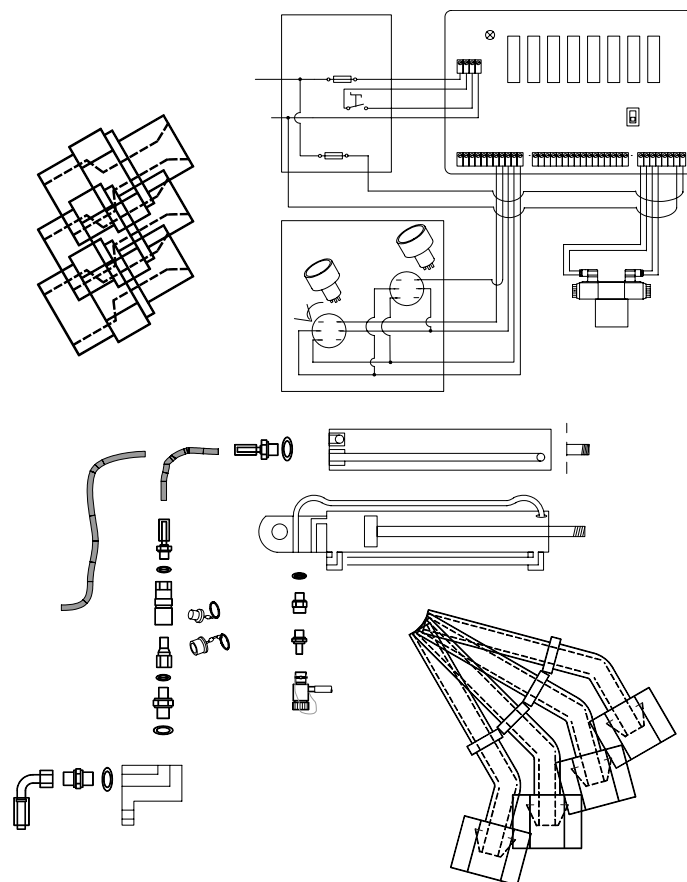


# Hydraulic systems 1

## *Practical guide*



Hydraulic systems 1	1
Practical guide .....	1
Introduction .....	3
Revision log.....	4
1 BASIC HYDRAULIC THEORY .....	5
1.1 Units - Formulas.....	5
1.2 Principles of Hydraulics .....	5
1.3 Piston Pump - Cylinder .....	7
1.4 Rotating Pump - Motor .....	8
1.5 Seldén Hydraulic Motors .....	8
2 COUPLINGS AND HOSES .....	9
2.1 Threads .....	9
2.2 Adapters from BSPP to JIC.....	9
2.3 Hydraulic couplings .....	10
2.3.1 1/4" couplings .....	10
2.3.2 3/8" couplings .....	11
2.3.3 Various couplings.....	12
2.4 Hydraulic hoses .....	13
1.4.1 Nylaflex hydraulic hose (datasheet).....	13
2.5 Furlex couplings and hoses .....	14
2.6 Mast motor couplings and hoses .....	15
2.7 Boom 200 couplings and hoses.....	16
2.8 Boom 250 couplings and hoses.....	17
2.9 Boom 300 couplings and hoses.....	18
3 HYDRAULIC SYSTEMS -- Schematics .....	19
3.1 Furlex and In-mast furling (main).....	19
3.2 Hydraulic boom outhaul.....	22
3.2.1 Hydraulic boom outhaul schematics – simplified.....	22
3.2.2 Hydraulic boom outhaul schematic – complete .....	24
4 ELECTRICAL INSTALLATION OF HYDRAULICS .....	24
4.1 Electrical circuit diagrams.....	24
4.1.1 Circuit diagram for Hydraulic Powerpac 1 - simplified.....	24
4.1.2 Circuit diagram for Hydraulic Powerpac 2 - simplified.....	24
4.1.2 Circuit diagram for Hydraulic Powerpac 2 - simplified.....	24
4.1.3 Circuit diagram for Controlbox 532-426 - complete .....	24
4.1.3 Circuit diagram for Controlbox 532-426 - complete .....	24

## Introduction

HYDRAULIC SYSTEMS 1 – PRACTICAL GUIDE contains documentation of interest for both internal use at Seldén, and for customers. It's meant to be a guide for Seldén's hydraulic applications, where you can find out how the systems work, get some help when troubleshooting etc.

As the manuals for the different hydraulic products are revised, some of the information in this guide will be transferred to these manuals as well.

HYDRAULIC SYSTEMS 1 is available as a word-file, and it can be revised without notice. The revisions are logged on the next page.

## Revision log

2004-05-18

2004-08-20

Chapter 1.1 to 1.5 added

# 1 BASIC HYDRAULIC THEORY

## 1.1 Units - Formulas

Hydraulic power is defined by pressure and flow. Here are some basic hydraulic formulas and unit definitions.

F	force	1N (newton)
A	area	1m <sup>2</sup> = 10.000cm <sup>2</sup>
P	pressure	1N/m <sup>2</sup> = 1Pa (pascal)
		1N/cm <sup>2</sup> = 10.000Pa
		10N/cm <sup>2</sup> = 100.000Pa = 0.1 MPa = 1 bar ~1kg/cm <sup>2</sup>
ΔP	pressure difference	
t	time	min, s
V	volume	1l = 1000cm <sup>3</sup>
S	stroke	m, cm
Q	oilflow	l/min
D	displacement	cm <sup>3</sup>
M	torque	Nm
n	rotating speed	n/min

$$P = \frac{F}{A}$$

$$F = A \times P$$

$$Q = \frac{V}{t} = \frac{A \times S}{t}$$

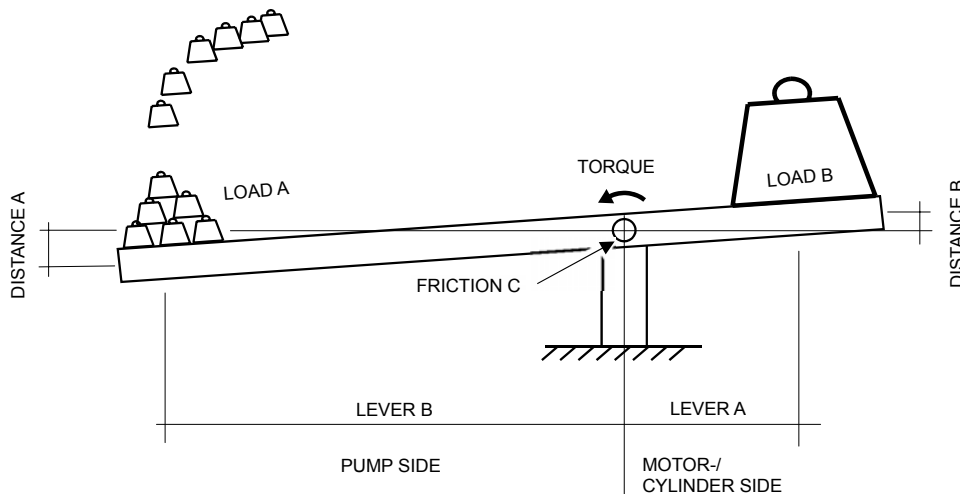
$$S = \frac{Q \times t}{A}$$

$$Q = n \times D$$

$$M = \frac{\Delta P \times D}{2\pi}$$

## 1.2 Principles of Hydraulics

In this chapter we make some comparison between a lever system and a hydraulic one. The comparison is not strictly mathematically/physically correct, but might be a help to understand some hydraulic terms.



Lever A

Area of pump piston or pump displacement (the oil volume achieved from one revolution of the pump wheel)

Lever B

Area of cylinder piston or motor displacement (NOTE: Lever A and lever B are on opposite sides compare to the loads)

Load B

Represents the given load on a cylinder or motor

Friction C

During movement there is "friction" between the oil and the system. In a hydraulic system this friction (pressure fall) is

decided by hose/pipe diameter and length, bending radiuses and other geometrical features of the system. The pressure fall rises with higher oil flow.

Torque

Compare it with the system pressure. This is the pressure read immediately after the pump.

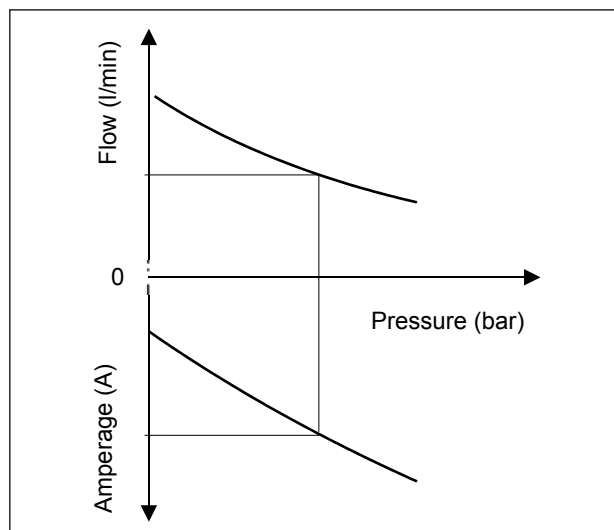
Distance A,B

The relation between distance A and Distance B will be the same as between pump stroke and cylinder stroke, or between pump and motor displacement.

Load A

This is the power the pump motor has to develop (or the force applied on a pump piston) to build up the pressure enough to turn the motor around or move the cylinder piston.

If the load B increases we have to add weights on the “pump side” to raise the torque enough to lift load B. When the load on a cylinder (or motor) increases, the system pressure and the pump motor current rises automatically. At the same time the oil flow drops. The relation between pressure, flow and current consumption (motor effect) is called the pump curve and it is illustrated in a diagram.



PUMP CURVE

### 1.3 Piston Pump - Cylinder

In the picture below we apply a force  $F_1$  on the pump side piston to move the load,  $F_2$ . The force is transmitted by the hydraulic oil enclosed between this piston and the cylinder piston.

To move the load we have to apply a force  $F_1=100\text{N}$ . We push the pump cylinder  $S_1=100\text{cm}$ . This takes us 60 s or 1 min. We can now calculate P and Q. These values describe how the pump works at this moment.

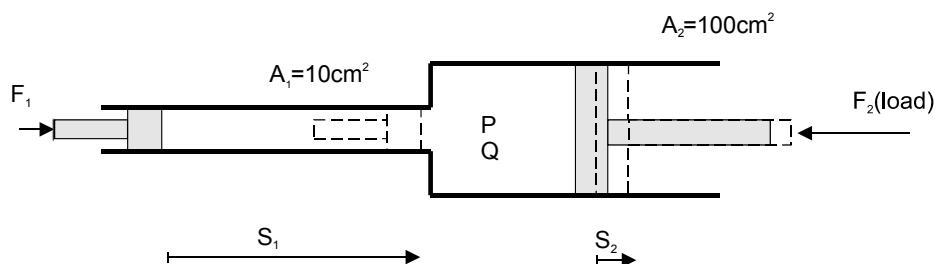
$$P = F_1/A_1 = 100/10 = 10 \text{ N/cm}^2 \text{ (1 bar)}$$

$$Q = A_1 \times S_1/t = 10 \times 100/1 = 1000 \text{ cm}^3/\text{min} \text{ (1 l/min)}$$

The pressure and the flow is the same everywhere in this system which gives us;

$$F_2 = A_2 \times P = 100 \times 10 = 1000 \text{ N} = 1 \text{ kN}$$

$$S_2 = Q \times t/A_2 = 1000 \times 1/100 = 10 \text{ cm}$$



Now the load,  $F_2$ , is increased to 1,5kN. We have to apply a force  $F_1=150 \text{ N}$  to achieve the required pressure and move the load. It takes more effort so during 1 min we only manage to give the piston a stroke  $S_1$  of 70 cm. P and Q below describes how the pump is working at this moment.

$$P = F_1/A_1 = 150/10 = 1,5 \text{ N/cm}^2 \text{ (1,5 bar)}$$

$$Q = A_1 \times S_1/t = 10 \times 70/1 = 700 \text{ cm}^3/\text{min} \text{ (0,7 l/m)}$$

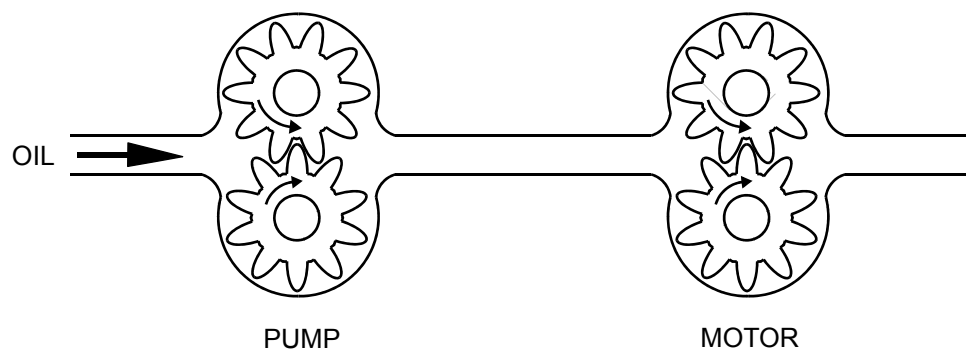
As the flow is less now the speed of the cylinder is less. If the goal is to move the cylinder  $S_2=10 \text{ cm}$  we have to push the pump for longer time. ( $t=A_2 \times S_2/Q = 1,4 \text{ min}$ ).

