Atlas Copco Air dryers

FD90, FD110, FD130, FD170 and FD230

Instruction book

- This instruction book meets the requirements for instructions specified by the machinery directive 98/37/EC and is valid for CE as well as non-CE labelled machines.

No. 2920 1390 02
Replaces No. 2920 1390 01

Registration code: APC FD / 38 / 975

2001-12

Web-site: http://www.atlascopco-compressors.com

Atlas Copco

This instruction book describes how to handle and operate the subject machine(s) to ensure safe operation, optimum working economy and long service life.

Read this book before putting the machine into operation to ensure correct handling, operation and proper maintenance from the beginning. The maintenance schedule contains a summary of the measures for keeping the dryer in good repair. The maintenance procedures are simple but must be carried out regularly.

Keep the book available for the operator(s) and make sure that the dryer is operated and that the maintenance actions are carried out according to the instructions. Record all operating data, maintenance work effected, etc. in an operator's logbook available from Atlas Copco. Follow all applicable safety precautions, amongst others those mentioned in this book.

Repair operations should be performed by trained personnel from Atlas Copco who can also be contacted if any further information is desired.

In all correspondence always mention the dryer type and the complete serial number, shown on the data plate.

For all specific data not mentioned in the text, consult sections "Maintenance" and "Principal data".

The company reserves the right to make changes without prior notice.

Contents

1 LEADING PARTICULARS

1.1 General description

The FD air dryers remove moisture from compressed air by cooling the air to near freezing point. This causes water to condense. The condensate is automatically drained. The air is warmed up before leaving the dryer.

1.2 Air circuit (Fig. 1.2)

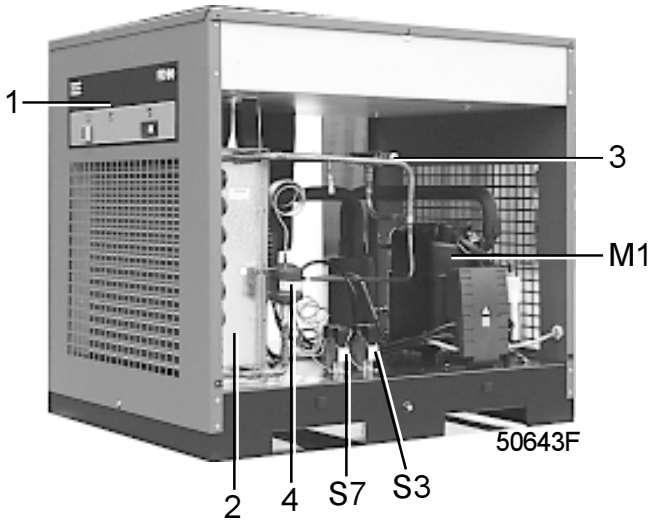
Compressed air enters heat exchanger (13) and is cooled by the outgoing, cold, dried air. Water in the incoming air starts to condense. The air then flows through heat exchanger/ evaporator (11) where the refrigerant evaporates causing the air to be further cooled to close to the evaporating temperature of the refrigerant. More water in the air condenses. The cold air then flows through separator (3) where all the condensate is separated from the air. The condensate collects in condensate trap (4) and is automatically drained. The cold, dried air flows through heat exchanger (13), where it is warmed up by the incoming air to approx. 10 degrees Celsius below the incoming air temperature. Condensation in the air net cannot occur unless the air is cooled to below the pressure dewpoint indicated by gauge (1).

1.3 Refrigeration circuit (Fig. 1.2)

Compressor (M1) delivers hot, high-pressure refrigerant gas which flows through condenser (9) where most of the refrigerant condenses.

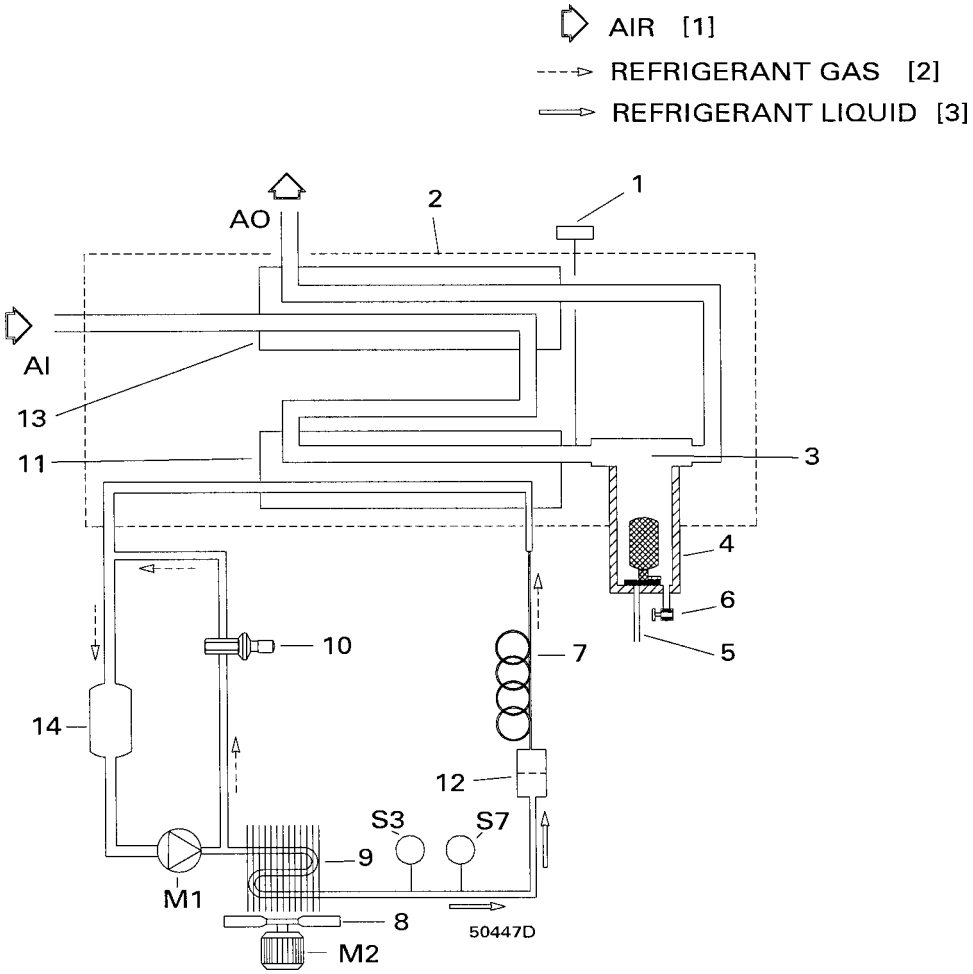
The liquid flows through liquid refrigerant dryer/filter (12) to capillary tube (7). The refrigerant leaves the capillary tube at evaporating pressure.

The refrigerant enters evaporator (11) where it withdraws heat from the compressed air by further evaporation at constant pressure. The heated refrigerant leaves the evaporator and is sucked in by the compressor via accumulator (14).



