Supplementary Operating Instructions

for Explosion Protection for Liquid Ring Compressors

These supplementary operating instructions are an addendum to the operating instructions. The operating instructions for the product are to be observed without fail.

ATTENTION

Any warranty claims including claims for damages cease in case of non-observance.

The liquid-ring compressors are suitable for the intended use for operation in an environment prone to explosion as well as for the conveying of explosive gases and vapour mixtures, which can also contain hydrogen.

According to Directive 94/9/EC, the compressors conform to the equipment group II and to the following categories depending on the type series and on the measurement and safety technology:

Outside the compressor:

category according to EN 13463	The media of the environment at the site of installation belong according to EN 13463-1 to the		
	Temperature classes	Explosion groups	further details
For all type series			
2G 2D	T1, T2, T3 or T4	IIA or IIB or IIC	maximum surface temperature (cf 3)

Inside the compressor:

category according to EN 13463	The conveyed media belong according to EN 13463-1 to the		
	Temperature classes	Explosion groups	further details
For all type series			
2G 2D	T1, T2, T3 or T4	IIA or IIB	maximum surface temperature (cf 3)

Inside the compressor:

category according to EN 13463	The conveyed media belong according to EN 13463-1 to the		
	Temperature classes	Explosion groups	further details
for VU 20 to VU 1600, VH 20 to VH 1600 and VZ 110 to VZ 180 only			
1G	T1, T2, T3 or T4	IIA or IIB	Medium contains hydrogen
		or	
1G	T1, T2, T3 or T4	IIA or IIB	

The authorizations for the corresponding equipment categories and media apply in each case only in connection with the measurement-, control- and process-technology necessary for them. The authorization ceases with a restriction of the functionality of the prescribed safety technology, a modified operational mode or the non-compliance with the required maintenance procedures. Maintenance work may only be performed by technically trained personnel.

1 Operating thresholds

Operation as vacuum pump and compressor		
Suction pressure p_S	33…1000 mbar absolute	The suction pressure must be greater by at least 20 mbar than the vapour pressure of the operating liquid discharging on the pressure side. The minimum suction pressure described by the manufacturer-characteristic may not be exceeded.
Compression pressure p_D	800…2600 mbar absolute	The maximum compression pressure described by the manufacturer-characteristic may not be exceeded.
Pressure differential p_D - p_S	200…1800 mbar	The maximum pressure differential described by the manufacturer-characteristic may not be exceeded.
Inlet temperature of the medium to be pumped	Directive 94/9/EC max. 60 °C Directive 98/24/EC max. 120 °C	A maximum temperature of 60 ° applies for machines to be employed according to Directive 94/9/EC: Higher temperatures can only be met per Machine Directive 98/24/EC.
Temperature t_B of the operating liquid	t_B = - 20…110 °C	The minimum temperature is to be selected so that a viscosity of 90 mm²/s is not exceeded. The maximum temperature is to be selected so that the vapour pressure of the operating liquid discharging on the pressure side is at least 20 mbar less than the suction pressure.
Supply pressure p_B of the operating liquid	$p_B = p_S$ +300 mbar $p_B = p_D…p_D$ +200 mbar	The supply pressure of the operating liquid directly at the compressor should be at least 300 mbar above the suction pressure after a maximum of 60 s. But this may also exceed the compression pressure maximally by 200 mbar.
Temperature t_S of the flushing liquid (double-action slide ring gasket)	t_S = - 20…110 °C	The minimum temperature is to be selected so that a viscosity of 90 mm²/s is not exceeded. The maximum temperature must have a minimum distance of 10 U to the boiling point of the flushing liquid under process conditions.
Ambient temperature	-20 °C - +40 °C	

The minimum allowable pressure on the suction side of the compressor as well as the maximum gas-, vapour- and liquid-temperatures must make possible a safe distance to the vapour pressure of the operating liquid independent of the operating liquid and ensure an operation free of cavitation.

Different operating conditions on request.

2 Motor allocation

The following maximum torques and revolution speeds, depending on the operation as vacuum pump or compressor, may in no case be exceeded.

Type		VH 20	VH 40	VH 60	VH 110	VH 140	VH 180	VH 300	VH 350	VH 400	VH 500	VH 600	VH 800	VH 1200	VH 1600
M_{Vacuum}	[Nm]	5,8	9,0	10,3	33	42	60	96	110	121	173	217	481	611	741
$M_{Compressor}$	[Nm]	10,8	20,2	19,8	68	74	83								
n_{max}	[min^{-1}]	3600	3600	3600	1800	1800	1800	1800	1800	1800	1800	1800	1200	1200	1200

Type		VU 20	VU 40	VU 80	VU 140	VU 220	VU 300	VU 450	VU 500	VU 600	VU 800	VU 1200	VU 1600
M_{Vacuum}	[Nm]	4,9	7,5	13	40	59	82	114	151	192	364	494	650
$M_{Compressor}$	[Nm]	6,7	11,7	22	74		157	227	288	375	728	962	1183
n_{max}	[min^{-1}]	3600	3600	3600	1800	1800	1800	1800	1800	1800	1200	1200	1200

Type		VZ 30	VZ 50	VZ 110	VZ 140	VZ 180	VN 95	VN 125	VN 180
M_{Vacuum}	[Nm]	6,7	10	33	42	60	33	42	60
$M_{Compressor}$	[Nm]			68	74	83			
n_{max}	[min^{-1}]	3600	3600	1800	1800	1800	1800	1800	1800

Type		VI 2	VI 8	VI 15	VI 30	VI 55	V 6	V/VG 30	V/VG 55	V/VG 95	V/VG 130	V/VG 255	V 330	V 430
M_{Vacuum}	[Nm]	0,5	1,8	2,5	5	10	33	42	60	33	42	60	0,5	1,8
$C_{ompressor}$	[Nm]													
n_{max}	[min^{-1}]	1800	3600	3600	3600	3600	1800	1800	1800	1800	1800	1800	1800	3600

See data sheet for further operating data.

The power input designated in the process-specific data sheet for the motor to be used as well as the adjustment of the protective motor switch is significant. The motor current is to be limited so that the power input is maximally 15% above that of the data sheet.

3 Temperature limits

With knowledge of the temperature class, the surface temperature of the compressor may exceed the maximum allowable temperatures in the following table in no operating condition according to EN 13463-1.

EN 13463-1		Surface temperatures (EN 13463-1)	
Temperature class	Limit values	maximum allowable for category 1	maximum allowable for category 2
T 4	135 °C	108 °C	130 °C
T 3	200 °C	160 °C	195 °C
T 2	300 °C	240 °C	290 °C
T 1	450 °C	360 °C	440 °C

If the reference basis for the identification is a certain material, then the surface temperature for compressors of

Category 1 may reach maximally 80% of the ignition temperature in °C

Category 2 - with ignition temperatures ≤ 200°C may reach values at least 5U
- with ignition temperatures > 200°C may reach values at least 10U
below the ignition temperature

For dust explosion protection the surface temperature has to be lower than 2/3 of the ignition temperature in °C of the dust-air-mixture and 75 K below the glow temperature of a dust coat of 5 mm thickness.

4 Identification

The identification of the compressor with the label Ex and the corresponding classification applies only to the liquid-ring compressor.

Example: Ex II 1G IIB T4 **for explosive gas**

Example: Ex II 1D T 120 ° **for explosive dusts with a maximum admissible surface temperature of 120 °C**

All external equipment and components (coupling, motor, etc.) must at least satisfy the classifications specified by the manufacturer of the compressor, be suitable for the respective zone and exhibit an appropriate authorization and identification of the manufacturer of the respective equipment. This is ensured with acquisition of the complete compressor with drive and control systems.

5 Permissible operating modes

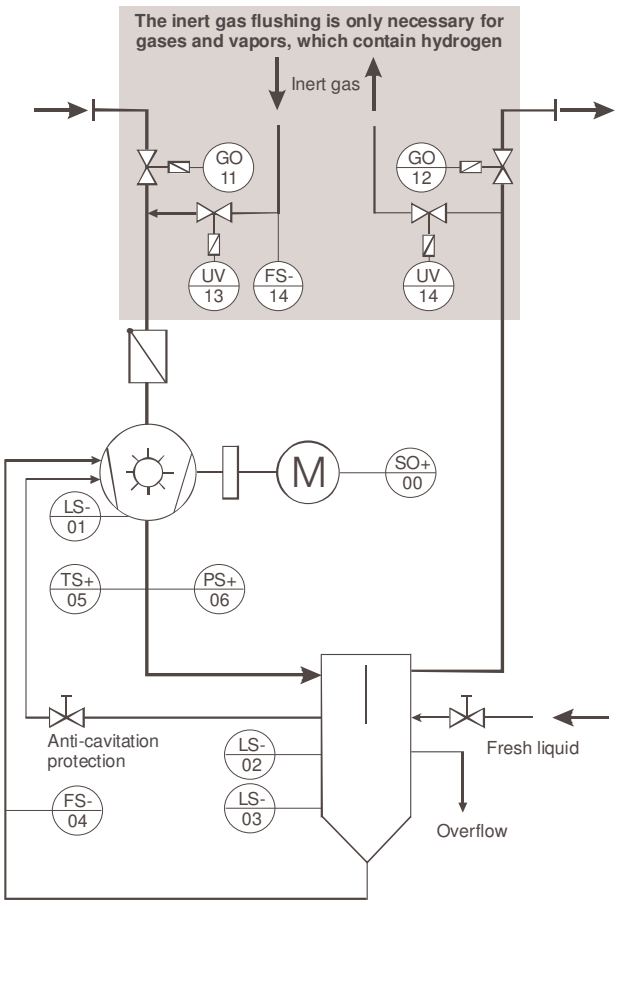

Fig. 5.1. open circuit cooling

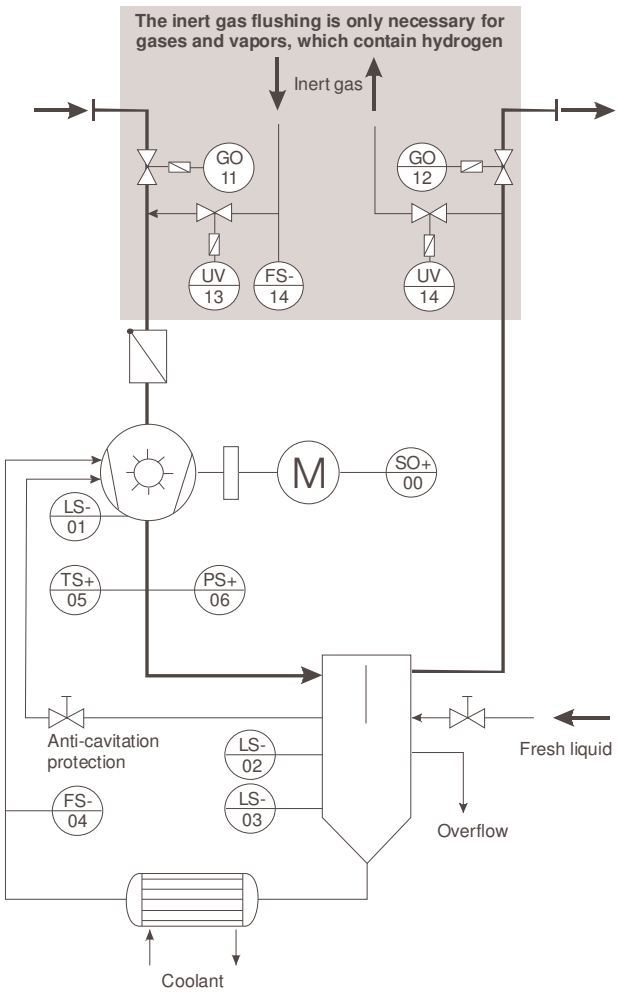

Fig. 5.2. closed circuit cooling

open circuit cooling	closed circuit cooling
The removal of the compression output takes place via the supply of cold fresh liquid. The minimum temperature of the fresh liquid is to be selected so that a viscosity of 90 mm²/s is not exceeded. The maximum temperature is to be selected so that after the mixture with the circulating liquid the vapour pressure of the operating liquid discharging on the pressure side is at least 20 mbar less than the suction pressure.	The removal of the compression output takes place in a heat exchanger. The minimum temperature of the circulating liquid at the outlet of the heat exchanger is to be selected so that a viscosity of 90 mm²/s is not exceeded. The maximum temperature at the outlet of the heat exchanger is selected so that the vapour pressure of the operating liquid discharging on the pressure side is at least 20 mbar less than the suction pressure. Despite the pressure losses on the product side of the heat exchanger the operating liquid pressure directly at the compressor should be at least 300 mbar above the suction pressure.
For the separation of the gas and liquid phase front- or state-mounted separators are to be used according to the specifications of the manufacturer.	

6 Inertisation in the conveying of gases and vapours which contain hydrogen

Before the beginning of the process the rotating liquid-ring compressor is to be flushed with inert gas (for example, nitrogen) with closed suction valve. The amount of flushing gas must correspond to at least quintuple the internal volume of the system.

Also, after the end of the process before turning off the compressor flushing is to be done in the same manner with closed suction valve.

Table 6.1 contains the volume specifications for the determination of nitrogen flushing times for the system, consisting of a liquid-ring compressor of the type series VH, VU or VZ, a front-mounted separator or side-mounted separator and the associated piping. This applies only for the front- or side-mounted separators explicitly named by the Speck firm and piping for the integration in vacuum systems for the conveying of mixtures, which contain hydrogen.

