

Probes and sensors



Selection and optimal installation guide

**LEGGI E CONSERVA
QUESTE ISTRUZIONI**
**READ AND SAVE
THESE INSTRUCTIONS**

  **NO POWER
& SIGNAL
CABLES
TOGETHER**
READ CAREFULLY IN THE TEXT!

AVVERTENZE



CAREL basa lo sviluppo dei suoi prodotti su una esperienza pluridecennale nel campo HVAC, sull'investimento continuo in innovazione tecnologica di prodotto, su procedure e processi di qualità rigorosi con test in-circuit e funzionali sul 100% della sua produzione, sulle più innovative tecnologie di produzione disponibili nel mercato. CAREL e le sue filiali/affiliate non garantiscono tuttavia che tutti gli aspetti del prodotto e del software incluso nel prodotto risponderanno alle esigenze dell'applicazione finale, pur essendo il prodotto costruito secondo le tecniche dello stato dell'arte.

Il cliente (costruttore, progettista o installatore dell'equipaggiamento finale) si assume ogni responsabilità e rischio in relazione alla configurazione del prodotto per il raggiungimento dei risultati previsti in relazione all'installazione e/o equipaggiamento finale specifico.

CAREL in questo caso, previ accordi specifici, può intervenire come consulente per la buona riuscita dello start-up macchina finale/applicazione, ma in nessun caso può essere ritenuta responsabile per il buon funzionamento del equipaggiamento/impianto finale.

Il prodotto CAREL è un prodotto avanzato, il cui funzionamento è specificato nella documentazione tecnica fornita col prodotto o scaricabile, anche anteriormente all'acquisto, dal sito internet www.carel.com.

Ogni prodotto CAREL, in relazione al suo avanzato livello tecnologico, necessita di una fase di qualifica / configurazione / programmazione / commissioning affinché possa funzionare al meglio per l'applicazione specifica. La mancanza di tale fase di studio, come indicata nel manuale, può generare malfunzionamenti nei prodotti finali di cui CAREL non potrà essere ritenuta responsabile.

Soltanto personale qualificato può installare o eseguire interventi di assistenza tecnica sul prodotto.

Il cliente finale deve usare il prodotto solo nelle modalità descritte nella documentazione relativa al prodotto stesso.

Senza che ciò escluda la doverosa osservanza di ulteriori avvertenze presenti nel manuale, si evidenzia che è in ogni caso necessario, per ciascun Prodotto di CAREL:

- Evitare che i circuiti elettronici si bagnino. La pioggia, l'umidità e tutti i tipi di liquidi o la condensa contengono sostanze minerali corrosive che possono danneggiare i circuiti elettronici. In ogni caso il prodotto va usato o stoccato in ambienti che rispettano i limiti di temperatura ed umidità specificati nel manuale.
- Non installare il dispositivo in ambienti particolarmente caldi. Temperature troppo elevate possono ridurre la durata dei dispositivi elettronici, danneggiarli e deformare o fondere le parti in plastica. In ogni caso il prodotto va usato o stoccato in ambienti che rispettano i limiti di temperatura ed umidità specificati nel manuale.
- Non tentare di aprire il dispositivo in modi diversi da quelli indicati nel manuale.
- Non fare cadere, battere o scuotere il dispositivo, poiché i circuiti interni e i meccanismi potrebbero subire danni irreparabili.
- Non usare prodotti chimici corrosivi, solventi o detersivi aggressivi per pulire il dispositivo.
- Non utilizzare il prodotto in ambiti applicativi diversi da quanto specificato nel manuale tecnico.

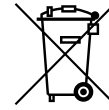
Tutti i suggerimenti sopra riportati sono validi altresì per il controllo, schede seriali, chiavi di programmazione o comunque per qualunque altro accessorio del portfolio prodotti CAREL.

CAREL adotta una politica di continuo sviluppo. Pertanto CAREL si riserva il diritto di effettuare modifiche e miglioramenti a qualsiasi prodotto descritto nel presente documento senza previo preavviso.

I dati tecnici presenti nel manuale possono subire modifiche senza obbligo di preavviso

La responsabilità di CAREL in relazione al proprio prodotto è regolata dalle condizioni generali di contratto CAREL editate nel sito www.carel.com e/o da specifici accordi con i clienti; in particolare, nella misura consentita dalla normativa applicabile, in nessun caso CAREL, i suoi dipendenti o le sue filiali/affiliate saranno responsabili di eventuali mancati guadagni o vendite, perdite di dati e di informazioni, costi di merci o servizi sostitutivi, danni a cose o persone, interruzioni di attività, o eventuali danni diretti, indiretti, incidentali, patrimoniali, di copertura, punitivi, speciali o consequenziali in qualunque modo causati, siano essi contrattuali, extra contrattuali o dovuti a negligenza o altra responsabilità derivanti dall'installazione, utilizzo o impossibilità di utilizzo del prodotto, anche se CAREL o le sue filiali/affiliate siano state avvisate della possibilità di danni.

SMALTIMENTO



INFORMAZIONE AGLI UTENTI PER IL CORRETTO TRATTAMENTO DEI RIFIUTI DI APPARECCHIATURE ELETTRICHE ED ELETTRONICHE (RAEE)

In riferimento alla Direttiva 2002/96/CE del Parlamento Europeo e del Consiglio del 27 gennaio 2003 e alle relative normative nazionali di attuazione, Vi informiamo che:

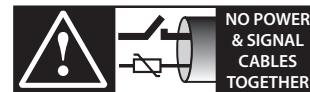
1. sussiste l'obbligo di non smaltire i RAEE come rifiuti urbani e di effettuare, per detti rifiuti, una raccolta separata;
2. Per lo smaltimento vanno utilizzati i sistemi di raccolta pubblici o privati previsti dalla leggi locali. È inoltre possibile riconsegnare al distributore l'apparecchiatura a fine vita in caso di acquisto di una nuova;
3. questa apparecchiatura può contenere sostanze pericolose: un uso improprio o uno smaltimento non corretto potrebbe avere effetti negativi sulla salute umana e sull'ambiente;
4. il simbolo (contenitore di spazzatura su ruote barrato) riportato sul prodotto o sulla confezione e sul foglio istruzioni indica che l'apparecchiatura è stata immessa sul mercato dopo il 13 agosto 2005 e che deve essere oggetto di raccolta separata;
5. in caso di smaltimento abusivo dei rifiuti elettrici ed elettronici sono previste sanzioni stabilite dalle vigenti normative locali in materia di smaltimento.

Garanzia sui materiali: 2 anni (dalla data di produzione, escluse le parti di consumo).

Omologazioni: la qualità e la sicurezza dei prodotti CAREL INDUSTRIES Hq sono garantite dal sistema di progettazione e produzione certificato ISO 9001.

ATTENZIONE: separare quanto più possibile i cavi delle sonde e degli ingressi digitali dai cavi dei carichi induttivi e di potenza per evitare possibili disturbi elettromagnetici.

Non inserire mai nelle stesse canaline (comprese quelle dei quadri elettrici) cavi di potenza e cavi di segnale



READ CAREFULLY IN THE TEXT!

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1. PASSIVE TEMPERATURE SENSORS

Preamble: the purpose of this manual is to guide users in choosing and correctly installing probes, so as to reduce typical measurement errors resulting from:

- the influence of thermal contact resistance, the conductive material and the environment surrounding the probe;
- radiation;
- temperature stratification.

1.1 Selection guide based on the application

The choice of the best installation conditions for a probe or sensor depends on the measurement requirements (what needs to be measured, where are the sensors positioned? E.g. low temperature and high humidity – probable condensate and frost formation on the sensor;

high temperature – damage to the sheath or the fixing system):

1. Based on the fluid (gas or liquid), static or moving, which determines stratification of the fluid measured, heat exchange with the measurement system (sensor element, sheath, tubing, etc.); everything that increases thermal resistance and inertia and therefore causes various reading errors;
2. Based on the dynamics (if the phenomenon measured is very slow with small variations over time, or alternatively varies considerably in a short time);
4. Based on the operating range with positive – negative temperature variations, or alternatively positive or negative temperature variations only;
5. Based on the presence and type of contaminants (no UV -> no direct exposure to sunlight of the probe cable or plastic enclosures).

Note: the application diagrams shown below represent typical installations. Some applications may be a combination of several diagrams.

P/N	Type	Working range [°C]	IP	Casing-cap		Material		NOTES
				Ø [mm]	L [mm]	cap	cable	
NTC*HP*	NTC	-50T105	IP67	6x5	15	Polyolefin	Polyolefin	Single insulated cable
NTC*WH*	NTC	-50T105	IP68	6	50	AISI316	TPE	
NTC*WF*	NTC	-50T105	IP67	4	40	AISI316	TPE	
NTC*WP*	NTC	-50T105	IP67	6	100/200/300	AISI316	TPE	
NTC*HF*	NTC	-50T105	IP67	6X6	20	TPE	TPE	With cable tie, single insulated cable
NTC*WS*	NTC	-40T105	IP67	6x6	20	TPE + Cu	TPE	With cable tie, double insulated cable
NTC*HT*	NTC	-30T150	IP67	5	20/50	PE/AISI316	PE	Two versions (PE and AISI)
NTC*LT*	NTC	-80T105	IP67	6x6	150	AISI316		
NTC*PS*	NTC	-50T105	IP67	98x20	105	Santoprene	TPE	Product temperature simulation
TSN*	NTC	-40T120	IP68	3	13	AISI316	-	Direct immersion M 1/8 Gas - PN40
TSC*	NTC	-40T90	IP68	4	15	Nickel-plated brass	TPE	Direct immersion M14 - PN40
NTC*INF*	NTC	-50T90	IP67	5/4	150/169/100	AISI304/316	Silicone	Suitable for use with food to measure product core temperature
NTC*WG*	NTC	-50T105	IP67	6x6	40	Aluminium	TPE	Used on showcases together with humidity probe to activate anti-sweat
PT100*	PT100	-50T250 0T400	IP65	6	100	AISI316	Silicone rubber	
PT1*HP*	PT1000	-50T105	IP67	6x5	15	Polyolefin	Polyolefin	Single insulated cable
PT1*WF*	PT1000	-50T105	IP67	4	40	AISI316	TPE	
PT1*WP*	PT1000	-50T105	IP67	6	50	AISI316	TPE	
PT1*HT*	PT1000	-50T250	IP67	6	40	AISI304	Silicon resin	
PT1*HF*	PT1000	-50T105	IP67	6x6	20	TPE	TPE	With cable tie, single insulated cable
PT1*PS*	PT1000	-50T105	IP67	98x20	105	Santoprene	TPE	Special applications
TST*	PT1000	-40T120	IP68	3	13	AISI316	-	Direct immersion M 1/8 Gas - PN40
TSM*	PT1000	-40T90	IP68	4	15	Nickel-plated brass	TPE	Direct immersion M14 - PN25
TSQ*	PT1000	-50T350	IP65	3	150	AISI316		
PT1*INF*	PT1000	-50T200	IP67	5/4	100	AISI316	TPE	Suitable for use with food to measure product core temperature
PTC*	PTC	-30T105	IP67	6	40		PVC	

Tab. 1.a

Note: for further technical details, see the passive sensor manual +030220655 (IT-EN).



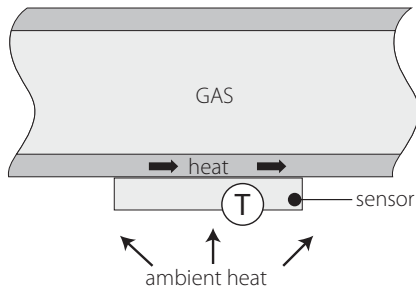
2. OBSERVATIONS ON HEAT TRANSMISSION IN TEMPERATURE MEASUREMENTS

Preamble: whatever method is used to measure temperature, the measured temperature is never the actual temperature of the fluid being measured.

The deviation from the real value (which represents the measurement error) is a result of heat transmission, a process that affects any object or fluid with a difference in temperature from another nearby fluid or object, or alternatively a dynamic variation in temperature (difference from previous values).

The following factors cause the measurement to deviate from the real value:

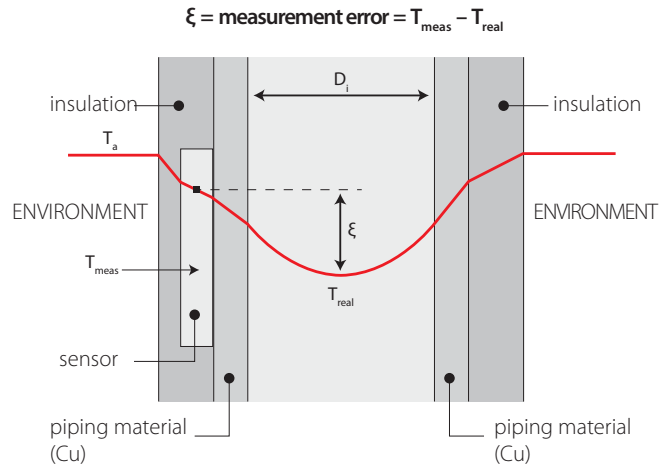
1. Temperature difference in the area surrounding the point of measurement;
2. Thermal mass of the temperature measuring system (e.g. pipe, socket, probe), which increases the total measurement time constant.



Commonly, when measuring the temperature of a fluid, the influence of the temperature difference in the area surrounding the point of measurement is often underestimated. When the difference between the point of measurement and the surrounding environment is significant (in the tens of degrees), the error is no longer negligible.

When needing to control a temperature that is subject to variations, precision of control will also depend on the measurement time constant:

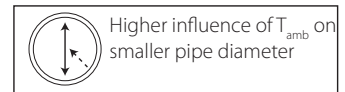
the lower the time constant, the quicker control will respond to a changing temperature, and consequently the lower the instant error will be between the value read and the real value.



Note: the measurement error generated by the influence of ambient temperature is particularly important with smaller diameter piping: the ratio between masses (pipe and fluid) is in fact inversely proportional to pipe diameter.

$$\frac{A_e}{V_i} = \frac{D_e \cdot \pi}{D_i^2 \cdot \pi/4} \cong \frac{4}{D}$$

A_e = outside surface area
 V_i = inside volume



3. ACTIVE TEMPERATURE AND HUMIDITY SENSORS

	Type of output							
	Temperature	Humidity	Carel NTC	Carel NTC & -0.5-1 V / 4-20 mA	-0.5-1 V 4-20 mA	Carel NTC & 0-10 V	0-10 V	RS485 serial
Duct	-10 T60°C	-	DPDT011000	-	DPDT010000	-	-	DPDT014000
	-10 T60°C	10-90%	-	DPDC111000	DPDC110000	-	DPDC112000	DPDC114000
	-20-70°C	0-100%	-	-	DPDC210000	-	DPDC212000	DPDC214000
Industrial environment	-10 T60°C	-	DPPT011000	-	DPPT010000	-	-	DPPT014000
	-10 T60°C	10-90%	-	DPDC111000	DPDC110000	-	DPDC112000	DPDC114000
	-20-70°C	0-100%	-	-	DPDC210000	-	DPDC212000	DPDC214000
Wall-mounting	-10 T60°C	-	DPWT011000	-	DPWT010000	-	-	DPWT014000
	-10 T60°C	10-90%	-	DPWC111000	DPWC110000	DPWC115000	DPWC112000	DPWC114000
Remote sensor	-	30-90°C	-	-	ASIT030000	-	-	-
	-	30-90°C Cable L= 2m	-	-	ASET030000	-	-	-
	-	30-90°C Cable L= 3m	-	-	ASET030001	-	-	-
		30-90°C Cable L= 4m	-	-	ASET030002	-	-	-

Tab. 3.a

Note: for further technical details, see the active sensor manual +030220660 (IT-EN)



4. ACTIVE AIR QUALITY SENSORS

Carel DP*Q* P/Ns		
Version	Outputs	Carel part number
VOC air quality sensor, wall-mounting	0 to 10V – 4 to 20 mA	DPWQ306000
CO2 air quality sensor, wall-mounting	0 to 10V	DPWQ402000
VOC + CO2 air quality sensor, wall-mounting	0 to 10V	DPWQ502000
VOC air quality sensor, duct version	0 to 10V – 4 to 20 mA	DPDQ306000
CO2 air quality sensor, duct version	0 to 10V	DPDQ402000
VOC + CO2 air quality sensor, duct version	0 to 10V	DPDQ502000

Tab. 4.a

Note: for further technical details see the air quality sensor technical leaflets:

VOC	VOC + CO ₂
+050001290 - IT	+050001300 - IT
+050001291 - GB	+050001301 - GB
+050001292 - FR	+050001302 - FR
+050001293 - DE	+050001303 - DE
+050001294 - RU	+050001304 - RU



5. REFRIGERANT GAS LEAKAGE SENSORS (R22, R134A, R290, R404A, R407C-F, R410A, R744, ETHYLENE)

Semiconductor (IP41)	Semiconductor with 5 m remote sensor (IP66)	Description
DPWLA07000	DPWLA27000	R22 gas leak detector
DPWLB07000	DPWLB27000	R134a gas leak detector
DPWLC07000	DPWLC27000	R404a gas leak detector
DPWLR07000		R407a gas leak detector
DPWLD07000	DPWLD27000	R407c gas leak detector
DPWLS07000		R407f gas leak detector
DPWLE07000	DPWLE27000	R410a gas leak detector
DPWLT07000	DPWLT27000	R507a gas leak detector
DPWLG07000		NH3 gas leak detector
DPWLQ07000		ETHYLENE gas leak detector
DPWLP07000		R290 gas leak detector
Infrared (IP66)	Infrared with 5 m remote sensor (IP66)	Description
DPWL417000	DPWL427000	Sensor rilevam. gas CO ₂

Tab. 5.a

Note: for further technical details, see the specific manual: +0300035EN or +0300035IT



6. PRESSURE SENSORS

Choice of pressure sensor according to operating pressure.