M1. Refrigerant compressor
S3. Fan control switch
S7. High pressure shut down switch
1. Control panel
2. Condenser
3. Hot gas by-pass valve
4. Liquid refrigerant dryer/filter

Fig. 1.1 General view of FD90



AI. Wet air inlet
AO. Dry air outlet
M1. Refrigerant compressor
M2. Condenser fan motor
S3. Fan control switch
S7. High pressure shut down switch
1. Pressure dewpoint gauge
2. Insulating block
3. Condensate separator
4. Condensate trap
5. Automatic condensate drain hose
6. Manual condensate drain valve
7. Capillary tube
8. Condenser cooling fan
9. Refrigerant condenser
10. Hot gas by-pass valve
11. Air/refrigerant heat exchanger/ evaporator
12. Liquid refrigerant dryer/filter
13. Air/air heat exchanger
14. Accumulator

Fig. 1.2 Air and refrigerant flow diagram

1.4 Automatic regulation system (Fig. 1.2)

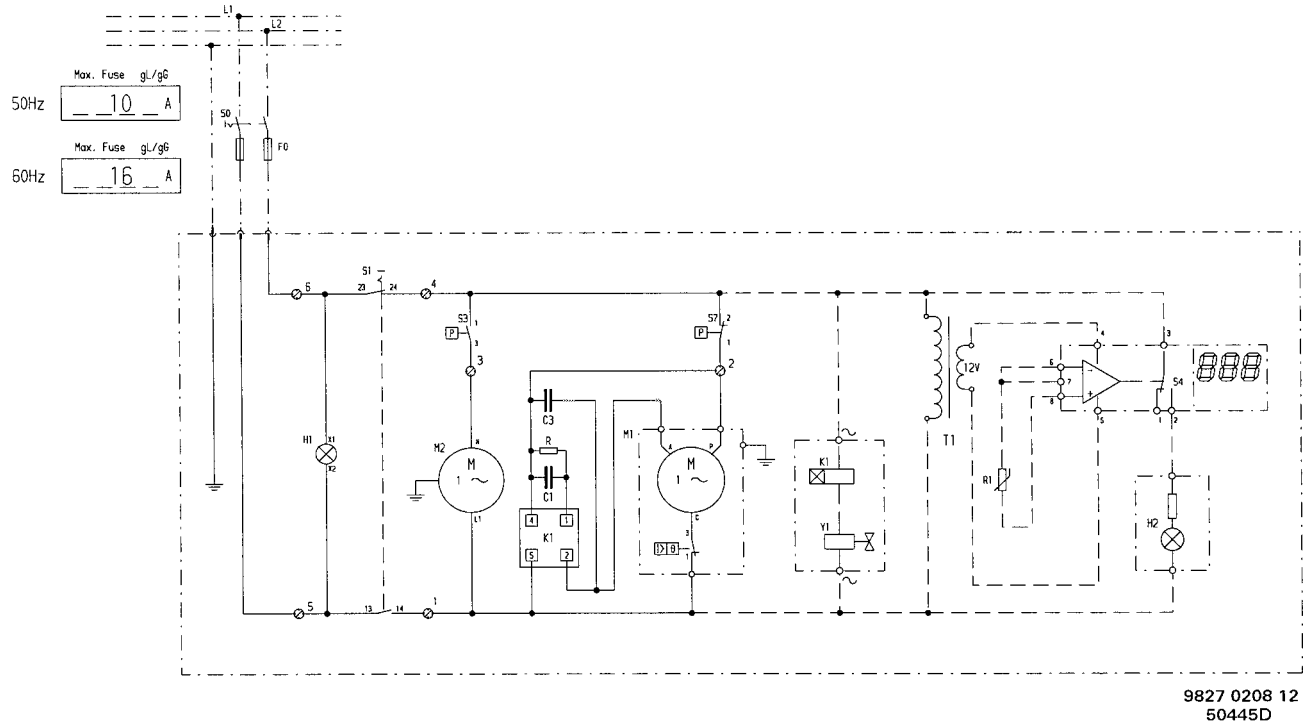
The condenser pressure must be kept as constant as possible to obtain stable operation, therefore, fan control switch (S3) stops and starts the cooling fan.

When, at partial or no load, the evaporator pressure drops to 2.25 bar(e), the by-pass regulator opens and hot, high pressure gas is fed to the evaporator circuit to prevent the evaporator pressure from dropping any further.

1.5 Electrical system (Figs. 1.3 up to 1.6)

FD170 60Hz and FD230 60Hz dryers are 3-phase units, all other FD dryers are single-phase units.

The refrigerant compressors (M1) of FD170 and FD230 dryers are equipped with a crankcase heater (Rs). When voltage is supplied, the heater is energized. It keeps the oil in the crankcase warm to prevent condensing of refrigerant in the compressor housing, which could result in serious damage of the compressor at start (liquid knock).



(1) TYPE	(2) VOLTAGE	(3) FREQUENCY	(4) Compr. motor M1 Input (6) Pe (kW)	(4) Compr. motor M1 Input (6) In (A)	(5) Fan motor M2 Input (6) P (kW)	(5) Fan motor M2 Input (6) In (A)	Pt (kW)	It (A)
FD90	230V	50Hz	1.10	5.2	0.14	0.6	1.24	5.8
FD90	230V	60Hz	1.56	7.8	0.17	0.7	1.73	8.5
FD110	230V	50Hz	1.25	5.9	0.14	0.6	1.39	6.5
FD110	230V	60Hz	2.14	10.4	0.17	0.7	2.31	11.1
FD130	230V	50Hz	1.74	8.0	0.14	0.6	1.88	8.6
FD130	230V	60Hz	2.14	10.4	0.17	0.7	2.31	11.1

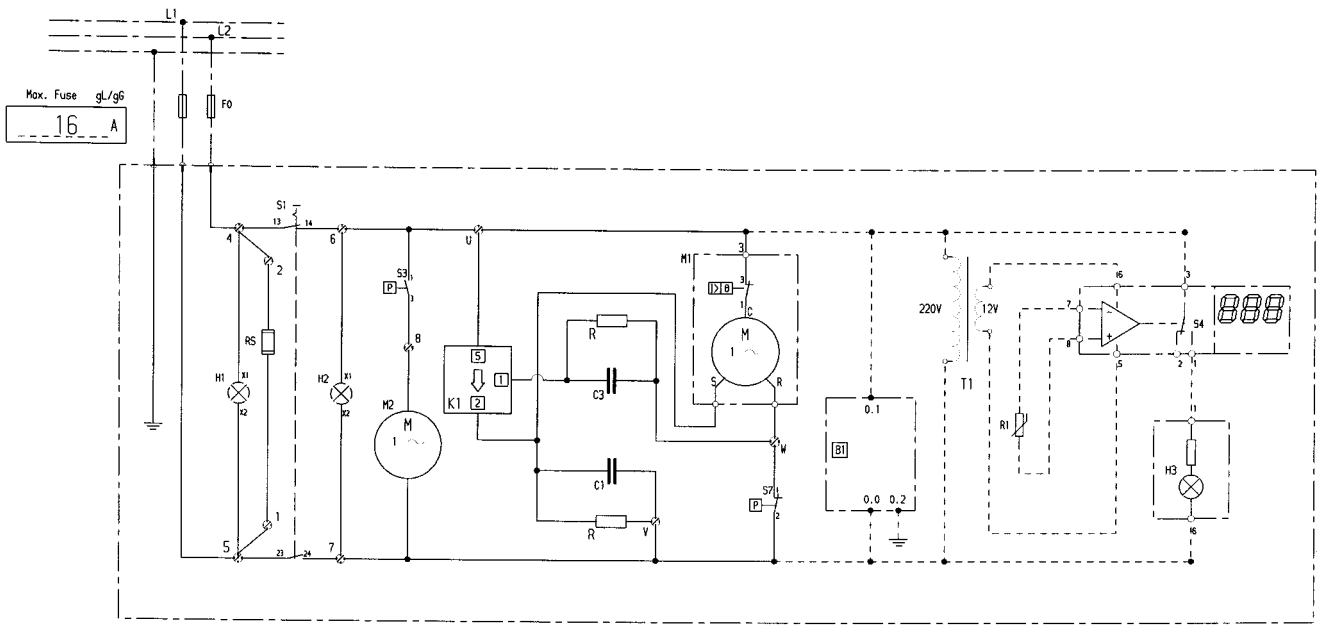
C1. Start capacitor
C3. Run capacitor
F0. Main fuses, local installation (customer's installation)
H1. Indicator lamp, VOLTAGE ON
H2. Indicator lamp, DEWPOINT ALARM (optional)
K1. Timer (optional)
M1. Compressor motor
M2. Condenser fan motor
R. Resistor
R1. Temperature sensor, dewpoint (optional)
S0. Main switch (customer's installation)
S1. Button, ON-OFF
S3. Fan control switch
S4. Electronic thermostat with display (optional)
S7. High pressure shut down switch
T1. Transformer (optional)
Y1. Solenoid valve, interval drain (optional)