Type		VH 20	VH 40	VH 60	VH 110	VH 140	VH 180	VH 300	VH 350	VH 400	VH 500	VH 600	VH 800	VH 1200	VH 1600
Volume contents															
of the compressor	[l]	2	2,4	2,8	8	11	14	18	20	24	32	38	72	94	108
of the piping	[l]	0,3	0,4	0,4	1,2	1,7	2,1	2,7	3,0	3,6	4,8	5,7	11	14	16
of the front-mounted separator	[l]	3	3	3	17	17	17	33	33	33	62	62	83	83	83
of the side-mounted separator	[l]	17	17	30	40	40	40	50	50	50	90	90	110	110	110
5-fold volume															
with front-mounted separator	**[l]**	**27**	**29**	**31**	**131**	**148**	**166**	**269**	**280**	**303**	**494**	**529**	**829**	**956**	**1036**
with side-mounted separator	**[l]**	**97**	**99**	**166**	**246**	**263**	**281**	**354**	**365**	**388**	**634**	**669**	**964**	**1091**	**1171**

Type		VU 20	VU 40	VU 80	VU 140	VU 220	VU 300	VU 450	VU 500	VU 600	VU 800	VU 1200	VU 1600
Type													
	[l]	1,8	2	7	9	11	16	24	24	28	64	70	76
Volume contents	[l]	0,3	0,3	1,1	1,4	2,2	2,4	4,8	4,8	5,6	10	14	15
of the compressor	[l]	3	3	17	21	34	33	39	55	55	83	72	72
of the piping	[l]	17	17	40	40	40	50	50	90	90	110	110	110
of the front-mounted separator													
of the side-mounted separator	**[l]**	**25**	**27**	**125**	**157**	**236**	**257**	**339**	**419**	**443**	**783**	**780**	**816**
5-fold volume	**[l]**	**95**	**97**	**240**	**252**	**266**	**342**	**394**	**594**	**618**	**918**	**970**	**1006**

Type		VZ 30	VZ 50	VZ 110	VZ 140	VZ 180	VN 95	VN 125	VN 180
Volume contents									
of the compressor	[l]	1,8	2	8	11	14	4	4,7	5,8
of the piping	[l]	0,3	0,3	1,2	1,7	2,1	1,1	1,4	2,2
of the front-mounted separator	[l]	3	3	17	17	17	22	22	22
of the side-mounted separator	[l]	17	17	40	40	40	40	40	40
5-fold volume									
with front-mounted separator	**[l]**	**25**	**27**	**131**	**148**	**166**	**136**	**141**	**150**
with side-mounted separator	**[l]**	**95**	**97**	**246**	**263**	**281**	**226**	**231**	**240**

Type		VI 2	VI 8	VI 15	VI 30	VI 55	V 6	V/VG 30	V/VG 55	V/VG 95	V/VG 130	V/VG 155	V/VG 255	V 330	V 430
Volume contents															
of the compressor	[l]	0,3	0,6	0,9	1,5	2,1	8	11	14	4	4,7	5,2	5,8	0,3	0,6
of the piping	[l]	1,2	1,7	2,1	1,7	2,1	1,2	1,7	2,1	1,1	1,4	1,4	2,2	1,2	1,7
of the front-mounted separator	[l]	1	1,7	2,2	3,5	3,5	17	17	17	22	22	22	22	1	1,7
of the side-mounted separator	[l]	2	3,5	4	6	6	40	40	40	40	40	40	40	2	3,5
5-fold volume															
with front-mounted separator	**[l]**	**13**	**20**	**26**	**34**	**39**	**131**	**148**	**166**	**136**	**141**	**143**	**150**	**13**	**20**
with side-mounted separator	**[l]**	**18**	**29**	**35**	**46**	**51**	**246**	**263**	**281**	**226**	**231**	**233**	**240**	**18**	**29**

Tab. 6.1 Volumes for systems with front- and side-mounted separator

7 Measuring-, Control- and Regulation Technology (MCR)

All MCR-equipment used must be tested and approved for explosion protection according to Directive 94/9/EC. The requirement profile of each individual invigilator as well as the associated control circuit must correspond to IPL-1 according to EN 13463-6.

- Measuring instruments, which contact the conveying medium : Category 1
- Measuring instruments for the external environment : Category 2

7.1 Required MCR-equipment

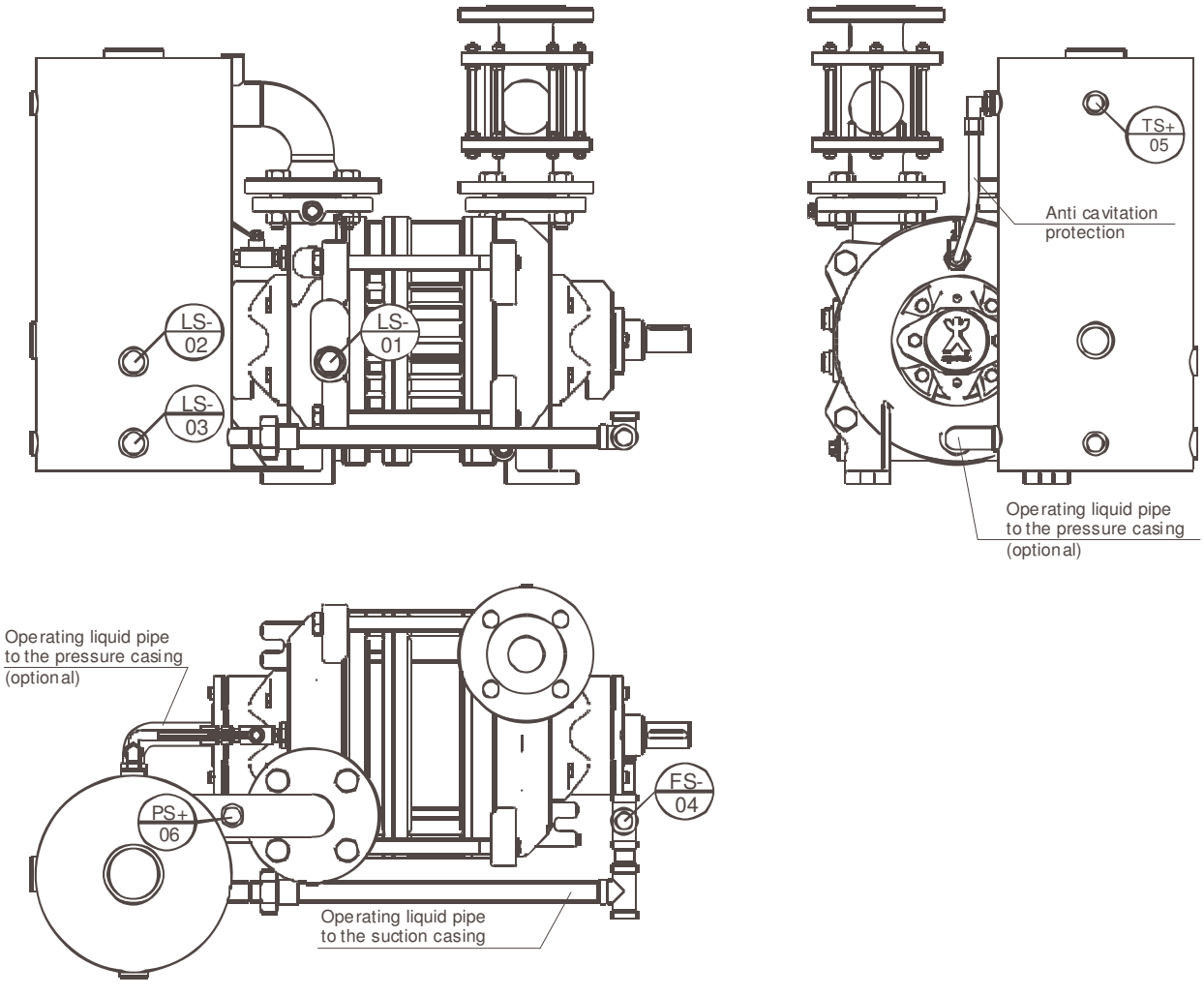

Fig. 7.1. MCR at the liquid-ring compressor

With employment of the compressor for the conveying of gases and vapours which contain hydrogen, in addition to the MCR at the liquid-ring compressor according to Fig. 1 on the site of the installation, the MCR technology corresponding to the switching diagrams according to Fig. 5.1 and 5.2 is also to be installed for flushing with inert gas.

7.1.1 MCR-equipment for compressors of the equipment category 1G (inside) / 2G/D (outside)

		comp. Fig. 7.1	When to install:
		Motor protection switch (comp. 2)	Always
LS-	01	Liquid level switch for clearance to start in the compressor	If suction- and pressure-casing do not ever have an appropriate piping to the separator tank
LS-	02	upper liquid level switch in the separator tank	Always
LS-	03	lower liquid level switch in the separator tank	If LS- 01 is not installed or the liquid level in the separator tank fluctuates significantly.
FS-	04	Flow rate switch in the operating liquid supply of the compressor	Always
TS+	05	Temperature switch on the pressure side of the compressor	Always
PS+	06	Pressure switch on the pressure side of the compressor	If the compression via ambient pressure is not excluded due to use

- For compressors with double-action slide ring gasket, section 7.1.3 is also to be taken into consideration
- For compressors with magnet coupling, section 7.1.4 is also to be taken into consideration
- With the conveying of gas-vapour mixtures, which contain hydrogen, an inertisation according to section 7.2.2 is to be taken into consideration

7.1.2 MCR-equipment for compressors of equipment category 2G/D (inside) / 2G/D (outside)

		comp. Fig. 7.1	When to install:
		Motor protection switch (comp. 2)	Always
LS-	02	upper liquid level switch in the separator tank	Always
LS-	03	lower liquid level switch in the separator tank	If the liquid level in the separator tank fluctuates significantly.
TS+	05	Temperature switch on the pressure side of the compressor	Always
PS+	06	Pressure switch on the pressure side of the compressor	If the compression via ambient pressure is not excluded due to use

- For compressors with double-action slide ring gasket, section 7.1.3 is also to be taken into consideration
- For compressors with magnet coupling, section 7.1.4 is also to be taken into consideration

7.1.3 MCR-equipment for compressors of equipment category 2G/D (outside)

		comp. Fig. 7.1	When to install:
		Motor protection switch (comp. 2)	Always
FS-	04	Flow rate switch in the operating liquid supply of the compressor	Always
TS+	05	Temperature switch on the pressure side of the compressor	Always
PS+	06	Pressure switch on the pressure side of the compressor	If the compression via ambient pressure is not excluded due to use

- For compressors with double-action slide ring gasket, section 7.1.3 is also to be taken into consideration
- For compressors with magnet coupling, section 7.1.4 is also to be taken into consideration

7.1.4 Additional required MCR-equipment for compressors with double-action slide ring gasket

LS-	07	Liquid level switch for clearance to start in each collecting tank of the slide ring gaskets
FS-	08	Flow rate switch in the flushing pipes of the slide ring gaskets
TS+	09	Temperature switch in the refeeding of the flushing liquid

After the clearance to start by LS- 07 a suitable time lag for the activation of the flow rate switch FS- 08 must be determined. The time lag depends on the gasket size and the viscosity of the sealing liquid. It is between 5 s and 90 s. (see data sheet).

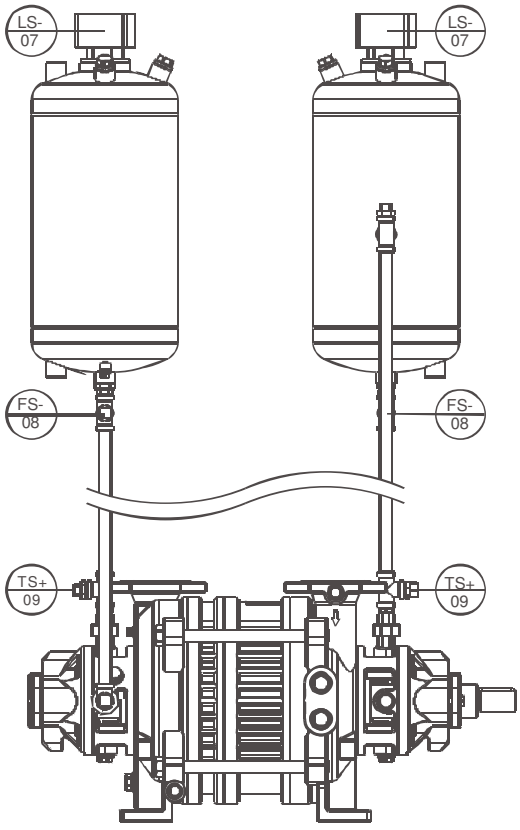

Fig. 7.2. MCR for double-action slide ring gasket

Additional required MCR-equipment for compressors with magnet coupling

TS+	10	Temperature switch at the separating can of the compressor

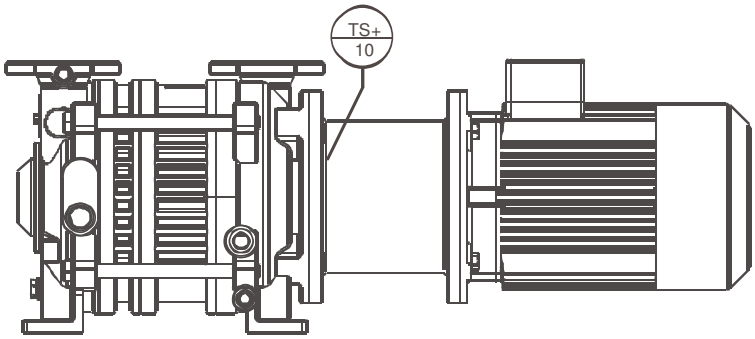

Fig. 7.3. MCR at the liquid-ring compressor with magnet coupling

The temperature at the separating can must be at least 20 U less than the maximum allowed temperature of the operating liquid.

Liquid-ring compressors with magnet coupling are always to be operated with a soft start!

7.2 Starting up / Operation / Shutdown

Compressors for the conveying of potentially explosive gas- and vapour-mixtures may initially be put into operation, if all assembly components corresponding to the requirements of the manufacturer of the individual components as well as the overall requirements of the compressor manufacturer were installed and inspected in regard to their operability in detail as well as in the system and are thus fully capable of functioning in terms of their provision.

7.2.1 General procedural method

- If an explosion danger already exists during the installation of the compressor or if a magnet-coupled execution is entailed in the installed liquid-ring machine, the inspection in a rotational direction may not take place under dry conditions. That concerns both the hydraulic area and the sealing areas of double-action slide ring gaskets.
- A potential equalization for the total system according to EN 50014:2000 section 15 and further applicable regulations must be ensured.
- The anti-cavitation protection pipe must be installed and be operational.
- Foreign particles from ferrous material may not get under the coupling protection. Danger of spark formation.
- The operation with closed shut-off equipment in the suction- and pressure-pipes is not permissible.

7.2.2 Sufficient supply with operating liquid

After inspection for the absence of malfunction, the clearance to start by LS- 01 or LS- 02 (comp. Fig. 7.1) and the start of the liquid-ring compressor, the appropriate time lag is necessary for the activation of the flow-rate switch FS- 04. The time lag depends on the size of the compressor, the intake pressure and the viscosity of the operating liquid. It is between 5 s and 90 s.

The volumetric currents of the operating liquid depend on the size of the compressor, the operating liquid used and the operating parameters. The switching points of the switch FS- 04 are therefore to be adjusted (see data sheet). The following table shows the switching ranges for water as the operating liquid with a differential of at least 600 mbar between suction- and operating liquid-pressure.