A piston pump is used for example in a backstay adjuster. Here we have a pump in combination with a cylinder. The bigger difference between pump and cylinder areas, the bigger load we can apply on the backstay.

## 1.4 Rotating Pump - Motor

To provide the sail-furling motors and the outhaul cylinder with oil we use a rotating, gear-driven pump, powered by an electrical motor.

The principle for a gear-driven pump is shown in the picture below. For the hydraulic motor the principle is the same as for a pump. (compare piston pump/cylinder)



The flow,  $Q$ , through a pump or motor is calculated by the formula below. The displacement,  $D$ , of a rotating pump or motor is the accumulated volume between the gears during one revolution (=transported oil during one revolution).

$$Q = n \times D$$

The torque,  $M$ , required for a pump or the output torque on a shaft of a motor is:

$$M = \frac{\Delta P \times D}{2\pi} \quad \text{where the } \Delta P \text{ is the difference in pressure just before and after the motor.}$$

The displacement for a rotating pump/motor could be compared to the area of a piston pump/cylinder. The bigger motor displacement or cylinder piston area the stronger motor/cylinder. But to keep the speed up it requires a greater flow.

## 1.5 Seldén Hydraulic Motors

Furlex 300H, 400H and in-mast furling are normally equipped with OML12.5. These motors have a displacement=12.5 cm<sup>3</sup>. With the recommended nominal flow of 10 l/min at 40 bar, these motors will make 10000/12.5=800 n/min

Furlex 500 is equipped with an OMM20-motor which requires 20 cm<sup>3</sup> of oil for every revolution. This means we have to have a bigger oil flow for this motor. Seldén recommend a powerpac delivering 20 l/min at 40 bar. The motor speed becomes 20000/20=1000 n/min. The cutter Furlex (400H) and the in-mast furling motors, supplied from this powerpac, will make 20000/12.5=1600 n/min. This is too fast, so the OML12.5 is changed for an OML20-motor in this case. This reduces the speed to 1000 n/min, the same as for the Furlex 500H. (OMM and OML have different dimensions, that is why we don't put an OMM20, it wouldn't fit).



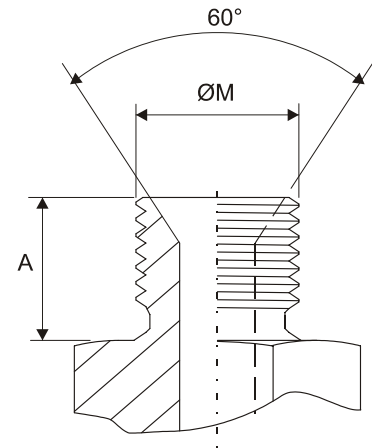
## 2 COUPLINGS AND HOSES

### 2.1 Threads

The fittings used by Seldén for the hydraulic products are BSPP with 60° cone, British Standard BS 5200 "K4" (BSPP= British Standard Pipe, Parallel)

The threads are also referred to as G1/4", G3/8", G1/2".

G	BSPP	Dash Size	ØM (in) (mm)	A (mm)
1/4"	1/4-19	4	0.51 13	~11
3/8"	3/8-19	6	0.65 16.5	~12
1/2"	1/2-14	8	0.82 20.83	~14

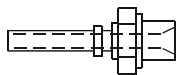


### 2.2 Adapters from BSPP to JIC

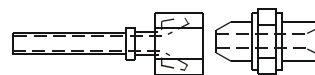
Some hydraulic companies use JIC fittings as standard.

It's possible to exchange the hoses for new ones using JIC fittings (37deg. female end) together with an adapter instead of the original male BSPP-coupling.

See drawing below.



BSPP



JIC / BSPP

PARKER ADAPTER TRIPLE-LOK SS

(Includes a plastic sealing washer on BSPP-side)

1/4 BSPP to JIC 7/16-20 male 37deg ; Parker 4-4F4OMXSS

3/8 BSPP to JIC 9/16-18 male 37deg ; Parker 6-6F4OMXSS

1 / 2 BSPP to JIC 3/4-16 male 37deg ; Parker 8-8F4OMXSS

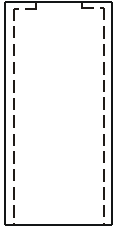
(SS= Stainless Steel)



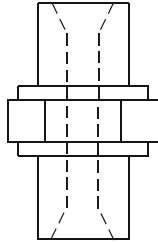
## 2.3 Hydraulic couplings

On the following pages you find the hydraulic couplings used by Seldén. These sketches are meant as a help to recognize different coupling. It's approximately scale 1:1.

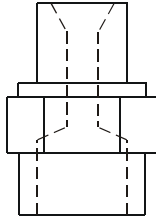
### 2.3.1 1/4" couplings



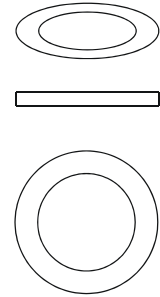
540-919  
CLAMP HYDR.HOSE 1/4"



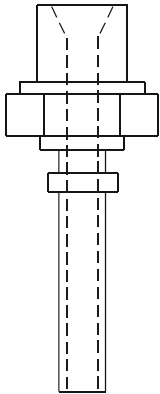
540-881  
NIPPLE 1/4"-1/4"



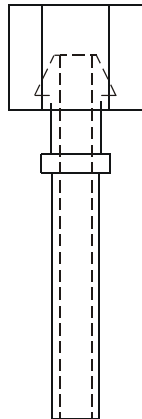
540-934  
NIPPLE 1/4 MLE-FMLE



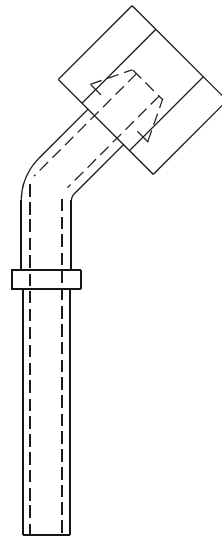
540-885  
HYDR.SEAL WASHER 1/4" ST



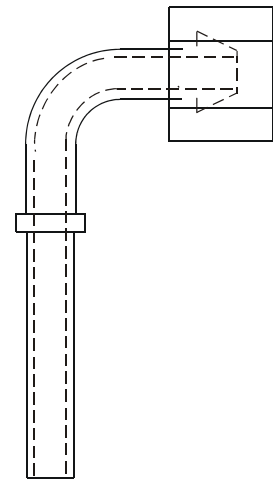
540-909  
HYDR.COUPLING 1/4 MALE 0°



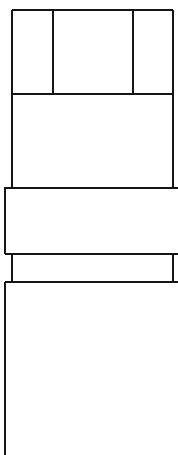
540-911  
HYDR COUPL. 1/4 NUT 0°



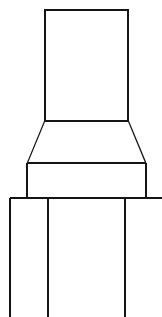
540-912  
HYDR.COUPL. 1/4 NUT 45°



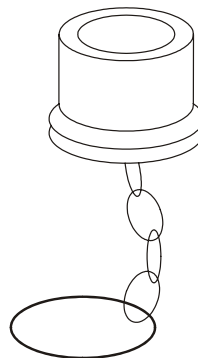
540-913  
HYDR.COUPLING 1/4 NUT 90°



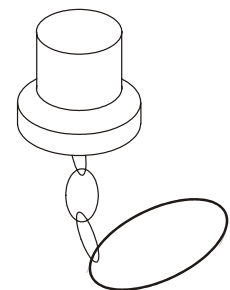
540-884  
COUPL. 1/4"(FEMALE)Q-ACT



540-883  
COUPL. 1/4"(MALE)Q-ACT.

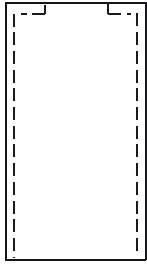


540-878  
CAP 1/4"(UN-THREADED)+CHAIN

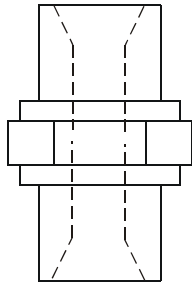


540-879  
PLUG 1/4"(UN-THREADED)+CHAIN

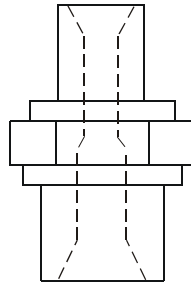
### 2.3.2 3/8" couplings



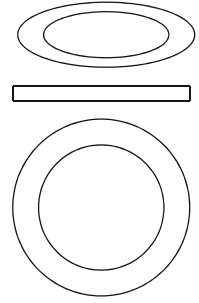
540-920  
CLAMP HYDR.HOSE 3/8"



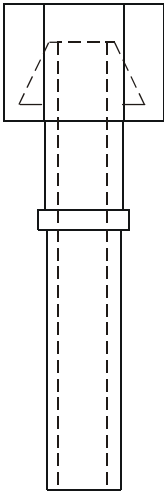
540-899  
NIPPLE G3/8-3/8



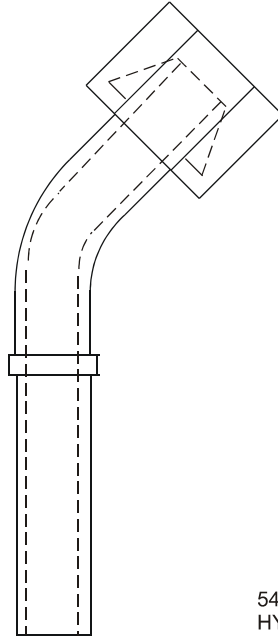
540-923  
NIPPLE 3/8-1/4



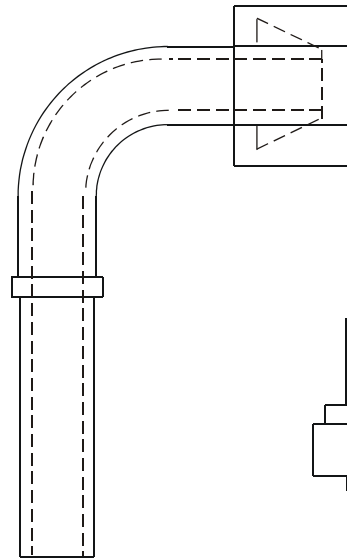
540-900  
HYDR.SEAL WASHER 3/8



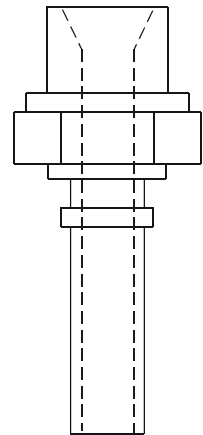
540-963  
HYDR.COUPL 3/8 NUT 0°



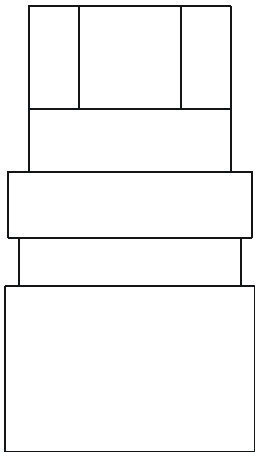
540-927  
HYDR.COUPL 3/8 NUT 45°



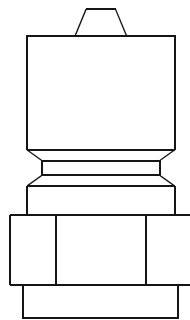
540-915  
HYDR COUPL 3/8 NUT 90°



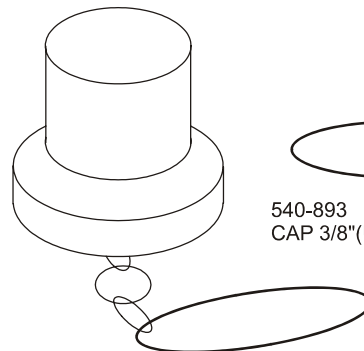
540-914  
HYDR.COUPL 3/8 MALE 0°



540-898  
COUPLING 3/8"(FEMALE)Q-ACT

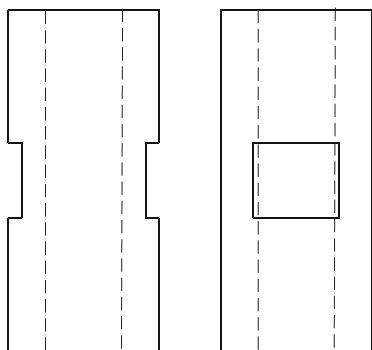


540-897  
COUPL. 3/8(MALE)Q-ACT.