Fig. 1.3 Electrical diagram of FD90 up to FD130

Fan control switch (S3) starts fan motor (M2) as soon as the condenser pressure reaches the upper set point of the switch and will stop the fan motor when the condenser pressure decreases to its lower set point.

High pressure shut-down switch (S7-Fig. 1.1) stops the compressor motor when the pressure in the refrigerant circuit reaches the upper set point of the switch. After tripping, it must be reset manually by pressing its reset knob.

The compressor motor has a built-in thermic protection. If the compressor motor stops without apparent reason, it will probably be the thermic protection which has tripped. In such case, the compressor will restart when the motor windings have cooled down, which may take up to 2 hours.



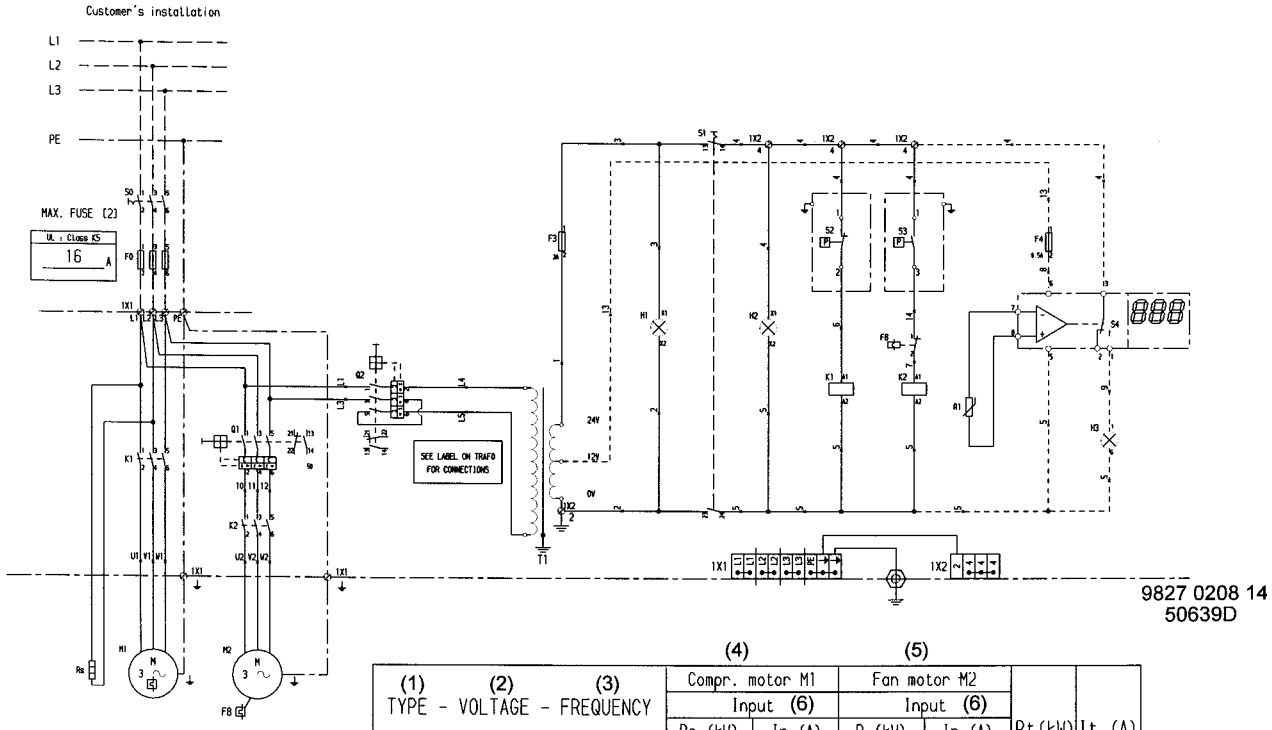
(1) (2) (3) TYPE - VOLTAGE - FREQUENCY			(4) Compr. motor M1 Input (6)		(5) Fan motor M2 Input (6)			
			Pe (kW)	In (A)	P (kW)	In (A)	Pt(kW)	It (A)
FD170	230V	50Hz	1.7	8.3	0.2	0.9	1.9	9.2
FD230	230V	50Hz	2.2	11.3	0.2	0.9	2.4	12.2

B1. Electronic condensate drain (optional)
C1. Run capacitor
C3. Start capacitor
F0. Main fuses, local installation (customer's installation)
H1. Indicator lamp, VOLTAGE ON
H2. Indicator lamp, DRYER RUN
H3. Indicator lamp, DEWPOINT ALARM (optional)
K1. Start relay
M1. Compressor motor
M2. Condenser fan motor
R1. Temperature sensor, dewpoint (optional)
RS. Crankcase heater
S1. Button, ON-OFF
S3. Fan control switch
S4. Electronic thermostat with display (optional)
S7. High pressure shut down switch
T1. Transformer (optional)