Compressor-size			**VH 20**	**VH 40**	**VH 60**	**VH 110**	**VH 140**	**VH 180**	**VH 300**	**VH 350**	**VH 400**	**VH 500**	**VH 600**	**VH 800**	**VH 1200**	**VH 1600**
			VU 20	**VU 40**		**VU 80**	**VU 140**	**VU 220**	**VU 300**		**VU 450**	**VU 500**	**VU 600**	**VU 800**	**VU 1200**	**VU 1600**
			VZ 30	**VZ 50**		**VZ 110**	**VZ 140**	**VZ 180**								
						VN 95	**VN 125**	**VN 180**								
	V 6		**V/VG 30**	**V/VG 55**	**V/VG95**	**V/VG 130**	**V/VG 155**	**V/VG 255**	**V 330**		**V 430**					
	VI 2	**VI 8/15**	**VI 30**	**VI 55**												
Switching point FS- 04 [l/min]	0,5 to 1,0	1,0 to 2,0	3,5 to 5,0	3,5 to 5,0	6,5 to 10	9,0 to 13,5	9,0 to 13,5	9,0 to 13,5	10 to 18	10 to 18	10 to 18	12 to 22	12 to 22	20 to 60	20 to 60	20 to 60

Tab. 7.1 Amounts of operating liquid in the liquid-ring compressors

7.2.3 Inertisation with the conveying of gases and vapours, which contain hydrogen

The liquid-ring compressor is run by means of an appropriate start-up and rundown procedure so that no hydrogen-air mixture exists in the standing machine. Before the beginning of the process and before the stoppage, the compressor is flushed with inert gas.

With malfunctions the compressor is immediately decoupled from the process, flooded with inert gas and then switched off.

Start-up procedure:

The valves on the process side GO 11 and/or GO 12 (comp. Fig. 5.1/5.2) are closed.

After inspection for the absence of malfunction and the clearance to start by LS- 01 or LS- 02 (comp. Fig. 6.1), an appropriate time lag is necessary for the activation of the flow rate switch FS- 04. The time lag depends on the size of the compressor, the intake pressure and the viscosity of the operating liquid. It is between 5 s und 90 s. (see data sheet).

After a failure-free start-up of the liquid-ring compressor the nitrogen-flushing valves UV 13 and/or UV 14 open for a flushing time according to table 6.1. It must be flushed at least with the 5-fold, internal, free volume of the vacuum system. The clearance occurs with the closing of the nitrogen-flushing valves UV 13 and/or UV 14. The valves on the process side GO 11 and/or GO 12 can now be opened. The start-up procedure is concluded.

Operation:

With failure-free operation no further activities are required. The liquid-ring compressor is monitored by the existing monitoring organs.

Rundown procedure:

After the end of the process first the process valves GO 11 and/or GO 12 are closed. While the liquid-ring compressor continues to run, the nitrogen-flushing valves UV 13 and/or UV 14 open for a preset time. The flushing time is determined on the basis of the minimum pressure and the minimum quantity of flow. The flushing time is 5-fold of the free, internal volume of the vacuum system. After the conclusion of the flushing time the nitrogen valves UV 13 and/or UV 14 close. The liquid-ring compressor is switched off.

Malfunction:

If a malfunction occurs through the activation of one or several monitoring organs, then the process valves GO 11 and/or GO 12 close immediately. At the same time the nitrogen flushing valves UV 13 and/or UV 14 open for a preset time. For the inertisation, a minimum volume must flow through the compressor, which corresponds to 5-fold the internal volume of the system. After the flushing procedure the compressor is to be switched off.

7.3 MCR flowchart

7.3.1 Category 1G (inside) / 2G/D (outside)

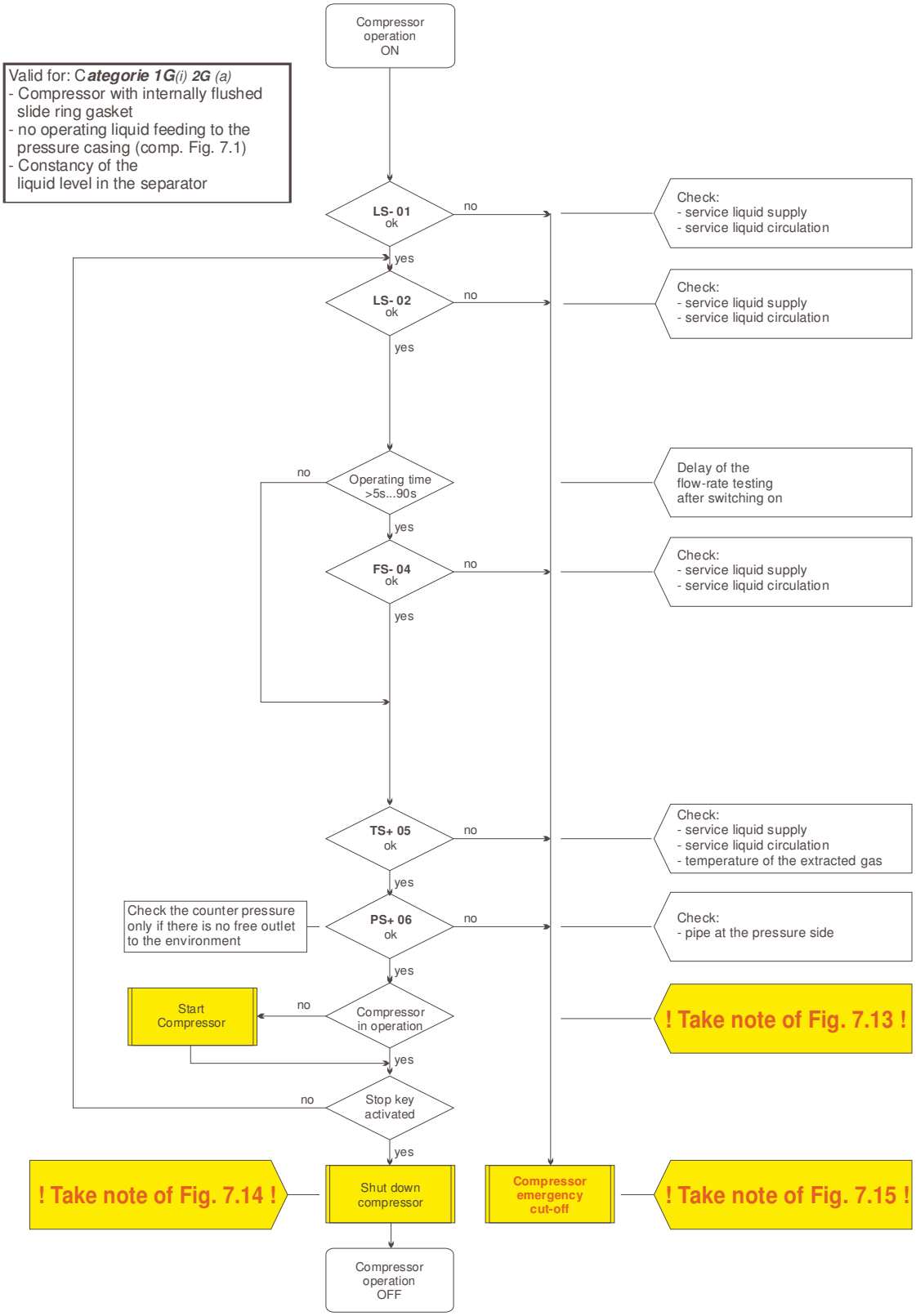

Fig. 7.4 MCR-diagram for compressors of category 1G (inside) / 2G/D (outside)

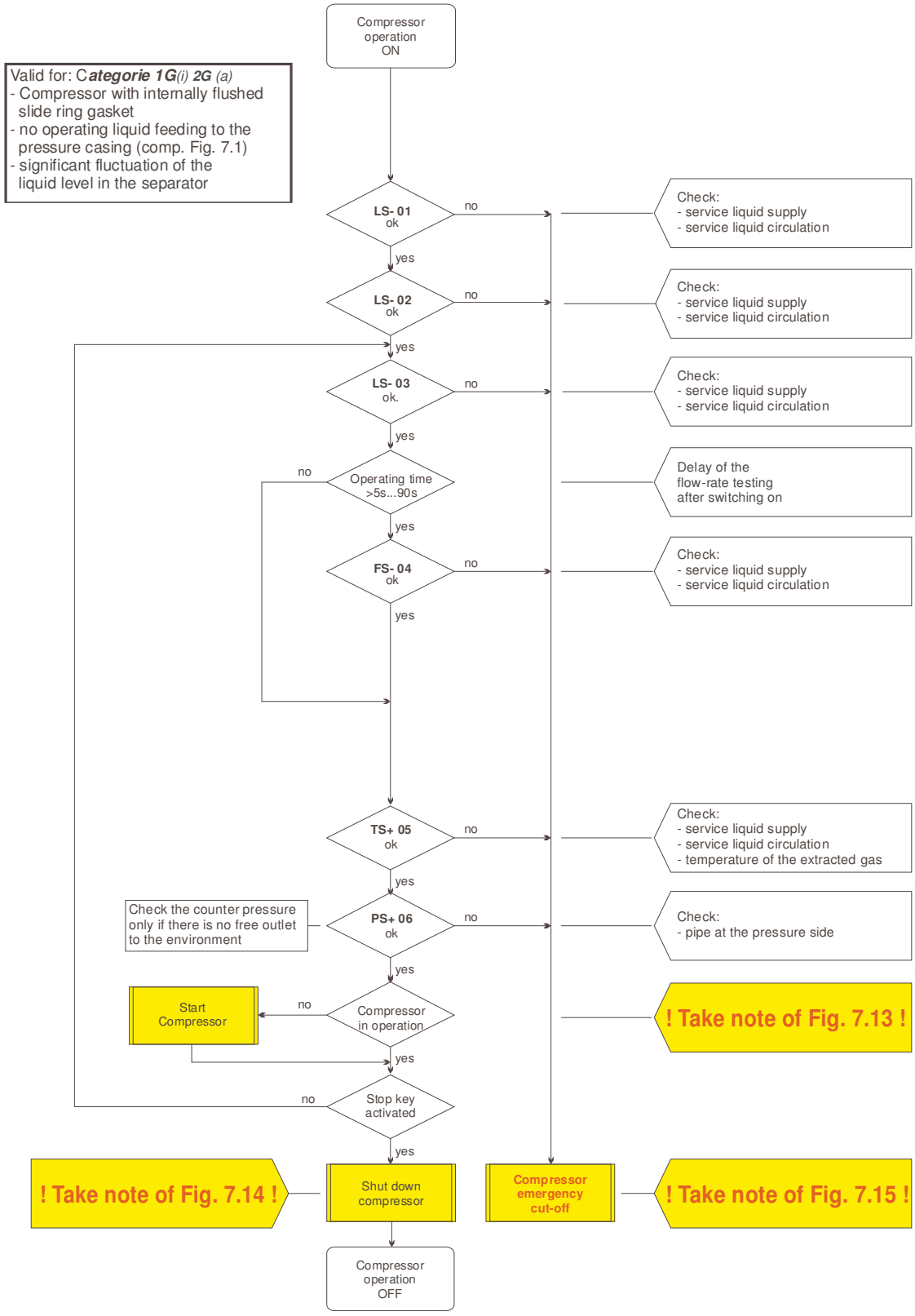

Fig. 7.5 MCR-diagram for compressors of category 1G (inside) / 2G/D (outside)

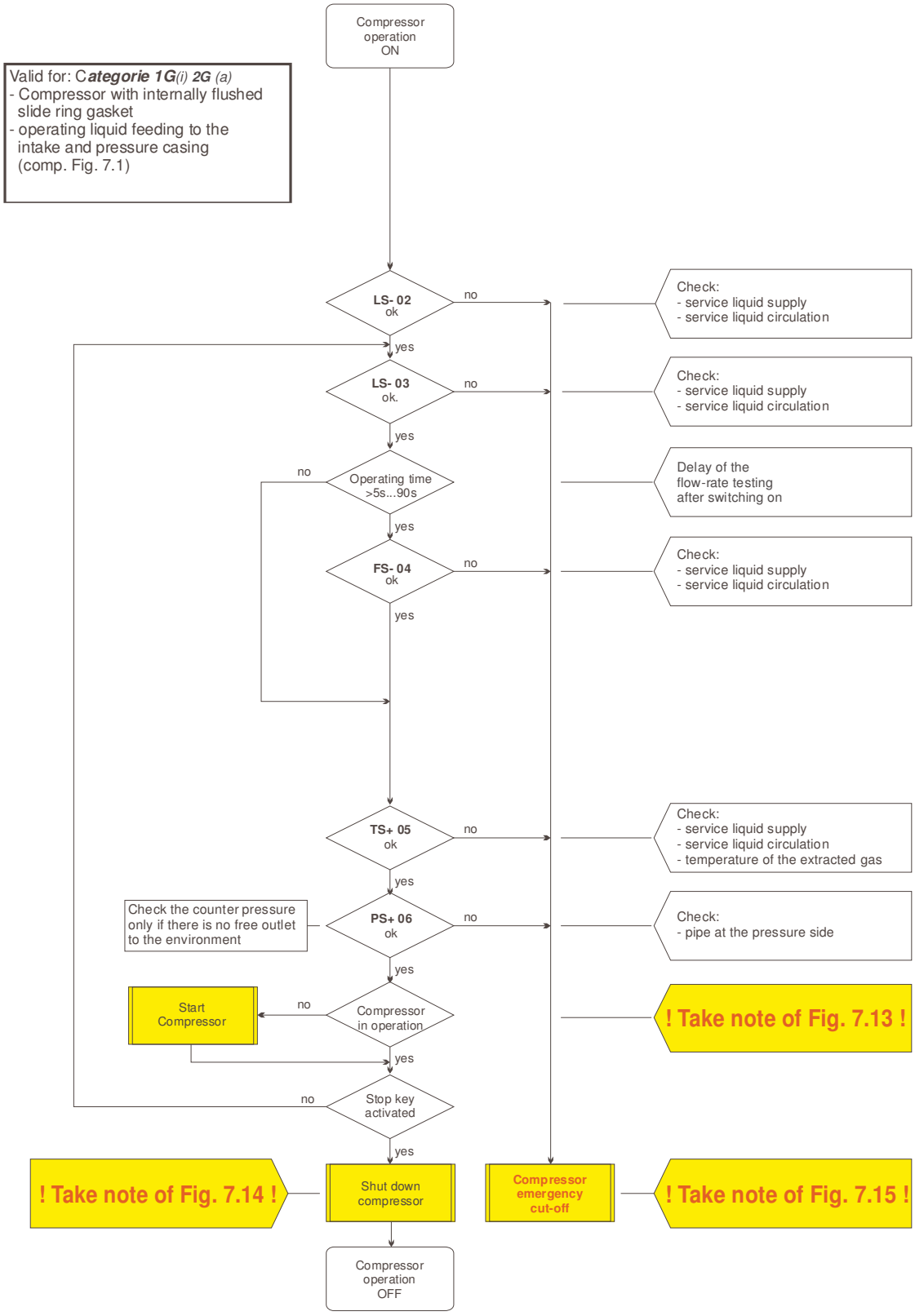

Fig. 7.6 MCR-diagram for compressors of category 1G (inside) / 2G/D (outside)