Gas	Low temperature evaporator	Medium and high temperature evaporator	Condenser
R134a	SPKT0053R*/P* (0-5 V; -1.0-4.2 barg) SPKT0021C*/D* (4-20 mA; -0.5-7.0 barg) SPKS0019R1 (0-5 V; 0-9 barg) weld version	SPKT0013R*/P* (0-5 V; -1-9.3 barg) SPKT0011C*/D* (4-20 mA; 0-10 barg) SPKS0019R1 (0-5 V; 0-9 barg) weld version	SPKT0033R*/P* (0-5 V; 0-34.5 barg) SPKT0031C*/D* (4-20 mA; 0-30 barg) SPKS0039R1 (0-5 V; 0-34 barg) weld version
R290	SPKT0013R*/P* (0-5 V; -1-9.3 barg) SPKT0011C*/D* (4-20 mA; 0-10 barg) SPKS0019R1 (0-5 V; 0-9 barg) weld version	SPKT0013R*/P* (0-5 V; -1-9.3 barg) SPKT0011C*/D* (4-20 mA; 0-10 barg) SPKS0019R1 (0-5 V; 0-9 barg) weld version	SPKT0033R*/P* (0-5 V; 0-34.5 barg) SPKT0031C*/D* (4-20 mA; 0-30 barg) SPKS0039R1 (0-5 V; 0-34 barg) weld version
R404a	SPKT0013R*/P* (0-5 V; -1-9.3 barg) SPKT0011C*/D* (4-20 mA; 0-10 barg) SPKS0019R1 (0-5 V; 0-9 barg) weld version	SPKT0013R*/P* (0-5 V; -1-9.3 barg) SPKT0011C*/D* (4-20 mA; 0-10 barg) SPKS0019R1 (0-5 V; 0-9 barg) weld version	SPKT0033R*/P* (0-5 V; 0-34.5 barg) SPKT0031C*/D* (4-20 mA; 0-30 barg) SPKS0039R1 (0-5 V; 0-34 barg) weld version
R407A	SPKT0013R*/P* (0-5 V; -1-9.3 barg) SPKT0011C*/D* (4-20 mA; 0-10 barg) SPKS0019R1 (0-5 V; 0-9 barg) weld version	SPKT0013R*/P* (0-5 V; -1-9.3 barg) ⁽¹⁾ SPKT0011C*/D* (4-20 mA; 0-10 barg) ⁽¹⁾ SPKS0019R1 (0-5 V; 0-9 barg) weld version	SPKT0033R*/P* (0-5 V; 0-34.5 barg) SPKT0031C*/D* (4-20 mA; 0-30 barg) SPKS0039R1 (0-5 V; 0-34 barg) weld version
R407C	SPKT0013R*/P* (0-5 V; -1-9.3 barg) SPKT0011C*/D* (4-20 mA; 0-10 barg) SPKS0019R1 (0-5 V; 0-9 barg) weld version	SPKT0013R*/P* (0-5 V; -1-9.3 barg) ⁽¹⁾ SPKT0011C*/D* (4-20 mA; 0-10 barg) ⁽¹⁾ SPKS0019R1 (0-5 V; 0-9 barg) weld version	SPKT0033R*/P* (0-5 V; 0-34.5 barg) SPKT0031C*/D* (4-20 mA; 0-30 barg) SPKS0039R1 (0-5 V; 0-34 barg) weld version
R407F	SPKT0013R*/P* (0-5 V; -1-9.3 barg) SPKT0011C*/D* (4-20 mA; 0-10 barg) SPKS0019R1 (0-5 V; 0-9 barg) weld version	SPKT0013R*/P* (0-5 V; -1-9.3 barg) ⁽¹⁾ SPKT0011C*/D* (4-20 mA; 0-10 barg) ⁽¹⁾ SPKS0019R1 (0-5 V; 0-9 barg) weld version	SPKT0033R*/P* (0-5 V; 0-34.5 barg) SPKT0031C*/D* (4-20 mA; 0-30 barg) SPKS0039R1 (0-5 V; 0-34 barg) weld version
R410A	SPKT0043R*/P* (0-5 V; 0-17.3 barg) SPKT0041C*/D* (4-20 mA; 0-18.2 barg) SPKS00F9R1 (0-5 V; 0-19 barg) weld version	SPKT0043R*/P* (0-5 V; 0-17.3 barg) SPKT0041C*/D* (4-20 mA; 0-18.2 barg) SPKS00F9R1 (0-5 V; 0-19 barg) weld version	SPKT00B6R*/P* (0-5 V; 0-45 barg) SPKT00B1C*/D* (4-20 mA; 0-44.8 barg) SPKS00B9R1 (0-5 V; 0-45 barg) weld version
R717	SPKT0021C*/D* (4-20 mA; -0.5-.7 barg)	SPKT0011C*/D* (4-20 mA; 0-10 barg)	SPKT0031C*/D* (4-20 mA; 0-30 barg)
R744	SPKT00G1C*/D* (4-20 mA; 0-60 barg)	SPKT00G1C*/D* (4-20 mA; 0-60 barg)	SPKT00H8C* (4-20 mA; 0-120 barg) SPKT00D8C* (4-20 mA; 0-150 barg)

Tab. 6.a

(1): for HVAC applications, use respectively

- SPKT0043R*/P* (0-5 V 0-17.3 barg)
- SPKT0041C*/D* (4-20 mA 0-18.2 barg)
- SPKS00F9R1 (0-5 V 0-19 barg) weld version

Specific documents: for further technical details see the pressure transducer technical leaflets:

- cable and connector +050000484
- 4-20 mA C series +050000486 (IT-EN) alternative: 4-20 mA D series +050000595 (IT-EN)
- 4-20 mA C series high pressure +050000596 (IT-EN)
- 0-5 V R series +050000485 (IT-EN) alternative: 0-5 V P series +050000598 (IT-EN)
- 0-5 V S series +050000488 (IT-EN)
- 0-5 V SPKS* series weld version +050000489 (IT-EN)

Note: the SPKS*R* series weld-version sensors comply with F-GAS regulation 842/2006, which requires devices installed in the system to be hermetically sealed and solidly secured by welding.



7. DIFFERENTIAL PRESSURE SENSORS

See the specific technical leaflets:

4-20 mA active sensors +050000651 (IT-EN)

P/N	Working range (adjustable)	Output
SPKD00U5N0	0 - 1000 Pa	4 - 20 mA
	0 - 2500 Pa	
	0 - 3000 Pa	
	0 - 5000 Pa	
SPKD00C5N0	- 50 - + 50 Pa	4 - 20 mA
	- 100 - + 100 Pa	
	0 - + 50 Pa	
	0 - + 100 Pa	

Tab. 7.a

On-off sensors +050000645 (IT-EN)

P/N	Description	Range (mbar)	
DCPD000100	Differential pressure switch	0.5 - 5.0	
DCPD010100	Differential pressure switch	0.5 - 5.0	with connection kit
DCPD001100	Differential pressure switch	0.2 - 2.0	
DCPD011100	Differential pressure switch	0.2 - 2.0	with connection kit

Tab. 7.b



8. FLOOD SENSORS

Technical leaflet +050004116

P/N	Description
FLOE000010	Flood detector
FLOS000000	Spot probe
FLOR000000	Strip sensor 25 m

Tab. 8.a



9. FROST SENSORS

Technical leaflet +050000646

P/N	Description	Range (°C)
DCTF000320	Single-stage frost thermostat	-10 to 15

Tab. 9.a



10. SMOKE-FIRE SENSORS

Technical leaflet +050000520

Smoke

P/N	Power supply voltage
SFFS000000	12-24 Vdc

Tab. 10.a

Fire

P/N	Power supply voltage
SFFF000000	12-24 Vdc

Tab. 10.b



11. LEVEL SENSORS

Technical leaflet +0500075ML

P/N	Description
LSR0013000	Level sensor – 2" Gas mechanical connector
LSR0023000	Level sensor – flanged mechanical connector

Tab. 11.a

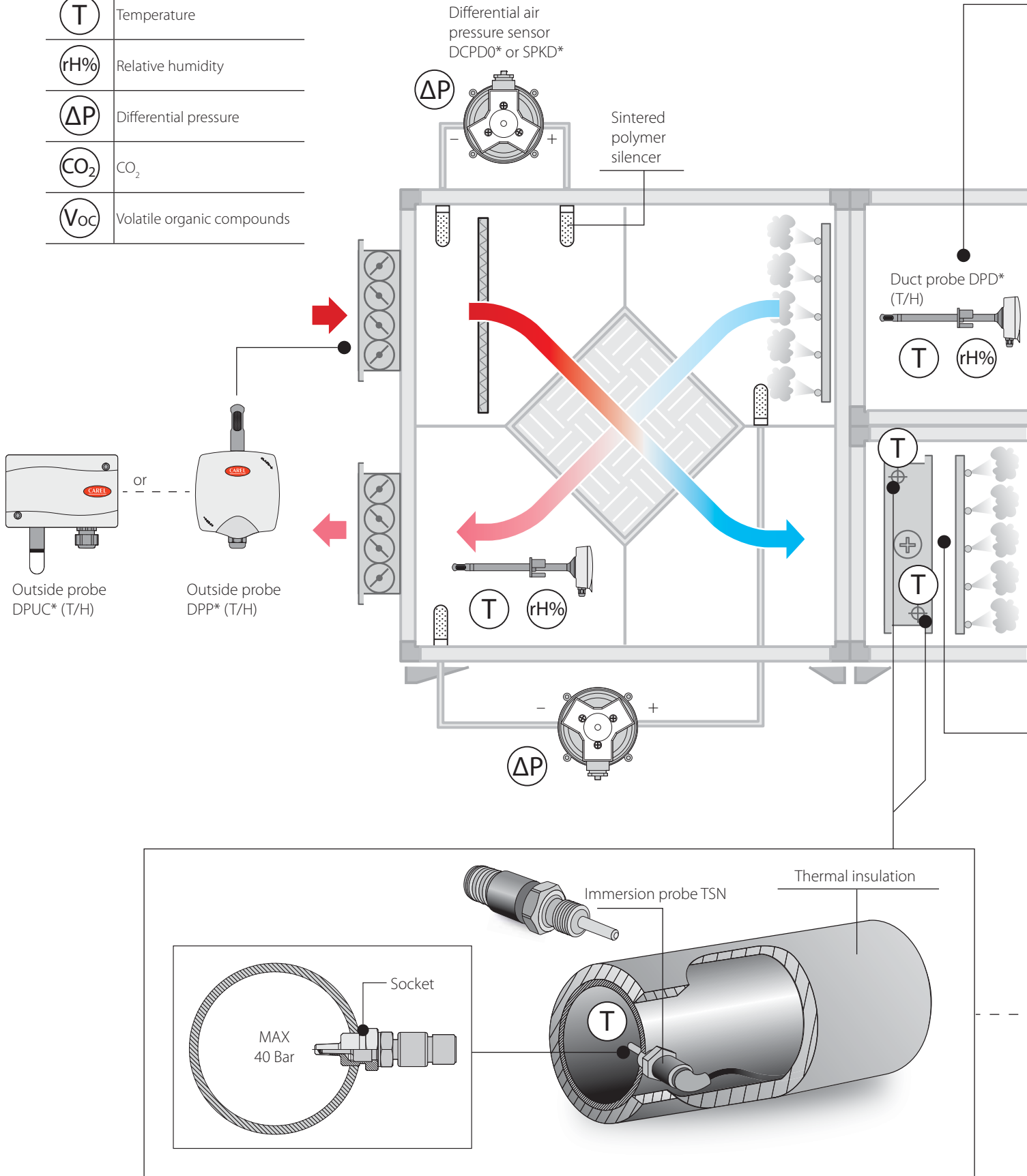


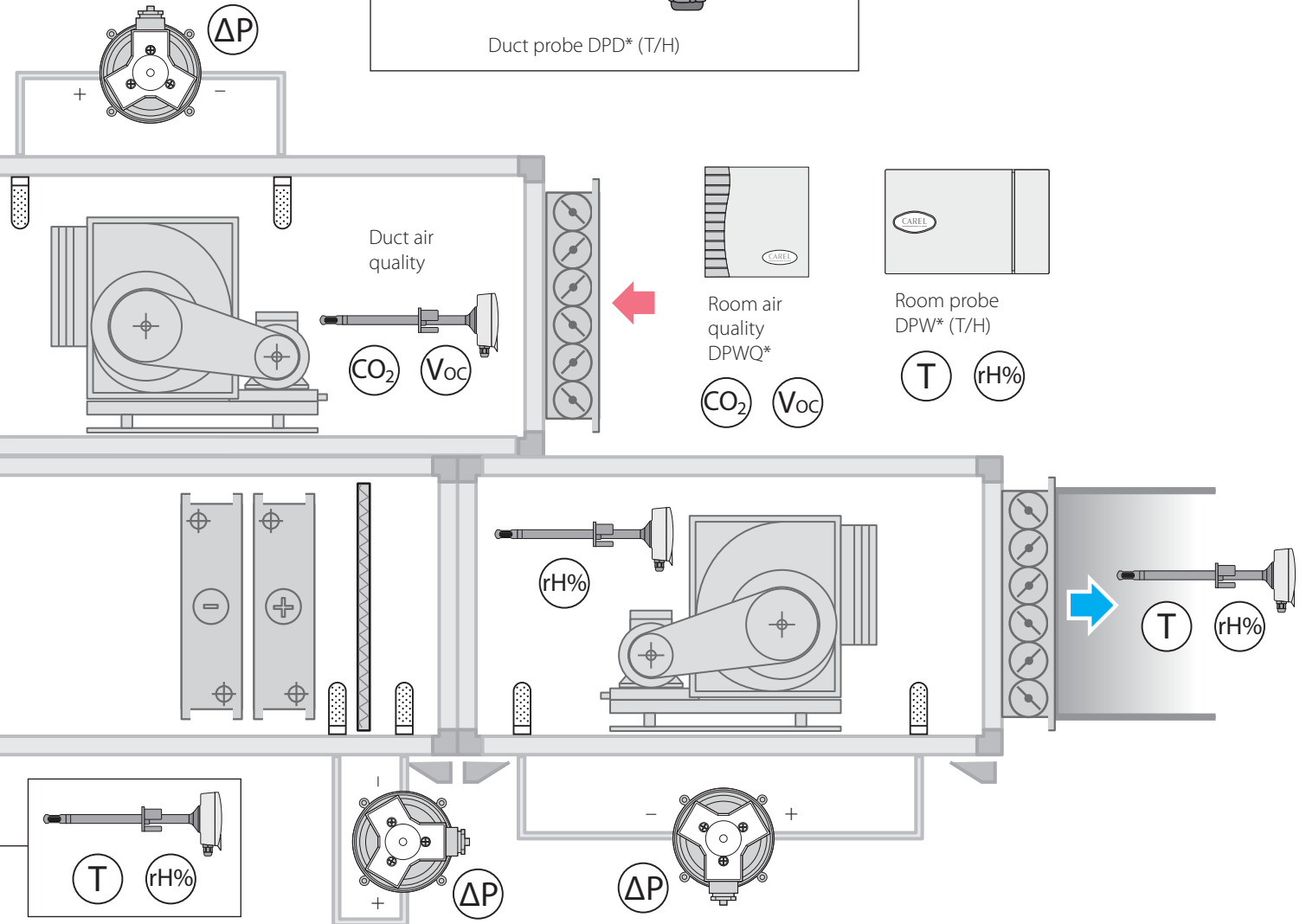
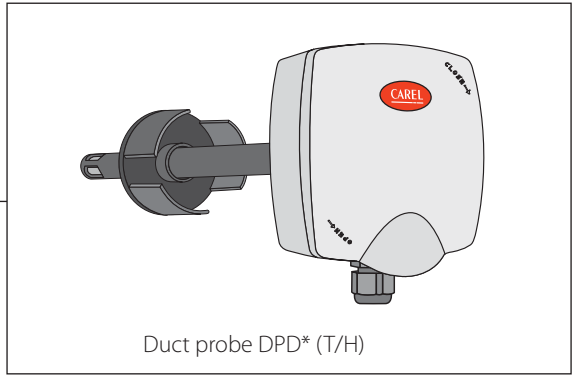
12. INSTALLATION DIAGRAMS BY APPLICATION

12.1 AHU

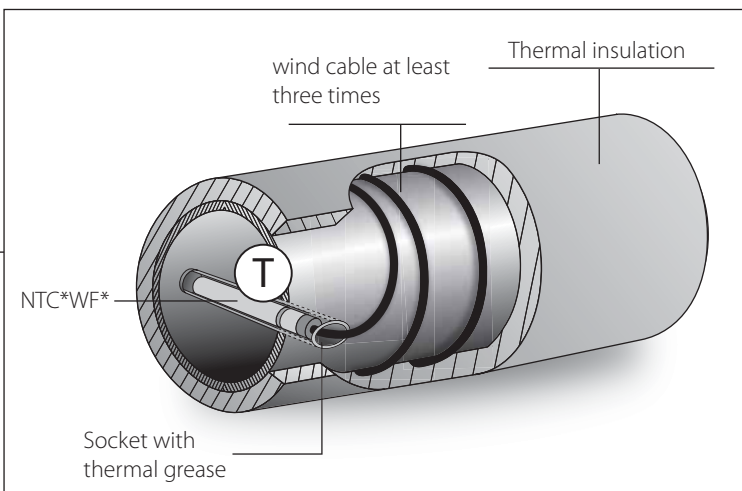
KEY

T	Temperature
rH%	Relative humidity
ΔP	Differential pressure
CO_2	CO_2
Voc	Volatile organic compounds





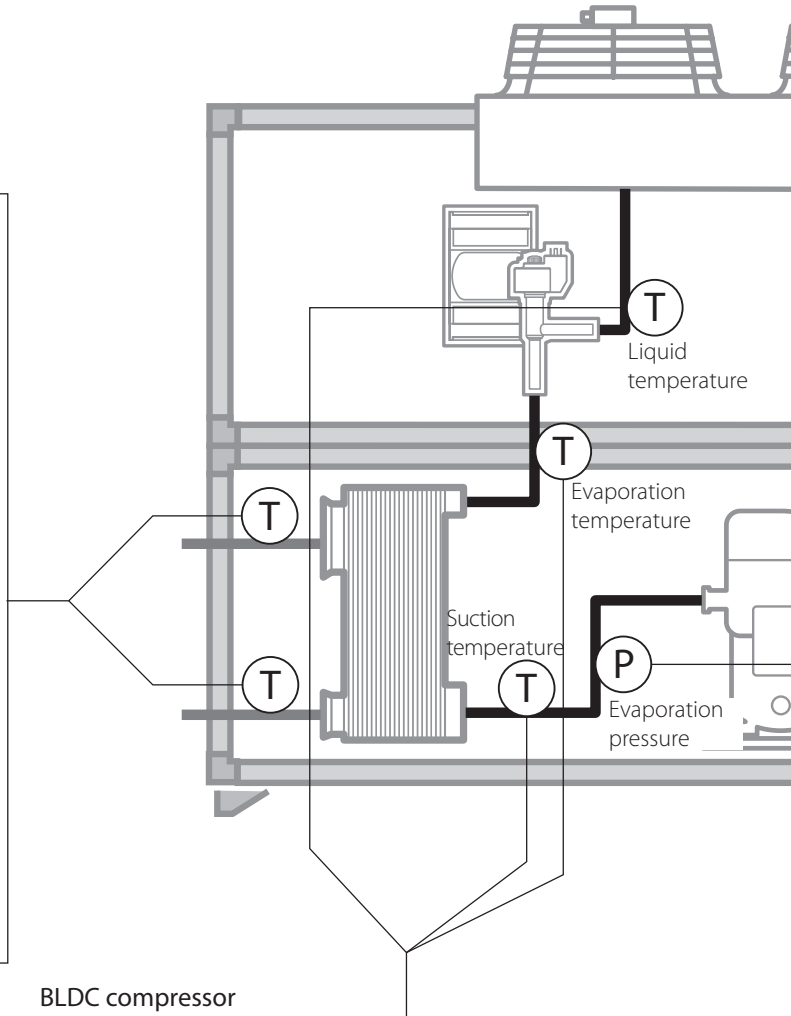
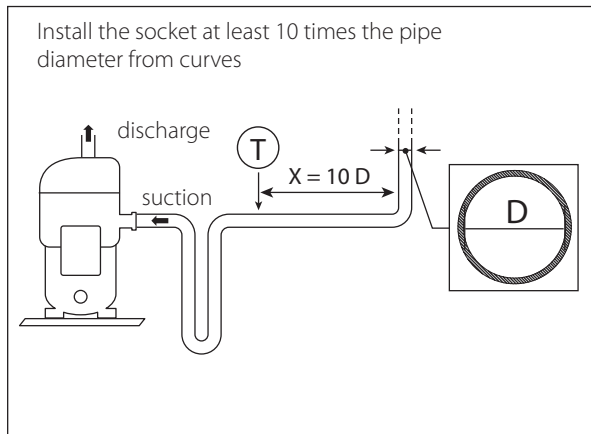
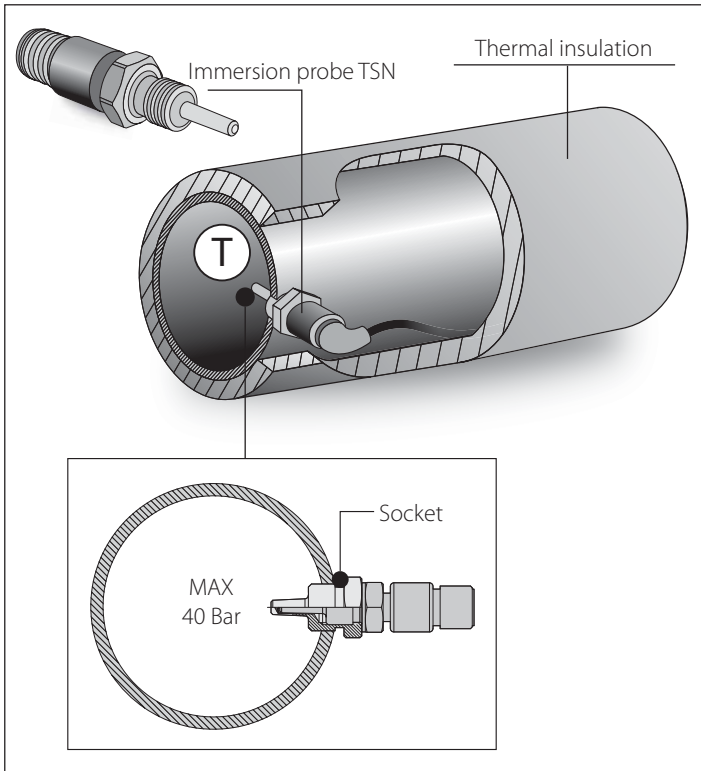
Alternative solutions