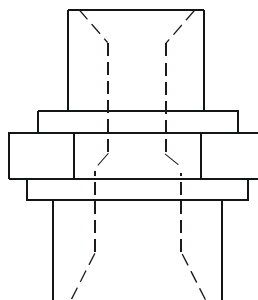


540-893  
CAP 3/8"(UN-THREADED)+CHAIN

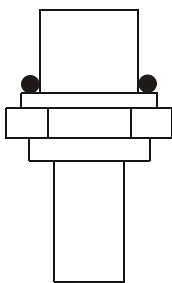
### 2.3.3 Various couplings



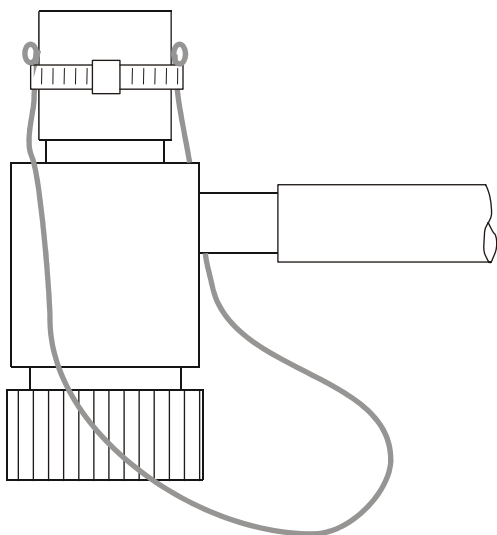
540-933  
ADAPTER G1/4-1/4 FE/FE



540-931  
NIPPLE G1/2-3/8



540-936  
NIPPLE(VENT.)1/4 MLE-MLE(QUICK)



540-935  
VALVE Q INCL.BTL+ HOSE (VENT.)

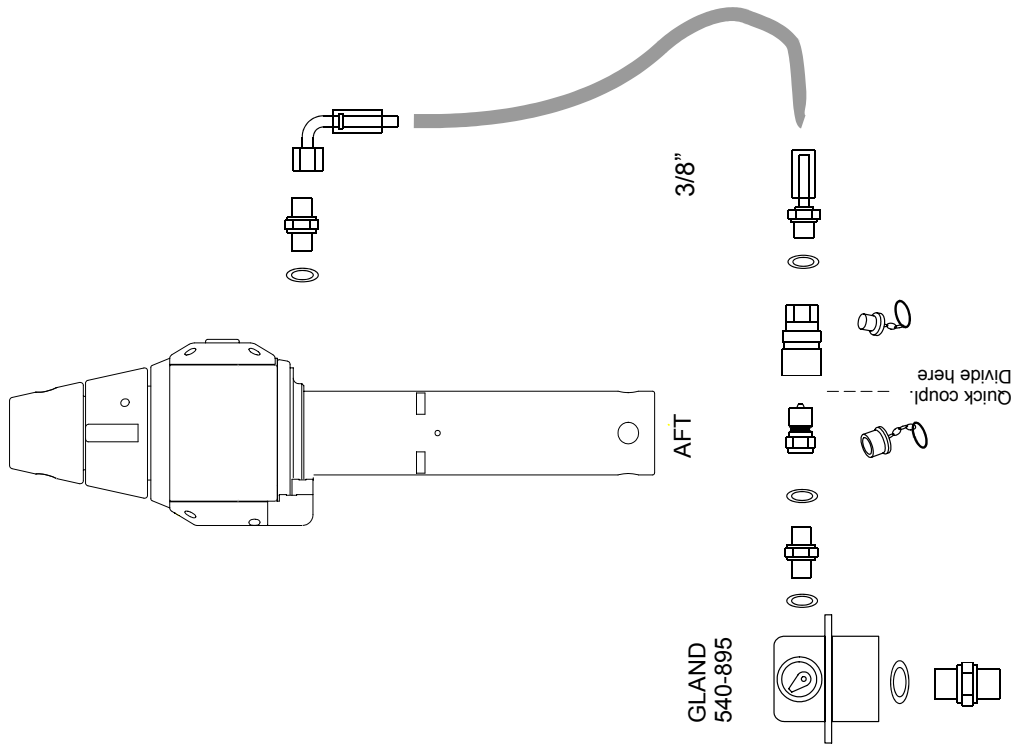
## 2.4 Hydraulic hoses

### 1.4.1 Nylaflo hydraulic hose (datasheet)

NYLAFLOW TYPE 347		Polypenco spec. ALM 01027-A		SAE 100R7 DIN 24951 BS 4983 ISO 3949		140...240		Type Code		mm		inch		mm		inch		bar		psi		bar		psi		kg/100m lb/100ft		Ref. Code		D <sub>f</sub> +/-0.1mm	
Construction	Braiding	Cover	Applications	Properties	Eigenschaften	Applications	Propriétés	Construction	Braiding	Cover	Applications	Properties	Eigenschaften	Applications	Propriétés	Construction	Braiding	Cover	Applications	Properties	Eigenschaften	Applications	Propriétés	Construction	Braiding	Cover	Applications	Properties	Eigenschaften	Applications	Propriétés
Flexible Pressure Hose Black	<b>A</b> INNERTUBE Polyester Elastomer Compound	<b>B</b> BRAIDING Synthetic	<b>C</b> COVER Polyurethane Compound Pinpricked	Medium pressure hydraulic, greasing and lubrication lines for mechanical handling, agricultural equipment, fork trucks, attachments, machine tools, etc.	• Excellent flex fatigue resistance. • Fungus resistant. • Light weight. • Low O.D. to I.D. ratio.	Hydraulikleitung mittlerer Drücke, Schmierleitung, ei. nichtleitende Leitung, Leitung für Druckwaschgeräte, für Lösungsmittel etc.	• Excellente tenue à la fatigue en flexion. • Grande légèreté. • Parois minces. • Résistance aux moisissures.	Tuyau Flexible Haute Pression Noir	<b>A</b> TUBE Compound de Polyester Elastomère	<b>B</b> TRESSES Synthétique	<b>C</b> GAINE Compound de Polyuréthane Microperforé	Lignes hydrauliques moyenne pression, lignes de graissage et de lubrification pour manutention mécanique, équipement agricole, chariots élévateurs, accessoires, machines-outils, etc.	• Excellente tenue à la fatigue en flexion. • Grande légèreté. • Parois minces. • Résistance aux moisissures.	<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">+65°C</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">-40°C MIN</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">L R ≤ 3%</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">TESTED L R PASSED</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">100°C MAX</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">UV W O<sub>3</sub></div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">?</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">TYPE ... D</div> </div>	<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">P (min)</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">P (dyn)</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">R<sub>min</sub></div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">+/-0.1mm</div> </div>	<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">347-2</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">347-2.5</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">347-3</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">347-4</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">347-5</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">347-6</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">347-8</div> </div>	<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">3</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">4</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">5</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">6</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">8</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">10</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">12</div> </div>	<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">1/8</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">5/32</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">3/16</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">1/4</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">5/16</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">3/8</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">1/2</div> </div>	<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">6.8</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">8.3</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">9.7</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">12.1</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">13.8</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">16.1</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">19.4</div> </div>	<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">0.268</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">0.326</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">0.380</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">0.475</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">0.545</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">0.635</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">0.765</div> </div>	<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">840</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">960</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">840</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">860</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">760</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">640</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">560</div> </div>	<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">12,000</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">14,000</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">12,000</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">12,400</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">11,000</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">9,300</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">8,000</div> </div>	<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">210</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">240</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">210</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">215</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">190</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">160</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">140</div> </div>	<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">3,000</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">3,500</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">3,000</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">3,100</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">2,750</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">2,325</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">2,000</div> </div>	<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">1.2</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">1.4</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">3.0</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">4.0</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">4.5</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">5.0</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">7.0</div> </div>	<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">3.4</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">4.9</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">6.3</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">9.7</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">11.6</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">15.7</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">19.9</div> </div>	<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">47-02-1/60</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">47-2.5-1/79</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">47-03-1/58</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">47-04-1/53</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">47-05-1/54</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">47-06-1/55</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">47-08-1/56</div> </div>	<div style="display: flex; flex-wrap: wrap; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">8.9 mm</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">11.0 mm</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">12.5 mm</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">15.4 mm</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">17.0 mm</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">18.9 mm</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">23.7 mm</div> </div>			