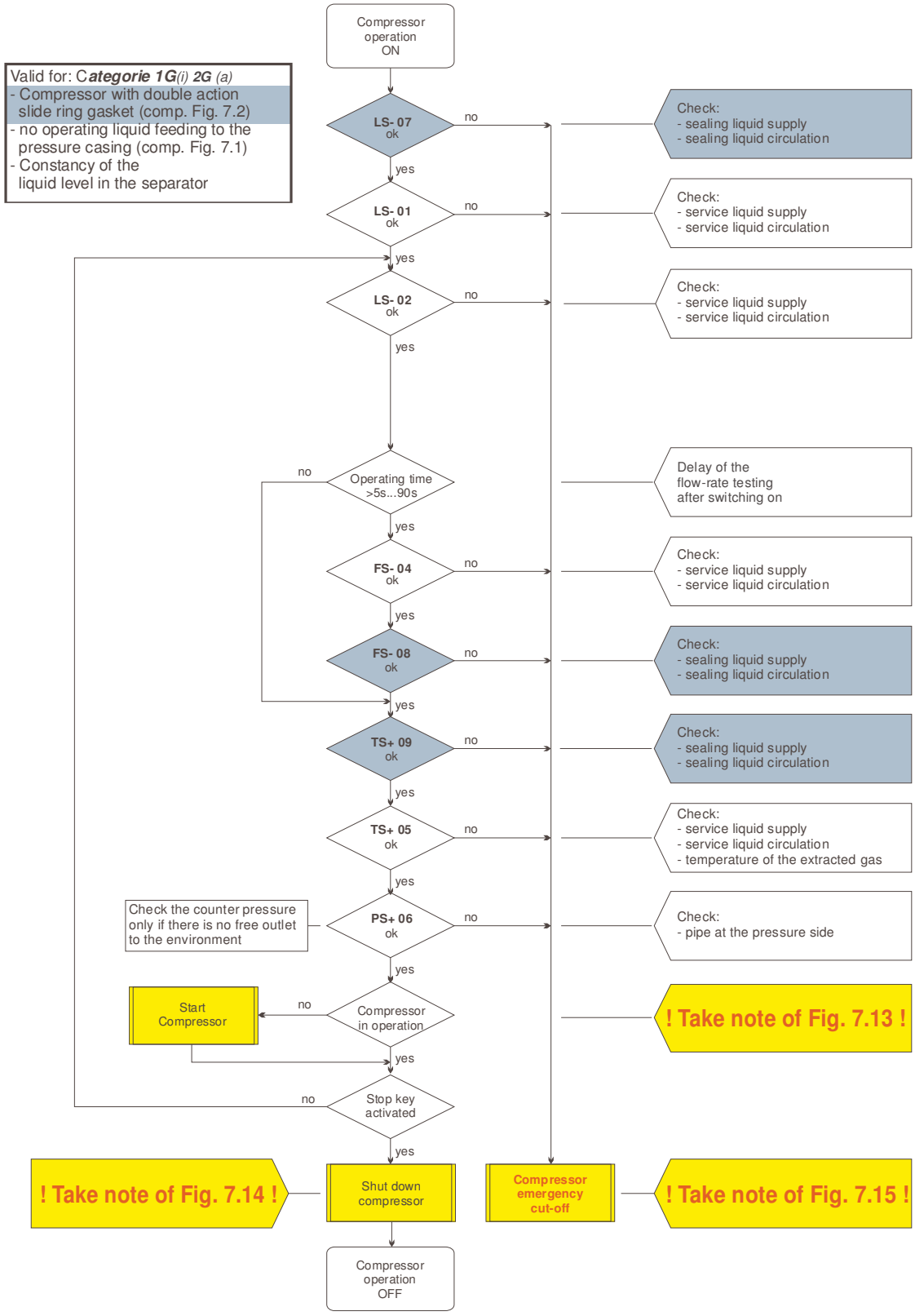

Fig. 7.7 MCR-diagram for compressors of category 1G (inside) / 2G/D (outside)

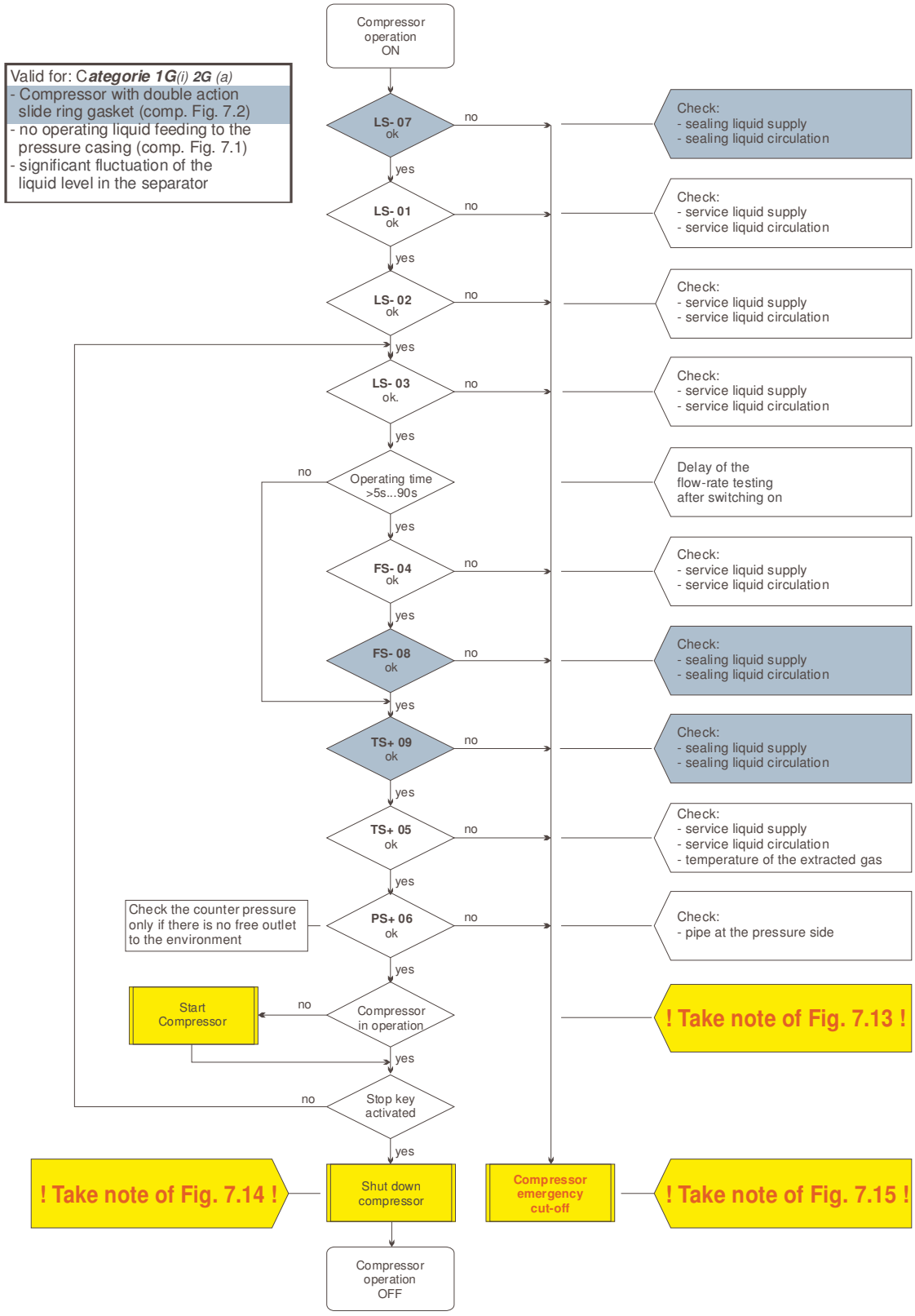

Fig. 7.8 MCR-diagram for compressors of category 1G (inside) / 2G/D (outside)

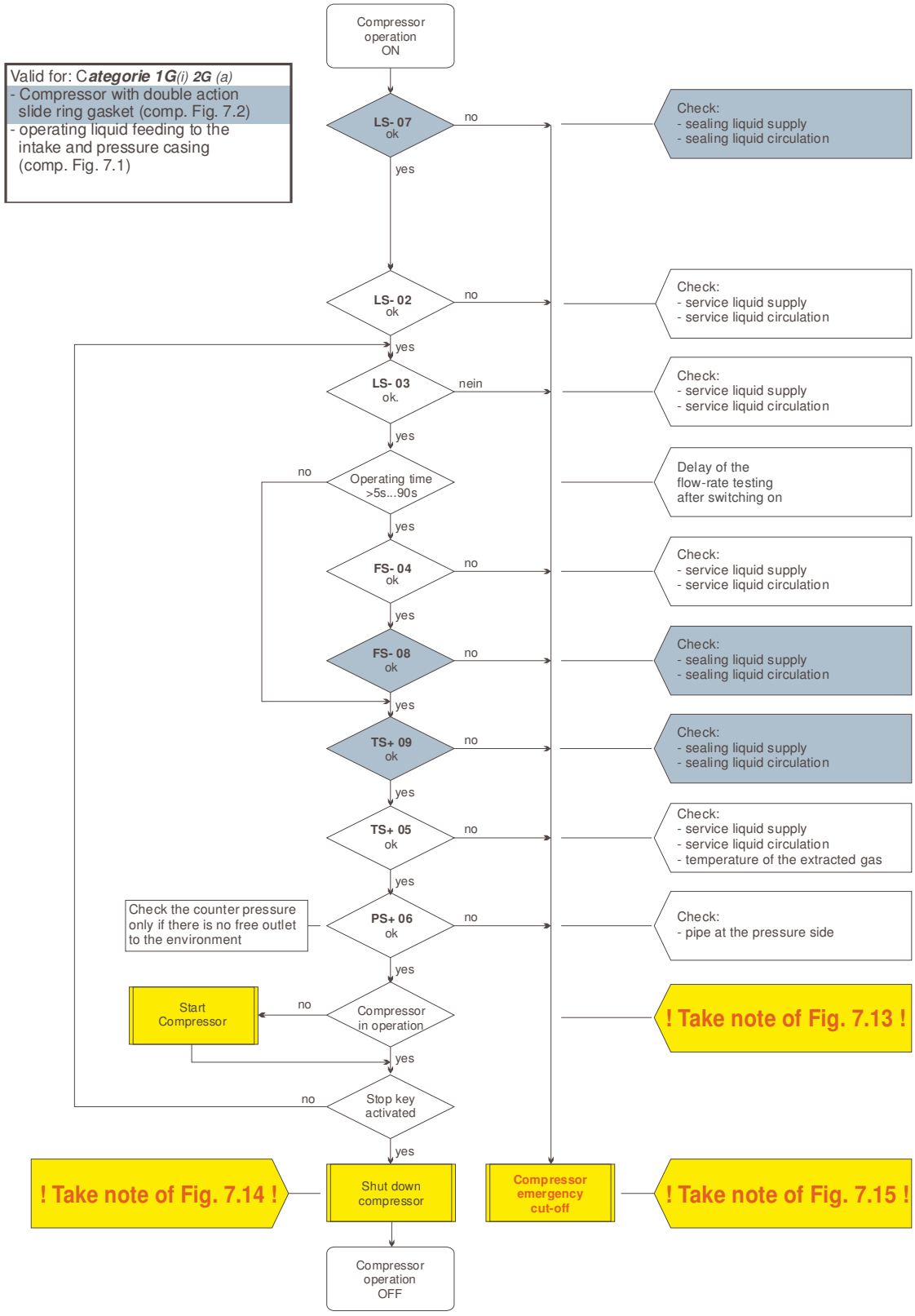

Fig. 7.9 MCR-diagram for compressors of category 1G (inside) / 2G/D (outside)

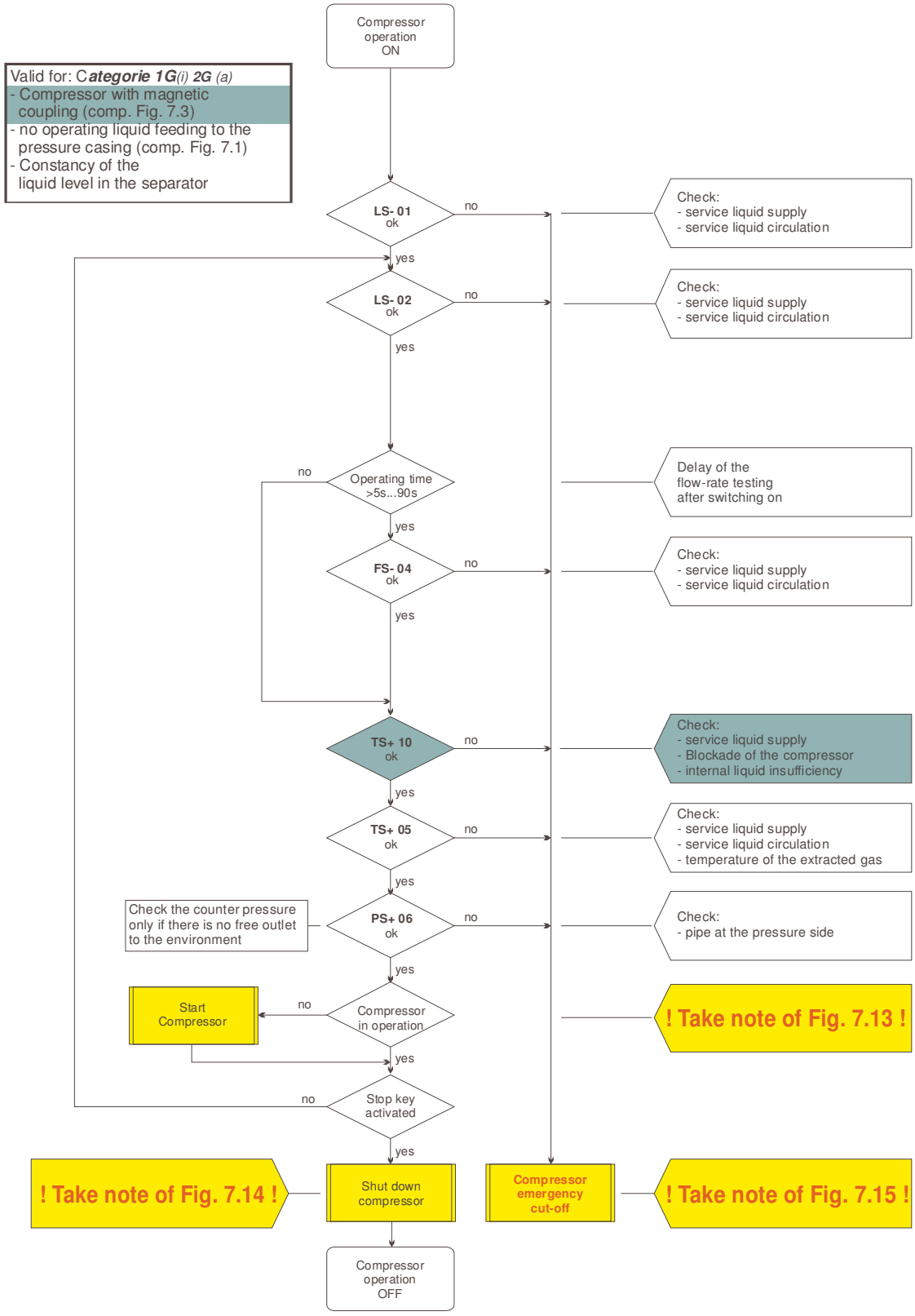

Fig. 7.10 MCR-diagram for compressors of category 1G (inside) / 2G/D (outside)