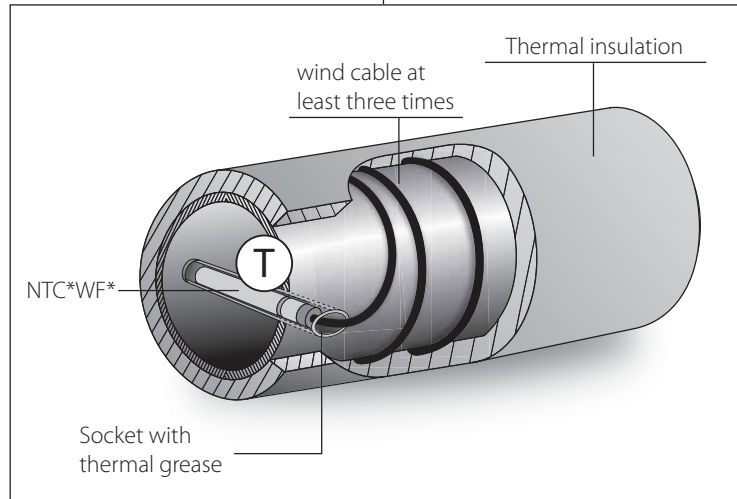
12.2 HVAC: /W - W/W chillers/heat pumps

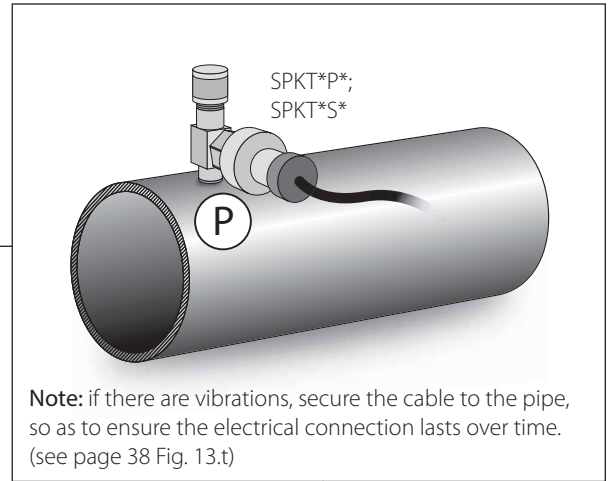
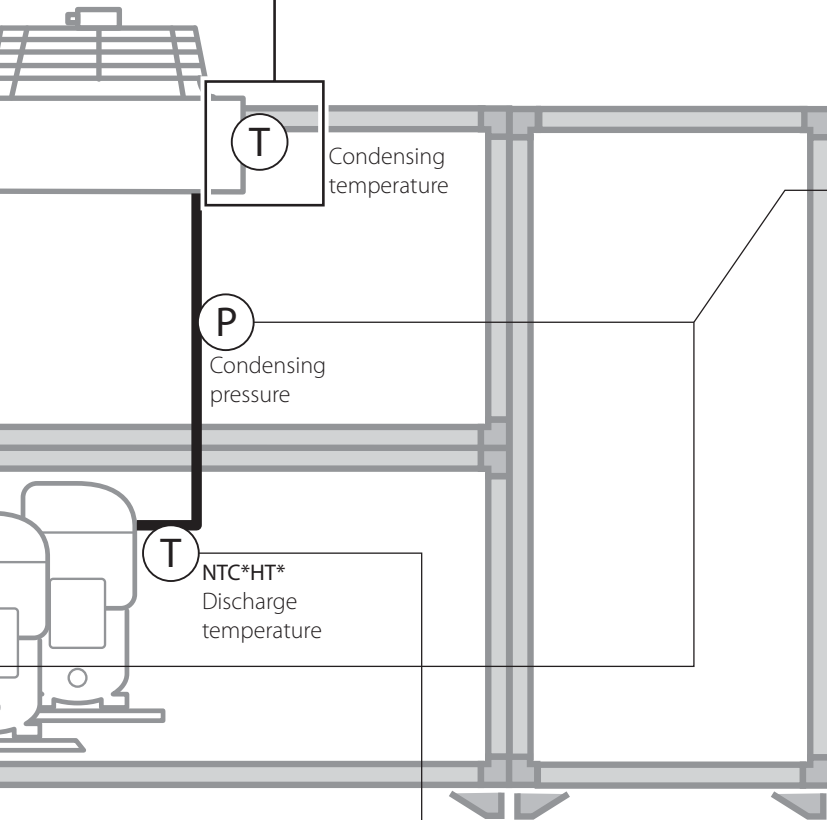
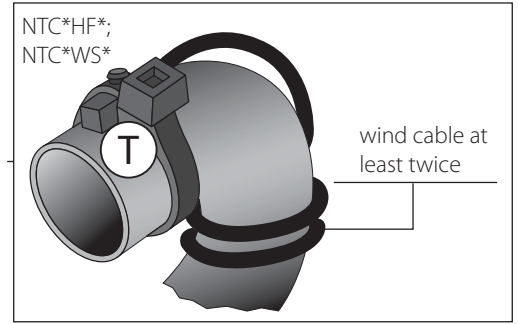
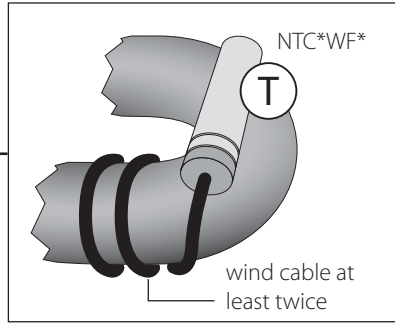
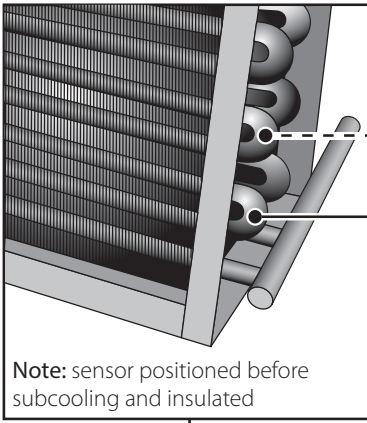
KEY

T	Temperature
P	Pressure

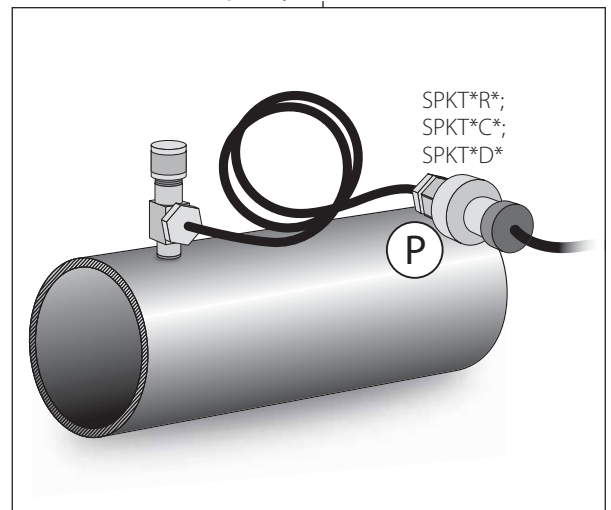


BLDC compressor

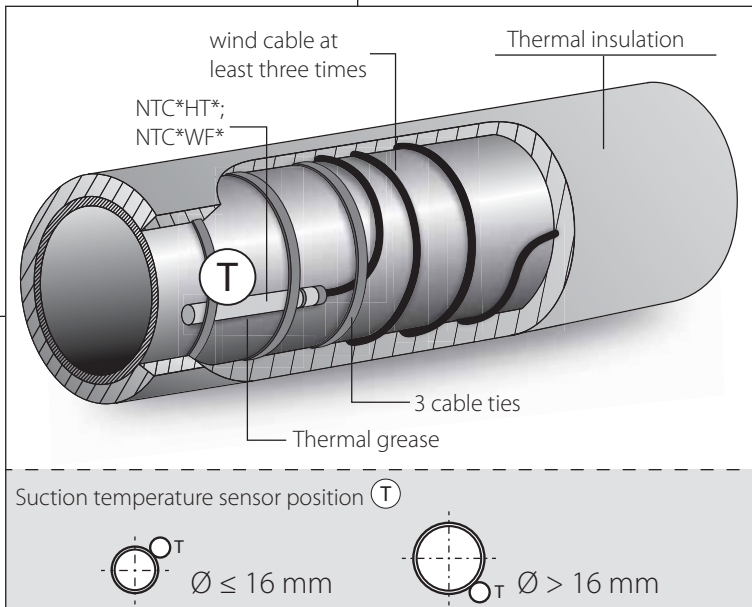




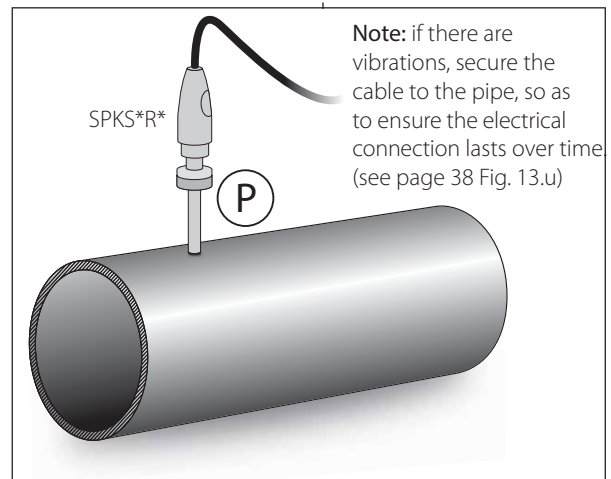
Connection with capillary



ON/OFF compressor



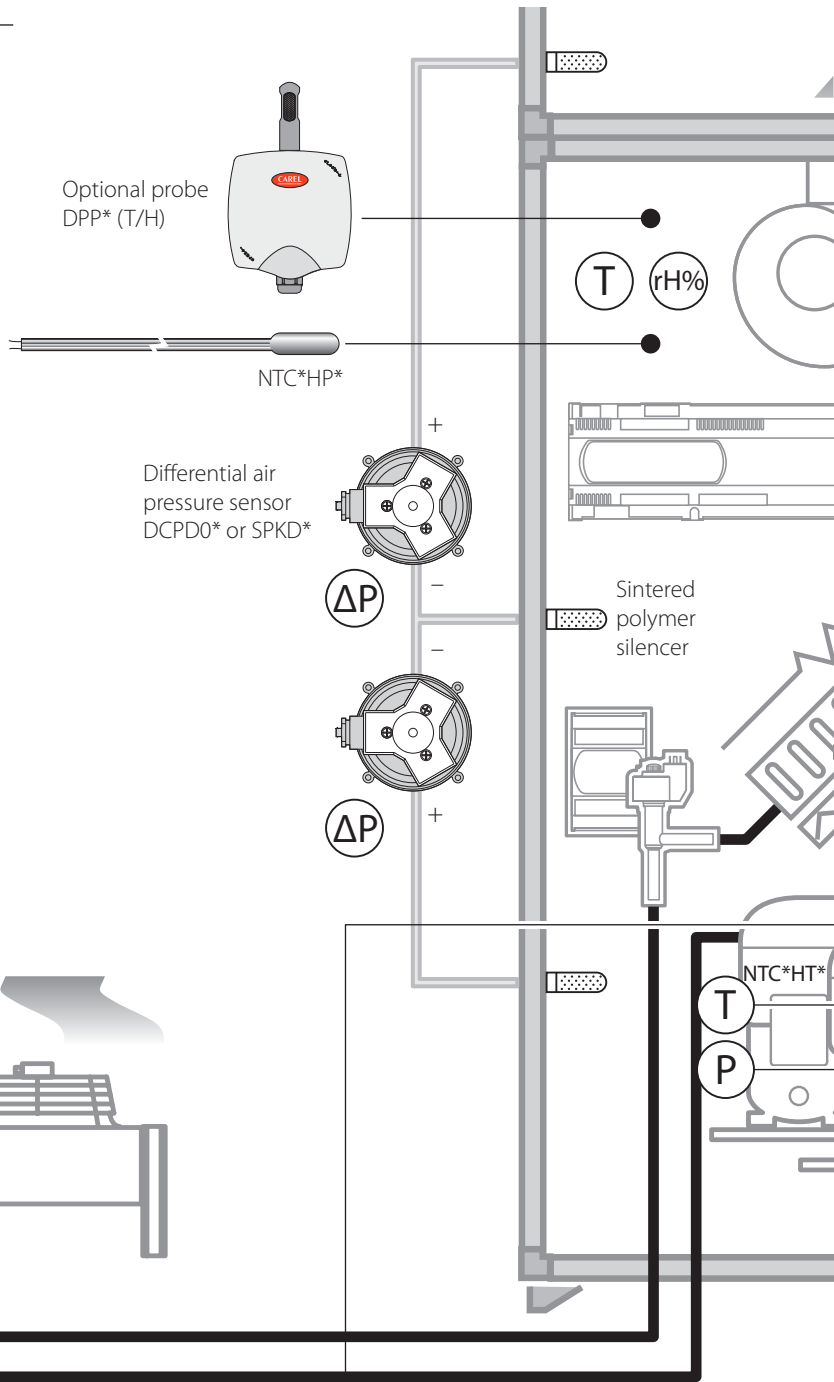
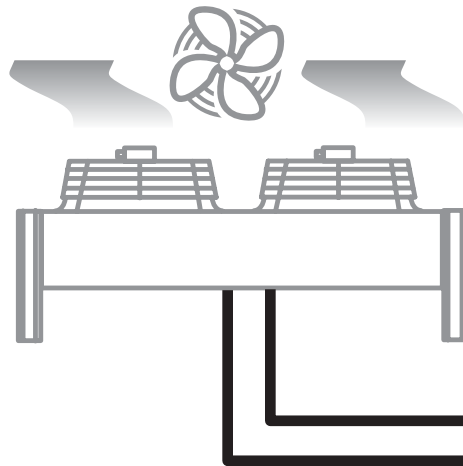
Welded connection



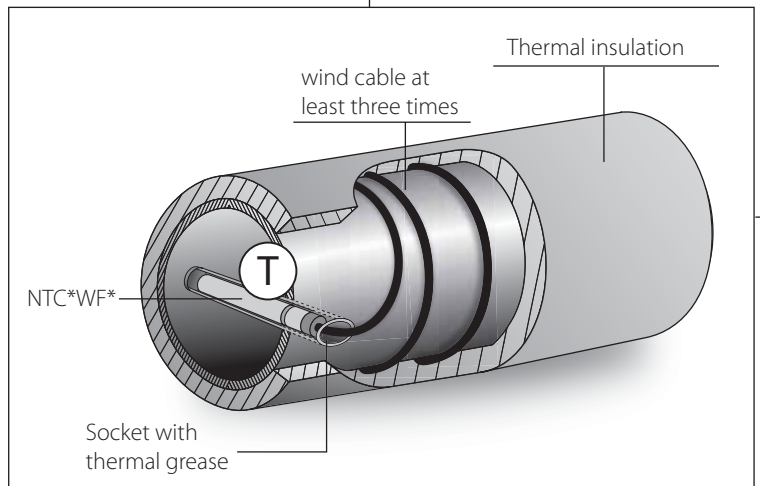
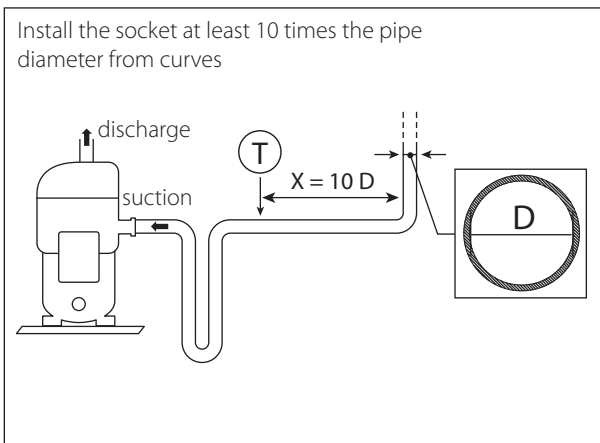
12.3 CRAC

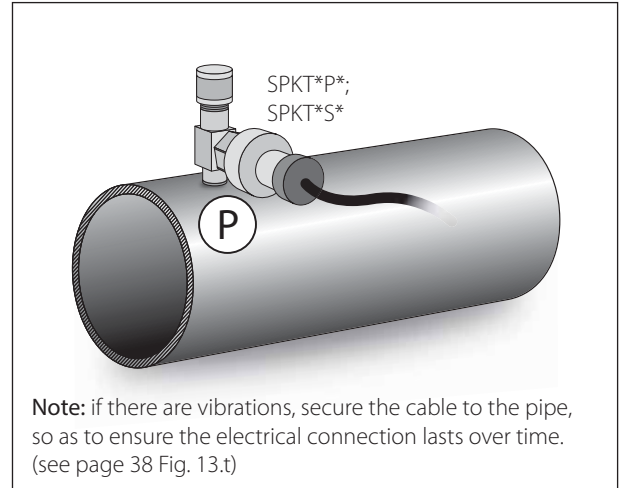
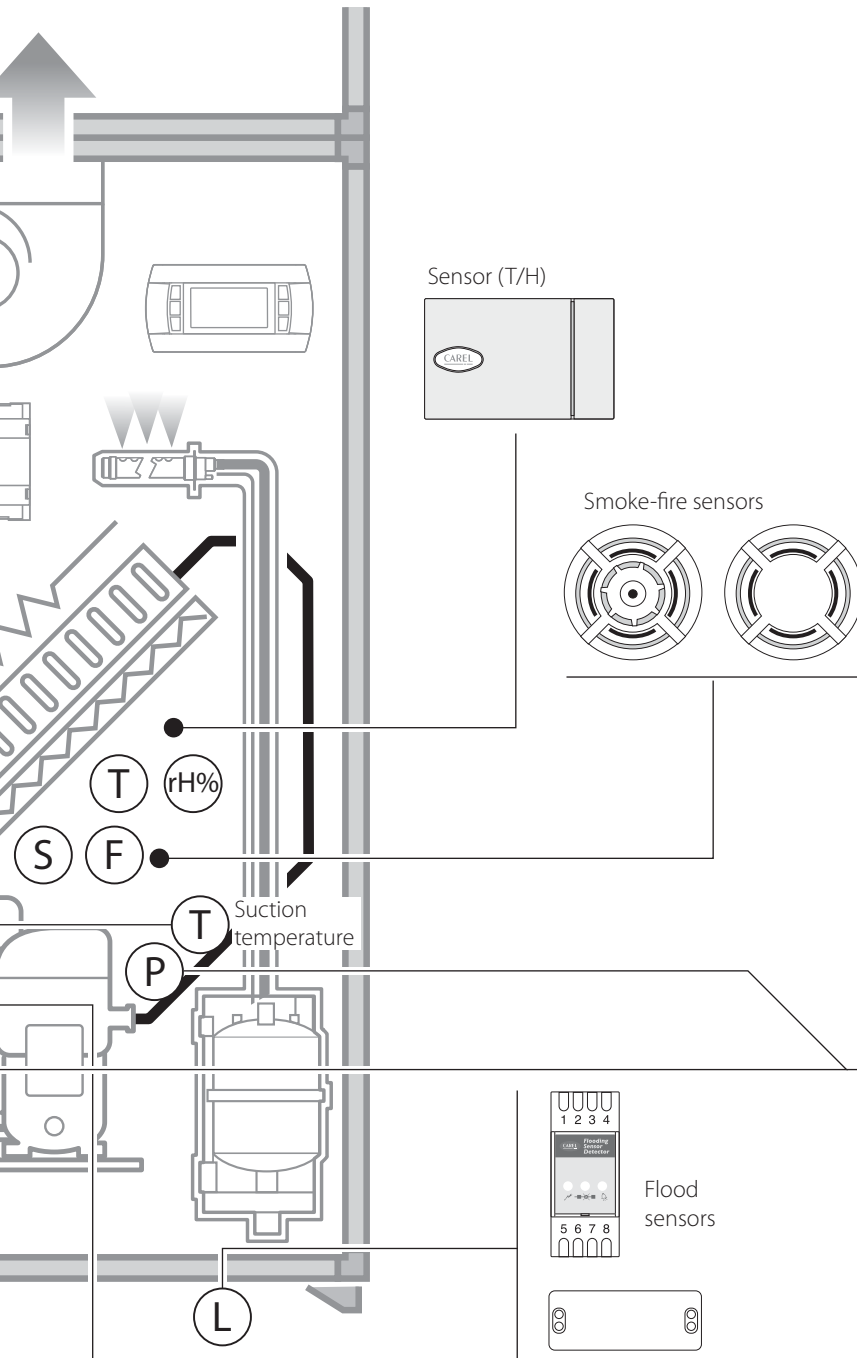
KEY