## 2.5 Furlex couplings and hoses

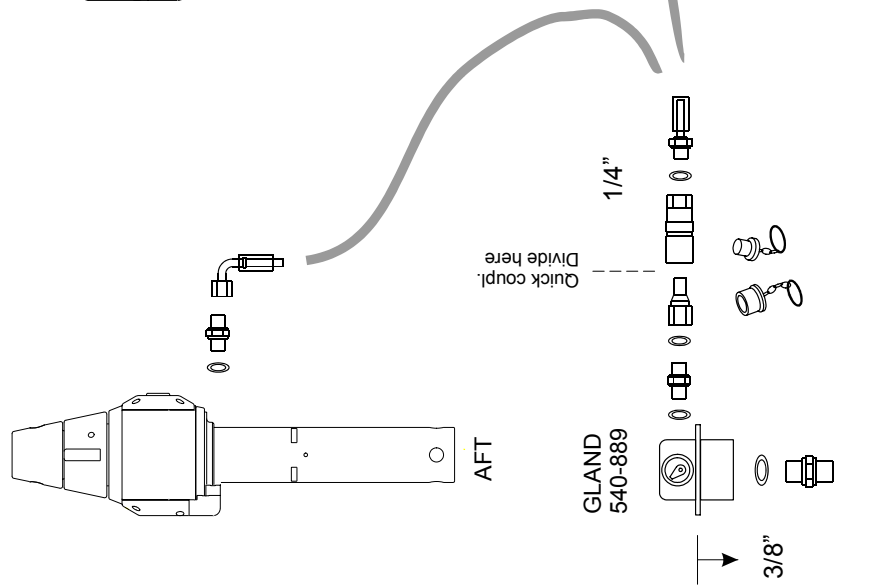
Furlex 500



Furlex 400  
OML 12,5 & 20

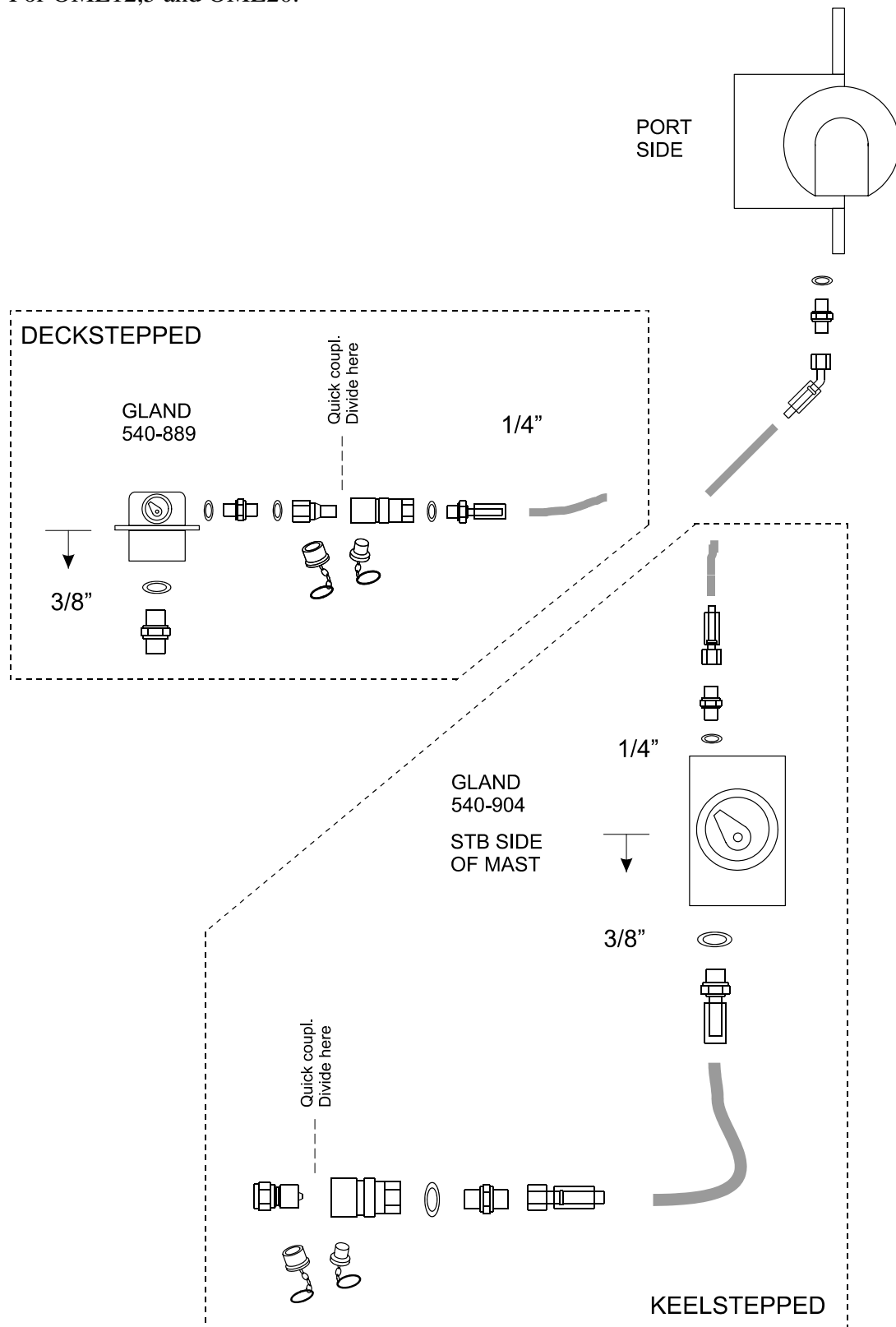


Furlex 300



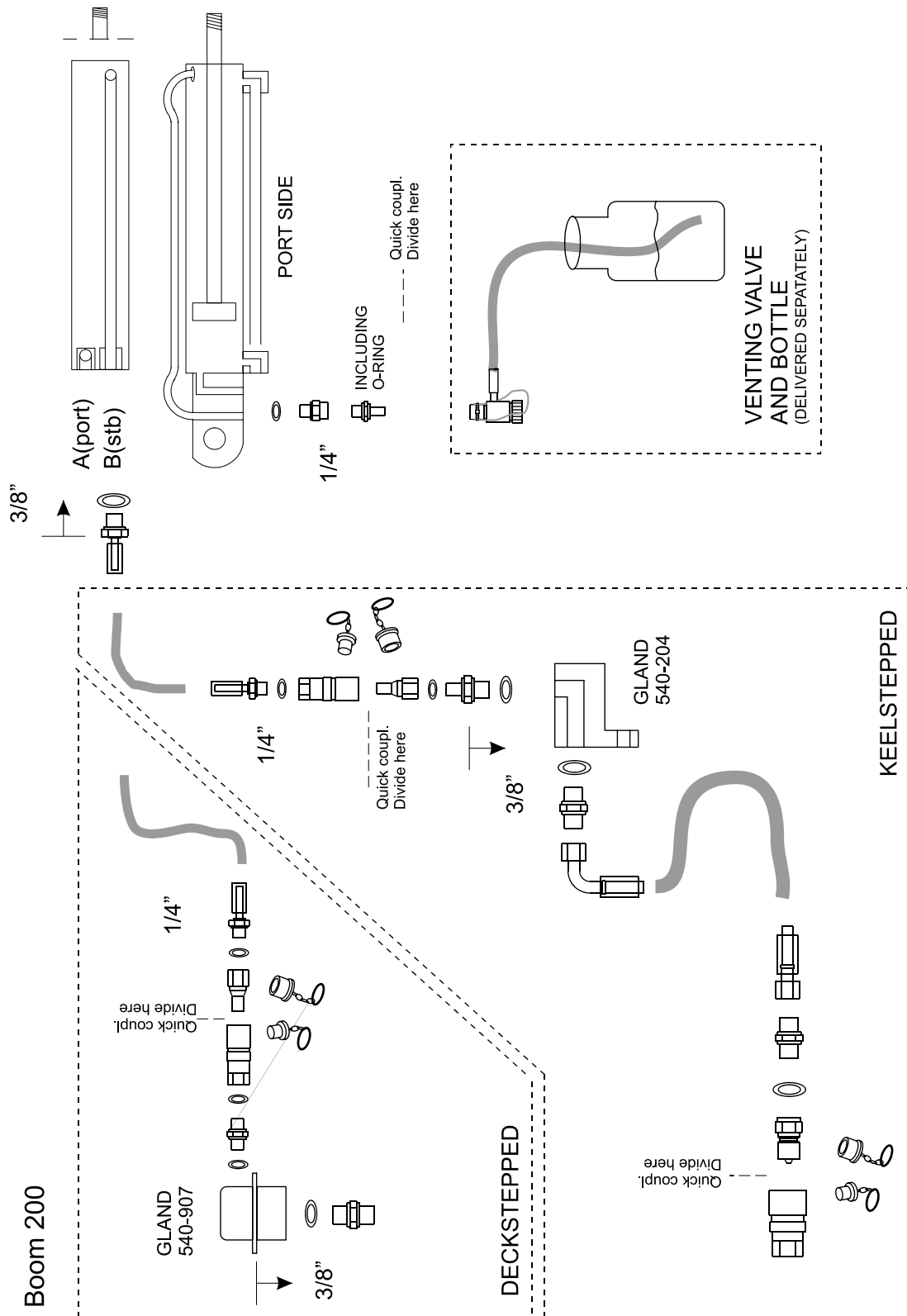
## 2.6 Mast motor couplings and hoses

For OML12,5 and OML20.