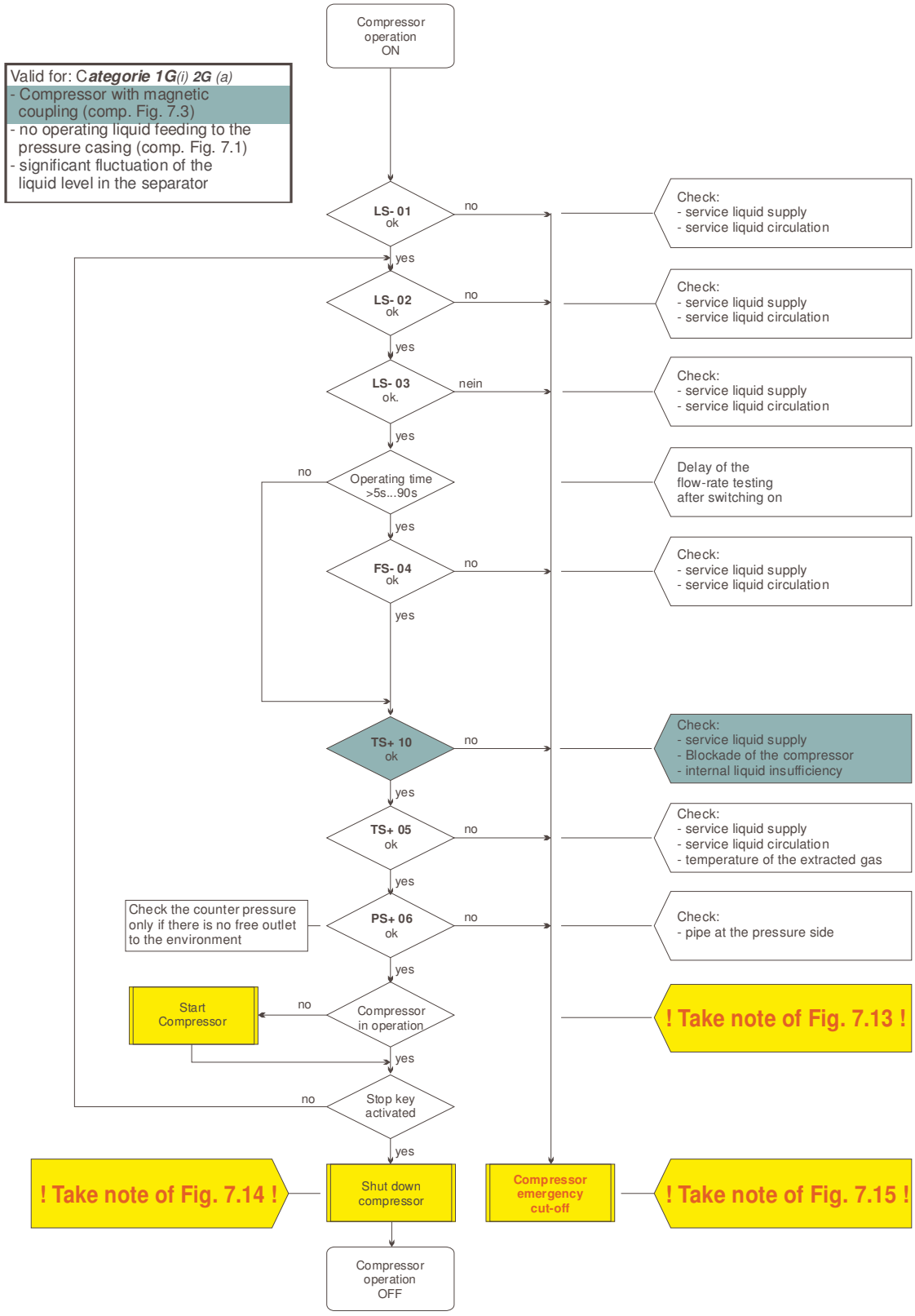

Fig. 7.11 MCR-diagram for compressors of category 1G (inside) / 2G/D (outside)

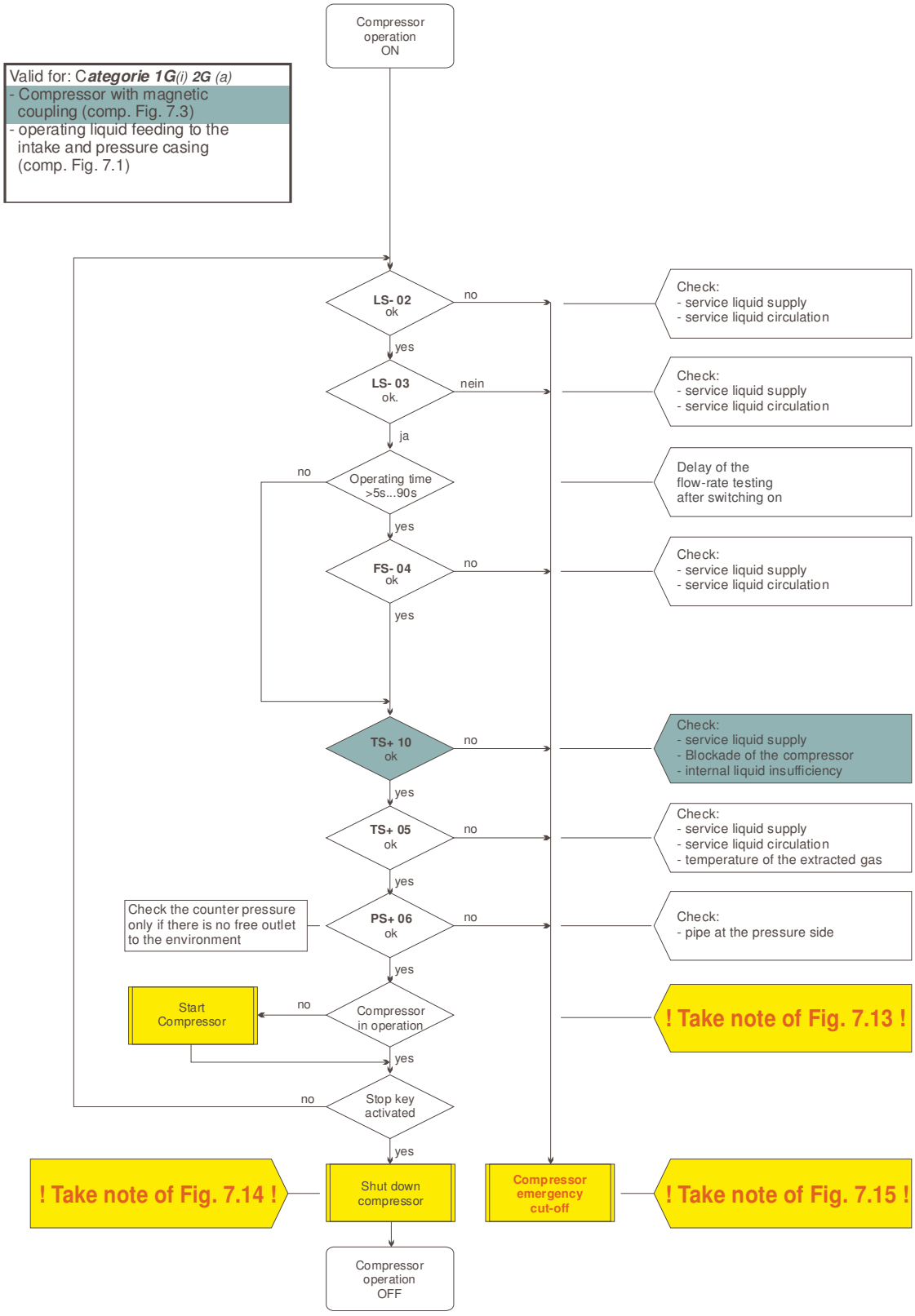

Fig. 7.12 MCR-diagram for compressors of category 1G (inside) / 2G/D (outside)

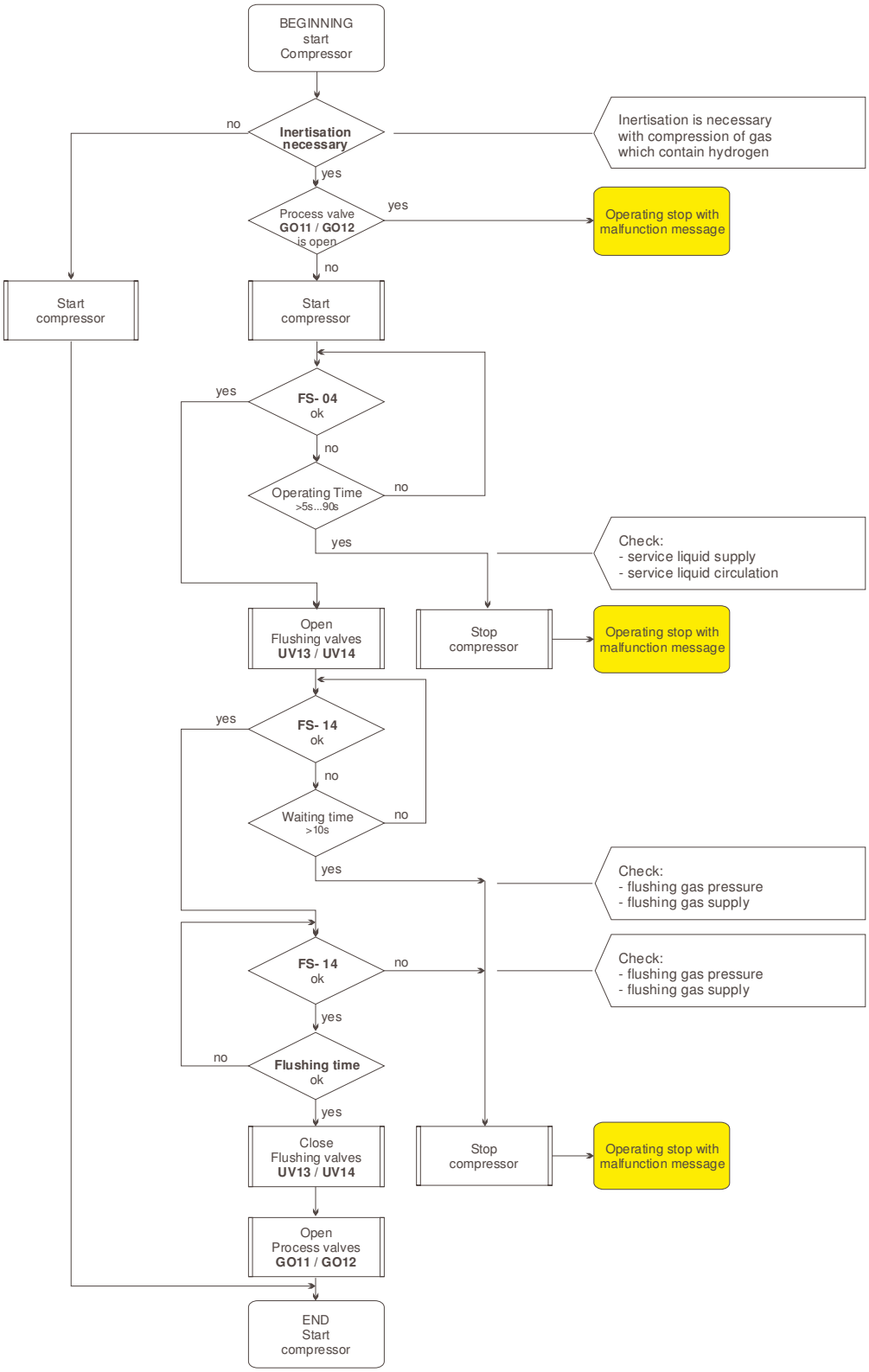

Fig. 7.13 Start of compressors of category 1G (inside) / 2G/D (outside)