T	Temperature
P	Pressure
rH%	Relative humidity
ΔP	Differential pressure
S	Smoke
F	Fire
L	Flood sensor

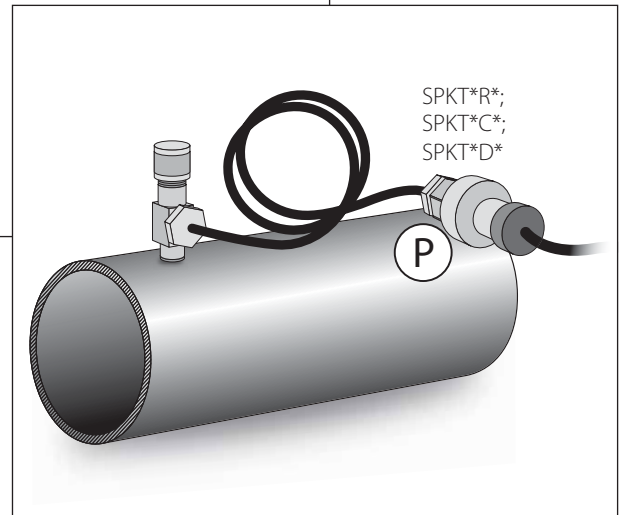


BLDC compressor

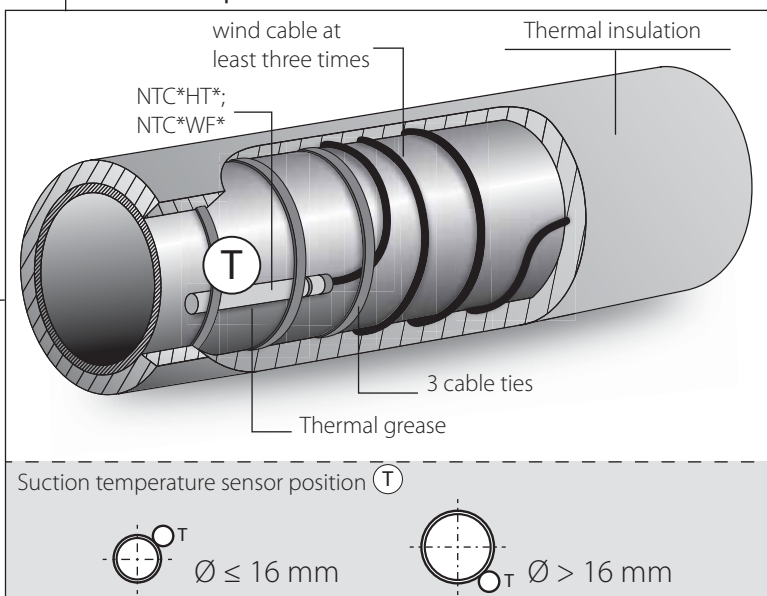
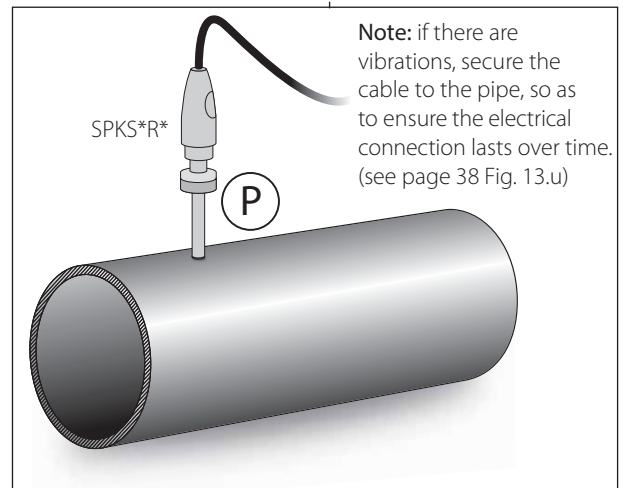




Connection with capillary



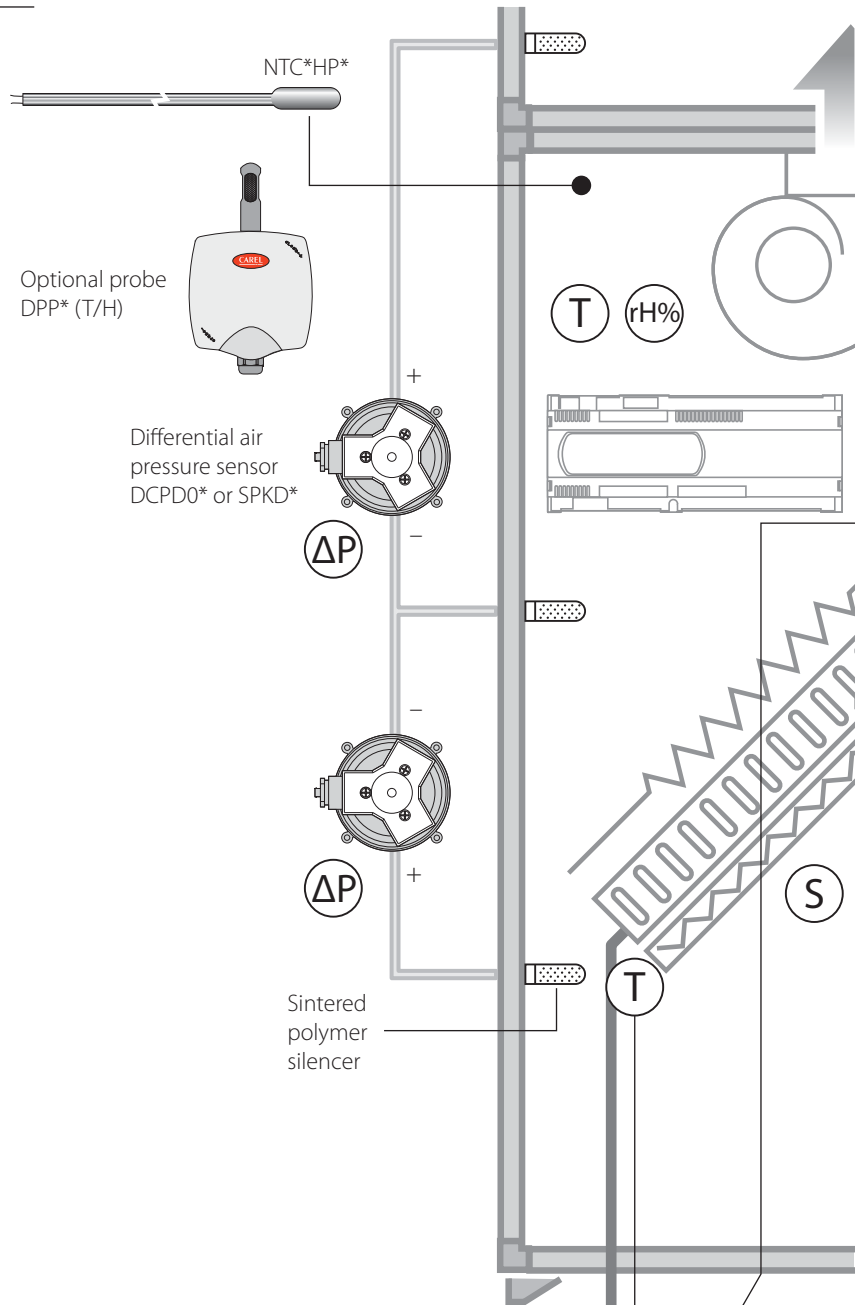
Welded connection



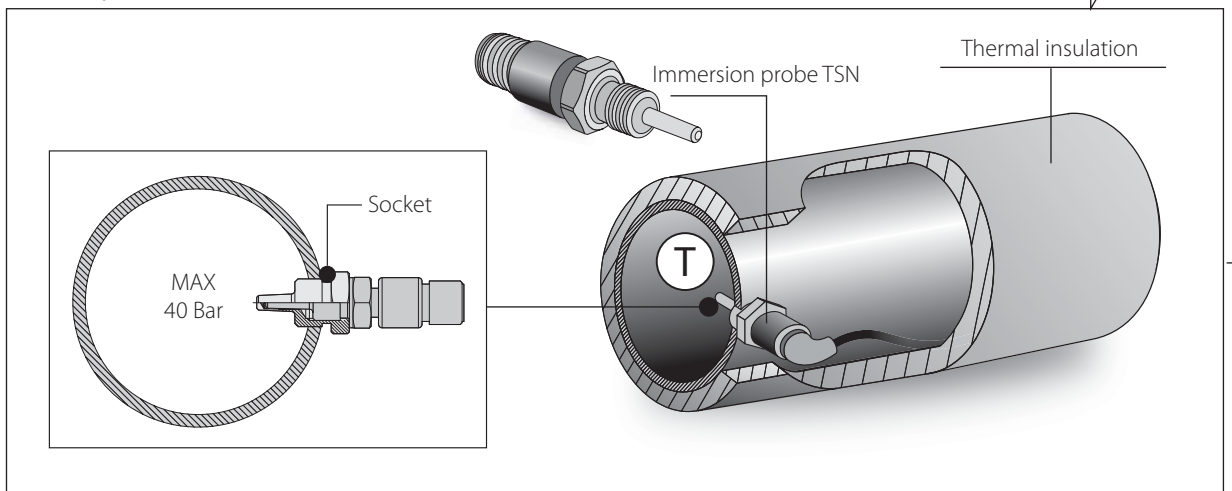
12.4 CRAC CW

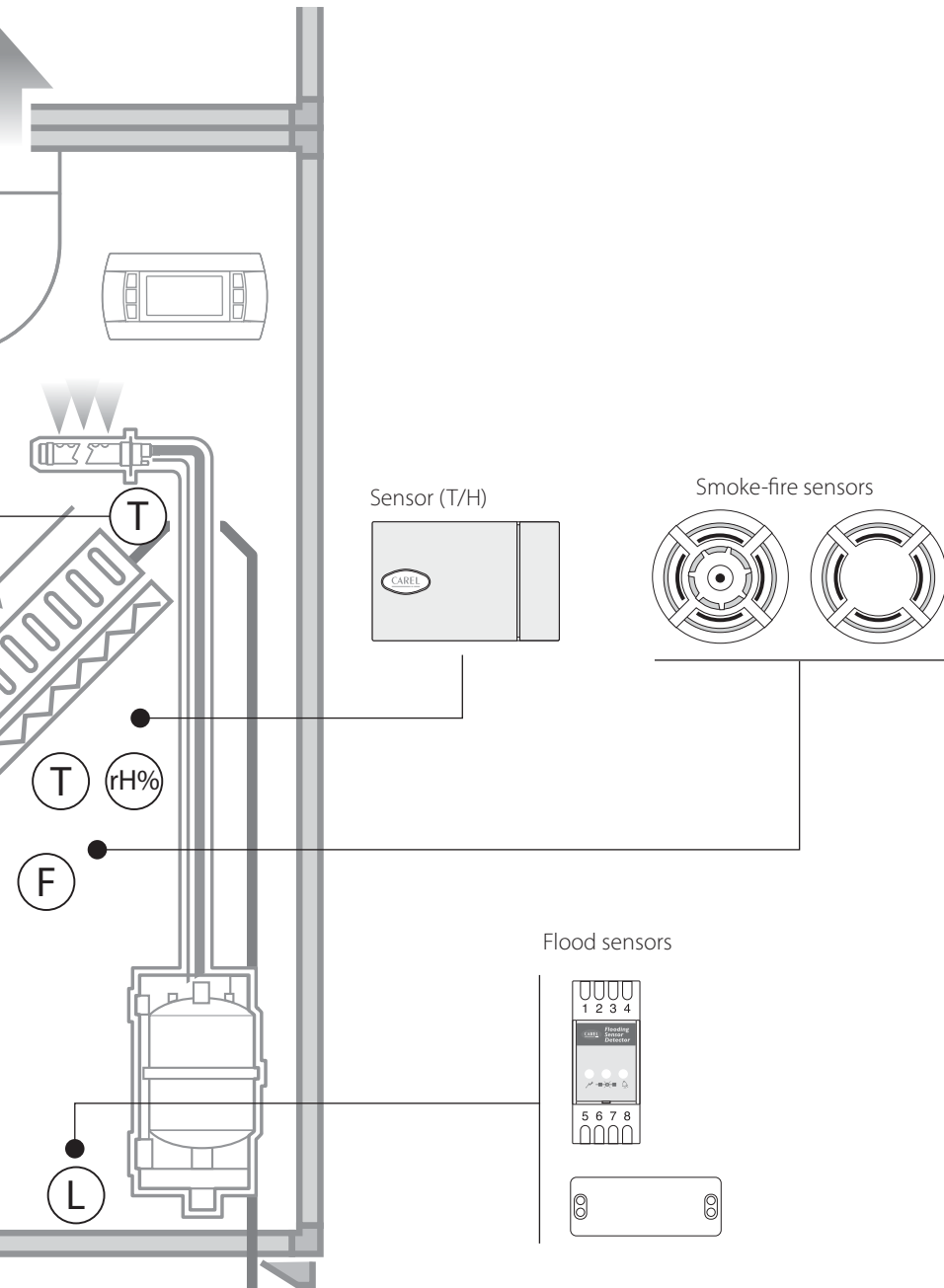
KEY

T	Temperature
rH%	Relative humidity
ΔP	Differential pressure
S	Smoke
F	Fire
L	Flood sensor

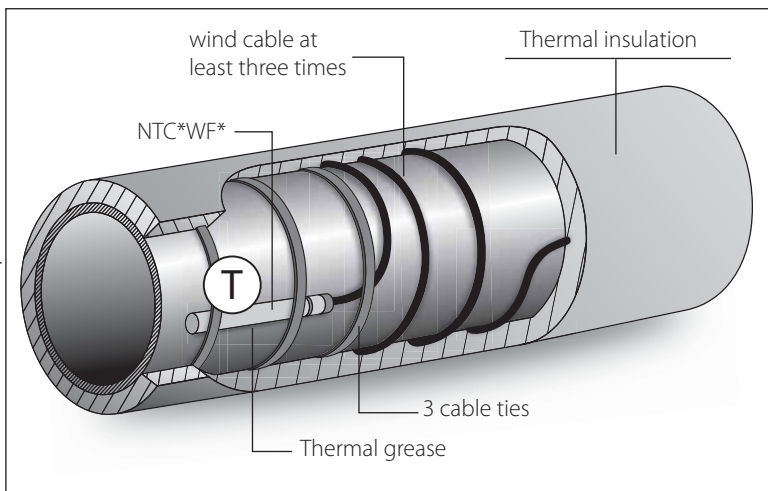


Control probe

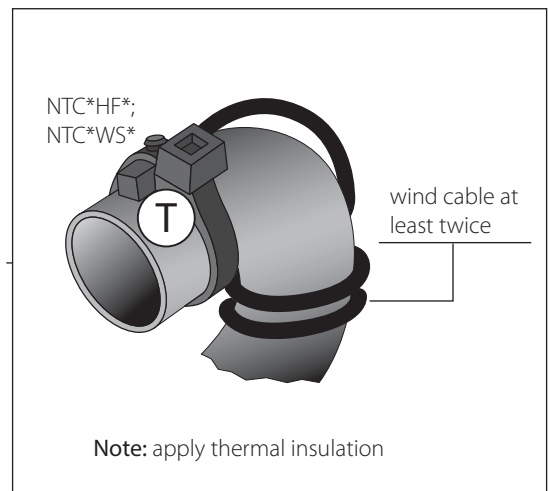




1st alternative solution - Reading probe



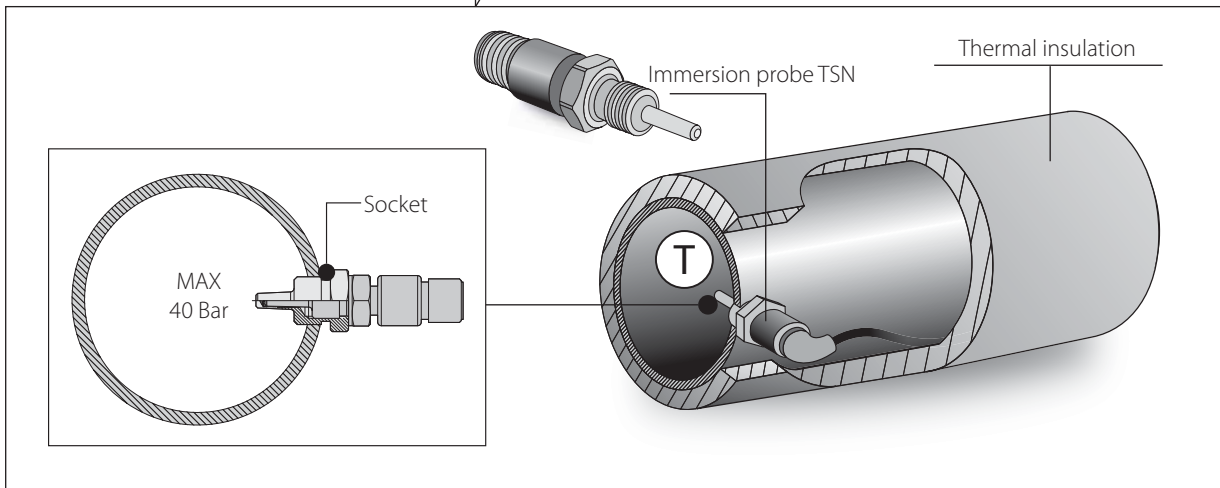
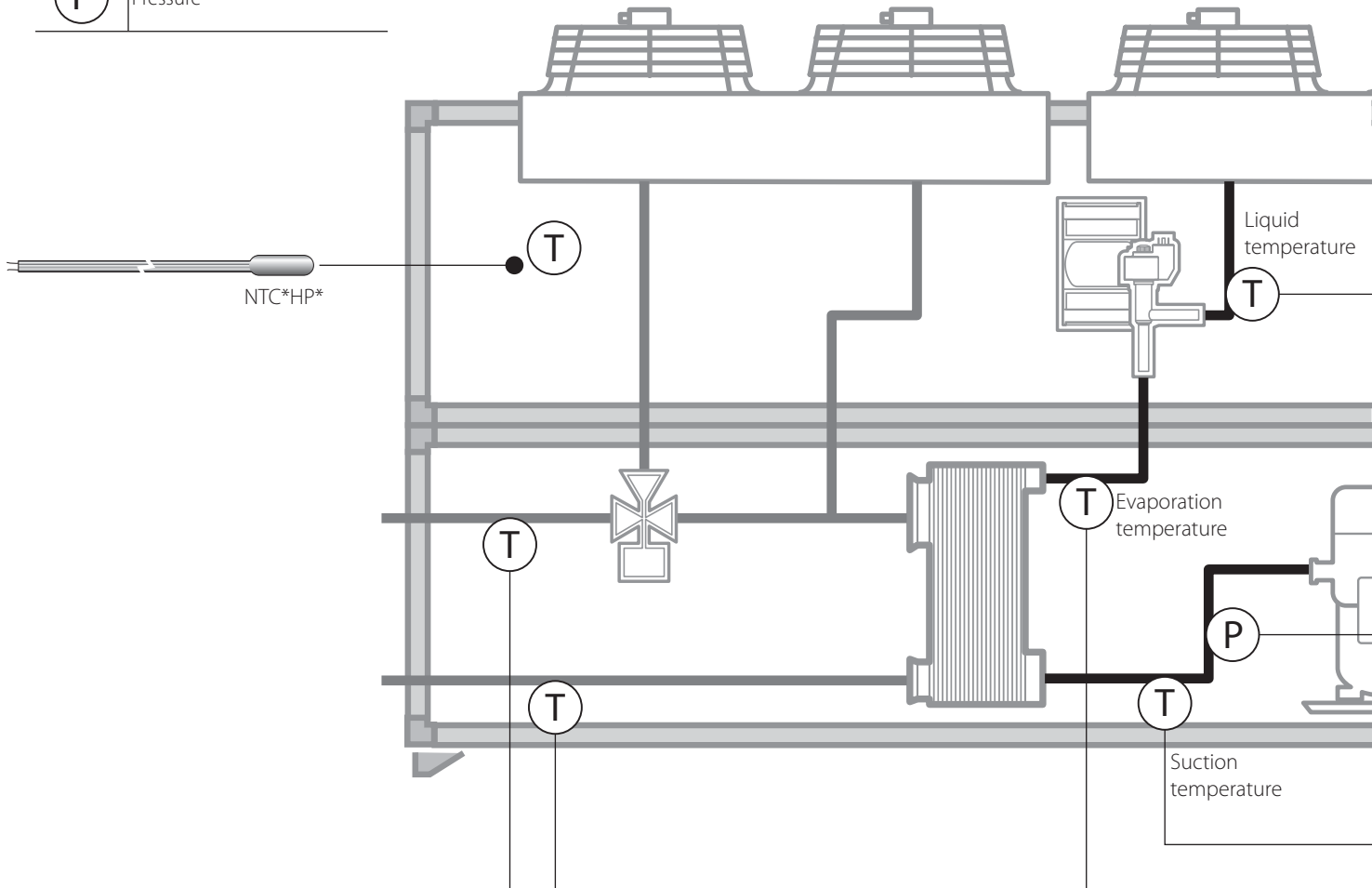
2nd alternative solution - Reading probe