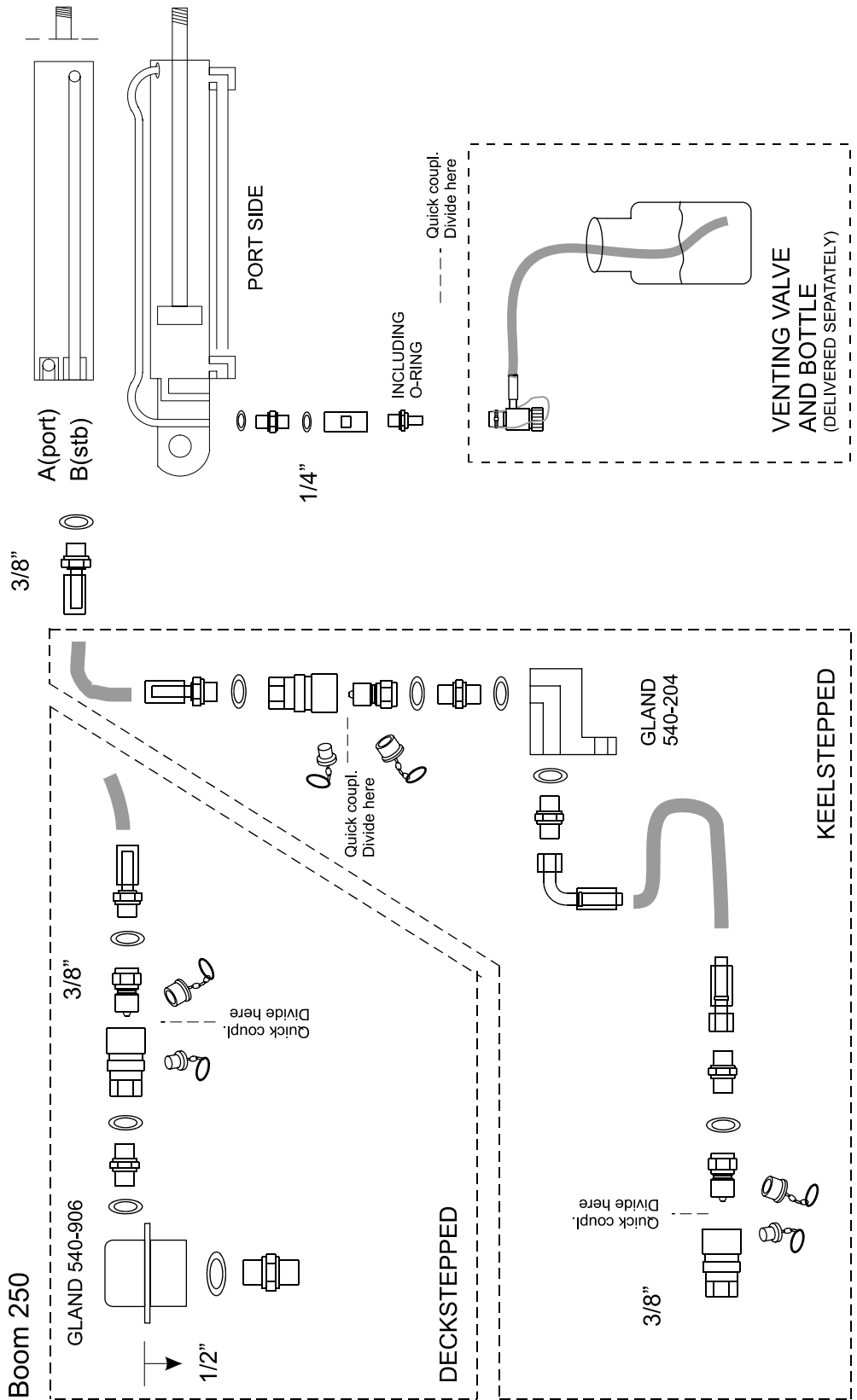


## 2.7 Boom 200 couplings and hoses

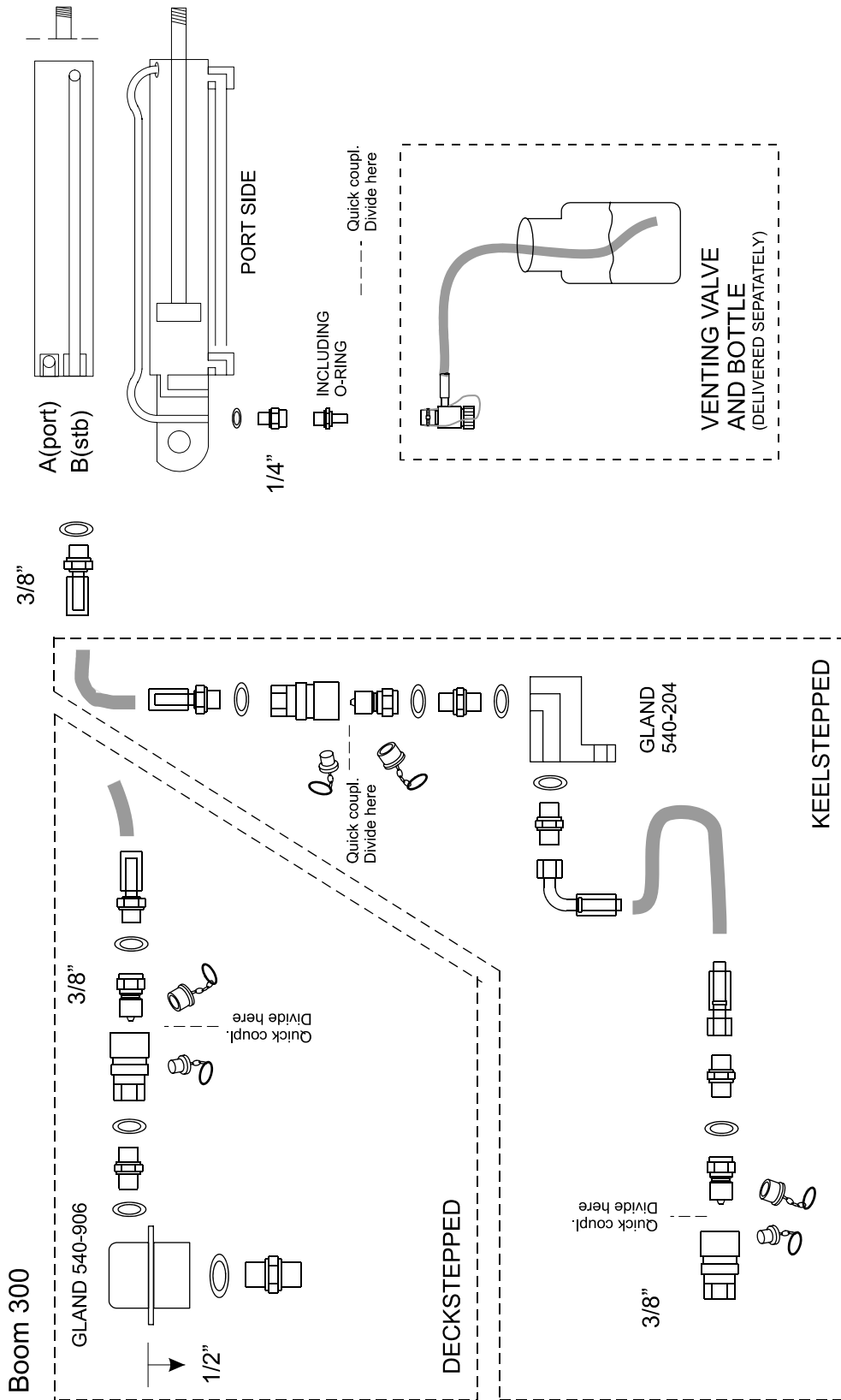




## 2.8 Boom 250 couplings and hoses



## 2.9 Boom 300 couplings and hoses



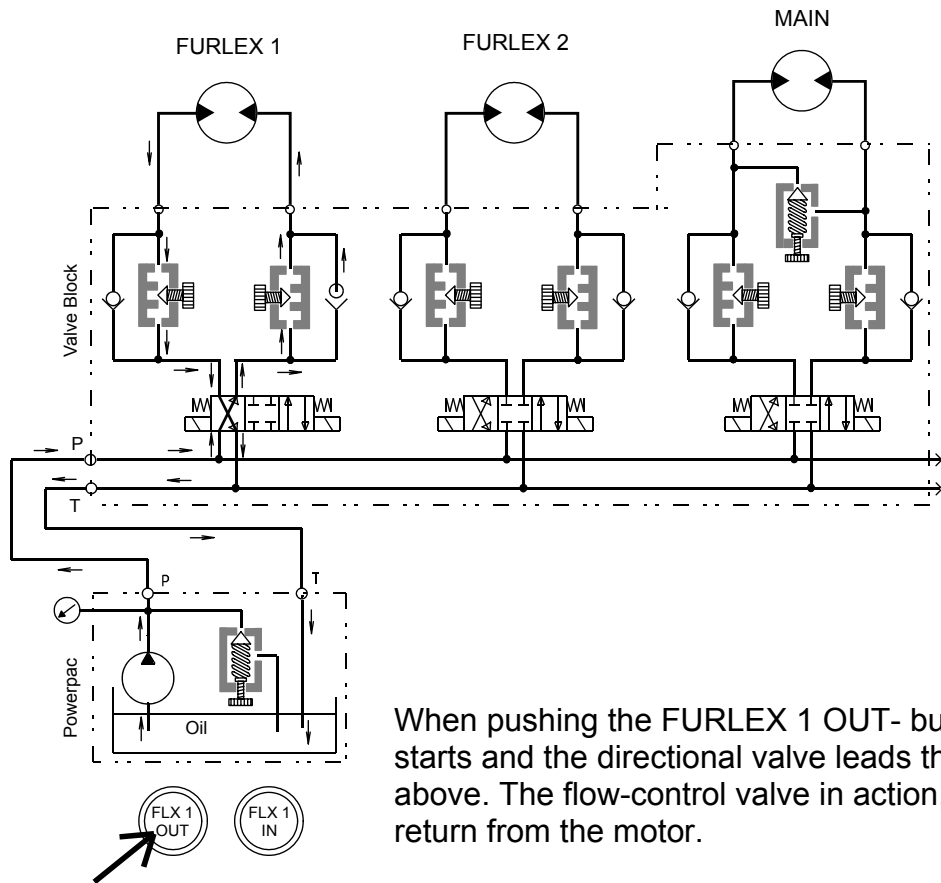
## 3 HYDRAULIC SYSTEMS -- Schematics

### 3.1 *Furlex and In-mast furling (main)*

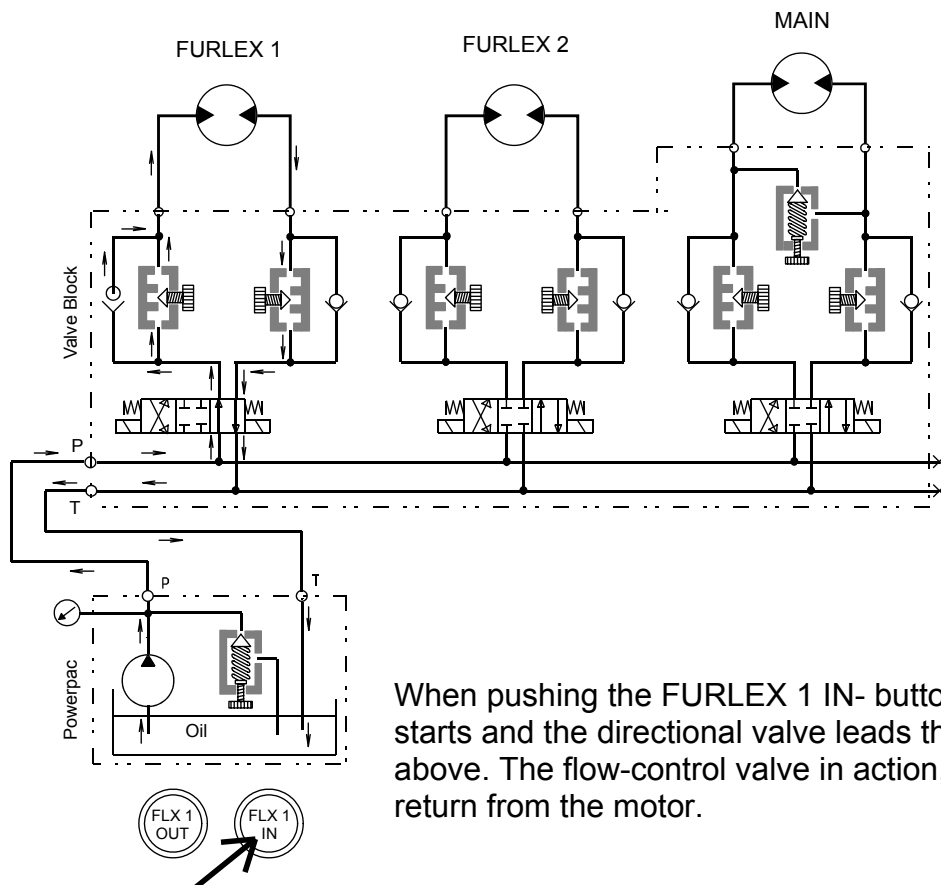
Seldén doesn't supply powerpacs and valve blocks for hydraulic Furlex and in-mast furling systems. However the following pages show a common solution for this type of system.

Note that the same powerpac also might supply winches. If more than one function runs at the same time, the oil flow will find the way where there is less resistance. This means a motor with little load will run faster than the one with heavy load. We recommend that the circuit for the In-mast furling motor is equipped with a pressure reducing valve. As the working pressure in general is set to 140 bar, it has to be reduced, at least for RB-systems (120 bar). See recommendations for oil flow and pressure in Seldén Product Catalogue.

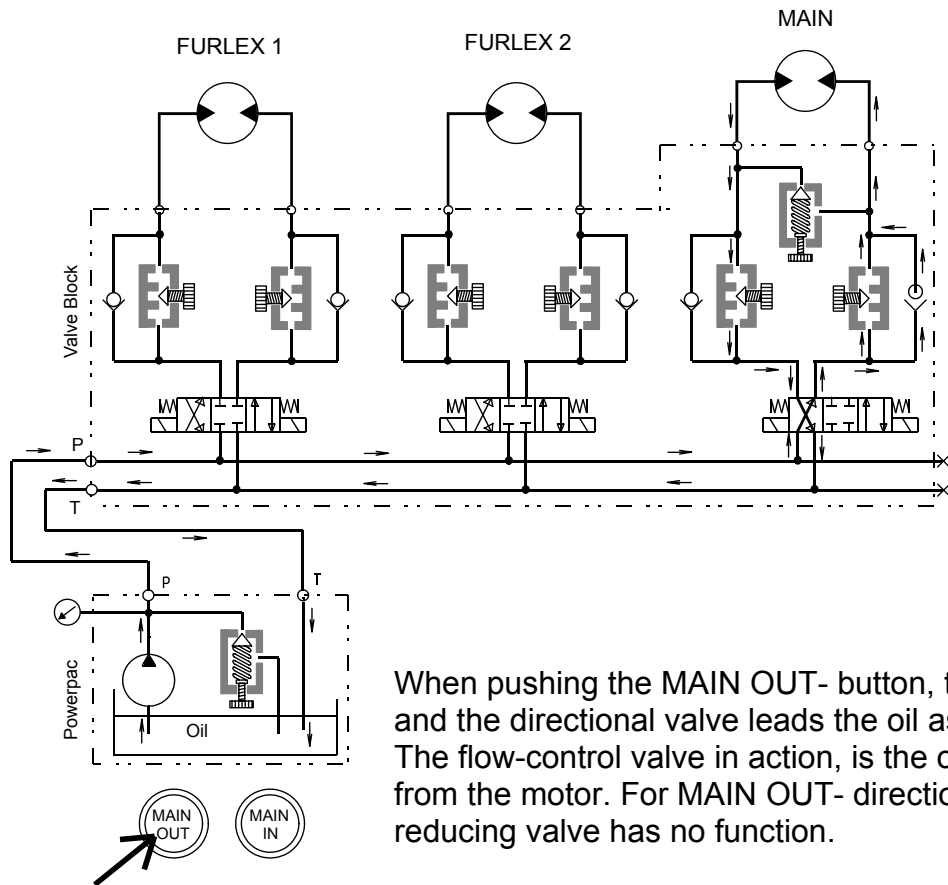
The hydraulic schematics are simplified, and some components (like the filter unit) are excluded.



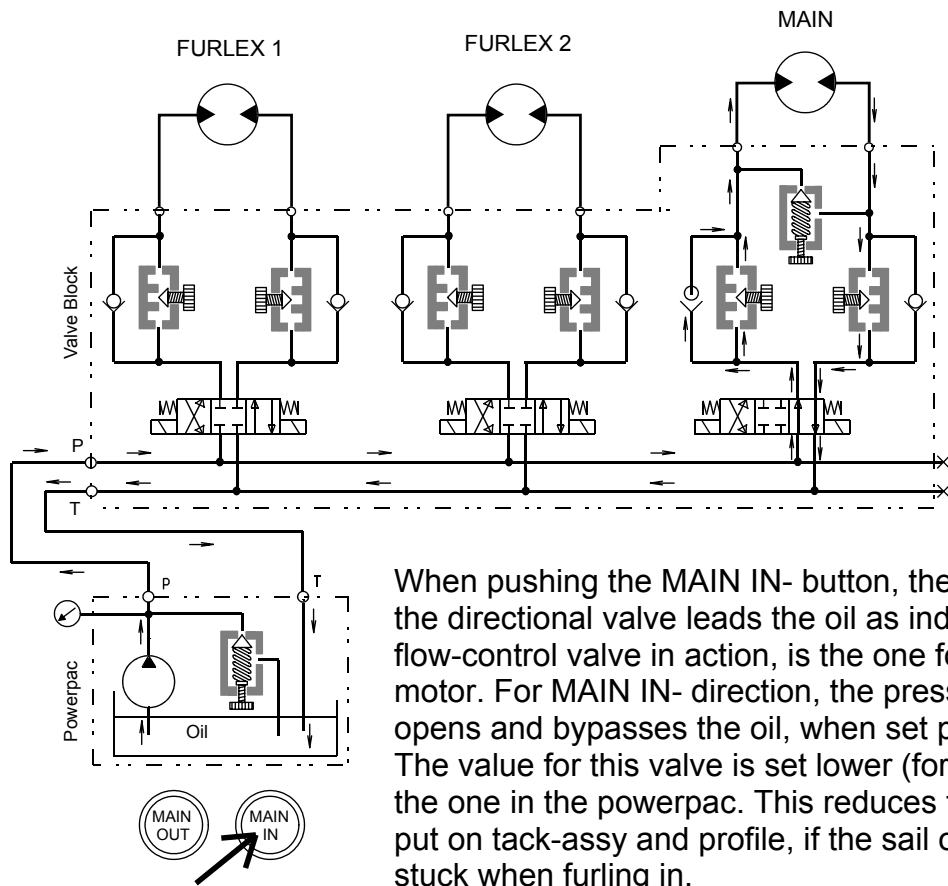
When pushing the FURLEX 1 OUT- button, the powerpac starts and the directional valve leads the oil as indicated above. The flow-control valve in action, is the one for the return from the motor.



When pushing the FURLEX 1 IN- button, the powerpac starts and the directional valve leads the oil as indicated above. The flow-control valve in action, is the one for the return from the motor.



When pushing the MAIN OUT- button, the powerpac starts and the directional valve leads the oil as indicated above. The flow-control valve in action, is the one for the return from the motor. For MAIN OUT- direction, the pressure reducing valve has no function.

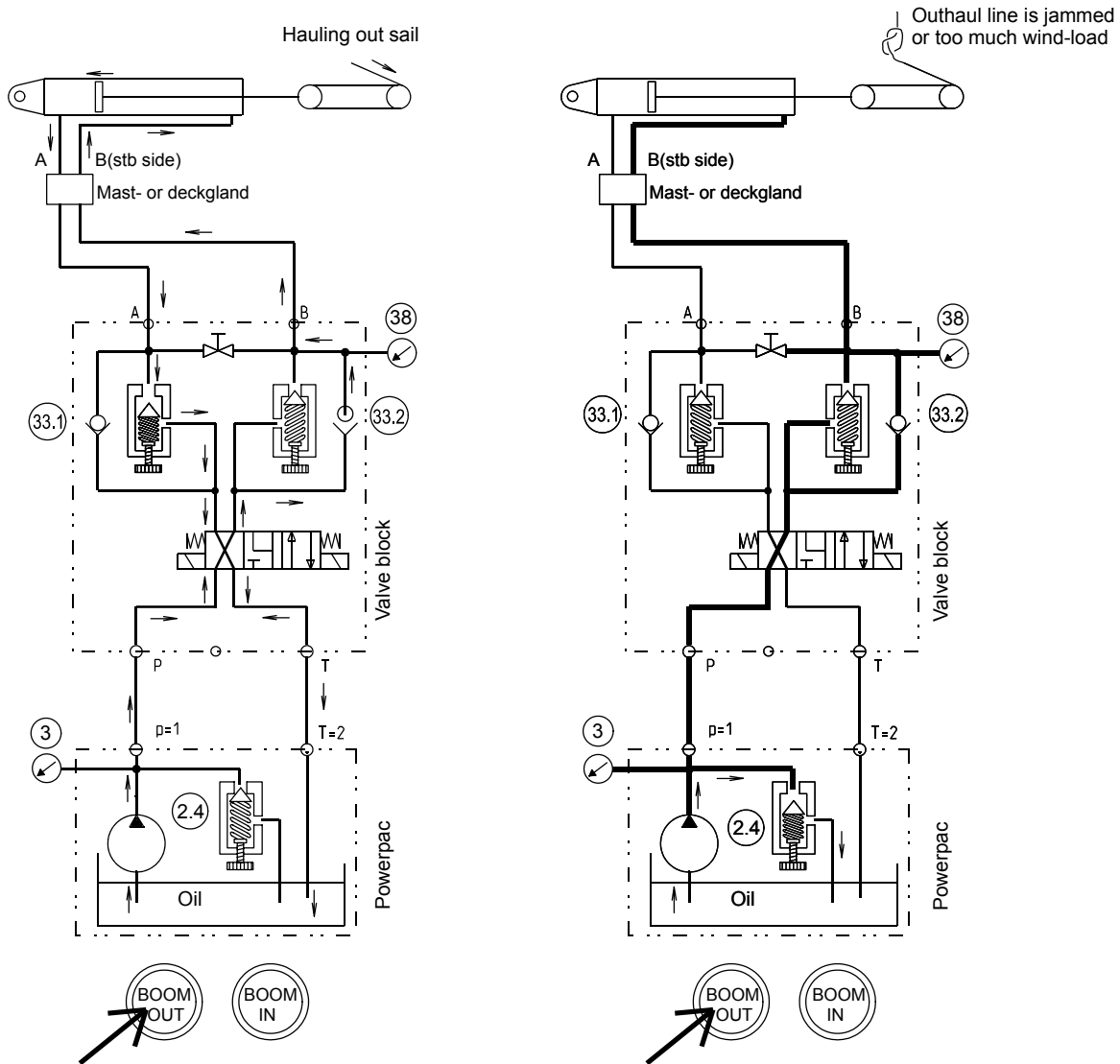


When pushing the MAIN IN- button, the powerpac starts and the directional valve leads the oil as indicated above. The flow-control valve in action, is the one for the return from the motor. For MAIN IN- direction, the pressure reducing valve opens and bypasses the oil, when set pressure is reached. The value for this valve is set lower (for RB- system) than the one in the powerpac. This reduces the maximum torque, put on tack-assy and profile, if the sail or outhaul line get stuck when furling in.