Fig. 1.4 Electrical diagram of FD170 50Hz and FD230 50Hz

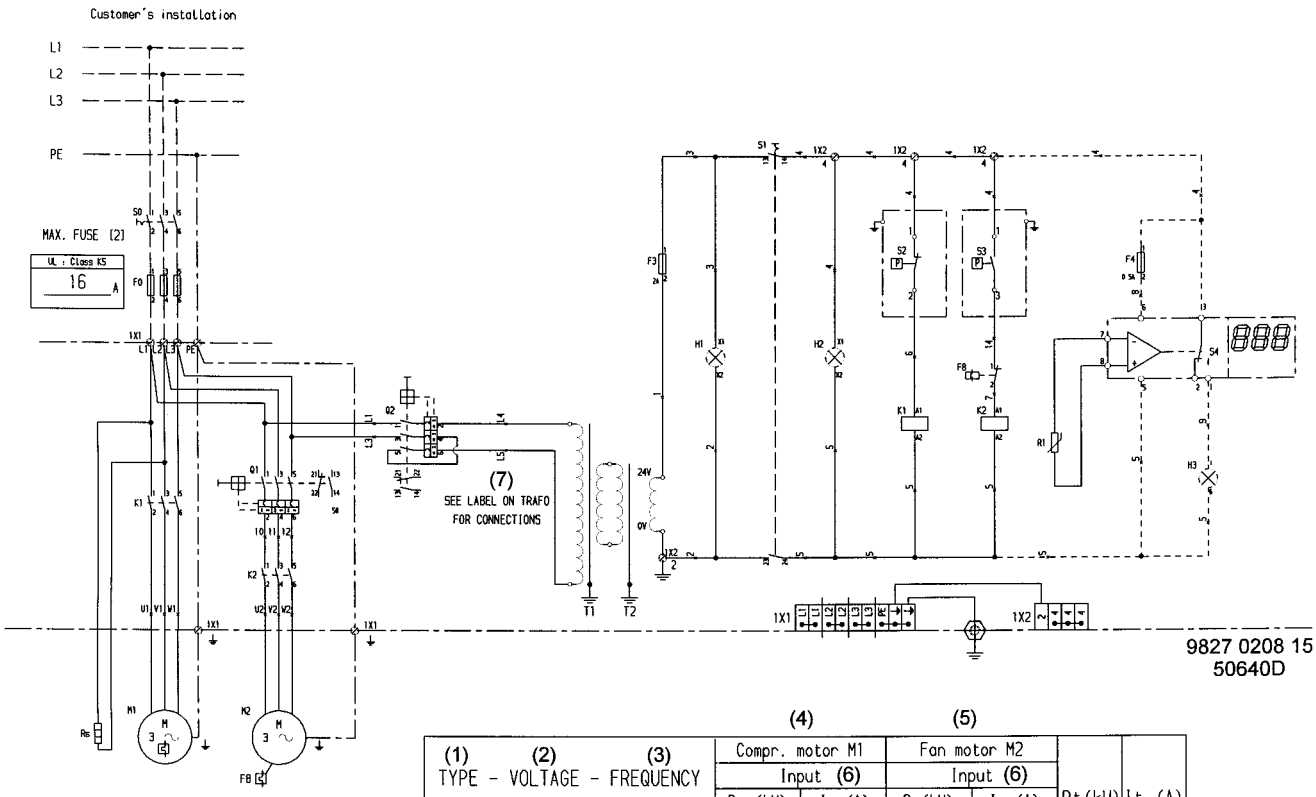
F0. Main fuses, local installation (customer's installation)
F3/4. Fuses
F8. Thermal overload, fan motor
H1. Indicator lamp, VOLTAGE ON
H2. Indicator lamp, DRYER RUN
H3. Indicator lamp, DEWPOINT ALARM (optional)
K1. Contactor, compressor motor
K2. Contactor, fan motor
M1. Compressor motor
M2. Condenser fan motor
Q1. Circuit breaker
Q2. Circuit breaker
R1. Temperature sensor, dewpoint (optional)
RS. Crankcase heater
S0. Main switch (customer's installation)
S1. Button, ON-OFF
S2. High pressure shut down switch
S3. Fan control switch
S4. Electronic thermostat with display (optional)
T1. Transformer (optional)
1x1. Terminal strip
1x2. Terminal strip

Figs. 1.5 and 1.6



(1) TYPE	(2) VOLTAGE	(3) FREQUENCY	(4) Compr. motor M1 Input (6) Pe (kW)	(4) Compr. motor M1 Input (6) In (A)	(5) Fan motor M2 Input (6) P (kW)	(5) Fan motor M2 Input (6) In (A)	Pt(kW)	It (A)
FD170	220-230V	60Hz	3.4	11.5	0.2	1.7	3.6	13.2
FD170	440-460V	60Hz	3.4	5.8	0.2	0.8	3.6	6.6
FD230	220-230V	60Hz	3.4	11.5	0.2	1.7	3.6	13.2
FD230	440-460V	60Hz	3.4	5.8	0.2	0.8	3.6	6.6

Fig. 1.5 Electrical diagram of FD170 220/440V/60Hz and FD230 220/440V/60Hz



(1) TYPE	(2) VOLTAGE	(3) FREQUENCY	(4) Compr. motor M1 Input (6) Pe (kW)	(4) Compr. motor M1 Input (6) In (A)	(5) Fan motor M2 Input (6) P (kW)	(5) Fan motor M2 Input (6) In (A)	Pt(kW)	It (A)
FD170	575V	60Hz	3.4	4.4	0.2	0.7	3.6	5.1
FD230	575V	60Hz	3.4	4.4	0.2	0.7	3.6	5.1

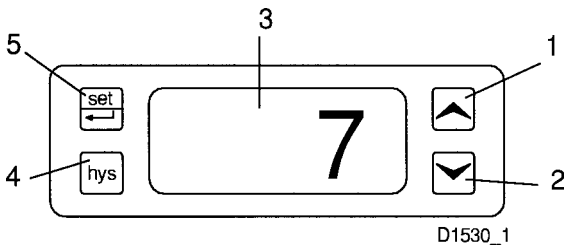
Fig. 1.6 Electrical diagram of FD170 575V/60Hz and FD 230 575V/60Hz

An electronic thermostat (Fig. 1.7) with display and alarm functions is available as an option. Display (3) shows the pressure dewpoint. The set point value, i.e. the pressure dewpoint at which the alarm indicator lamp lights up, can be checked by pressing key (5); the value will blink for approx. 5 seconds on the display. The differential value, i.e. the temperature difference between alarm on and alarm off, can be checked by pressing key (4); the value will blink on the display for approx. 5 seconds.

Altering the set point value (indicated "L1")
- Press key (5); the current value blinks on the display.
- Press the up (1) or down (2) key until the desired value is reached.
- To store the new value, press key (5) or wait a few seconds.

Altering the differential value (indicated "HY1")
- Press key (4); the current value blinks on the display.
- Press the up (1) or down (2) key until the desired value is reached.
- Press key (5) or wait a few seconds to store the new value.

If the temperature increases above the preset value, the alarm indicator lamp will light up.