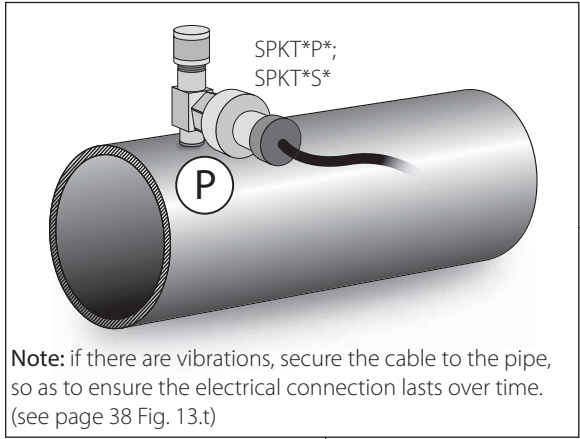


12.5 HVAC: Technological/process cooling application - Air/water chillers

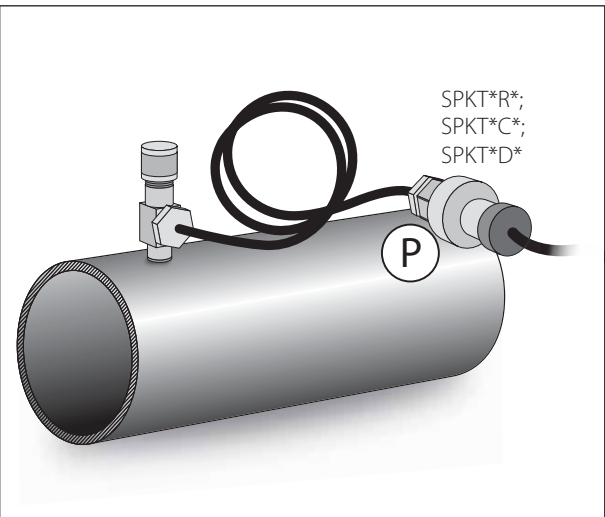
KEY

T	Temperature
P	Pressure

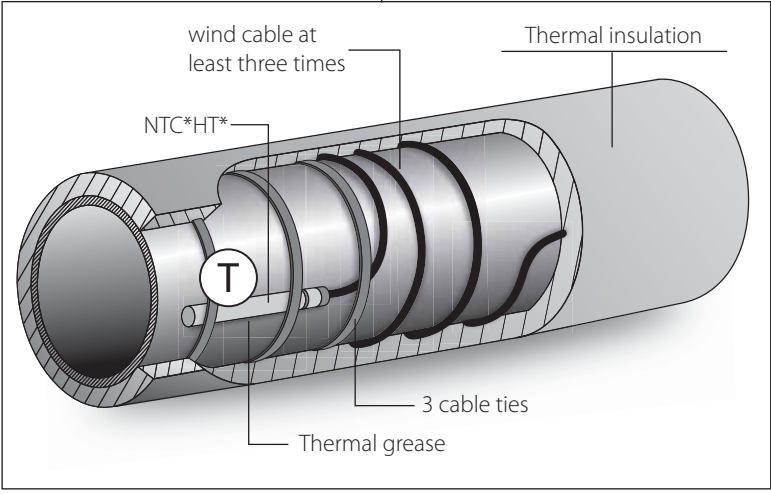
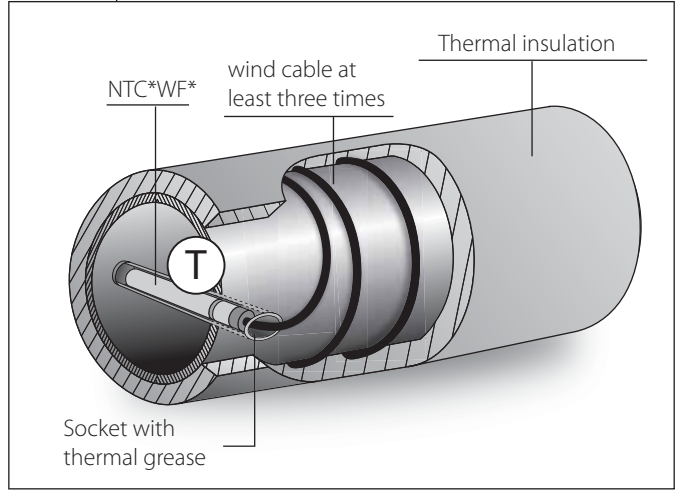
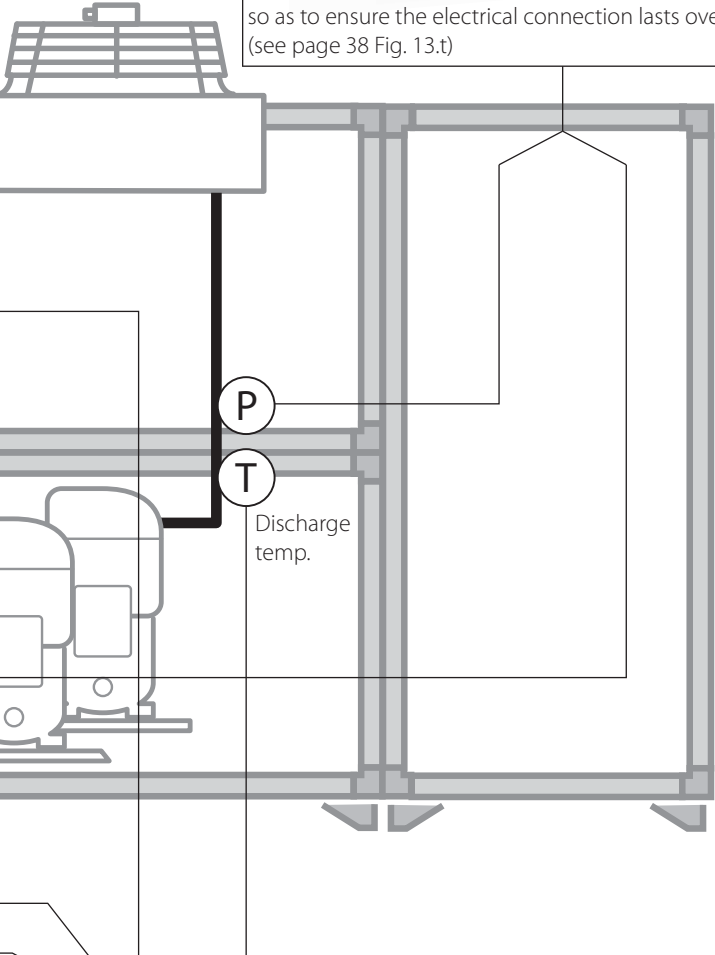
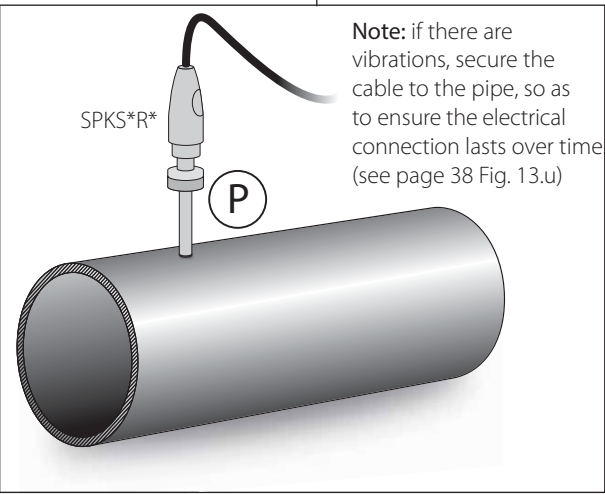




Connection with capillary



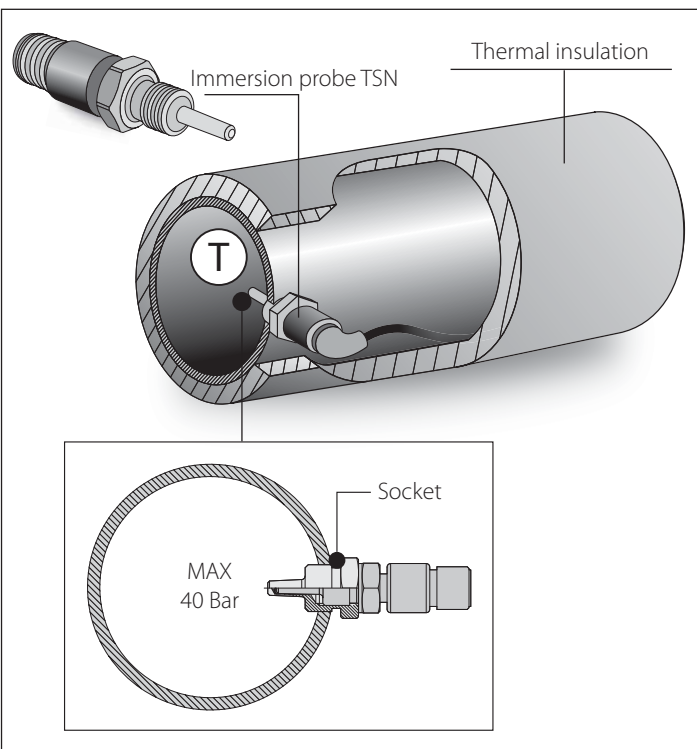
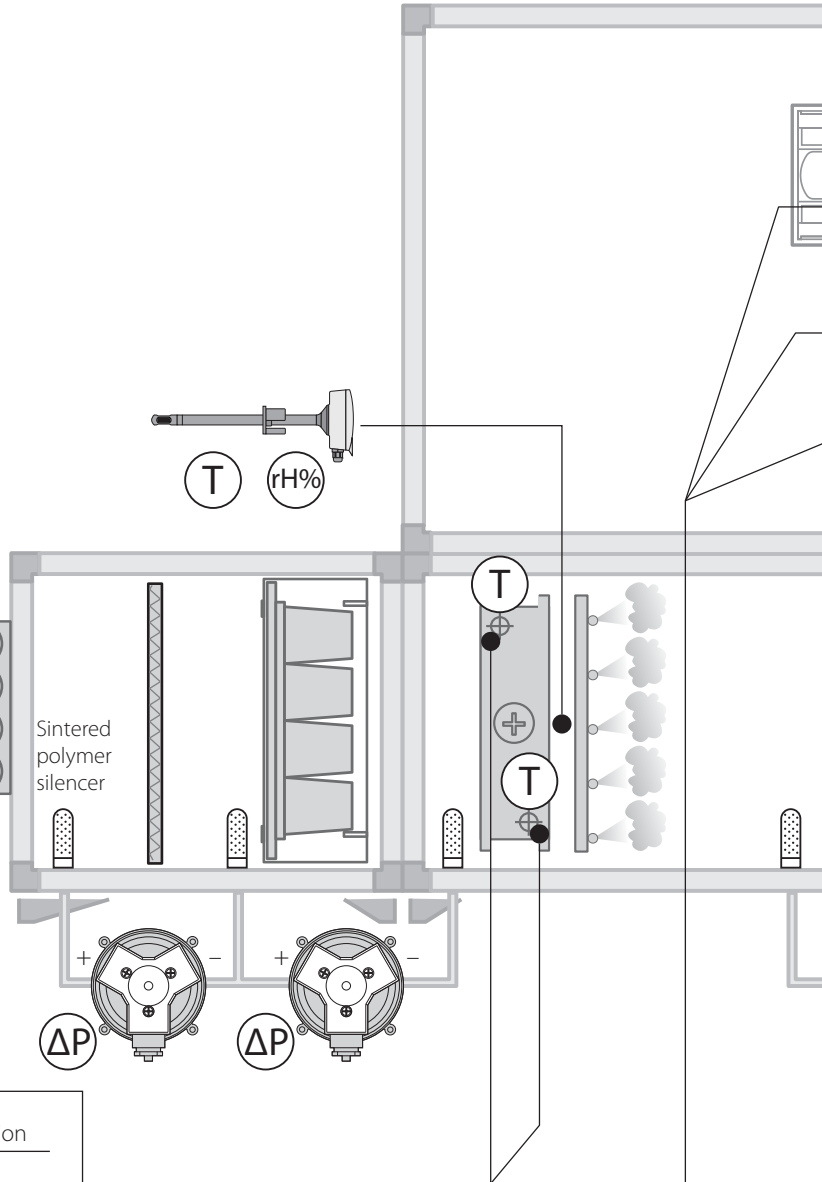
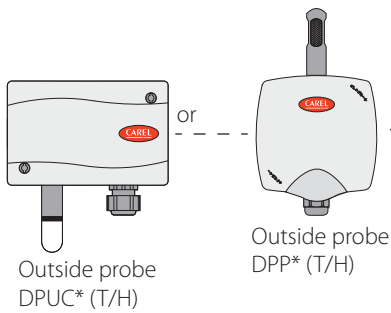
Welded connection



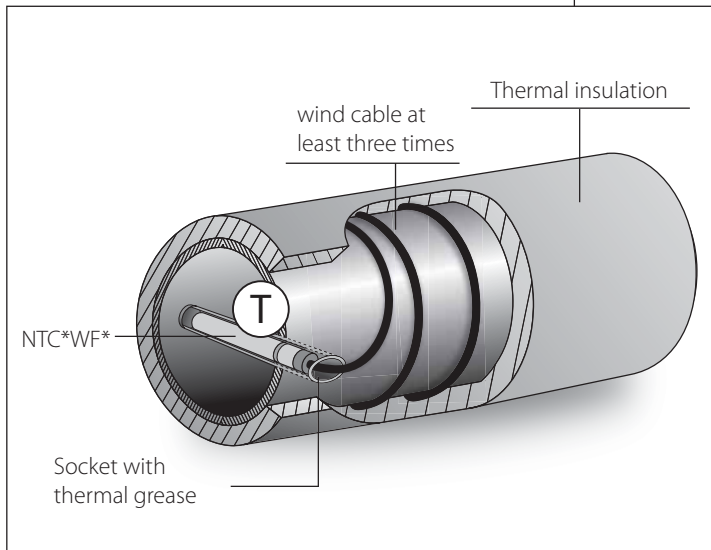
12.6 HVAC: Commercial/residential applications - Rooftop