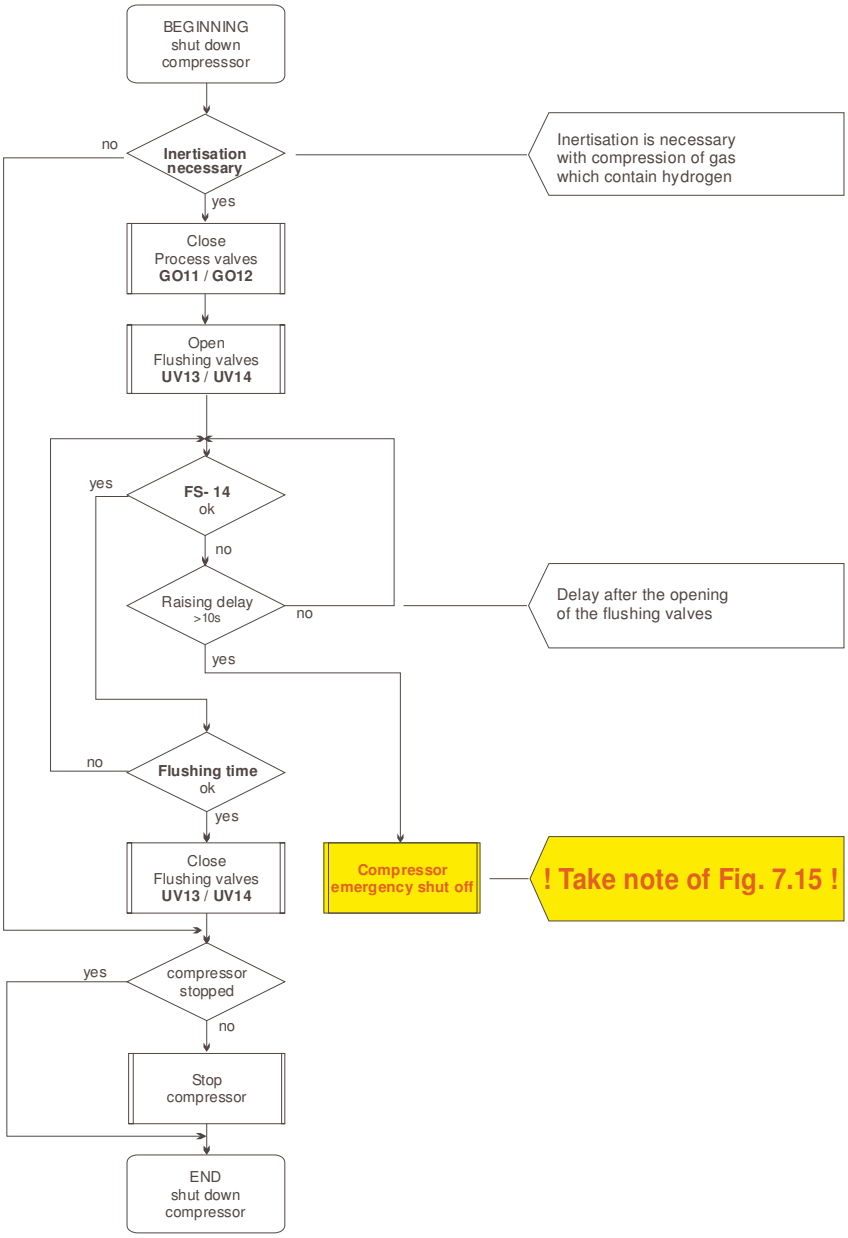

Fig. 7.14 Shut down of compressors of category 1G (inside) / 2G/D (outside)

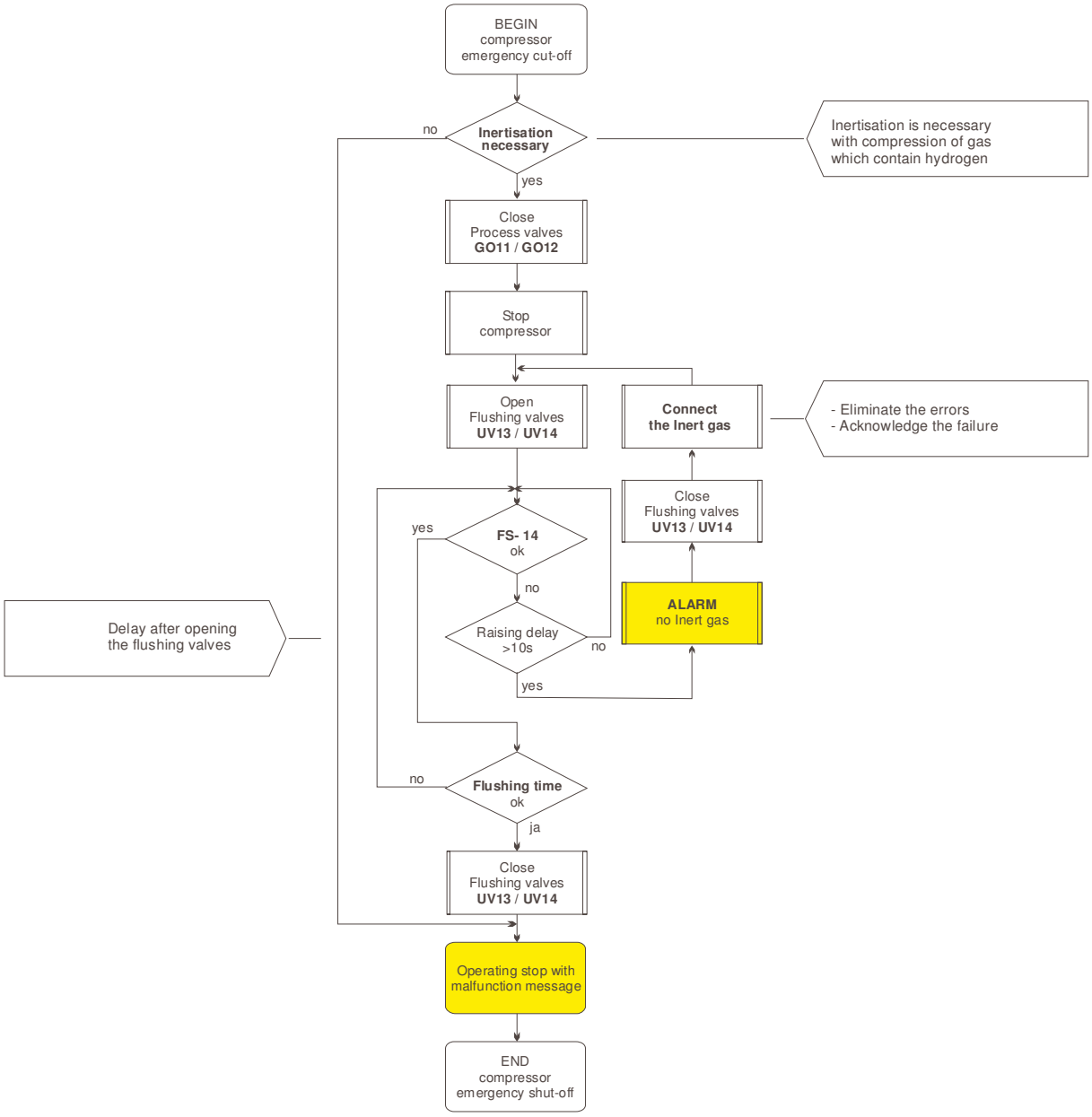

Fig. 7.15 Emergency cut-off of compressors of category 1G (inside) / 2G/D (outside)

7.3.2 Category 2G (inside) / 2G (outside)

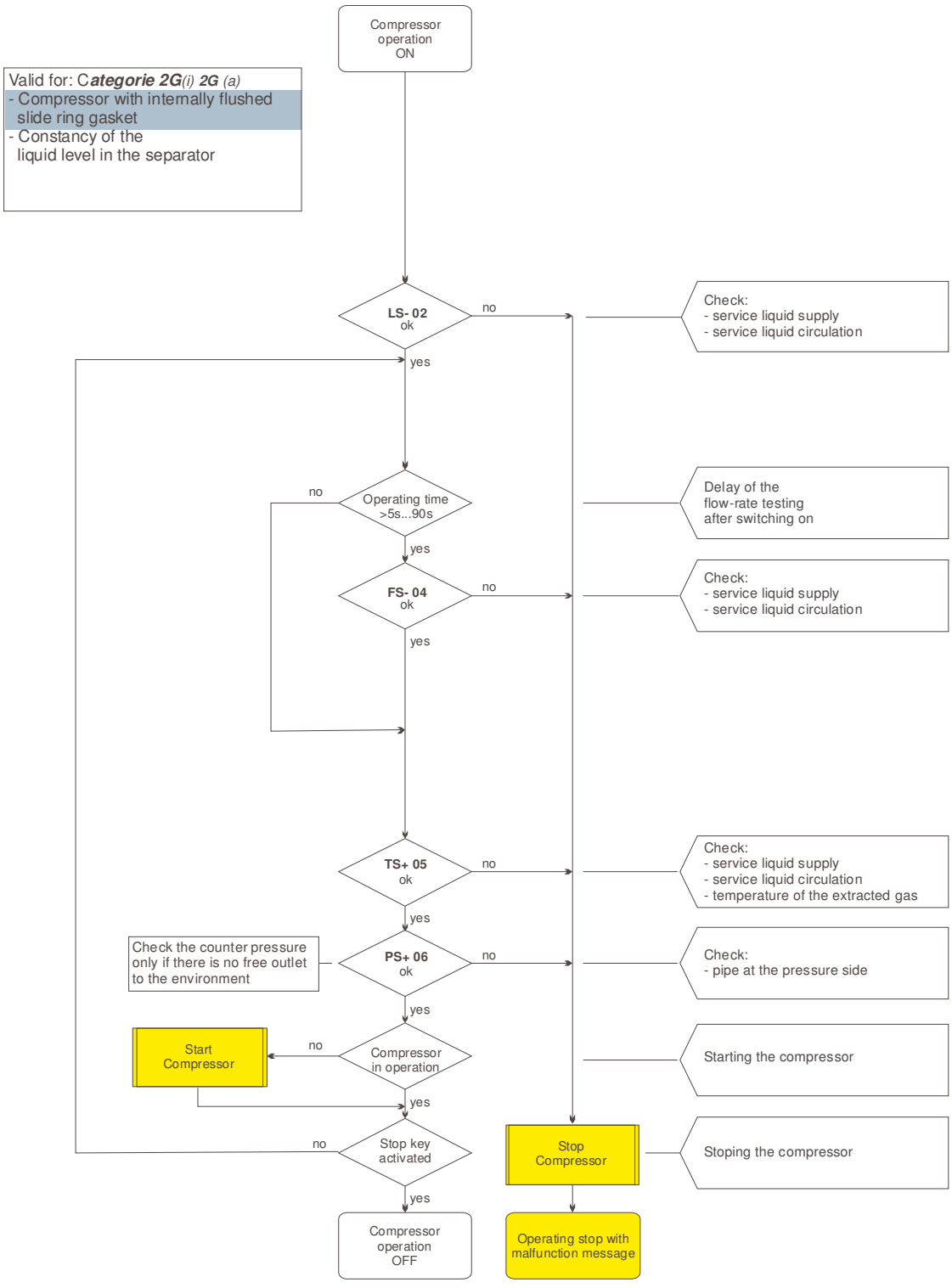

Fig. 7.16 MCR-diagram for compressors of category 2G/D (inside) / 2G/D (outside)

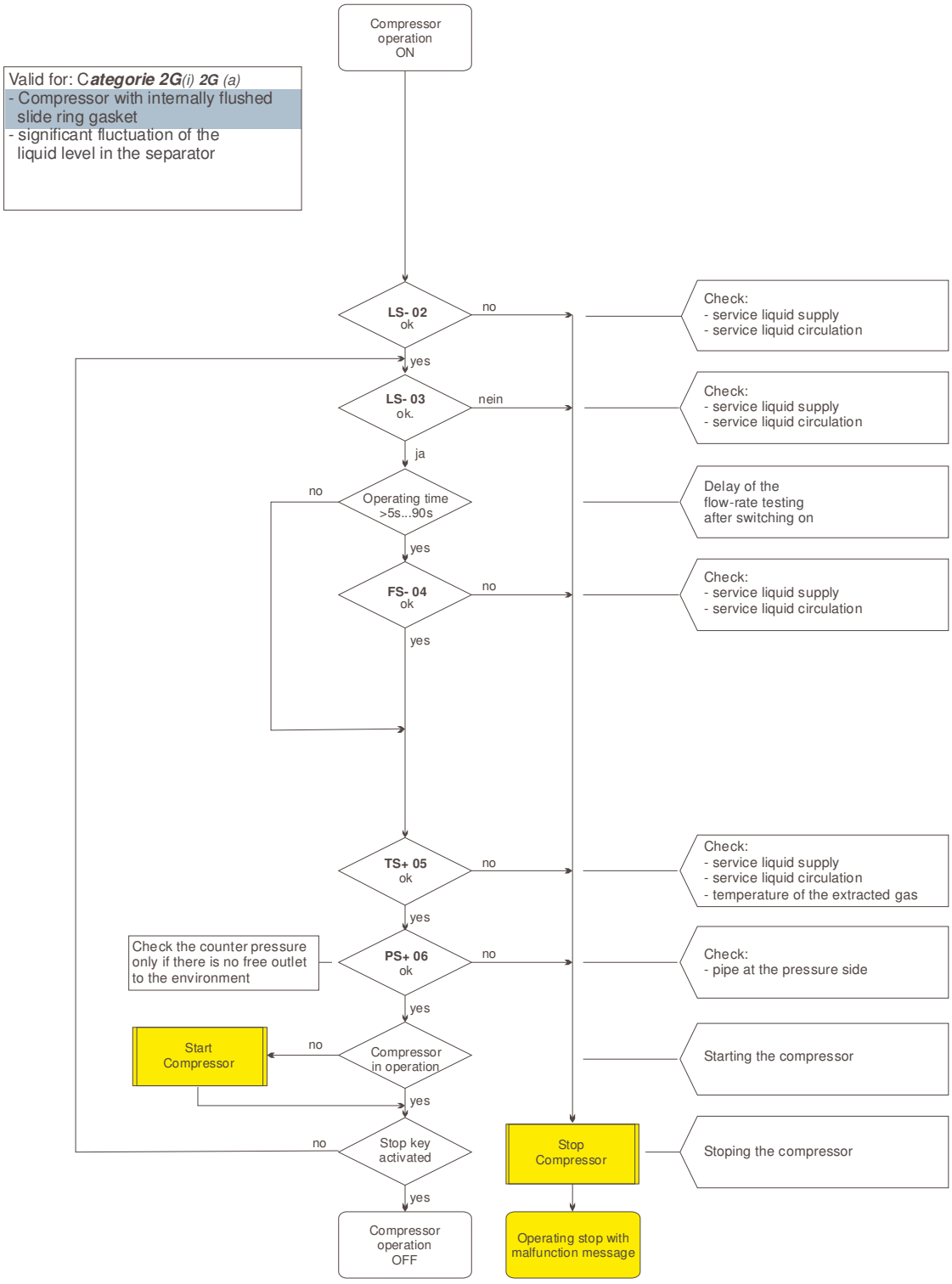

Fig. 7.17 MCR-diagram for compressors of category 2G/D (inside) / 2G/D (outside)