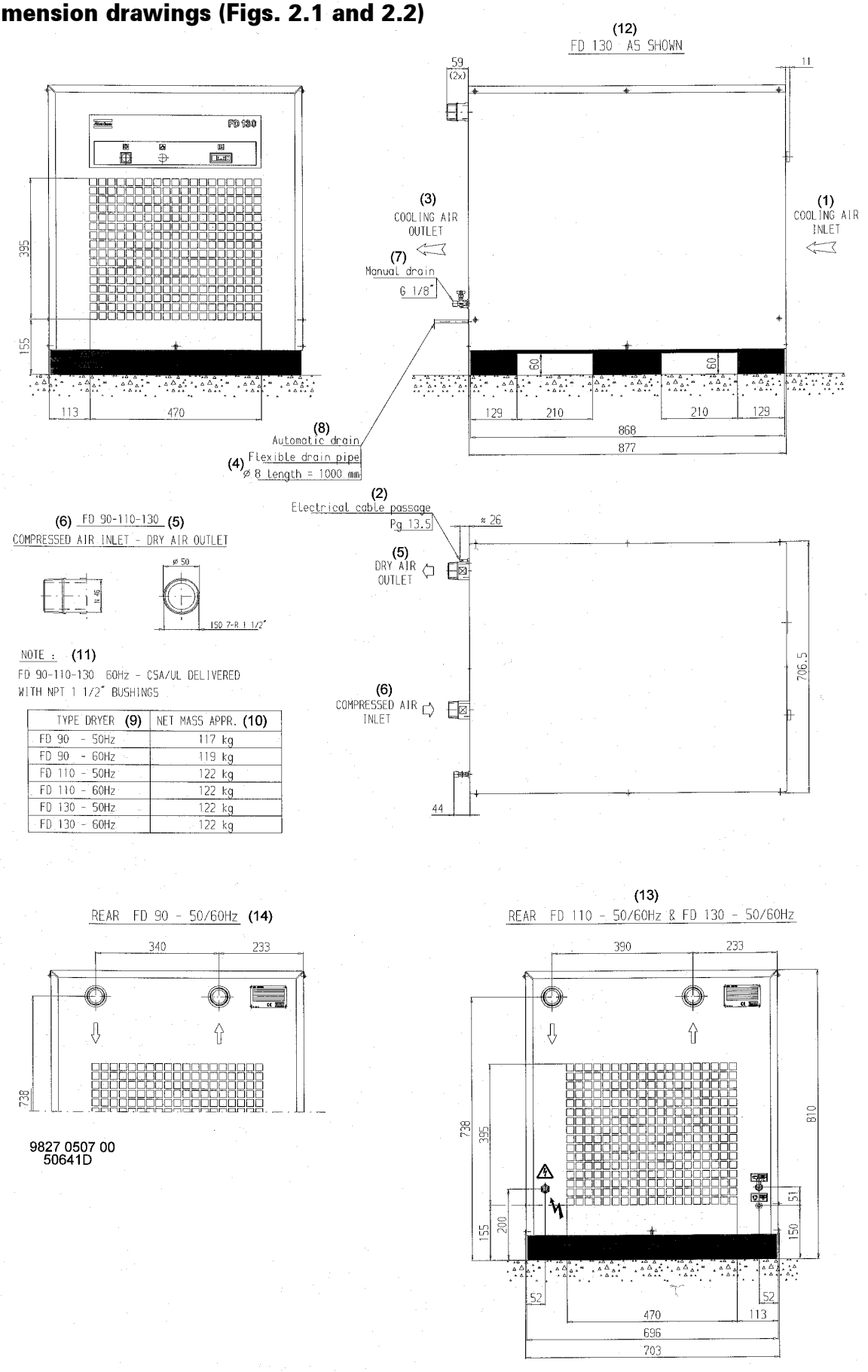


1. Key, value up
2. Key, value down
3. Display
4. Key, differential value
5. Key, set point of maximum pressure dewpoint

Fig. 1.7 Detail of electronic dewpoint indicator (optional)

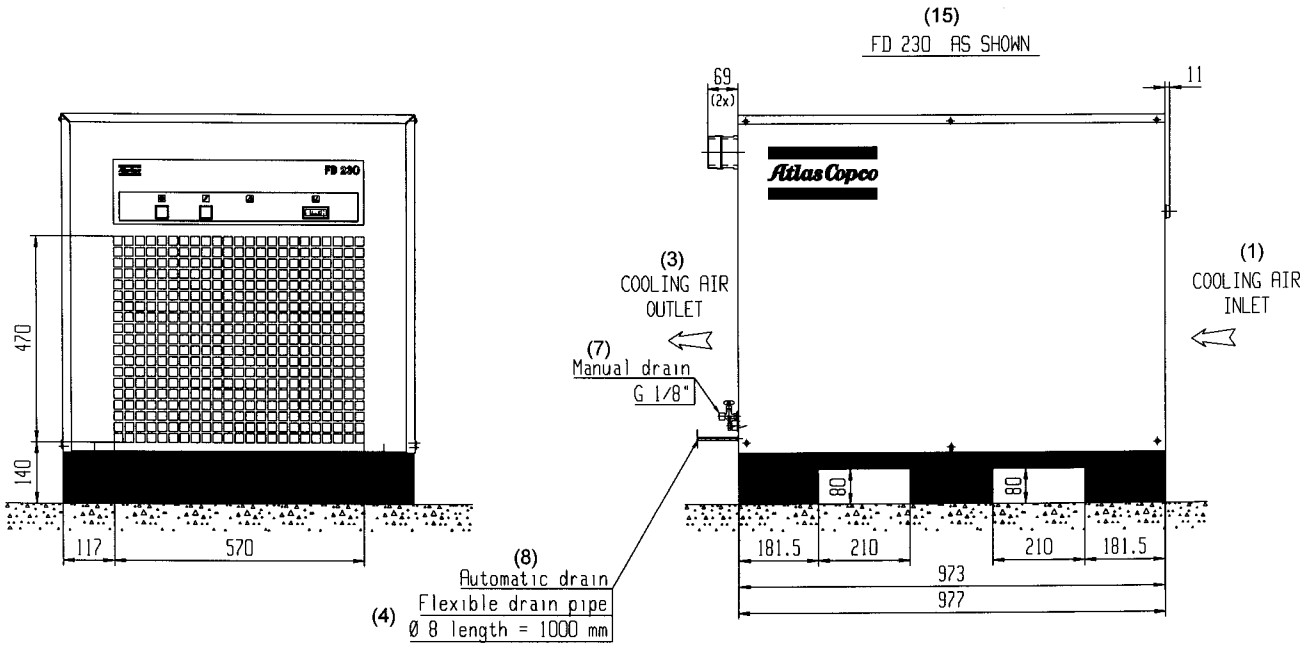
2 INSTALLATION

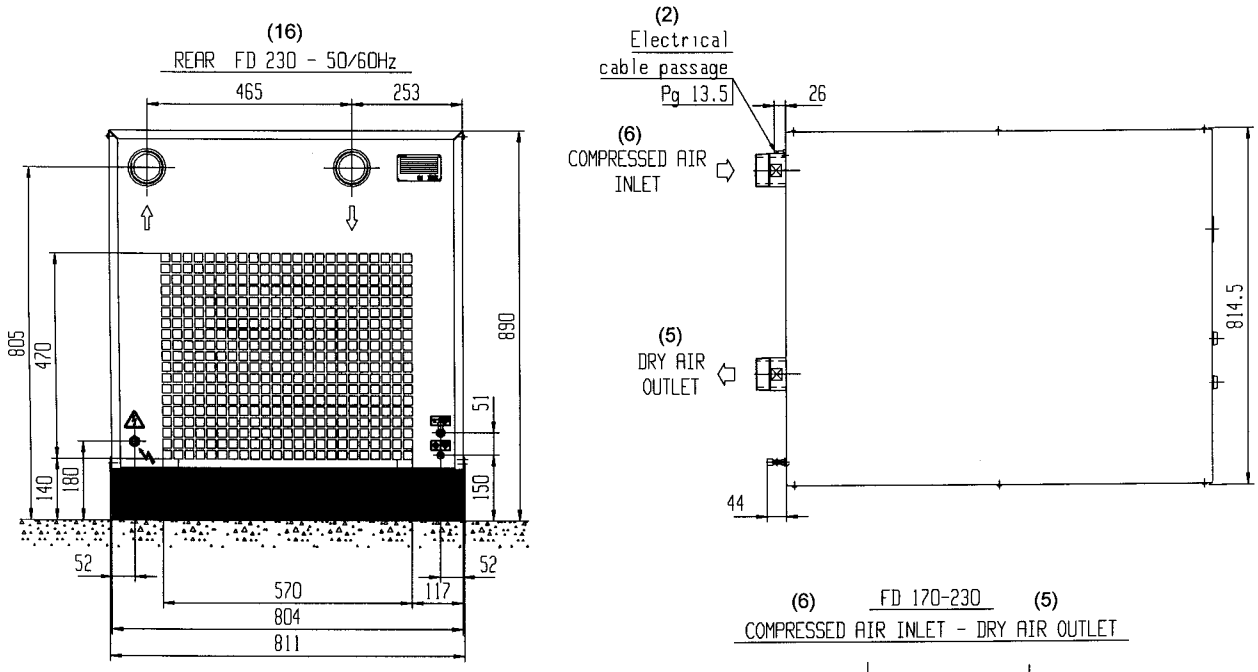
2.1 Dimension drawings (Figs. 2.1 and 2.2)