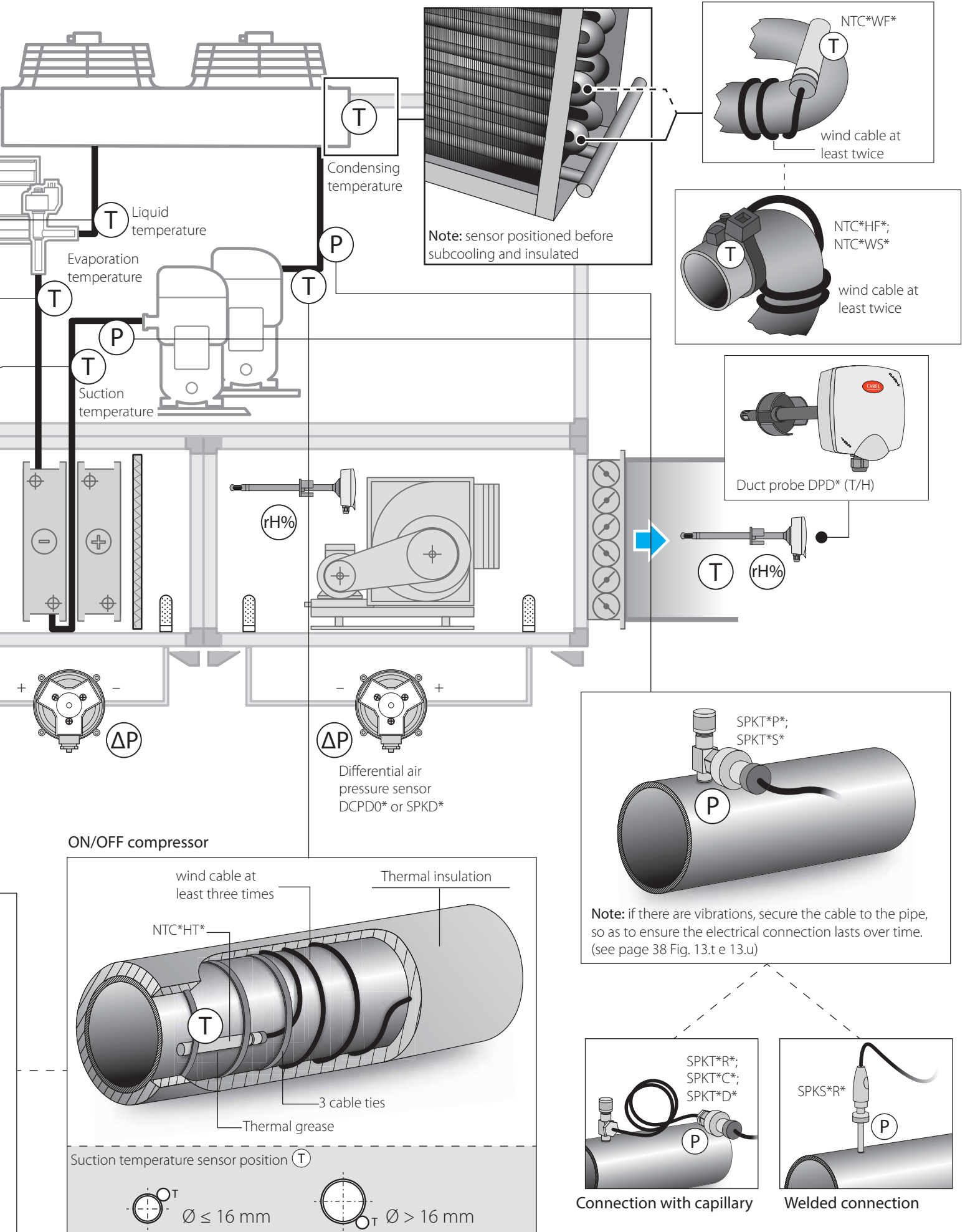
KEY

T	Temperature
P	Pressure
rH%	Relative humidity
ΔP	Differential pressure



BLDC compressor

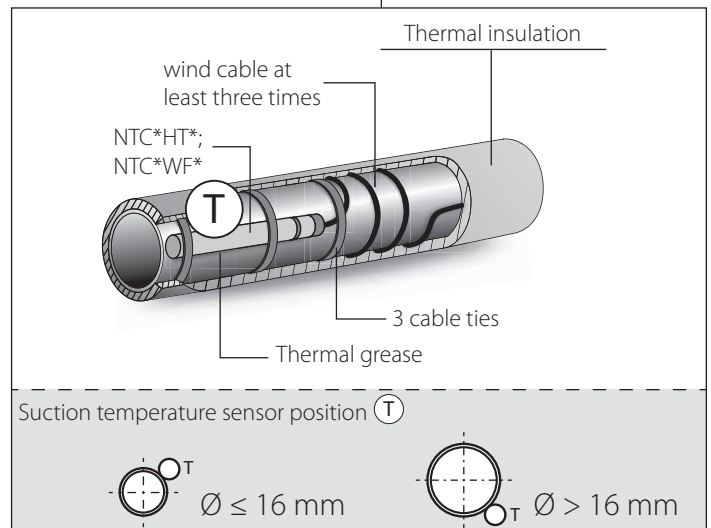
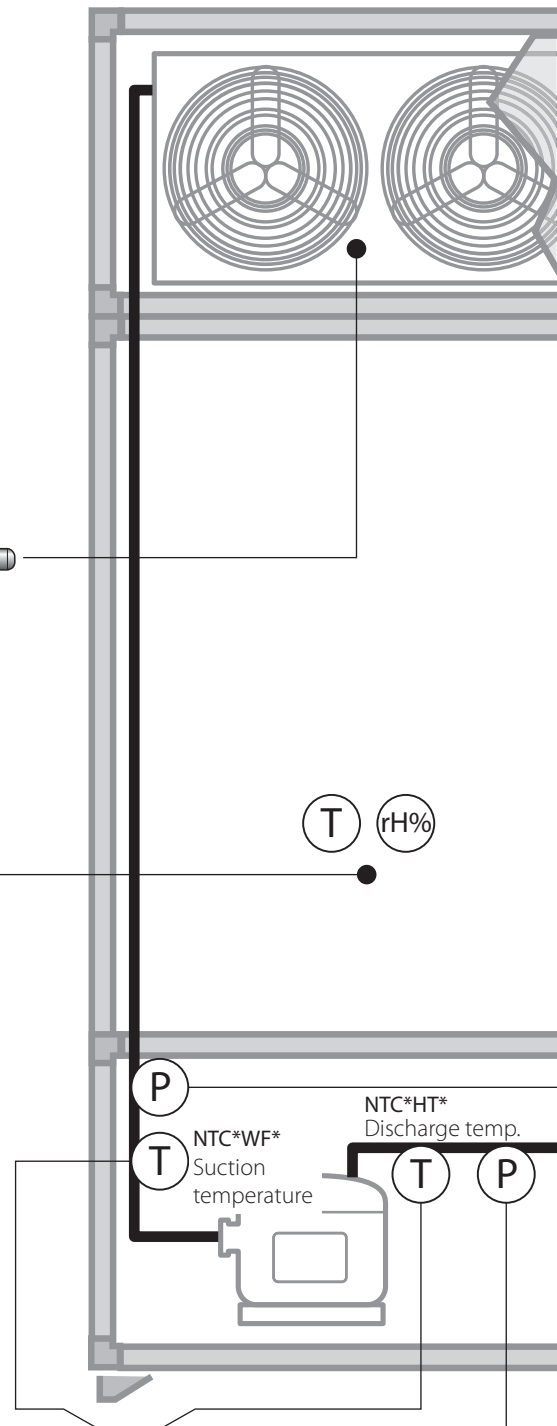
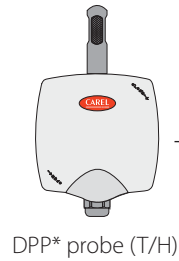
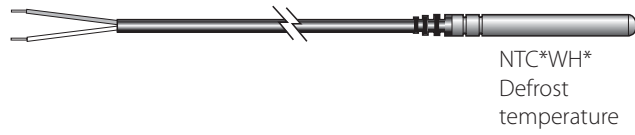


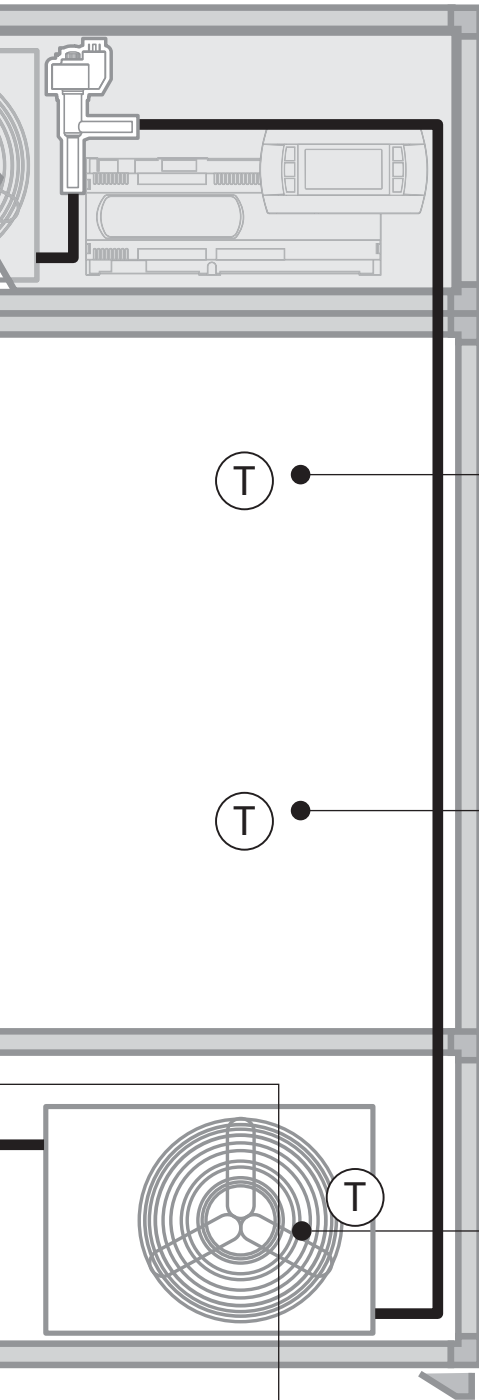


12.7 Blast chillers/freezers

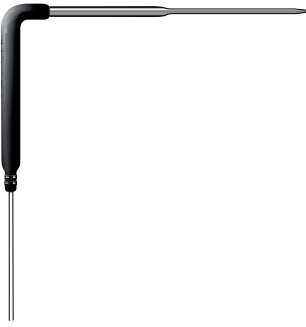
KEY

T	Temperature
P	Pressure
rH%	Relative humidity





Piercing probe NTCINF610*
Product temperature



T

NTC*HP*;
NTC*HF*;
NTC*WS*



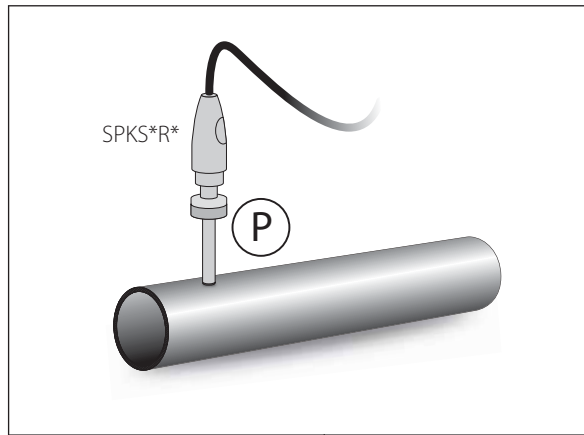
Cold room
temperature

T

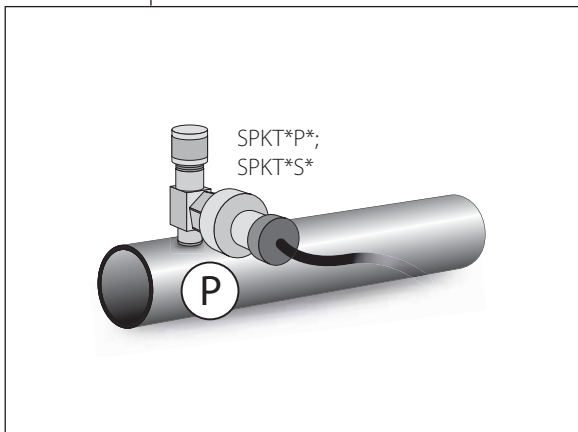
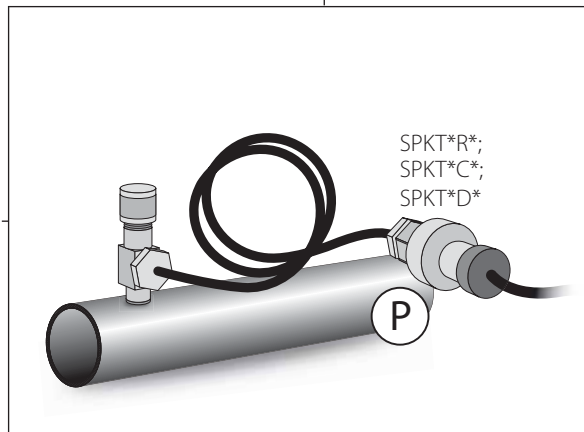
Condensing
temperature

T

Welded connection



Connection with capillary

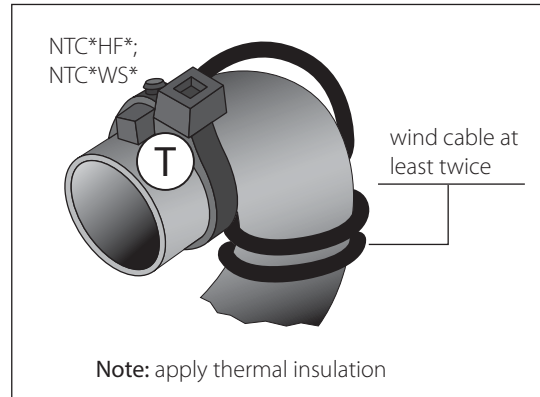
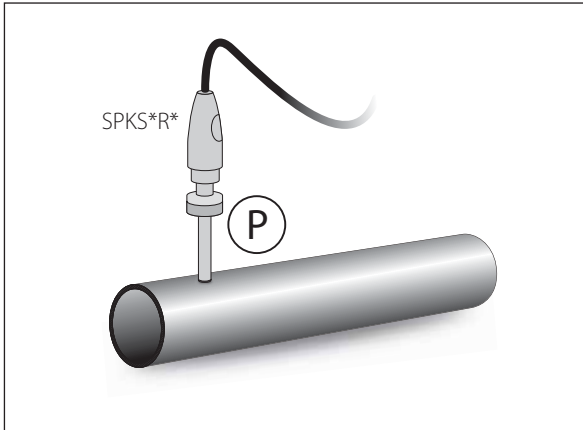


12.8 Stand-alone showcases/bottle coolers

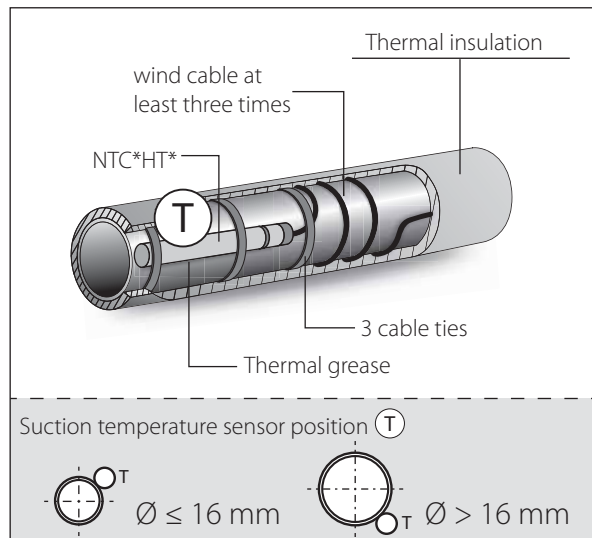
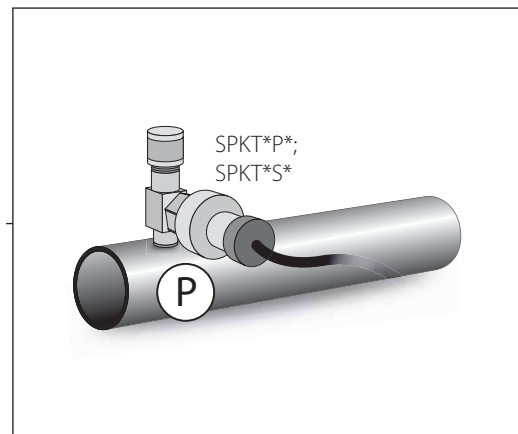
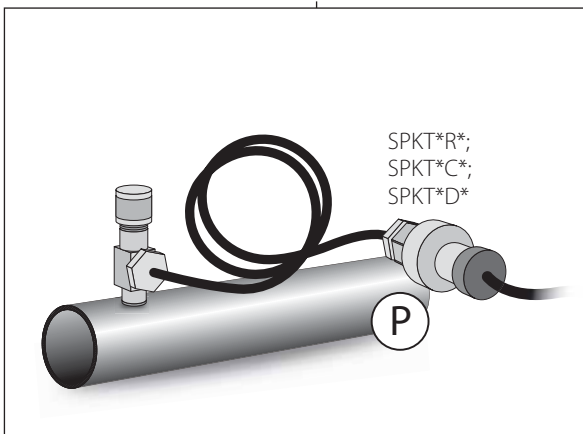
KEY

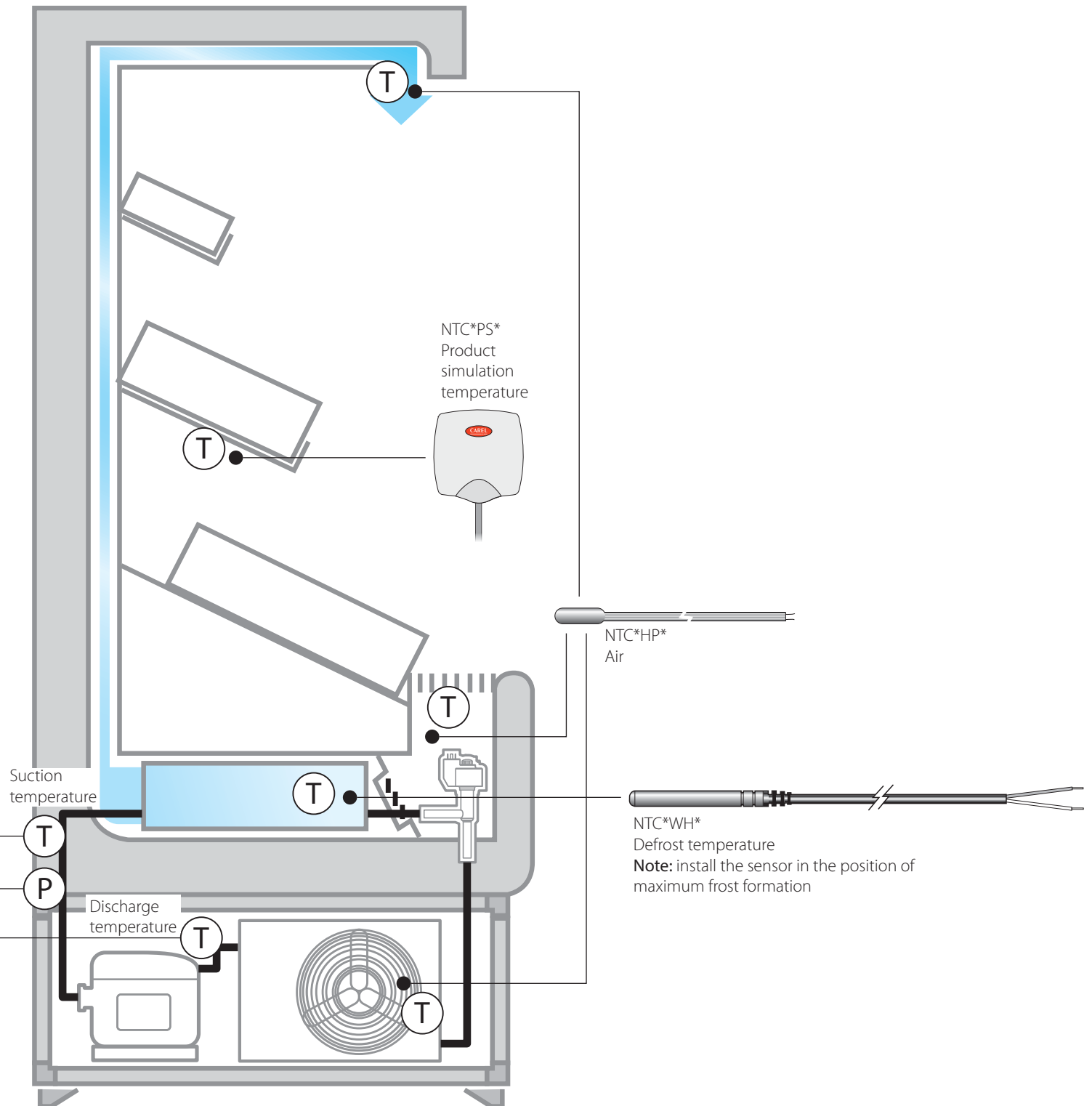
T	Temperature
P	Pressure

Welded connection



Connection with capillary

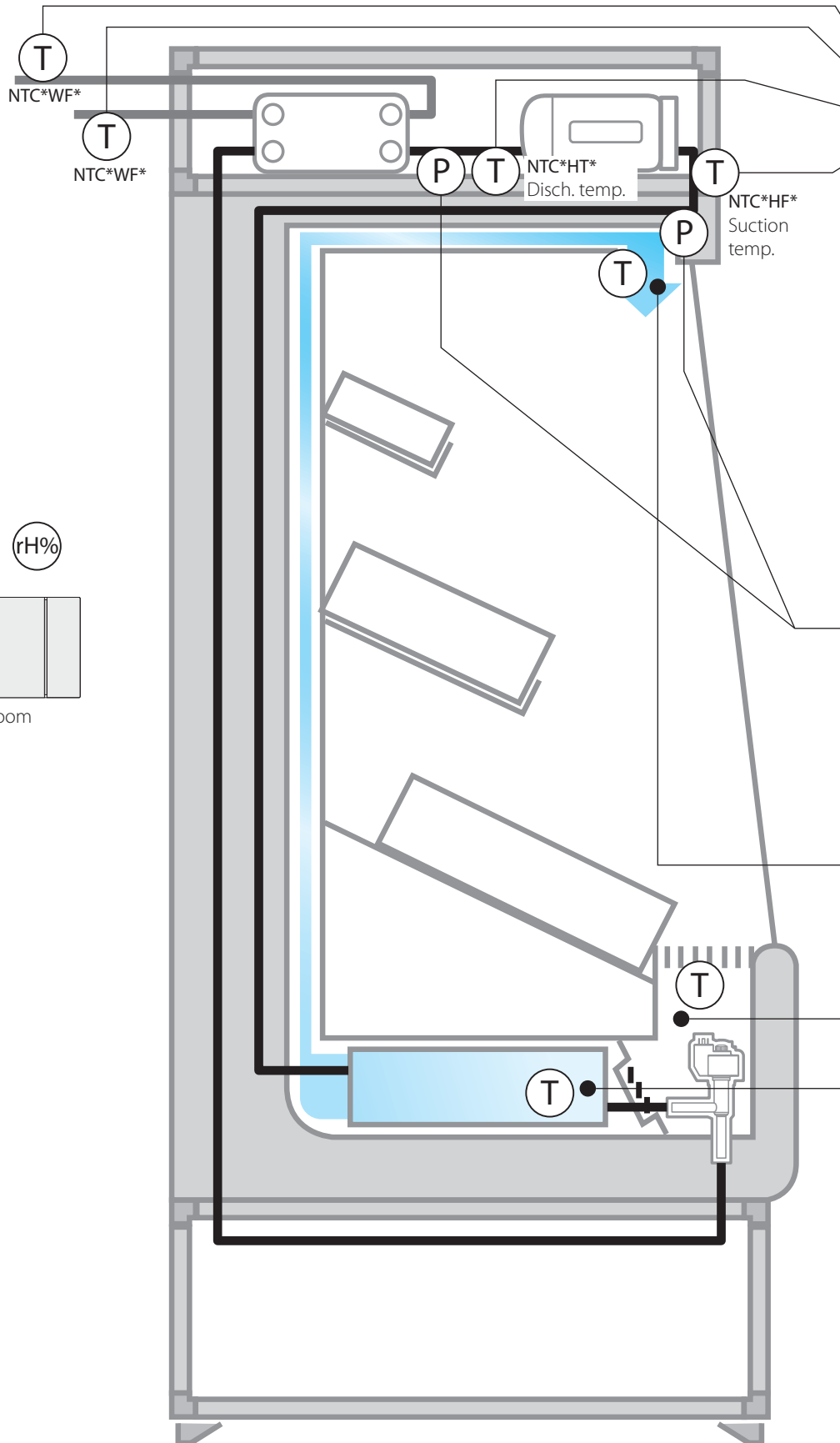
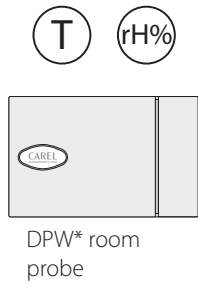