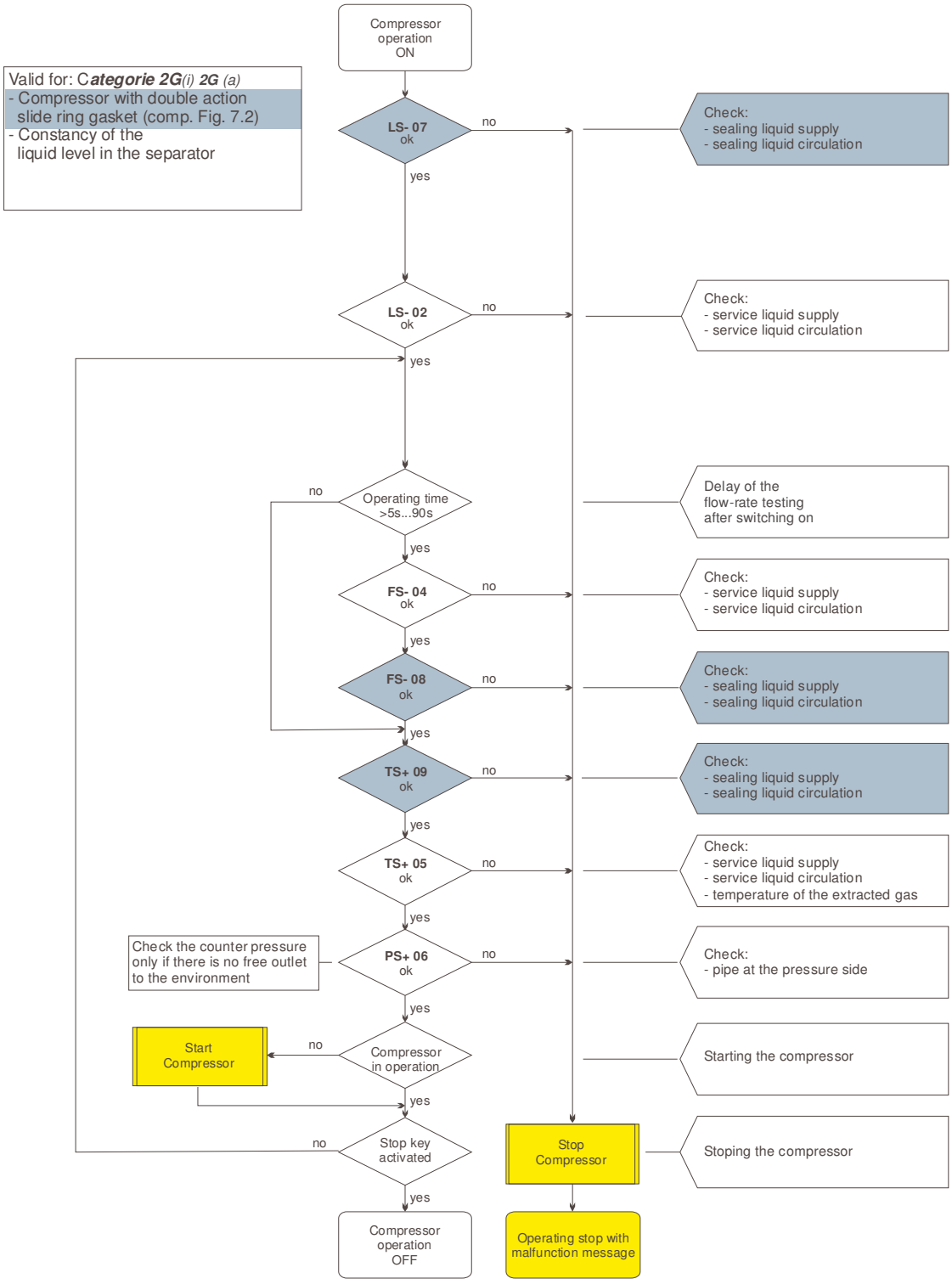

Fig. 7.18 MCR-diagram for compressors of category 2G/D (inside) / 2G/D (outside)

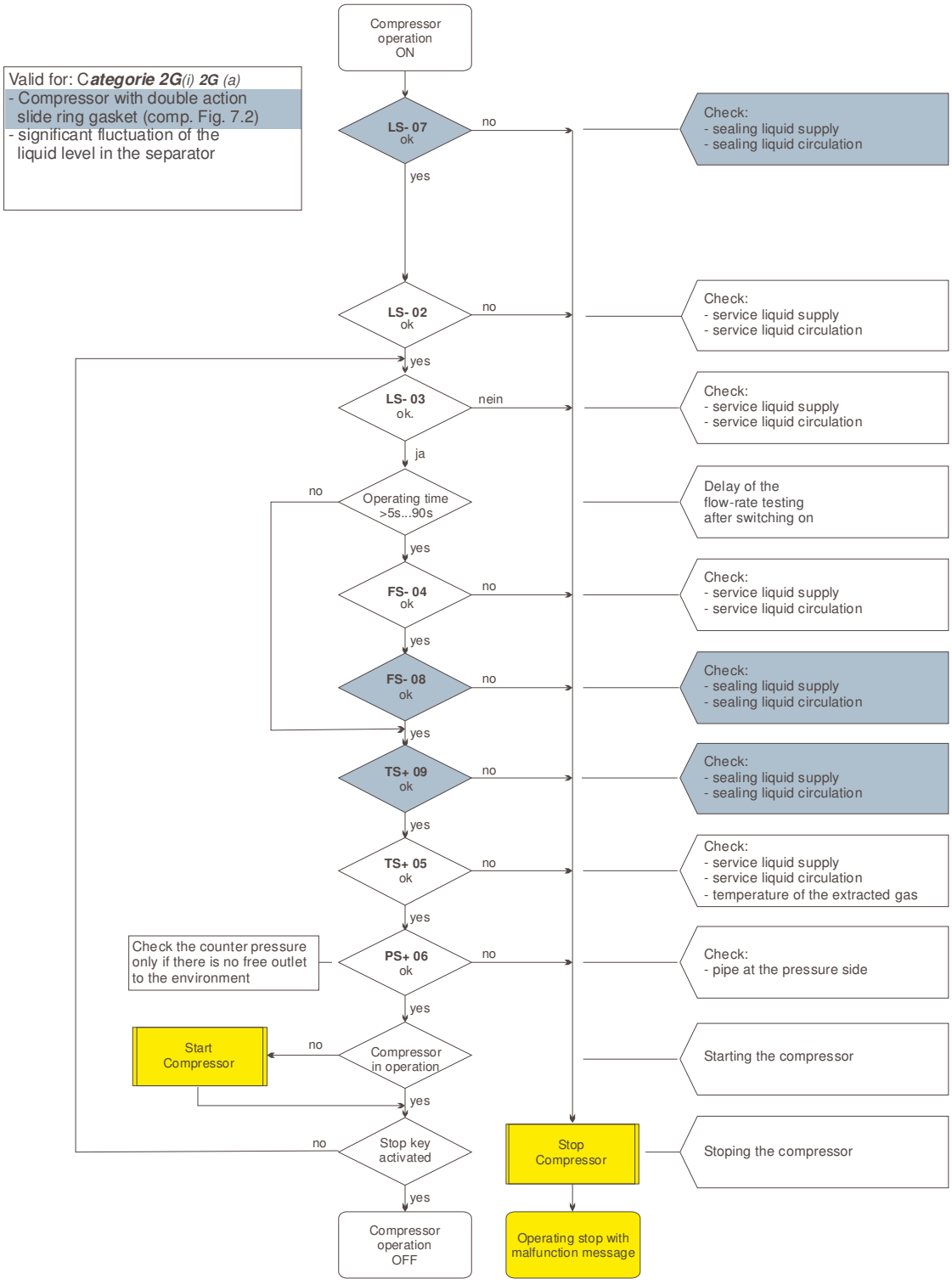

Fig. 7.19 MCR-diagram for compressors of category 2G/D (inside) / 2G/D (outside)

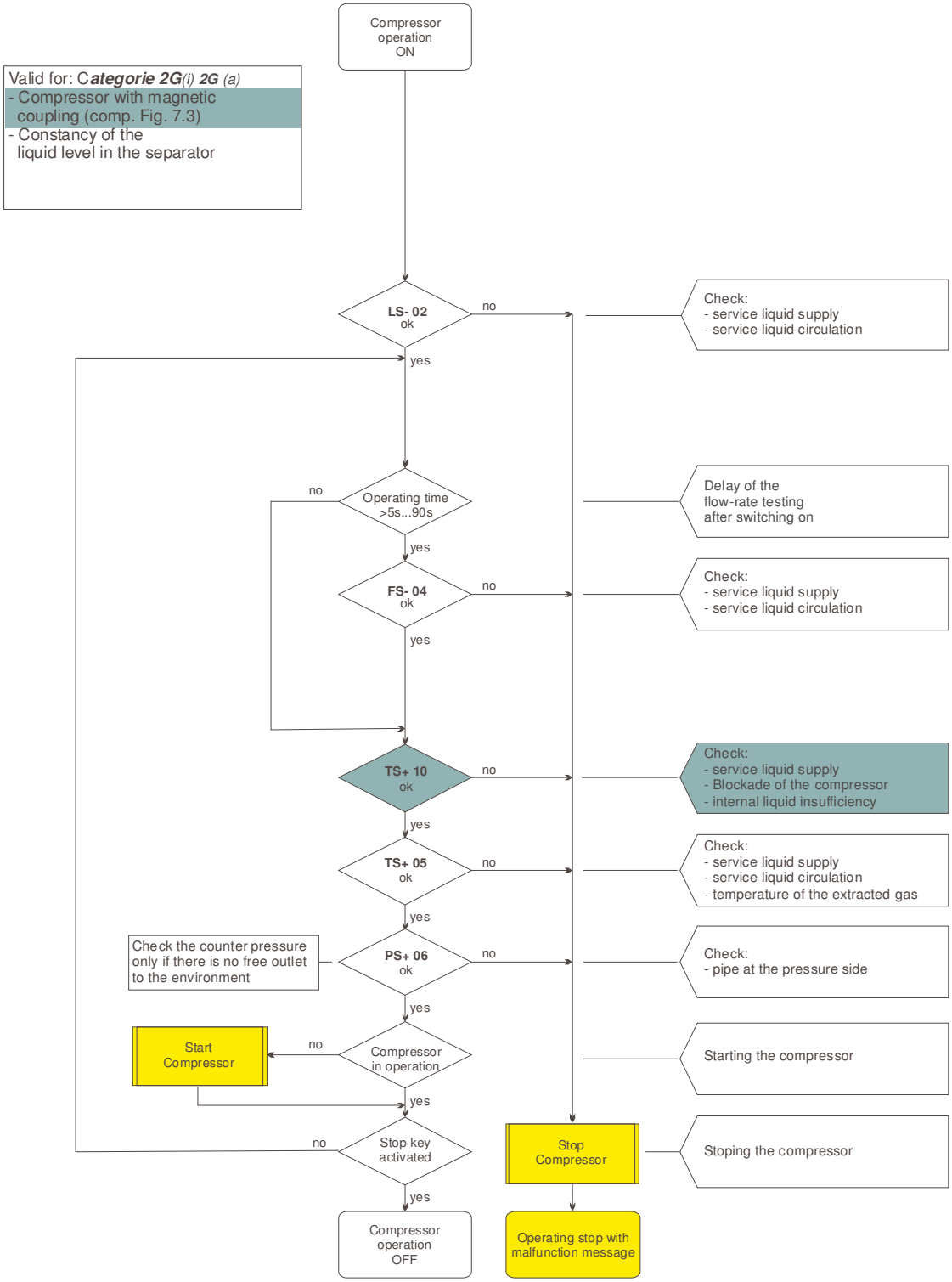

Fig. 7.20 MCR-diagram for compressors of category 2G/D (inside) / 2G/D (outside)

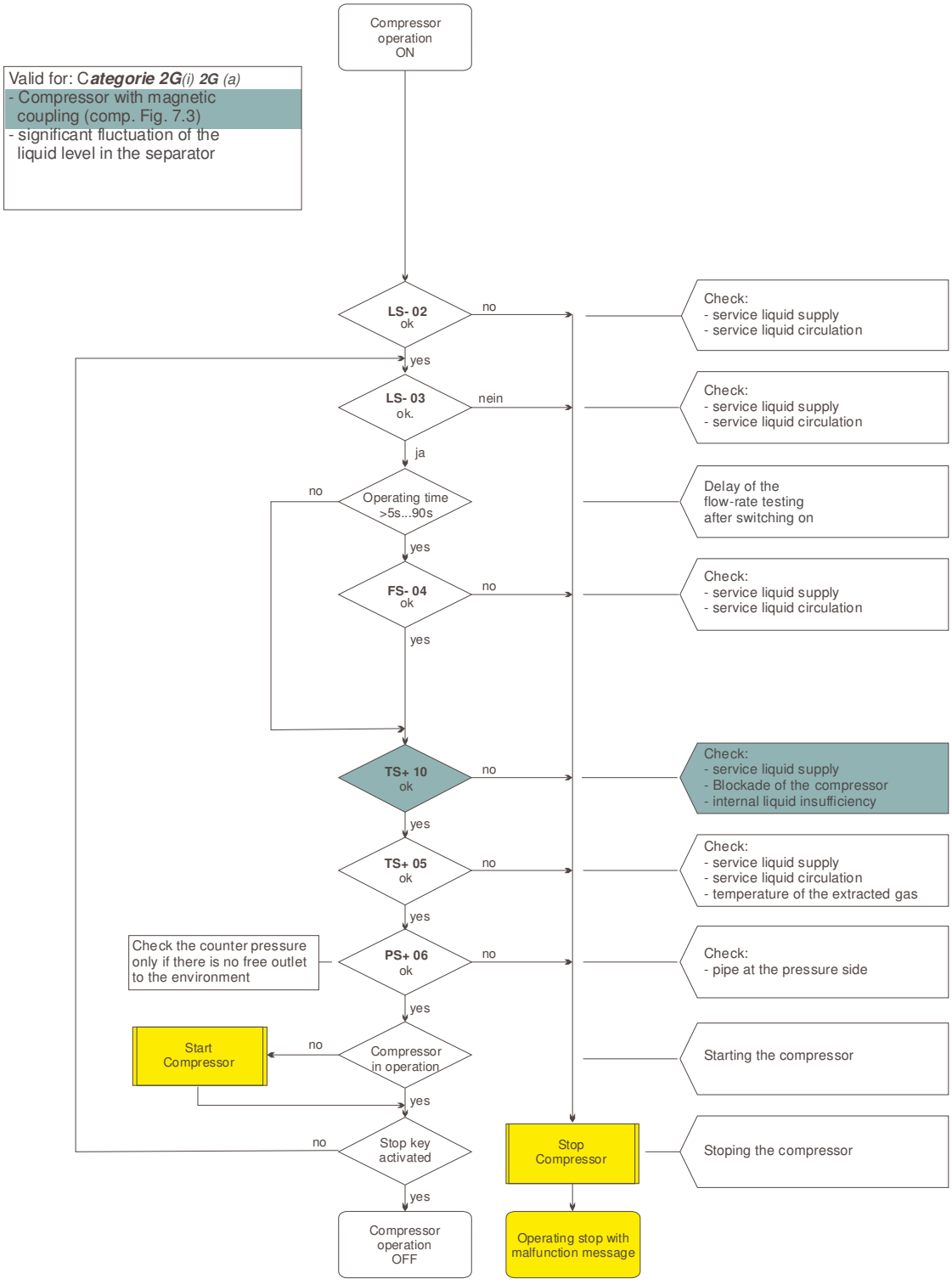
Compressor operation ON
Valid for: Categorie 2G(i) 2G (a)
- Compressor with magnetic coupling (comp. Fig. 7.3)
- significant fluctuation of the liquid level in the separator
LS- 02 ok
no
Check:
- service liquid supply
- service liquid circulation
yes
LS- 03 ok.
nein
Check:
- service liquid supply
- service liquid circulation
ja
no
Operating time >5s...90s
Delay of the flow-rate testing after switching on
yes
FS- 04 ok
no
Check:
- service liquid supply
- service liquid circulation
yes
TS+ 10 ok
no
Check:
- service liquid supply
- Blockade of the compressor
- internal liquid insufficiency
yes
TS+ 05 ok
no
Check:
- service liquid supply
- service liquid circulation
- temperature of the extracted gas
yes
Check the counter pressure only if there is no free outlet to the environment
PS+ 06 ok
no
Check:
- pipe at the pressure side
yes
Start Compressor
no
Compressor in operation
Starting the compressor
yes
no
Stop key activated
Stop Compressor
Stoping the compressor
yes
Compressor operation OFF
Operating stop with malfunction message