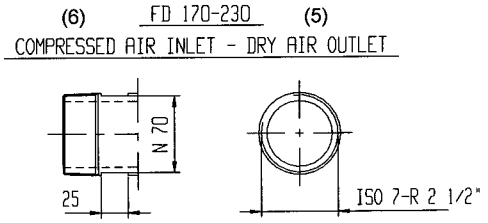


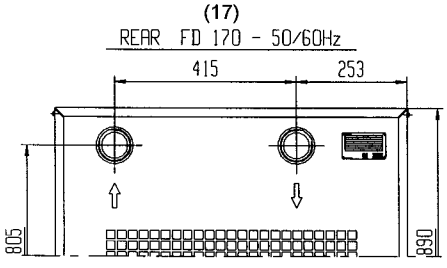
TYPE DRYER (9)	NET MASS APPR. (10)
FD 90 - 50Hz	117 kg
FD 90 - 60Hz	119 kg
FD 110 - 50Hz	122 kg
FD 110 - 60Hz	122 kg
FD 130 - 50Hz	122 kg
FD 130 - 60Hz	122 kg

Fig. 2.1 Dimension drawing of FD90 up to FD130









NOTE :

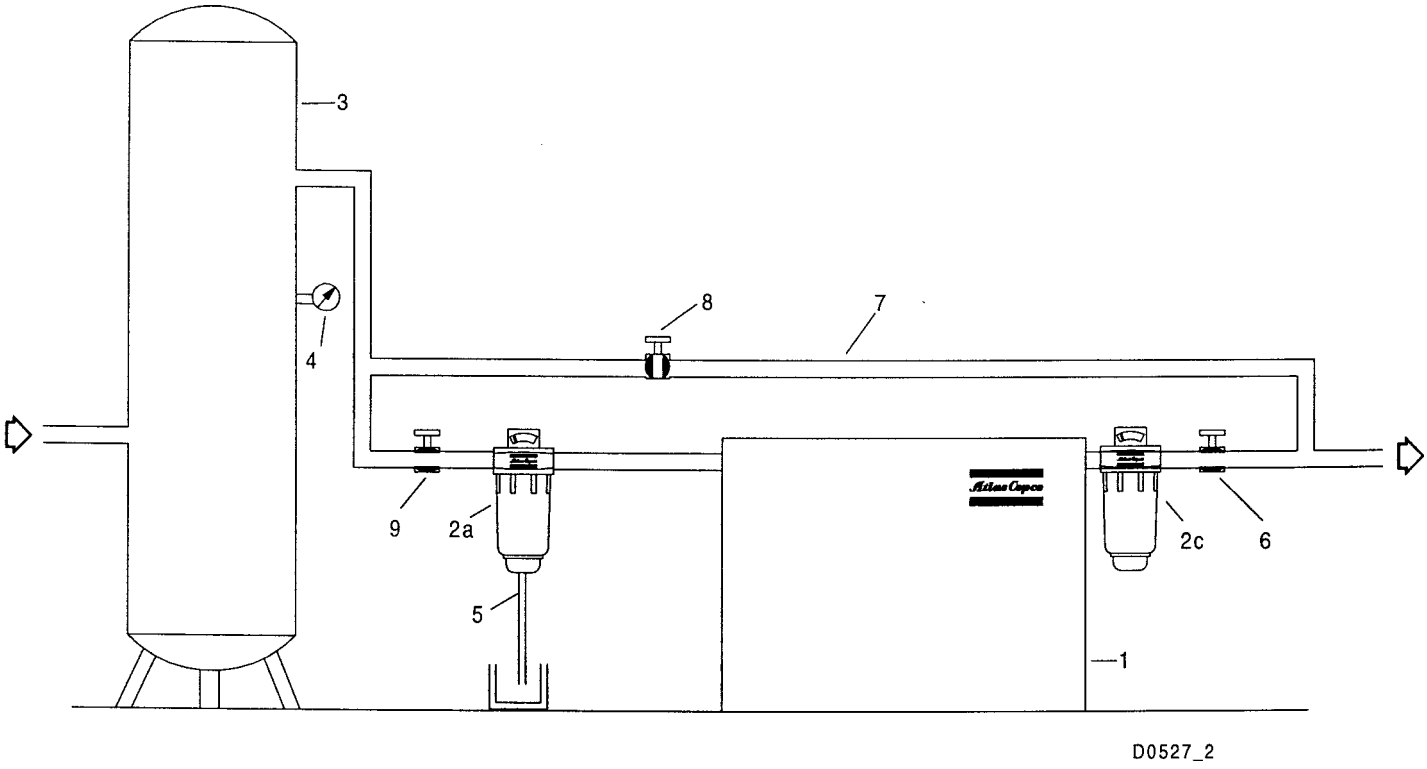
(18) FD 170-230 60Hz - CSA/UL DELIVERED WITH NPT 2 1/2" BUSHINGS

TYPE DRYER (9)	NET MASS APPR. (10)
FD 170 - 50Hz	143 kg
FD 170 - 60Hz	145 kg
FD 230 - 50Hz	157 kg
FD 230 - 60Hz	159 kg

9827 0637 00
50637D

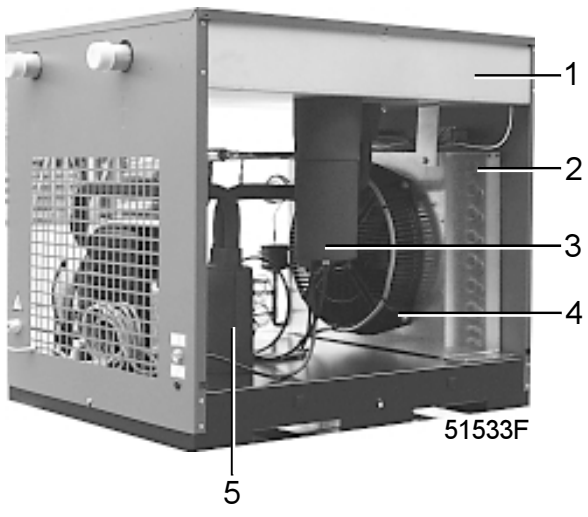
Fig. 2.2 Dimension drawing of FD170 up to FD230

2.2 Installation proposal (Fig. 2.3)



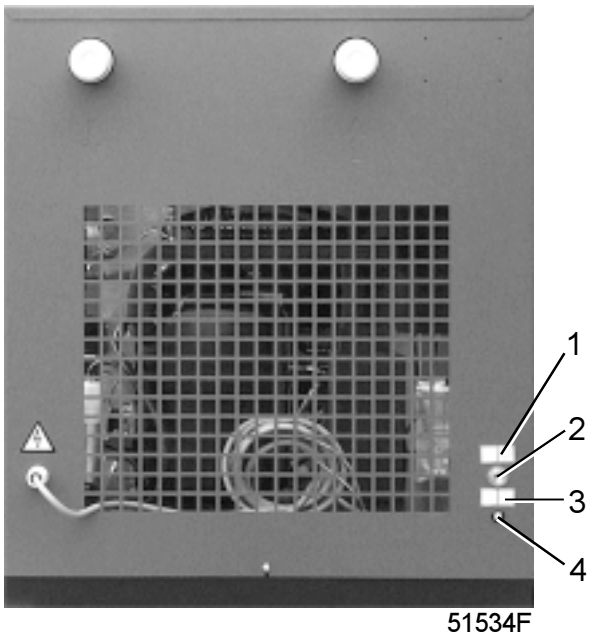
1. FD dryer
2a. DD-type general-purpose prefilter
2c. PD-type afterfilter
3. Air receiver with condensate drain
4. Pressure gauge
5. Drain pipe
6. Dryer outlet valve
7. By-pass system
8. By-pass valve
9. Dryer inlet valve