## 3.2 Hydraulic boom outhaul

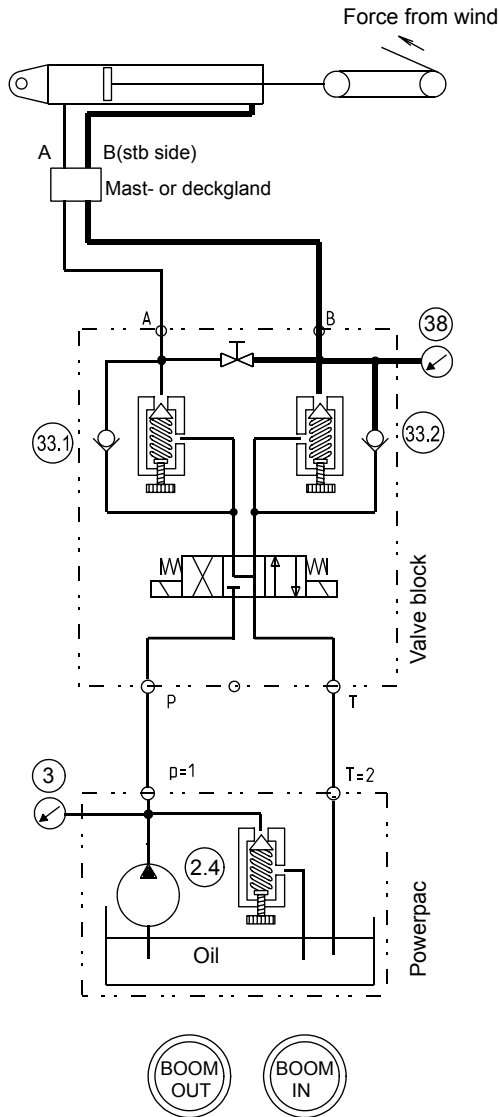
### 3.2.1 Hydraulic boom outhaul schematics – simplified

The hydraulic schematics used on the following pages are simplified. Some components (like filter unit) are excluded. A complete hydraulic schematic is found in 3.2.2.

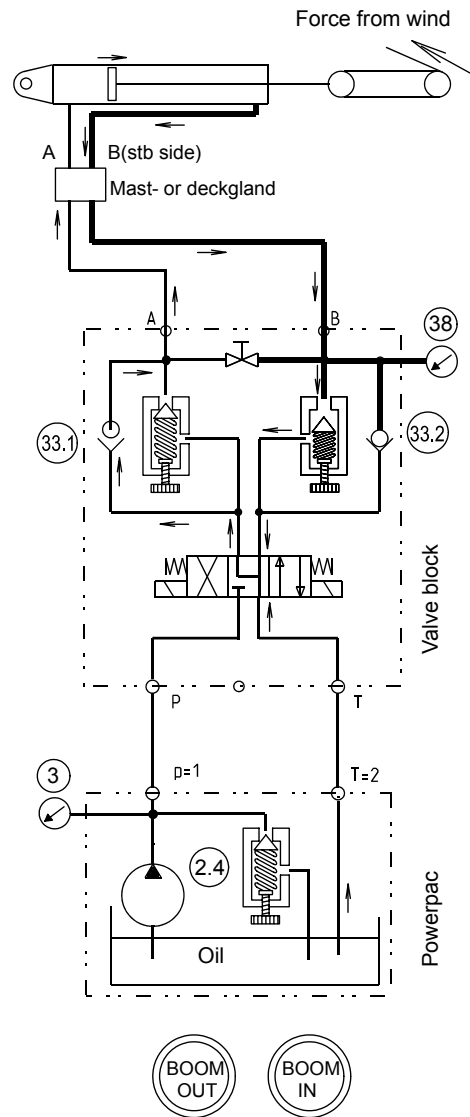


Pushing the BOOM OUT button the powerpac starts and the direction valve leads the oil as indicated above. 33.2 is closed and the oil runs by the non-return valve. Valve 33.1 opens by a servo-device. On manometer 3 you read the actual working pressure of the system. On manometer 38 you read a little less.

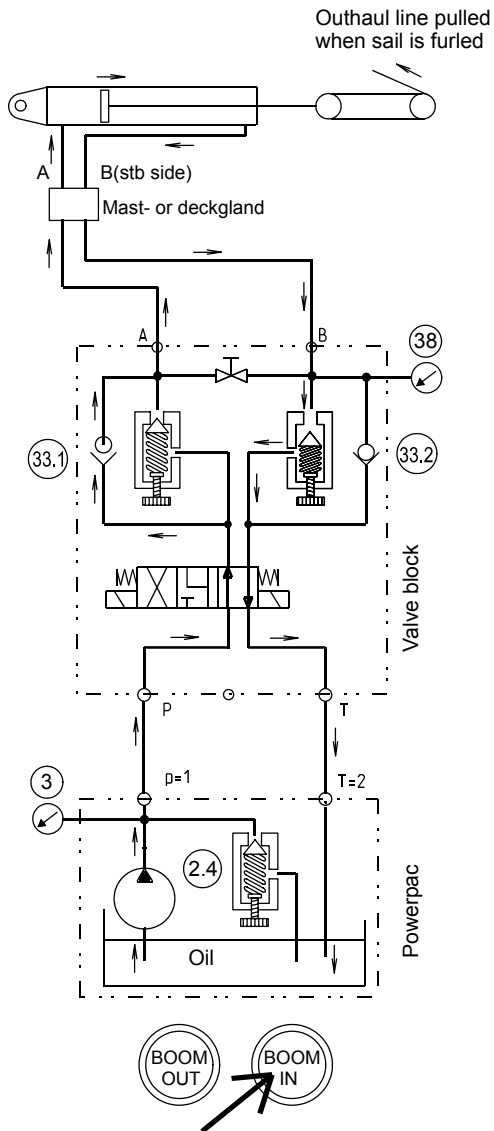
Still pushing the BOOM OUT button. If outhaul-line is jammed or there is too much resistance from the sail/wind the set pressure for 2.4 is exceeded and it will open. The high pressure is symbolized with fat lines in the picture. There is no flow in the system except through the 2.4 circuit. On both manometer 3 and 38 you read the maximum working pressure for the system, set on 2.4.



When sailing under normal conditions the force from wind builds up a pressure inside the B-chamber of the cylinder. Valve 33.2 will be closed as long as the set pressure is not exceeded. Manometer 38 indicates the pressure built by wind force. Manometer 3 indicates zero.



When the outhaul force from the wind increases the pressure in the system follows, until it reach the set level of valve 33.2. Now this valve opens and the piston moves. The oil is pressed out of the B-chamber and it's sucked into the A-chamber. The piston rod causes a difference in volume between the two chambers. This difference is compensated by oil from the reservoir. Manometer 38 indicates the pressure set on 33.2. Manometer 3 indicates zero.

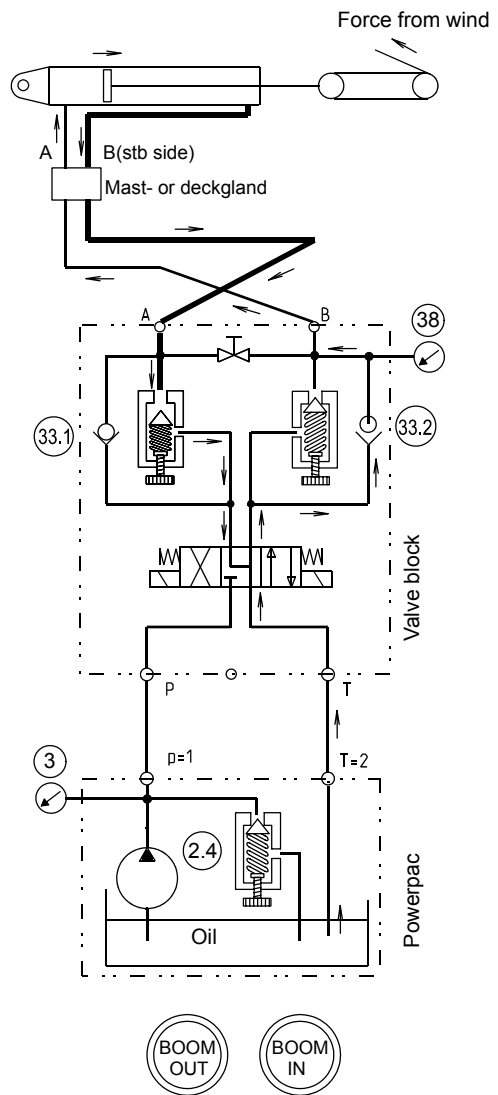


Pushing the BOOM IN button the powerpac starts and the direction valve leads the oil as indicated above.

33.1 is closed and the oil runs by the non-return valve.

Valve 33.2 opens by a servo-device.

On manometer 3 you read the actual working pressure for the system. On manometer 38 you read a lower pressure.



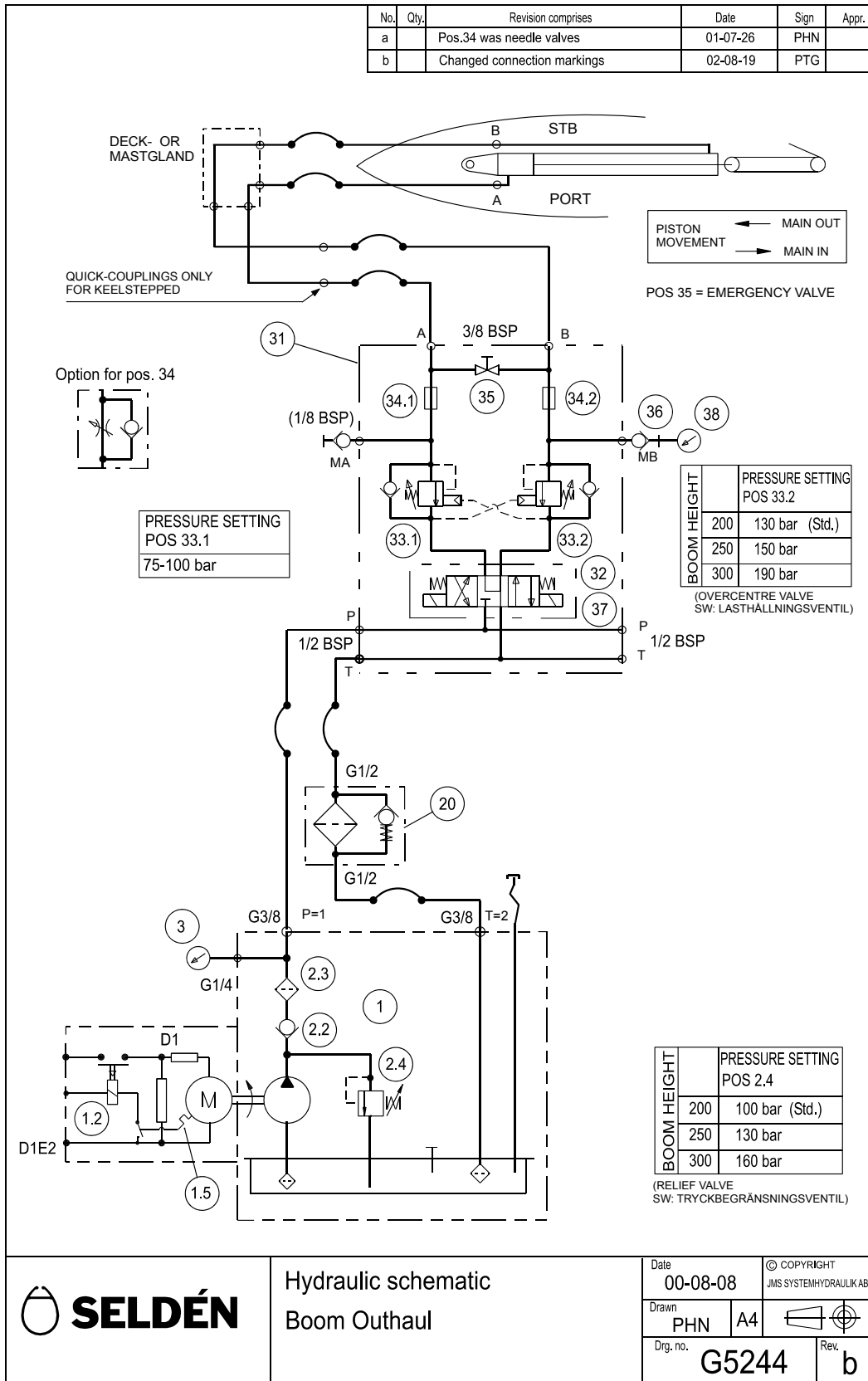
The sail is unfurled and the wind is moderate. The outhaul gives away. The picture indicates that the hoses are mixed up somewhere on the way between valve-block and boom cylinder. Now 33.1 will take the "load" from wind instead of 33.2. As the preset value for 33.1 is much lower it will open for much less force from wind. The hoses must be dismantled and put in the right position.