Fig. 7.21 MCR-diagram for compressors of category 2G/D (inside) / 2G/D (outside)

7.3.3 Category 2G (outside)

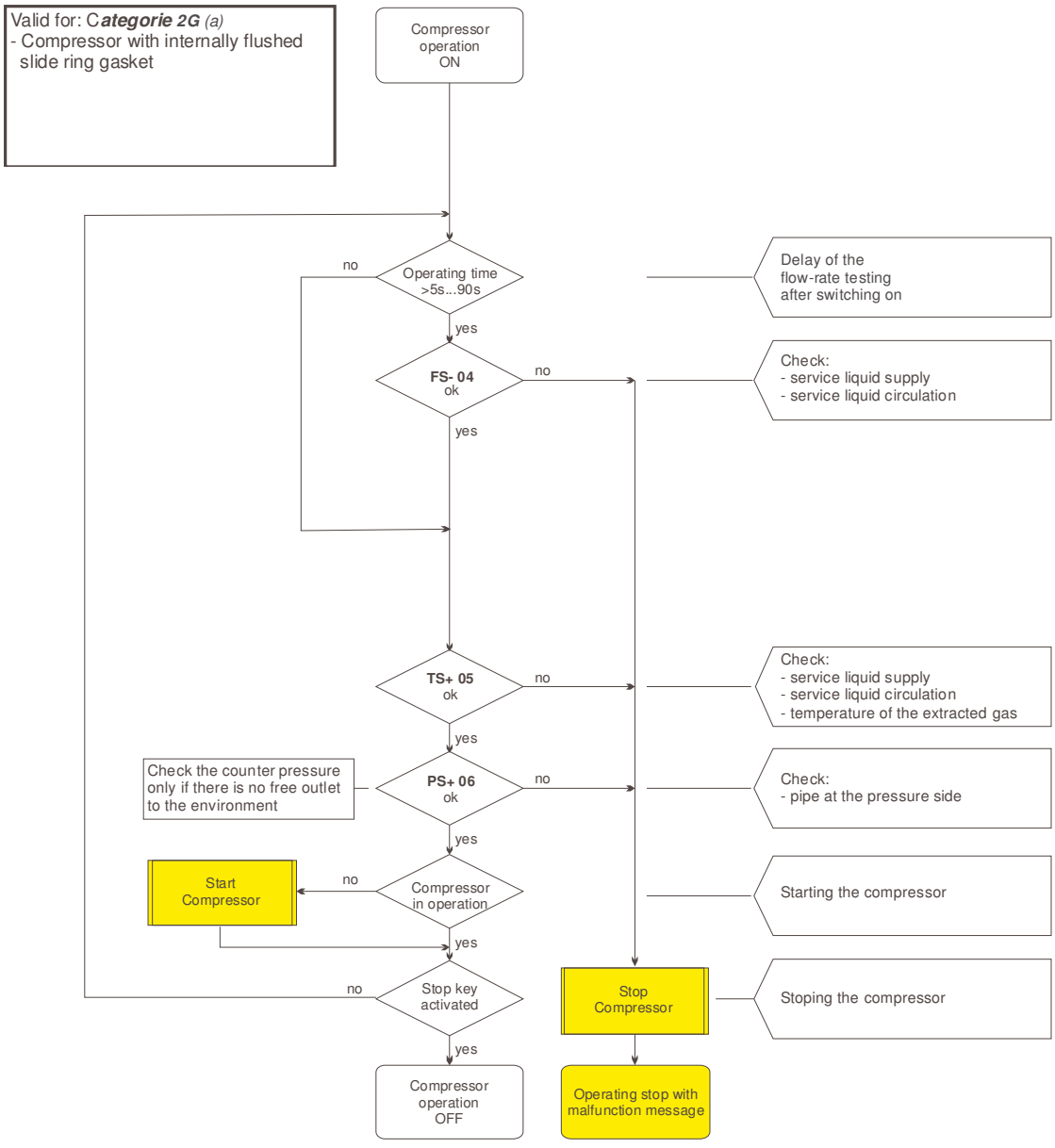

Fig. 7.22 MCR-diagram for compressors of category 2G/D (outside)

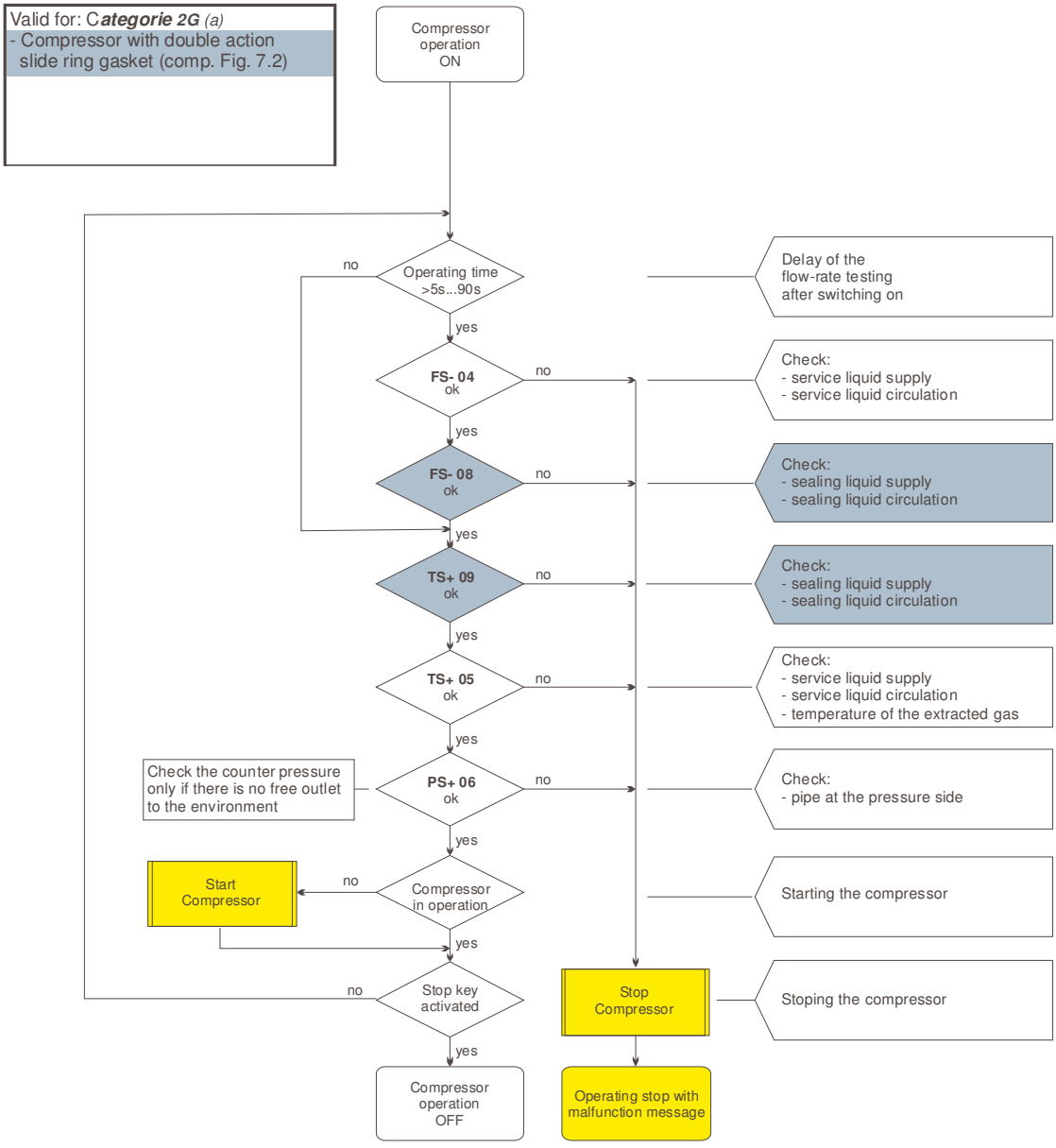

Fig. 7.23 MCR-diagram for compressors of category 2G/D (outside)

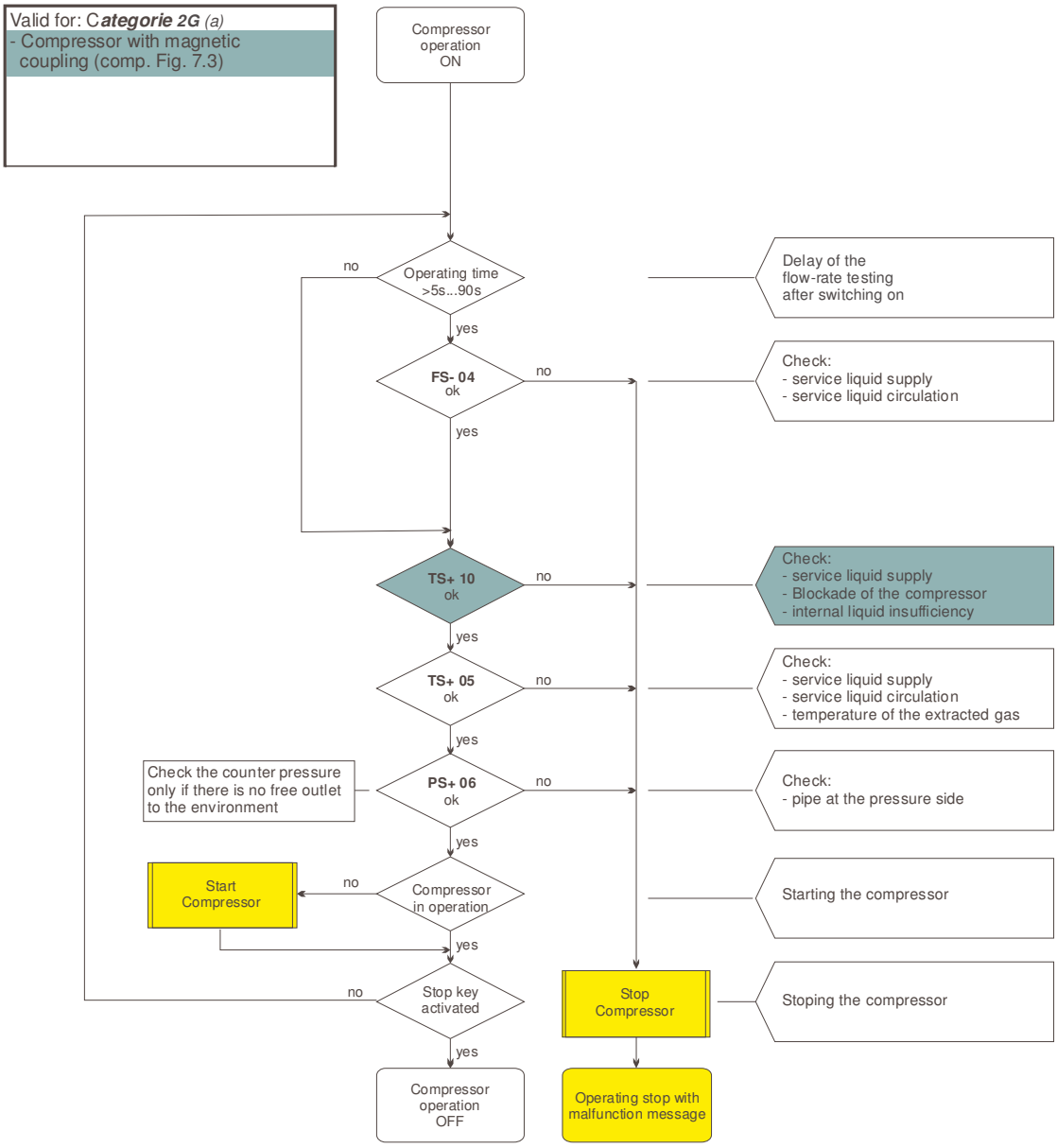

Fig. 7.24 MCR-diagram for compressors of category 2G/D (outside)

8 Maintenance

Regular maintenance is to be performed with use in an operation prone to explosion. Defective parts and components are to be replaced. Only replacement parts approved by the pump manufacturers are to be used.

The operator alone is responsible for the performance of monitoring procedures, maintenance and inspections. The procedures used are to be documented in written form.

So that with easily inflammable gases no potentially explosive gas-air mixtures can arise, the compressor must be sufficiently flushed with inert gas before the opening of the compressor as well as before the reconnection after the opening of the compressor.

Checklist for maintenance work

Maintenance procedures	Intervals		
	every 14 days	every 2000 h	every 8000 h
Acoustic test for absence of cavitation	**X**		
Acoustic check of the bearings (compressor and motor)	**X**		
Visual test for absence of leakage	**X**		
Visual run-out test of the coupling	**X**		
Relubrication of the anti-friction bearings VU 300/450; VU/VH 500/600 with 8g grease		**X**	
Relubrication of the anti-friction bearings VU/VH 800 – 1600 with 15g grease		**X**	
Replacement of all bearings and gaskets (dynamic and static)			**X**
Disassembly of the compressor and test of all parts for mechanical, corrosive and cavitation damages.			**X**
Functional test of the control technology. (Equipment-specific operating instructions are to be observed.)			**X**

Corporate Information

Title: Supplementary Operating Instructions
Document No.: 1096.0209 - 1
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