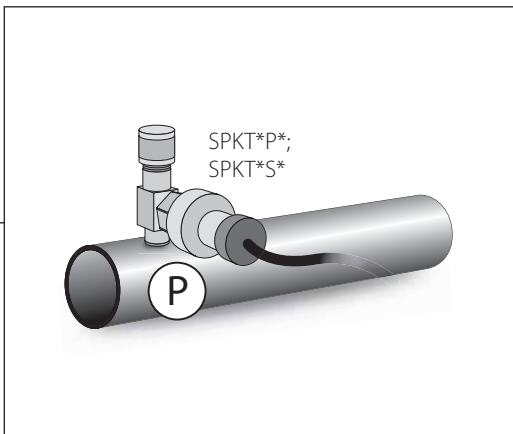
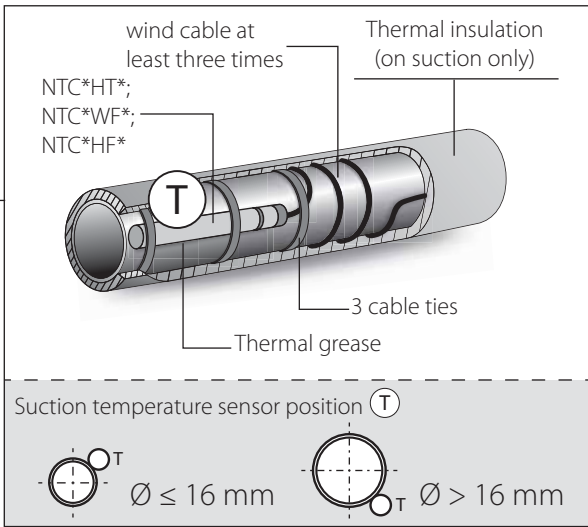


12.9 Water-cooled stand-alone showcases

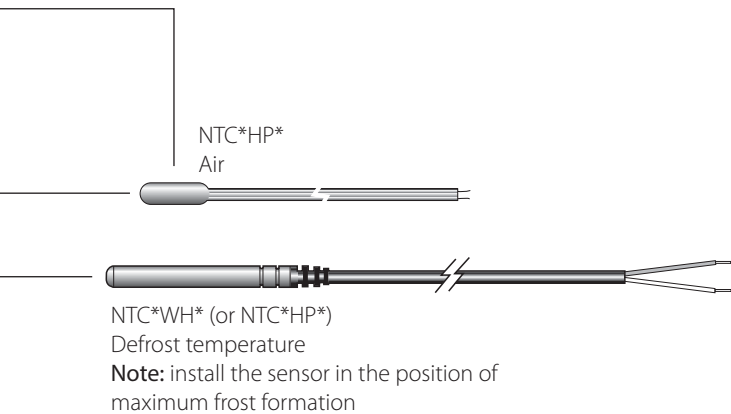
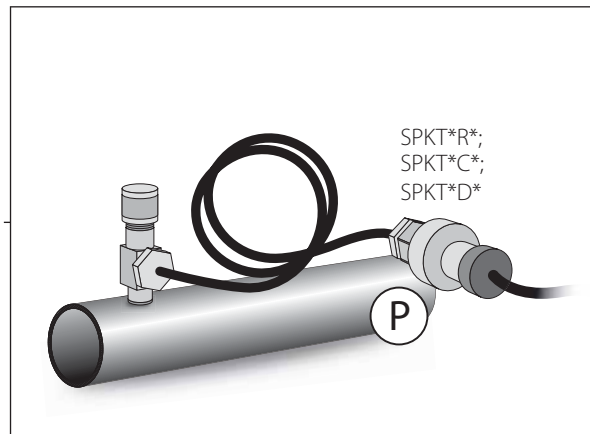
KEY

T	Temperature
rH%	Relative humidity
P	Pressure

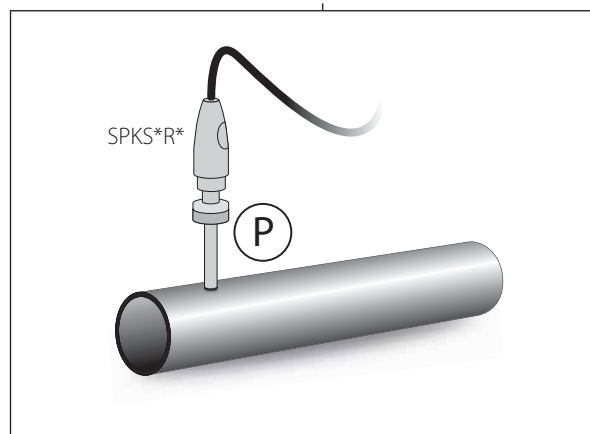




Connection with capillary



Welded connection

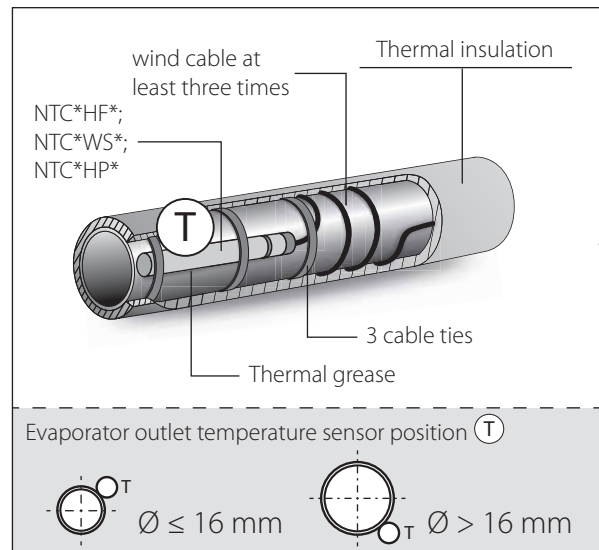
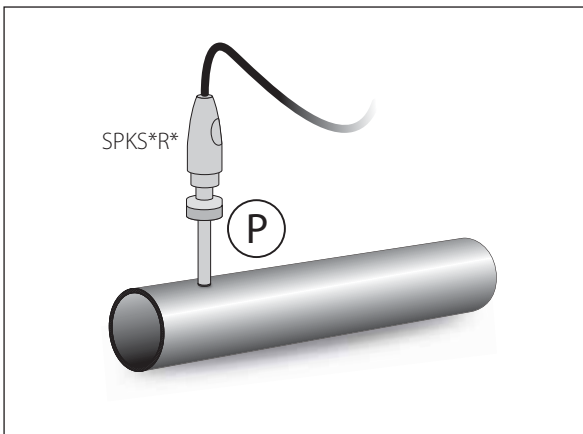


12.10 Centralised/multiplexed cabinets

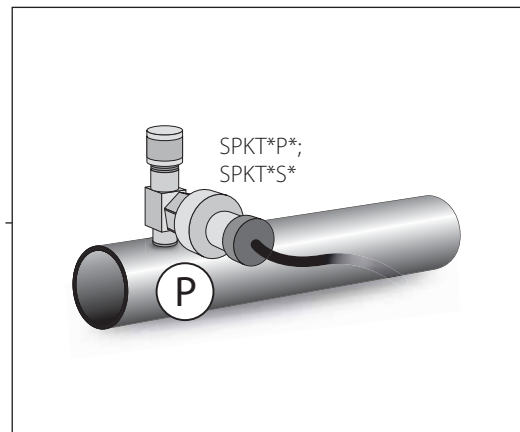
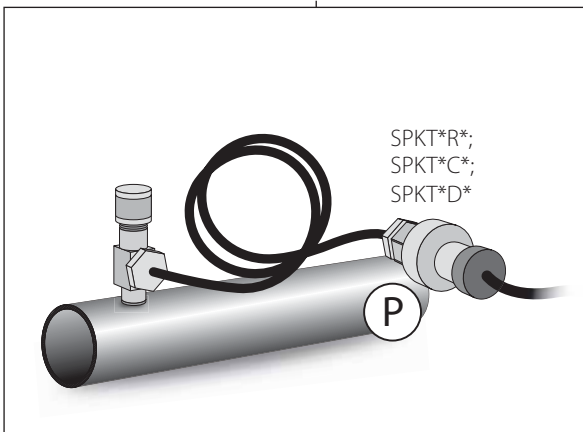
KEY

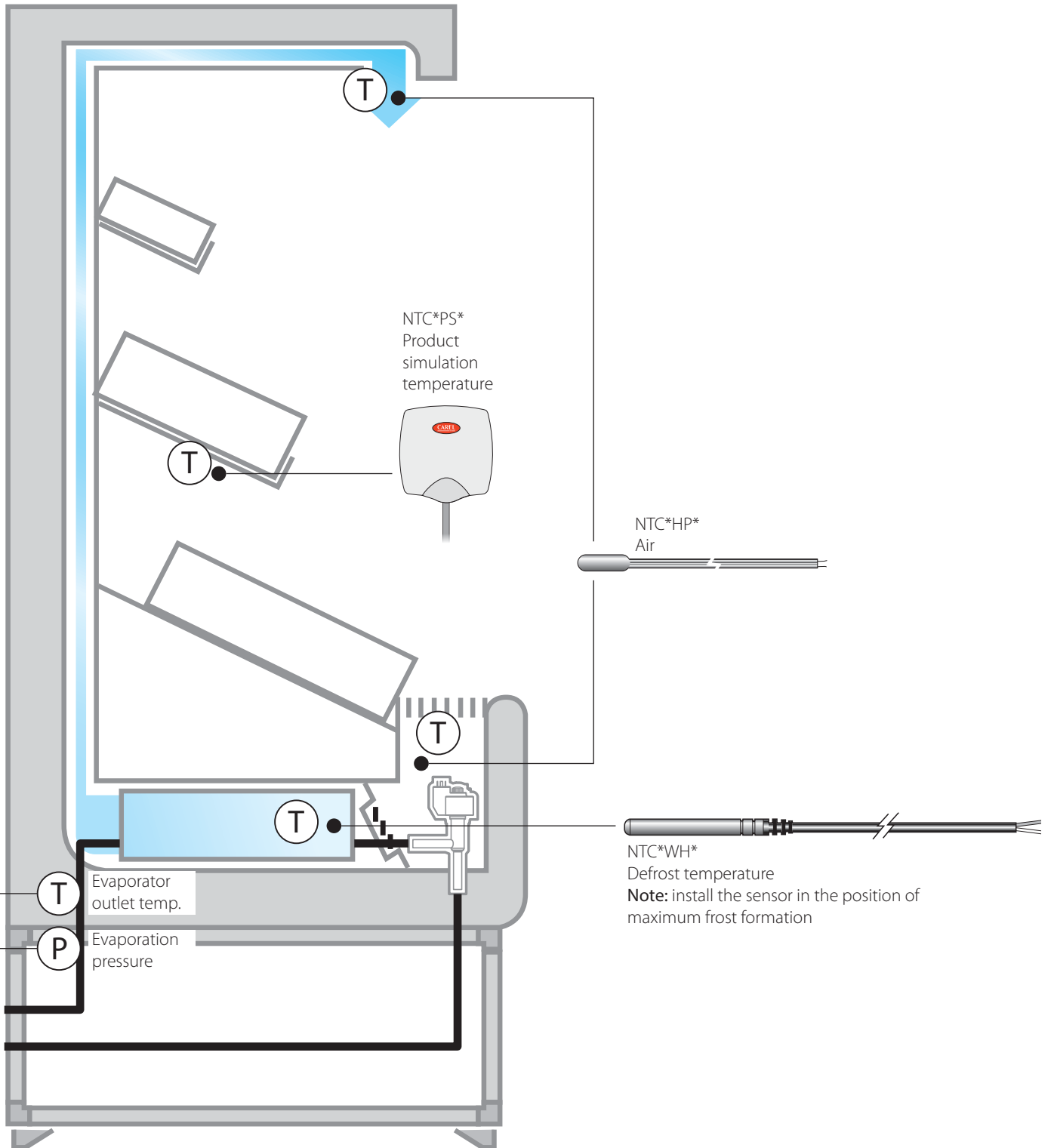
T	Temperature
P	Pressure

Welded connection



Connection with capillary

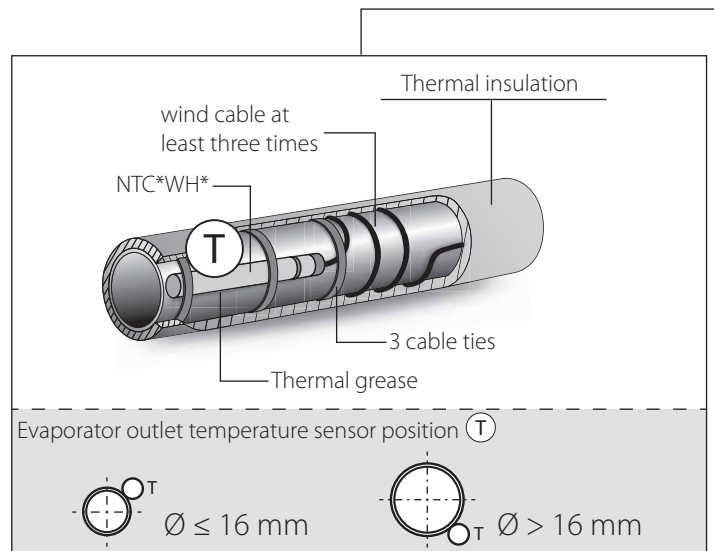
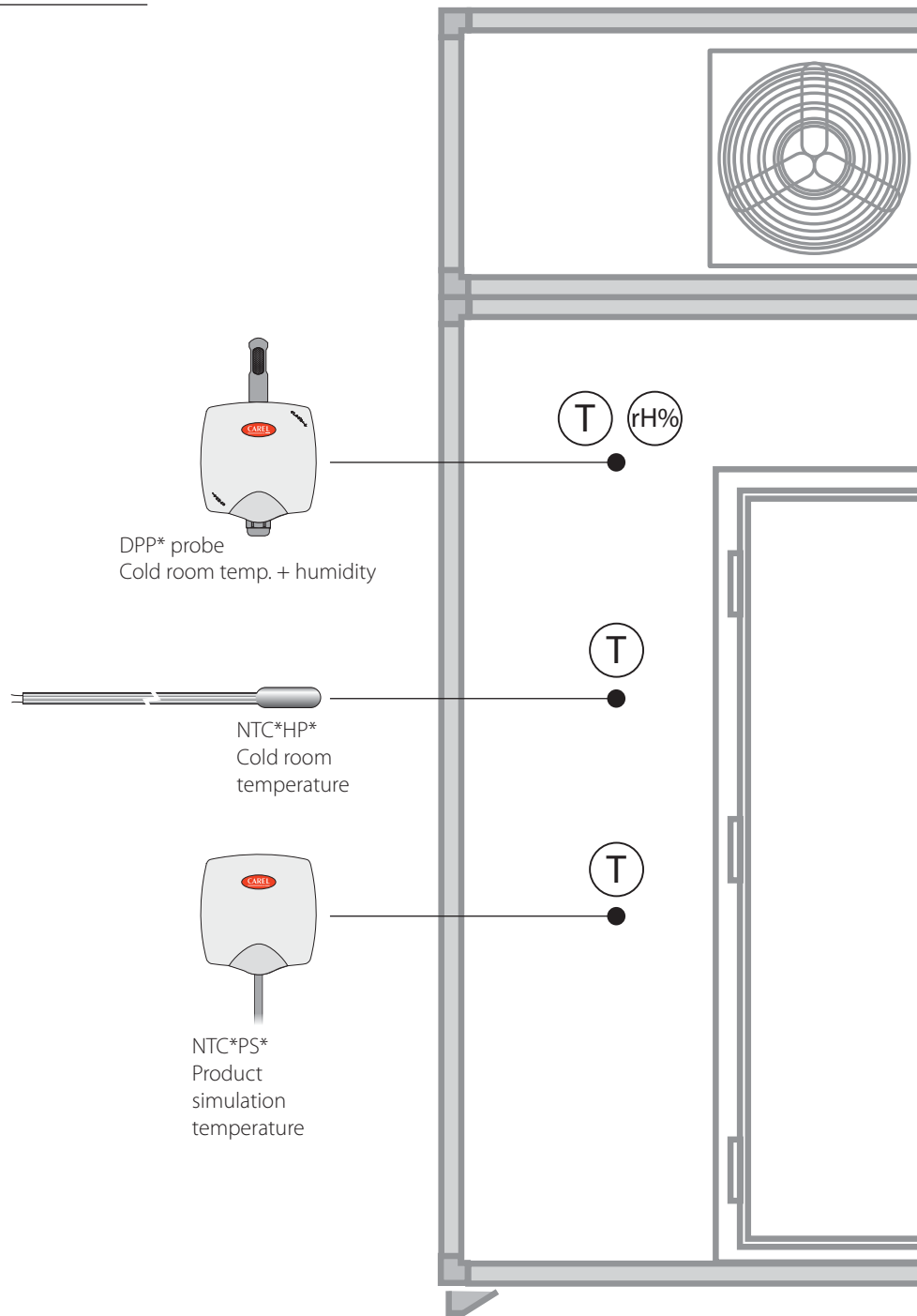