To solve the problem temporarily the A- and B-hoses can be switched over at the quick-couplings.

Both the manometers, 3 and 38, indicate zero.



### 3.2.2 Hydraulic boom outhaul schematic – complete



## 4 ELECTRICAL INSTALLATION OF HYDRAULICS

### 4.1 Electrical circuit diagrams

The following diagrams are simplified and they are meant as a help to understand the electrical system for controlling the hydraulic applications. To make a complete electrical installation, it's recommended also to use the circuit diagrams in the manuals.

The CONTROLBOX 532-426 is the same for 12 and 24 V, it's only the relays (K1-K8) that differs between 12 and 24 V.

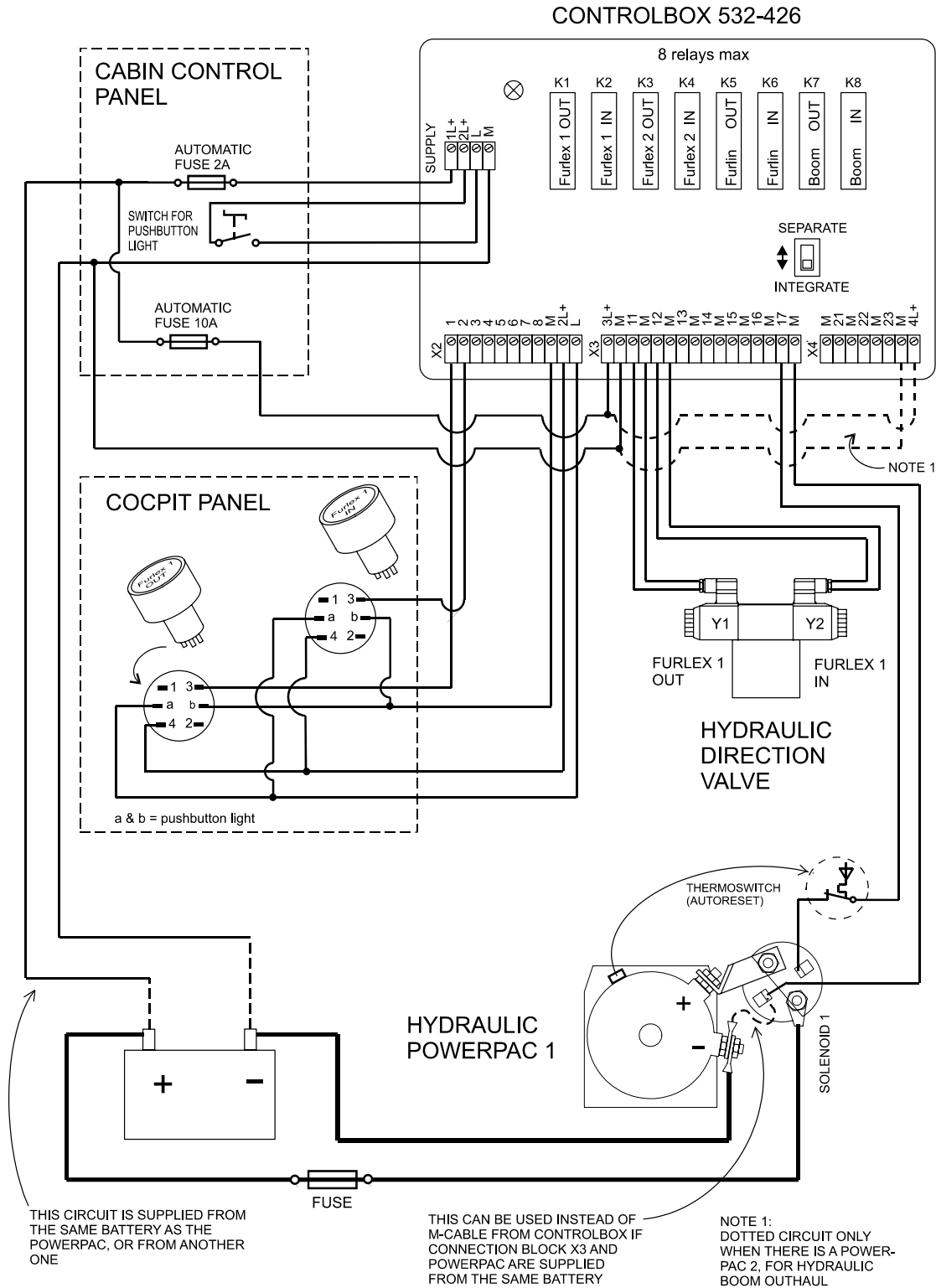
In the diagram for Powerpac1, FLX1 is connected as an example. Below is a table of missing connections for the blocks X2 and X3.

X2	1	2	3	4	5	6	7	8
	FLX1 OUT	FLX1 IN	FLX2 OUT	FLX2 IN	FURLIN OUT	FURLIN IN	BOOM OUT	BOOM IN

X3	11	12	13	14	15	16	17
	FLX1 OUT	FLX1 IN	FLX2 OUT	FLX2 IN	FURLIN OUT	FURLIN IN	SOLE- NOID 1

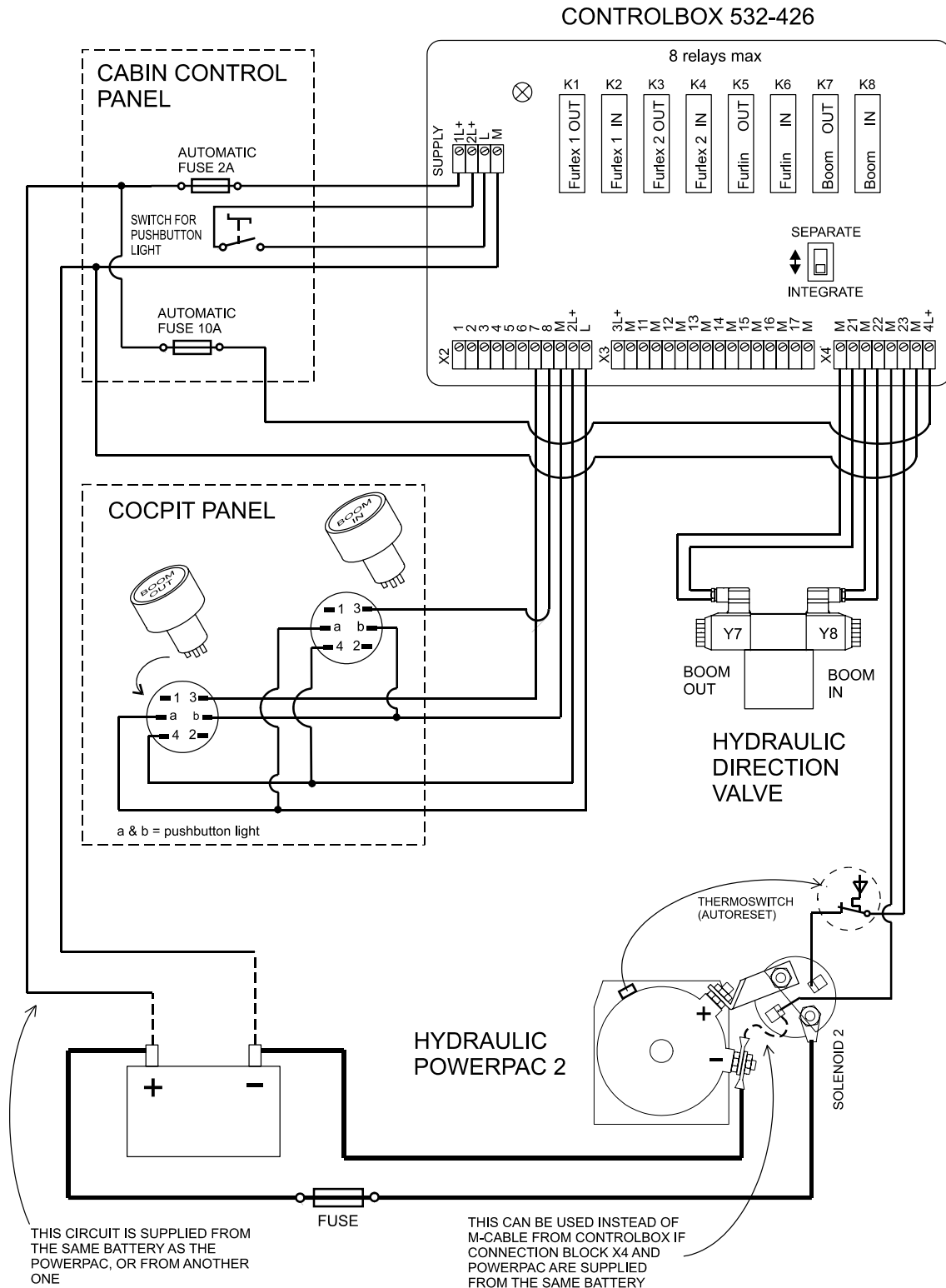
### 4.1.1 Circuit diagram for Hydraulic Powerpac 1 - simplified

(FLX1, FLX2, IN-MAST FURLING)  
 Below FLX1 is complete installed  
 Powerpac1 is not supplied by Seldén.

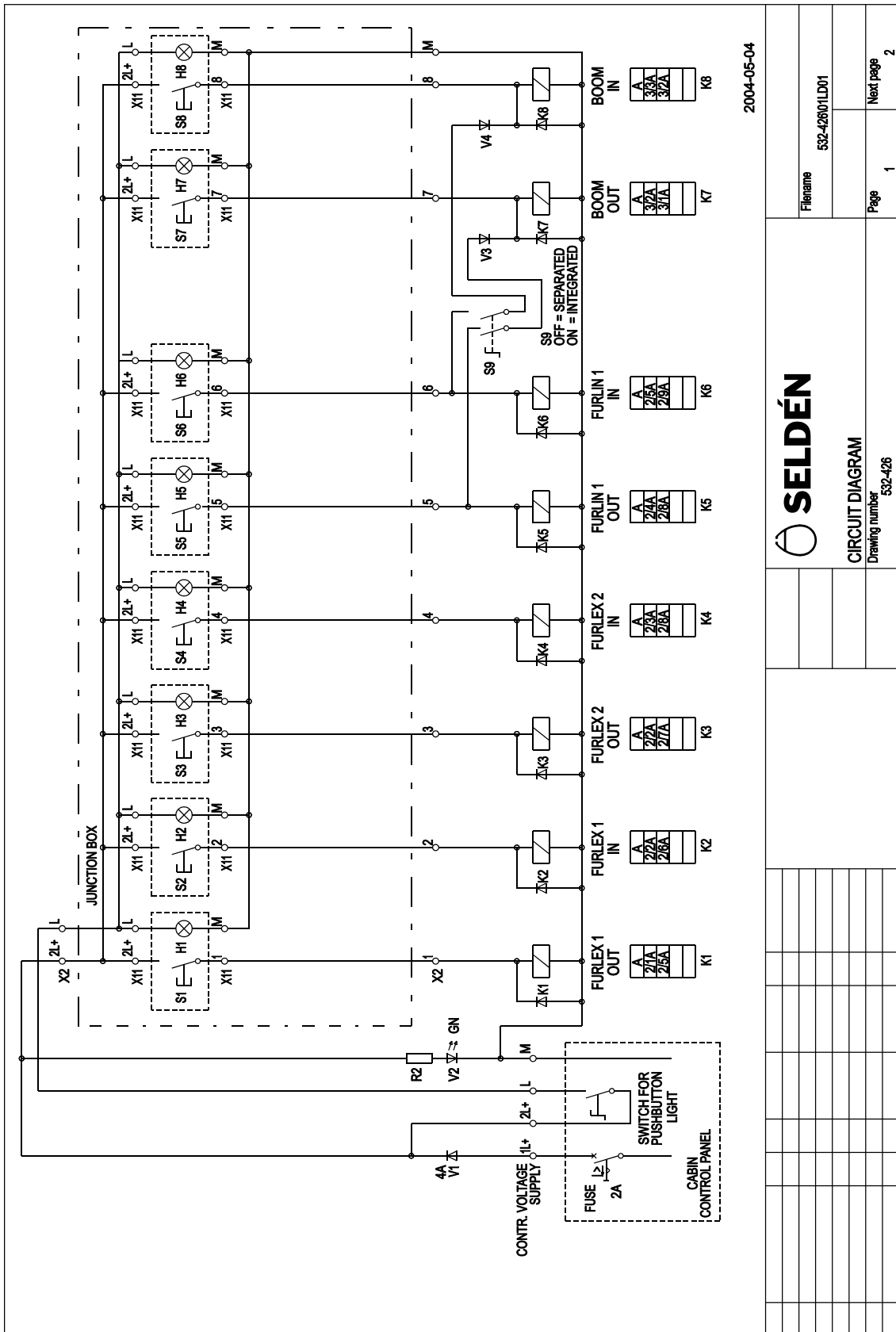


## 4.1.2 Circuit diagram for Hydraulic Powerpac 2 - simplified


(Hydraulic boom outhaul)

