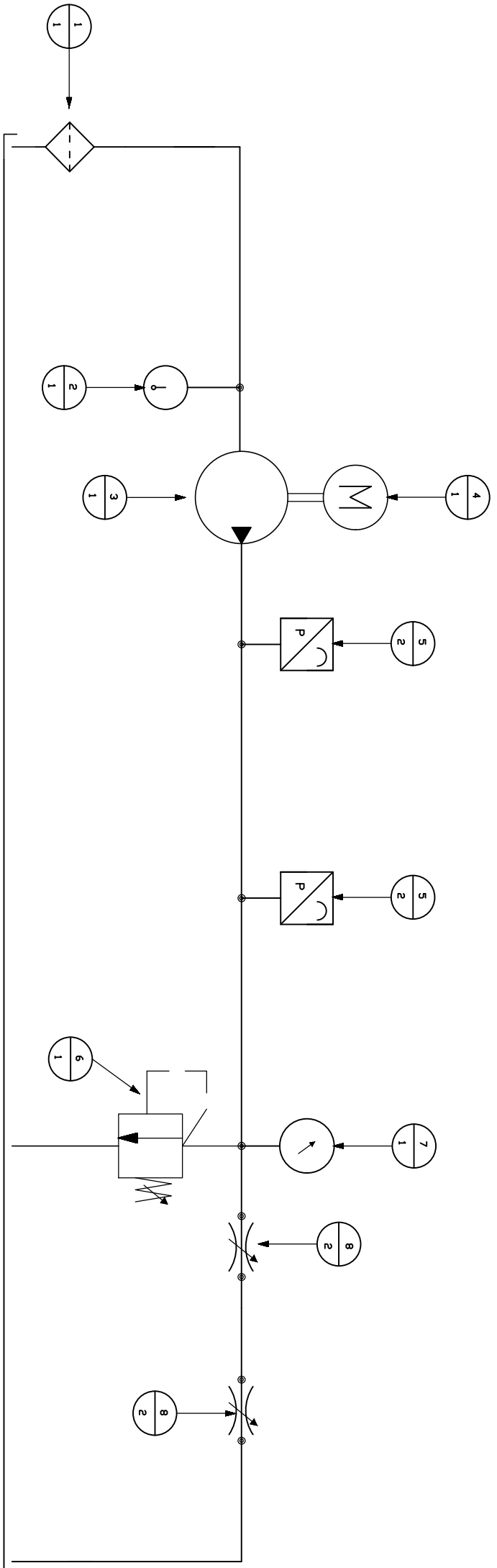
D

A

B

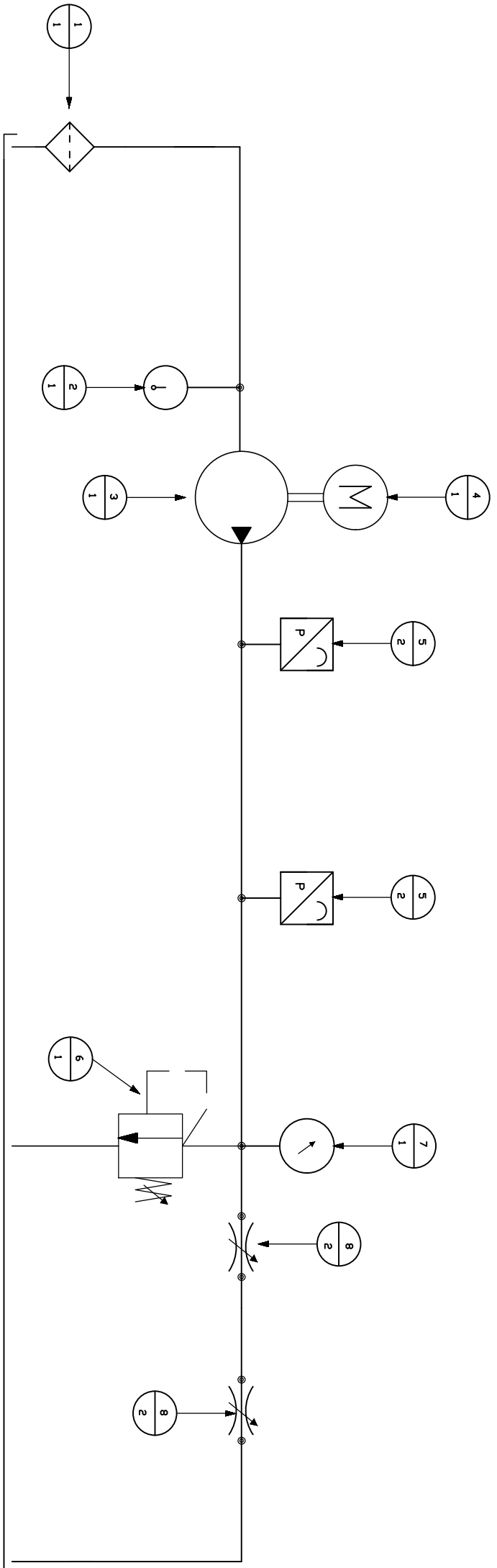
C

D



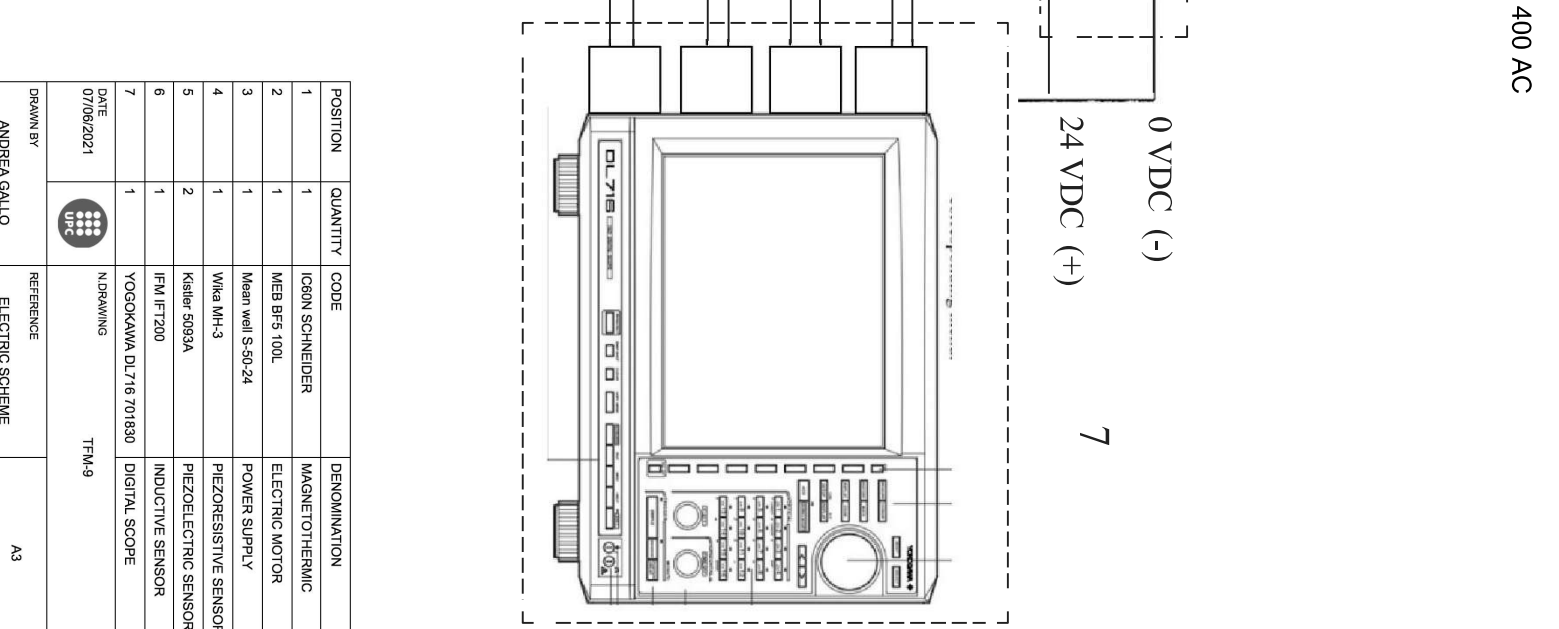
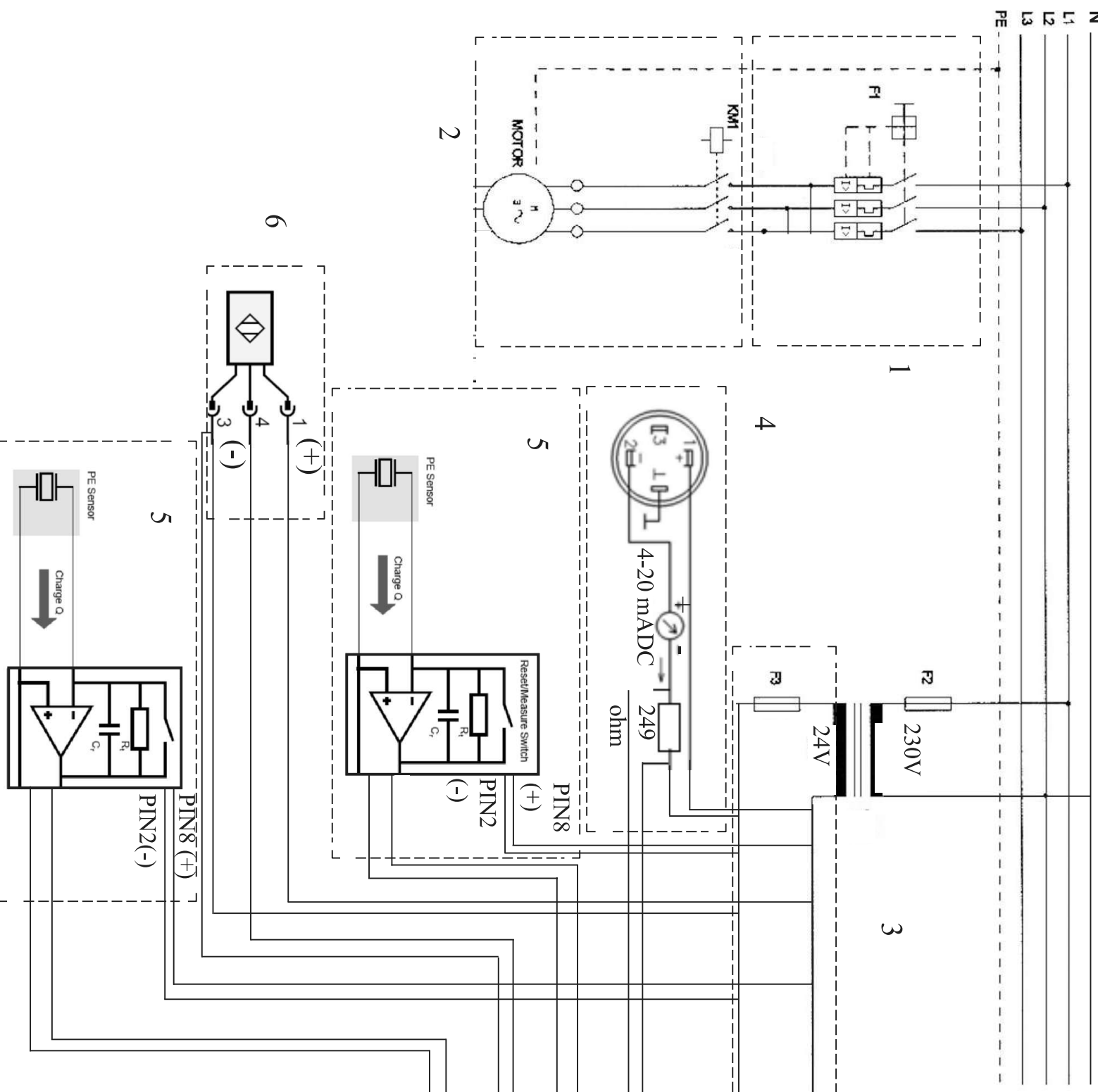
POSITION	QUANTITY	CODE	REFERENCE
1	1	RS 512-702	FILTER
2	1	TPM10	TEMPERATURE SENSOR
3	1	PL 20-16	HYDRAULIC PUMP
4	1	BF5 100L	ELECTRIC MOTOR
5	2	601 A	PIEZOELECTRIC SENSOR
6	1	SGRA06	RELIEF VALVE
7	1	MH-3	PIEZORESISTIVE SENSOR
8	2	VRFU9003	LOADING VALVE

DATE	REVISION
08/06/2021	TFM-A-8
DRAWN BY	AGALLD
AGALLD	AGALLD
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	BF5 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
HYDRAULIC SCHEME	
A3	



POSITION	QUANTITY	CODE	DENOMINATION
1	1	IC60N SCHNEIDER	MAGNETOTHERMIC
2	1	MEB BFF 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	YOGOKAWA DL716 701830	DIGITAL SCOPE

DATE	07/06/2021	N.DRAWING	TFM-9
DRAWN BY	ANDREA GALLO	REFERENCE	ELECTRIC SCHEME
			A3