Fig. 2.3 Installation proposal



1. Insulating block with heat exchangers
2. Condenser
3. Condensate separator
4. Condenser cooling fan
5. Accumulator

Fig. 2.4 Side view

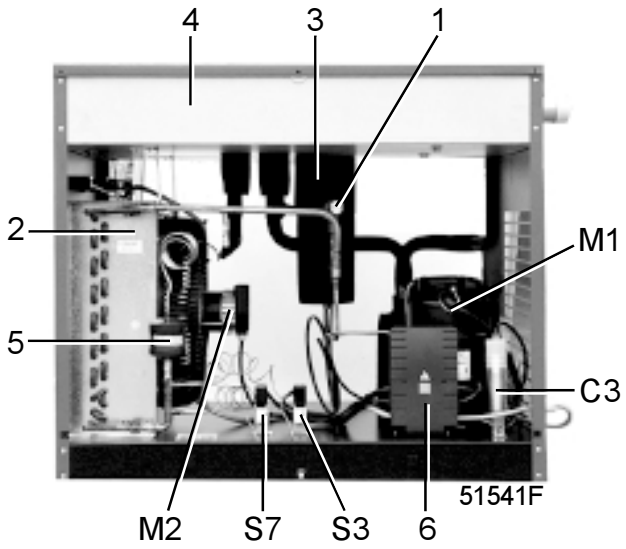


1. Pictograph, manual condensate drain
2. Manual condensate drain valve
3. Pictograph, automatic condensate drain
4. Automatic condensate drain

Fig. 2.5 Rear view

2.3 Installation instructions

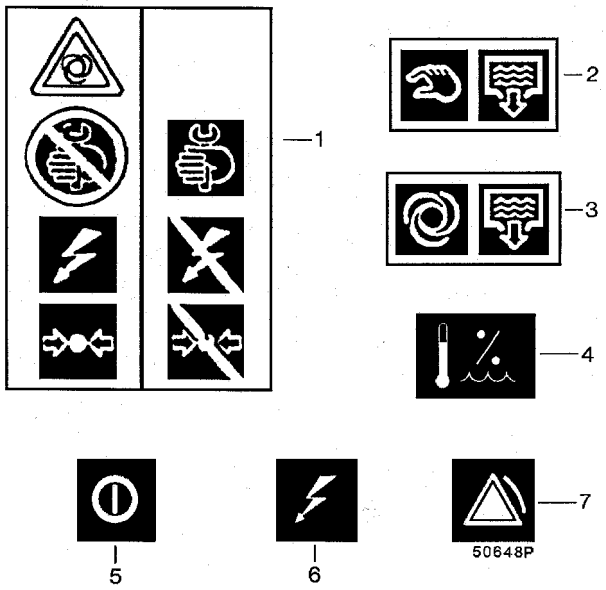
1. Install the dryer where the ambient air is as clean as possible and where the temperature of the air will never exceed the limits (see section 7). Keep the ventilation gratings of the dryer free.
   If necessary, take action to avoid external influences (wind, draughts, etc.) through the ventilation gratings of the dryer, as they may disturb the cooling air flow.
2. Connect the compressed air lines to the marked inlet and outlet pipes of the dryer (Figs. 2.1 and 2.2). Provide an air inlet valve and outlet valve. If a by-pass pipe and valve are installed, the dryer can be serviced while by-passing the dryer.
3. Fit manual condensate drain valve (2-Fig. 2.5).
   Lay out the condensate drain hoses via a funnel towards a drain collector to allow visual inspection. The hoses must slope downwards. For draining of pure condensate, install an oil/water separator; consult Atlas Copco.
   If the condensate drain has been led down outside the compressor room where it may be exposed to freezing temperatures, it must be insulated.
4. A sticker dealing in short with the operating instructions and explaining the pictographs is delivered with the literature set. Affix the sticker next to the control panel. Make yourself familiar with the instructions and pictographs explained.
5. **On single-phase dryers:** Fit the electric plug to the voltage supply cable. Plug in the dryer.
   On 3-phase dryers: Check that the primary side connections of transformer (T1-Figs. 1.5 and 1.6) correspond with the supply voltage.
   Check that the electrical installation corresponds to the local codes. The dryer must be earthed and protected against short circuits by fuses of the inert type in all phases. An isolating switch must be installed near the dryer.



C3. Run capacitor
M1. Refrigerant compressor
M2. Condenser fan motor
S3. Fan control switch
S7. High pressure shut down switch
1. Hot gas by-pass valve
2. Condenser
3. Condensate trap
4. Insulating block with heat exchangers
5. Liquid refrigerant dryer/filter
6. Cubicle

Fig. 2.6 Side view

2.4 Pictographs (Fig. 2.7)



1. Switch off and depressurize the dryer before starting maintenance or repairs
2. Manual condensate drain
3. Automatic condensate drain
4. Pressure dewpoint
5. Dryer on-off
6. Voltage on
7. Dewpoint alarm

Fig. 2.7 Pictographs

3 OPERATING INSTRUCTIONS

Safety precautions
The operator must apply all relevant safety precautions, including those mentioned in this book.

Altitude operation
Consult Atlas Copco if operating above 3000 m.

3.1 Initial start

1. At least 4 hours before starting, the mains supply to the dryer must be switched on to energize the crankcase heater of the refrigerant compressor.
2. **On 3-phase dryers** (see section 1.5), press on-off button (S1-Fig. 3.2). Check that the sense of rotation of fan motor (M2-Fig. 2.6) is correct. Cooling air must be drawn in through the condenser and blown over the refrigerant compressor to outside the dryer. If wrong, switch off the voltage and reverse two of the three phase connections at the mains terminals.

3.2 Starting (Figs. 3.1 and 3.2)

1. **On FD170 and FD230,** switch on the voltage 4 hours before starting to energize the crankcase heater. Voltage on lamp (H1) is alight.
2. If installed, close the dryer by-pass valve.
3. Press on-off button (S1).
4. Open the dryer air inlet valve (customer's installation).
5. Approx. 5 minutes later, open the dryer air outlet valve (customer's installation).
6. Approx. 10 minutes later, the nominal dewpoint will be reached.