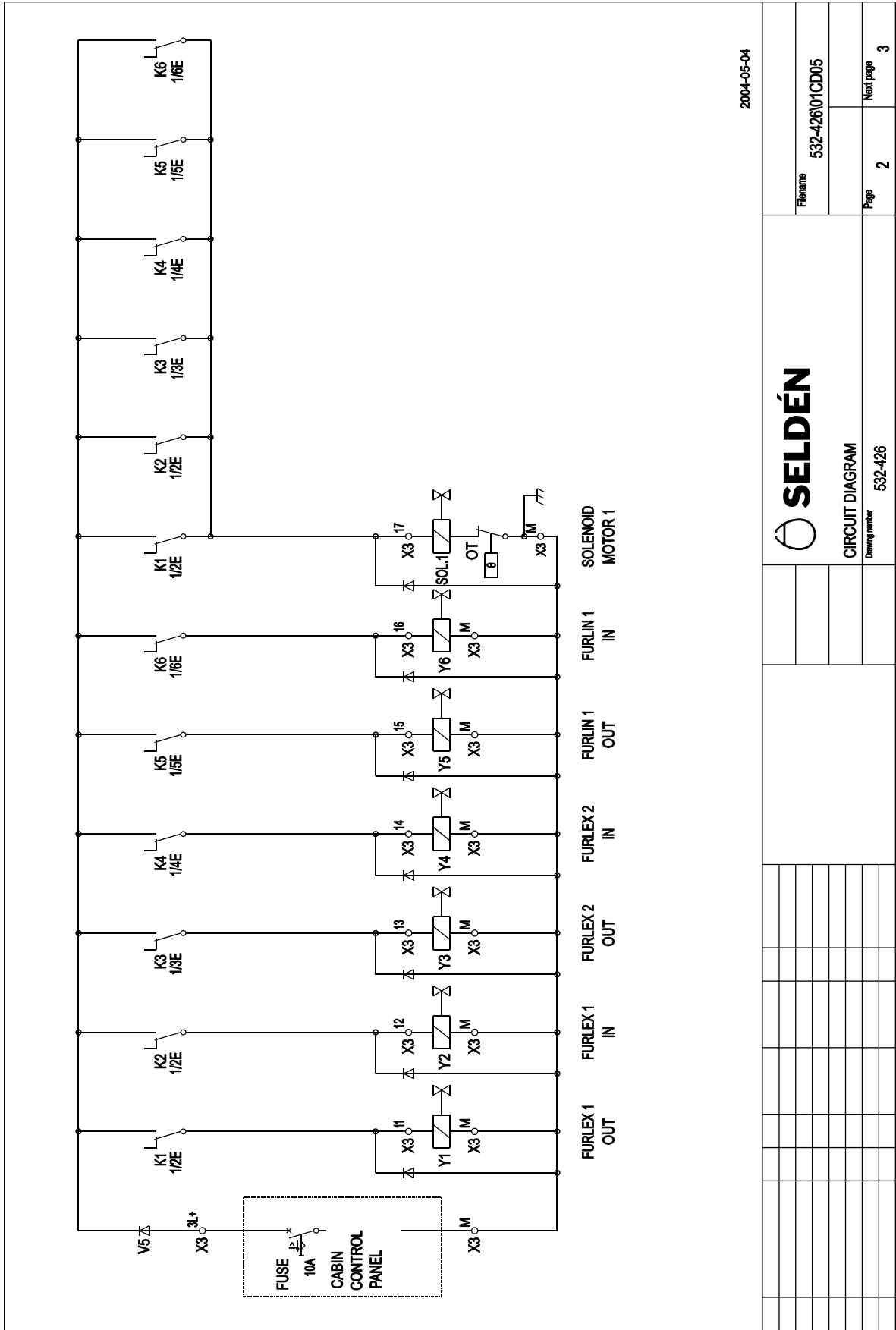


### 4.1.3 Circuit diagram for Controlbox 532-426 - complete (5 drawings)




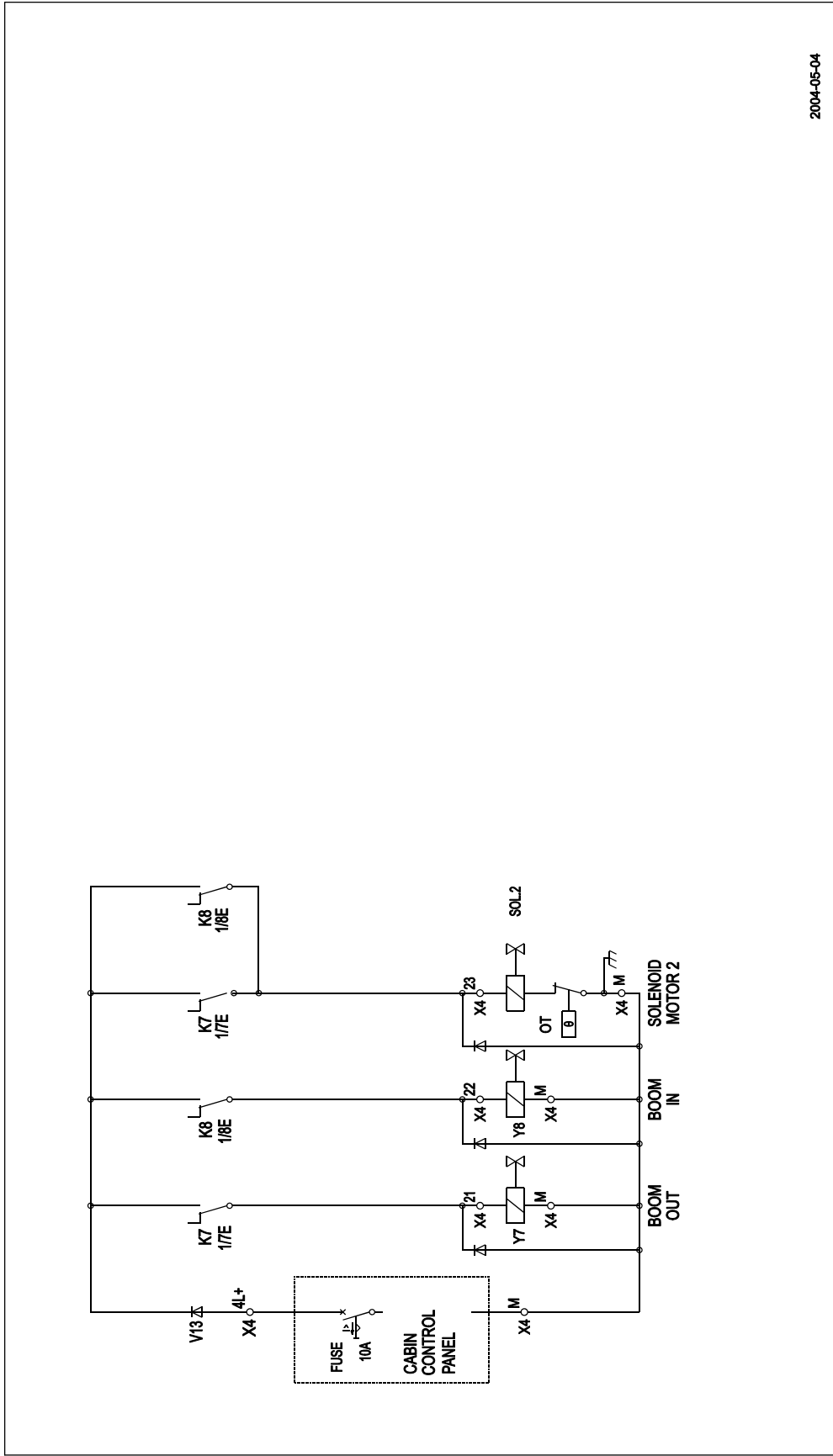
2004-05-04

		Filename	532-426(1)LD01
		Page	1
<b>CIRCUIT DIAGRAM</b> Drawing number 532-426		Next page	2




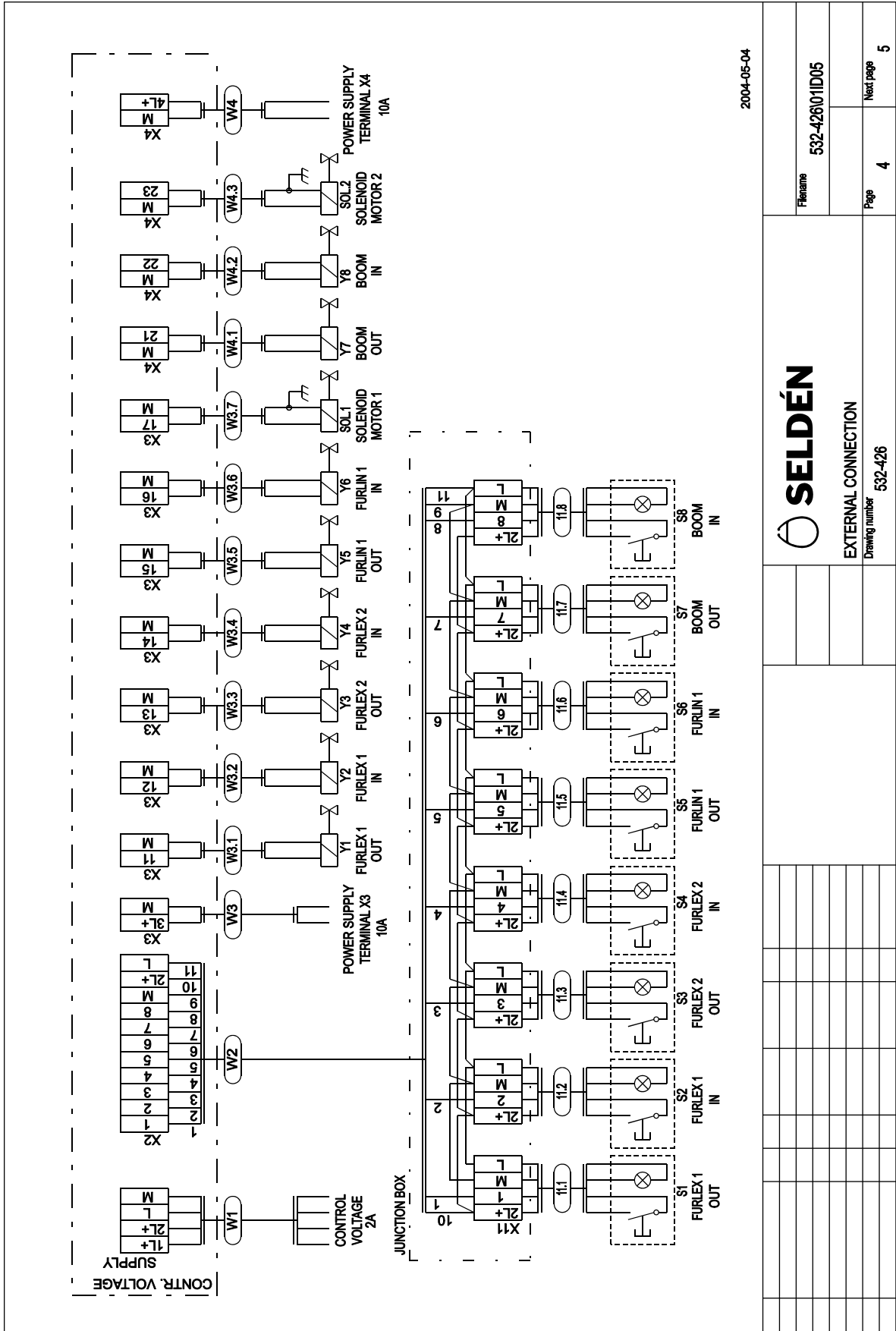
2004-05-04

		Filename	532-426/01CD05
		Page	2
<b>CIRCUIT DIAGRAM</b> Drawing number 532-426		Next page	3
		(Empty table cells for additional data)	



2004-05-04

 <b>SELDÉN</b>		Filename	532-426/01CD05
		Page	3
CIRCUIT DIAGRAM <small>Drawing number</small> 532-426		Next page	4



2004-05-04



EXTERNAL CONNECTION  
Drawing number 532-426

Filename 532-42601ID05

Page 4  
Next page 5