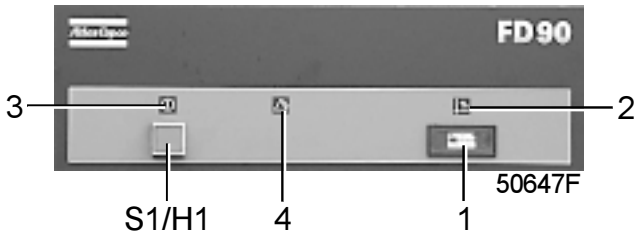


Fig. 3.1 Control panel of FD90 up to FD130 (typical example)

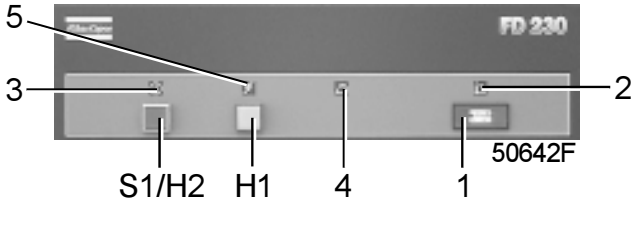


Fig. 3.2 Control panel of FD170 and FD230 (typical example)

H1. Indicator lamp, VOLTAGE ON
H2. Indicator lamp, DRYER RUN
S1. Button, ON-OFF

1. Pressure dewpoint indicator
2. Pictograph, pressure dewpoint
3. Pictograph, dryer on-off
4. Pictograph, dewpoint alarm
5. Pictograph, voltage on

Figs. 3.1 and 3.2

3.3 During operation

Regularly check:
1. Pressure dewpoint indicator (1-Figs. 3.1 and 3.2). **1)**
2. That condensate is discharged (4-Fig. 2.5). The amount depends on the operating conditions.
3. Regularly open manual drain valve (2-Fig. 2.5) for approx. 10 seconds to discharge condensate and possible impurities.

3.4 Stopping (Figs. 3.1 and 3.2)

1. Close the dryer inlet and outlet valves (customer's installation).
2. Press on-off button (S1). The dryer stops. Voltage on lamp (H1) remains alight. **On FD170 and FD230**, the crankcase heater remains switched on. Leave the voltage on if the dryer has to remain stand-by.

4 MAINTENANCE

Cooling dryers of FD type contain refrigerant HFC.

Safety precautions
When handling refrigerant R404a, all applicable safety precautions must be observed. The following points are stressed:
- Contact of refrigerant with the skin will cause freezing. Special gloves must be worn and in case of contact, the skin should be rinsed with water. On no account may clothing be removed.
- Fluid refrigerant will also cause freezing of the eyes; therefore, **safety glasses** are a must.
- Refrigerant R404a is poisonous. Do not inhale refrigerant vapours. Check that the working area is adequately ventilated.

Local legislation may impose that:
- work in the refrigerant circuit of the cooling dryer or on any equipment which influences its function should according to the law be executed by an **authorized control body.**
- the installation should according to the law be checked once a year by an **authorized control body.**

General
- Keep the dryer clean.
- Brush or blow off the finned surface of condenser (2-Fig. 1.1) regularly.
- Once every six months inspect and clean the inner components of condensate trap (3-Fig. 2.6).

5 SETTINGS

The regulating and safety devices are factory-adjusted to obtain optimum performance of the dryer. Do not alter the setting of any of the devices.

6 PROBLEM SOLVING (Fig. 1.2)

1. Pressure dewpoint too high
a. Air inlet temperature too high
a. Check and correct; if necessary, install a pre-cooler
b. Ambient temperature too high
b. Check and correct; if necessary, draw cooling air via a duct from a cooler place or relocate dryer
c. Air inlet pressure too low
c. Increase inlet pressure
d. Dryer capacity exceeded
d. Reduce air flow
e. Shortage of refrigerant
e. Have circuit checked for leaks and recharged
f. Refrigerant compressor (M1) does not run
f. See 3
g. Evaporator pressure too high
g. See 6
h. Condenser pressure too high
h. See 2

2. Condenser pressure too high or too low
a. Fan control switch (S3) out of order
a. Replace
b. Fan or fan motor out of order
b. Check fan/fan motor
c. Ambient temperature too high
c. Check and correct; if necessary, draw cooling air via a duct from a cooler place or relocate dryer
d. Condenser externally clogged
d. Clean condenser

3. Compressor stops or does not start
a. Electric power supply to compressor is interrupted
a. Check and correct as necessary
b. Thermic protection of refrigerant compressor motor (M1) has tripped
b. Motor will restart when motor windings have cooled down

4. Condensate trap remains inoperative
a. Automatic drain system clogged
a. Flush the assembly by opening manual drain valve. Have system inspected

Footnote chapter 3

1) The pressure dewpoint will deviate from nominal if the air inlet conditions or volume flow differ from nominal.

5. Condensate trap continuously discharges air and water
a. Automatic drain system out of order
a. Have system checked

6. Evaporator pressure is too high or too low at unload
a. Hot gas by-pass valve incorrectly set or out of order
a. Have hot gas by-pass valve adjusted
b. Condenser pressure too high or too low
b. See 2
c. Shortage of refrigerant
c. Have circuit checked for leaks and recharged

7 PRINCIPAL DATA

7.1 Limitations/nominal conditions

		50 Hz	60 Hz
Nominal conditions			
Compressed air inlet pressure	bar(e)	7	7
Compressed air inlet temperature	Celsius	35	38
Ambient temperature	Celsius	25	38
Inlet relative vapour pressure		1	1
Pressure dewpoint	Celsius	3	4
Cooling air inlet temperature	Celsius	25	38
Limitations			
Maximum compressed air inlet pressure	bar(e)	13	13
Min.-max. ambient air temperature	Celsius	0-45	0-45
Min.-max. compressed air inlet temperature	Celsius	0-55	0-55

7.2 Specific data of FD90, FD110 and FD130 1)

			FD90	FD110	FD130
Volume flow at dryer inlet at nominal conditions	50 Hz	l/s	90	110	130
	60 Hz	l/s	92	113	135
Pressure drop through dryer at nominal conditions, approx.		bar	0.16	0.15	0.21
Electric power input	50 Hz	kW	1.30	1.40	1.90
	60 Hz	kW	1.80	2.30	2.30
Refrigerant					
Tetrafluoroethane CH_2FCF_3			R404a	R404a	R404a
Total charge, approx.	50 Hz	kg	0.80	1.00	1.10
	60 Hz	kg	1.00	1.10	1.10

7.3 Specific data of FD170 and FD230 1)

			FD170	FD230
Volume flow at dryer inlet at nominal conditions	50 Hz	l/s	170	230
	60 Hz	l/s	175	235
Pressure drop through dryer at nominal conditions, approx.	50 Hz	bar	0.22	0.22
	60 Hz	bar	0.25	0.22
Electric power input	50 Hz	kW	1.90	2.40
	60 Hz	kW	3.60	3.60
Refrigerant				
Tetrafluoroethane CH_2FCF_3			R404a	R404a
Total charge, approx.	50 Hz	kg	1.80	1.80
	60 Hz	kg	1.60	1.70

Footnote chapter 7

1) At nominal conditions.

8 CONVERSION LIST OF SI UNITS INTO BRITISH UNITS

1 bar = 14.504 psi
1 g = 0.035 oz
1 kg = 2.205 lb
1 km/h = 0.621 mile/h
1 kW = 1.341 hp (UK and US)
1 l = 0.264 US gal
1 l = 0.220 Imp gal (UK)
1 l = 0.035 cu.ft
1 m = 3.281 ft
1 mm = 0.039 in
1 m^3/min = 35.315 cfm
1 mbar = 0.401 in wc
1 N = 0.225 lbf
1 Nm = 0.738 lbf.ft
x degrees Celsius = (32 + 1.8x) degrees Fahrenheit **1)**

Footnote chapter 8

1) A temperature difference of 1 degree Celsius = a temperature difference of 1.8 degrees Fahrenheit