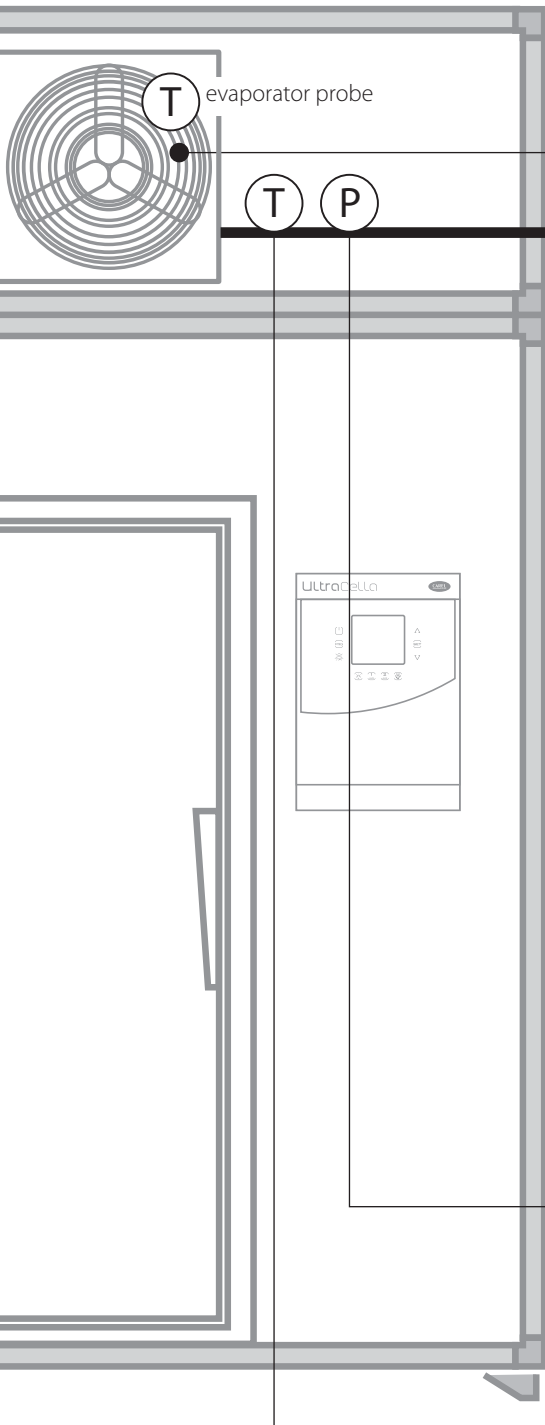


12.11 Cold rooms

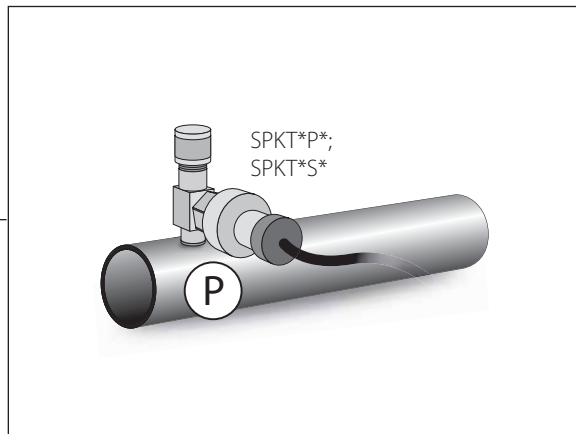
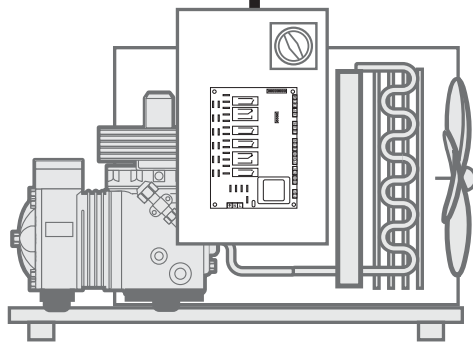
KEY

(T)	Temperature
(P)	Pressure
(rH%)	Relative humidity

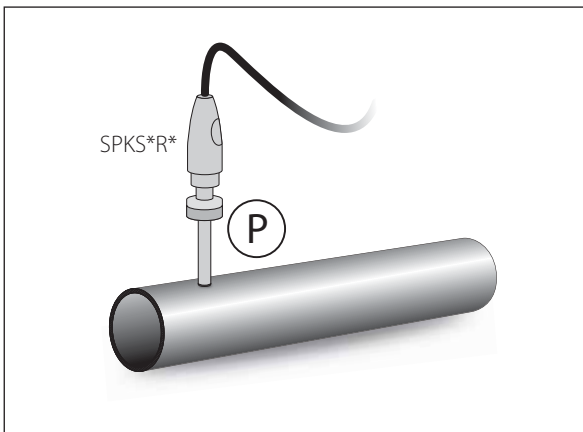




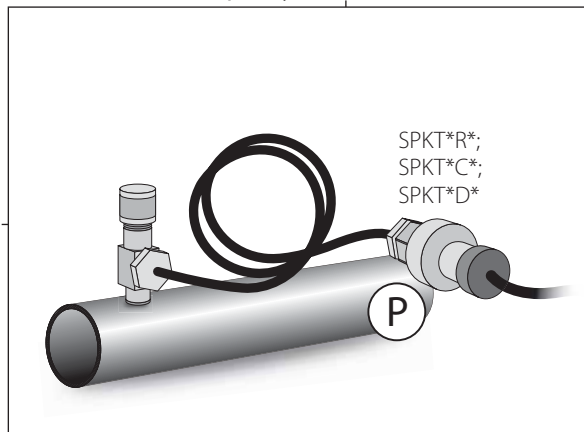
NTC*WH*
 Defrost temperature
Note: install the sensor in the position of maximum frost formation



Welded connection



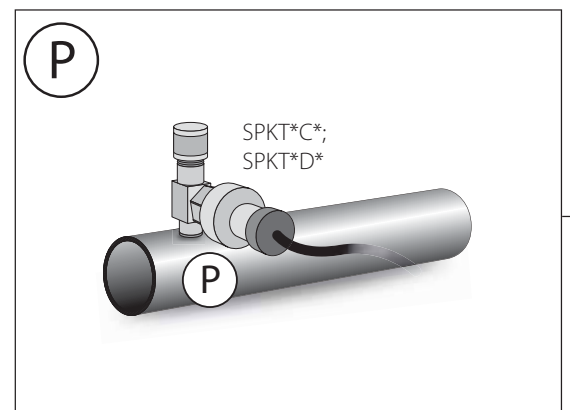
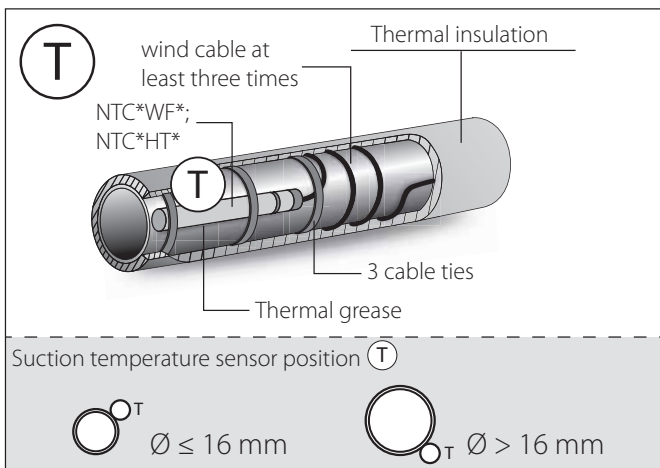
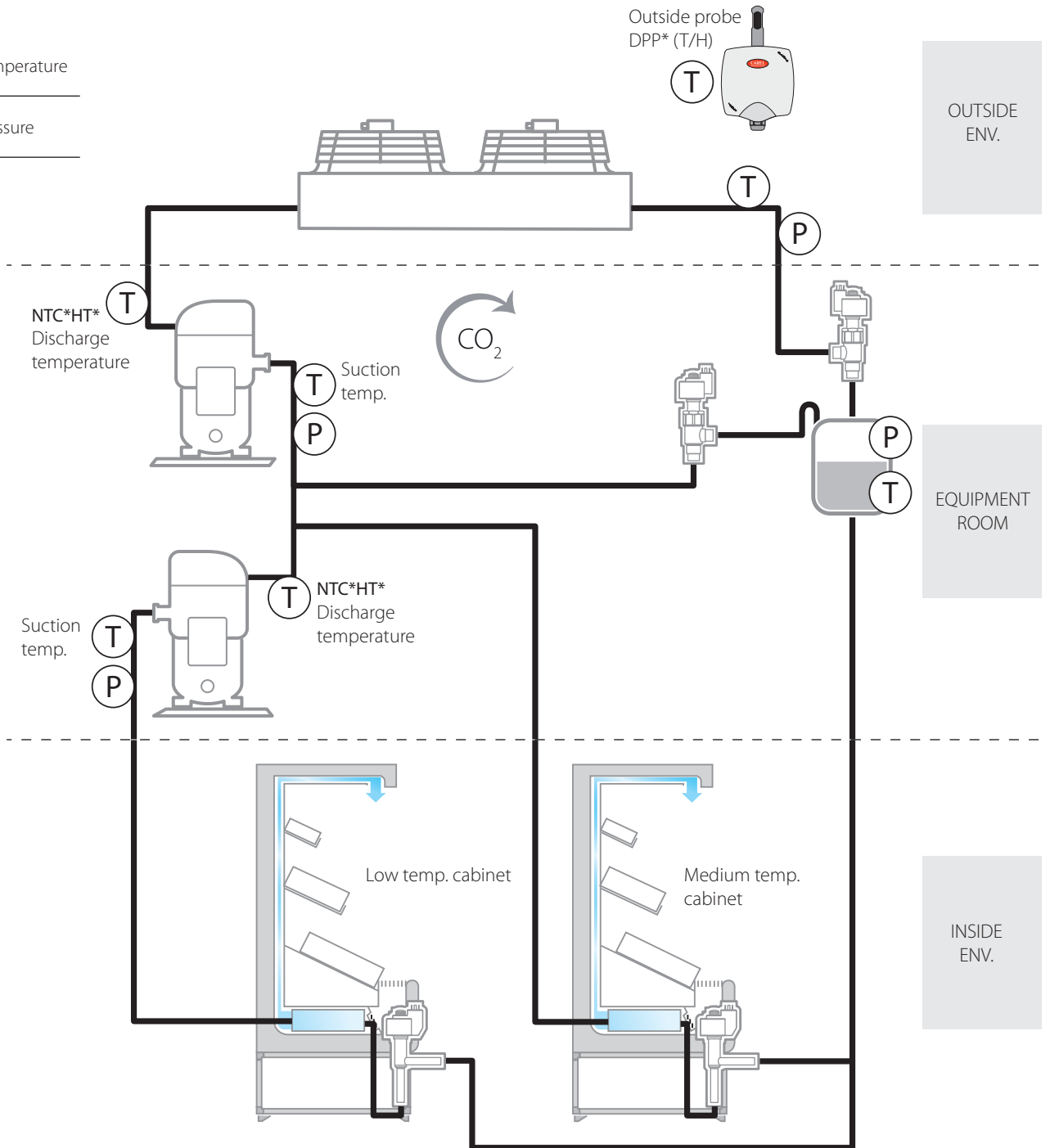
Connection with capillary



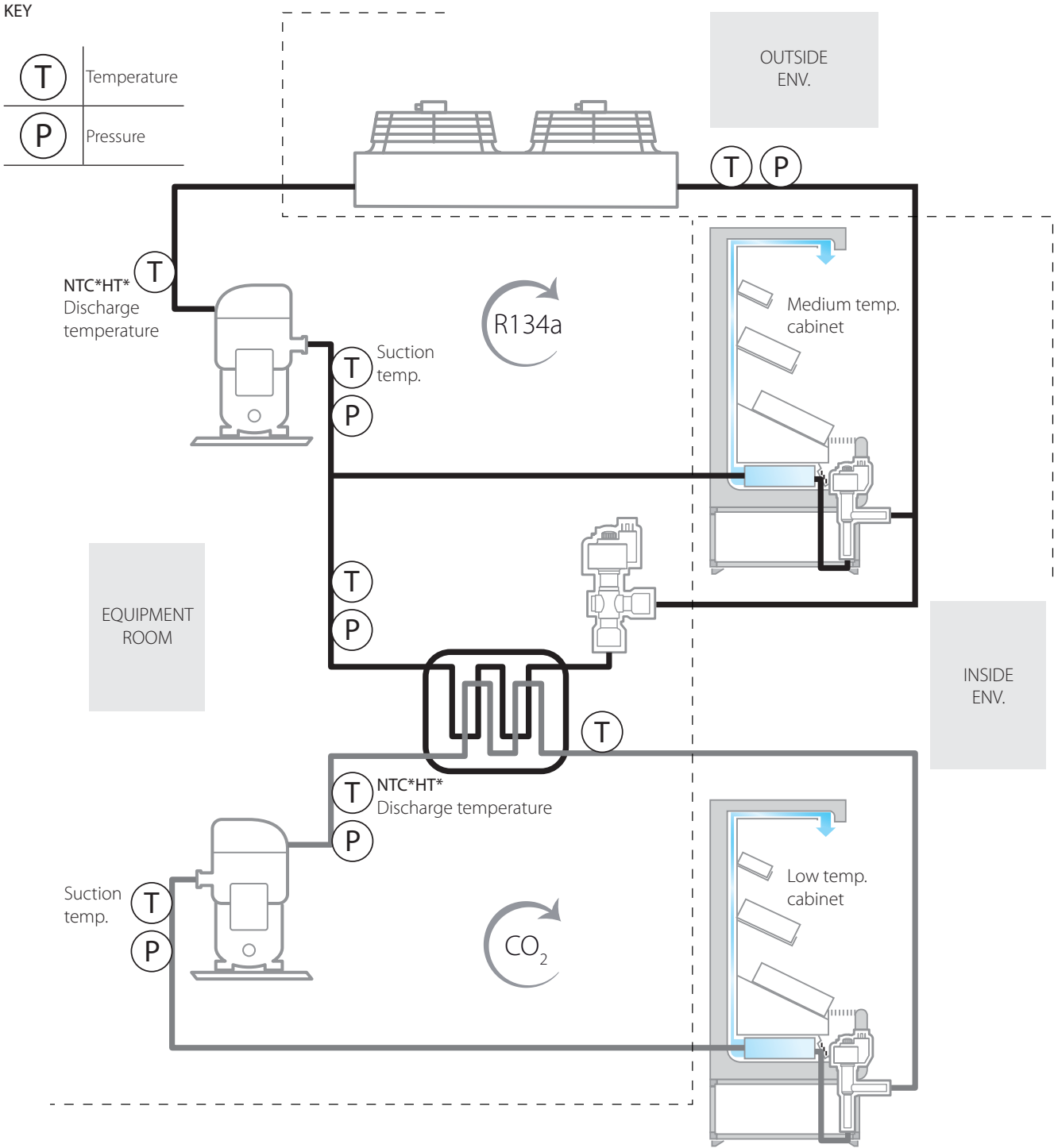
12.12 Transcritical CO₂ systems

KEY

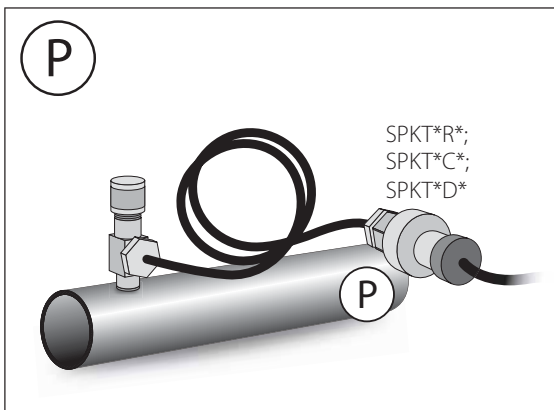
T	Temperature
P	Pressure



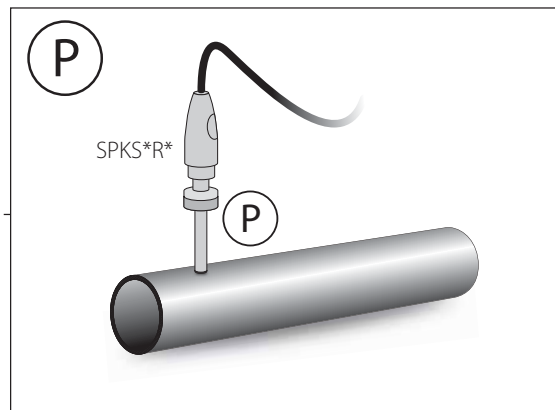
12.13 Subcritical CO₂ systems



Connection with capillary



Welded connection



13. FURTHER SUGGESTIONS

13.1 Room temperature and humidity sensors

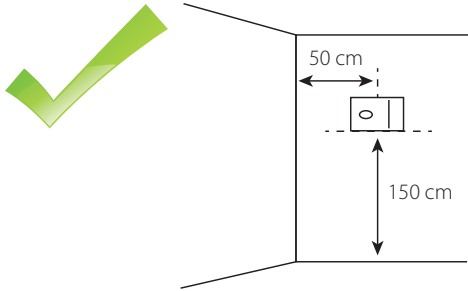


Fig. 13.a

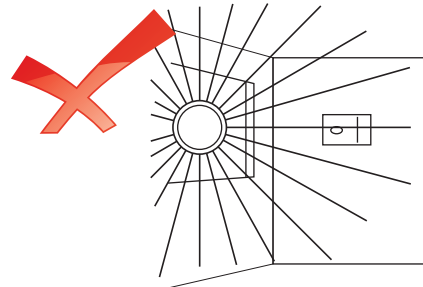


Fig. 13.b

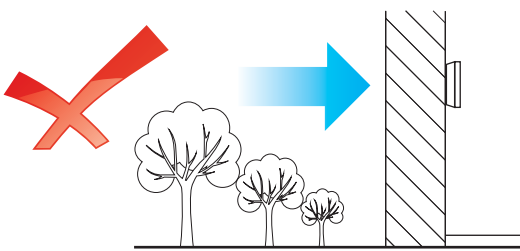


Fig. 13.c

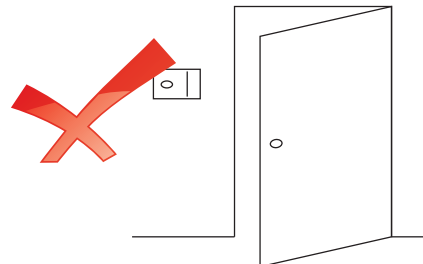


Fig. 13.d

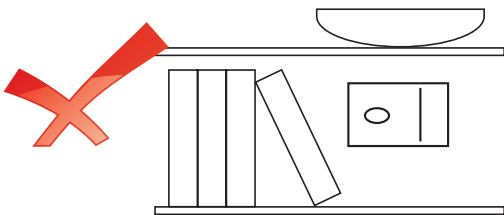


Fig. 13.e

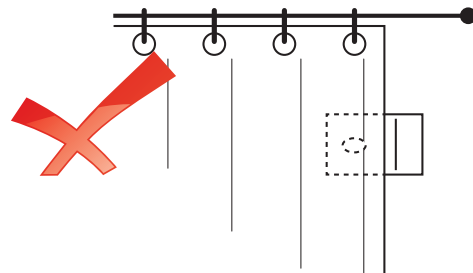


Fig. 13.f

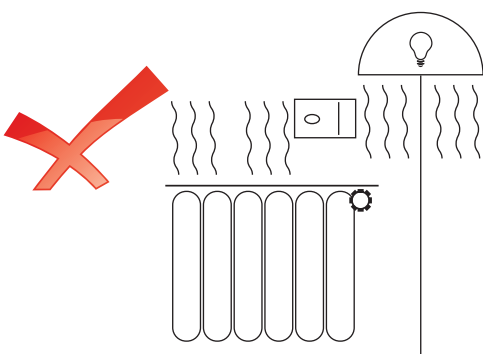


Fig. 13.g

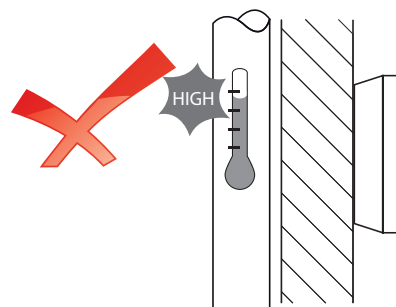


Fig. 13.h

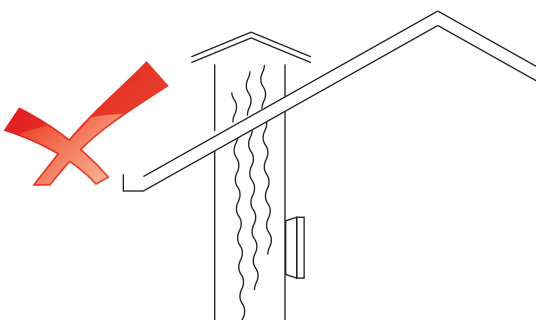


Fig. 13.i

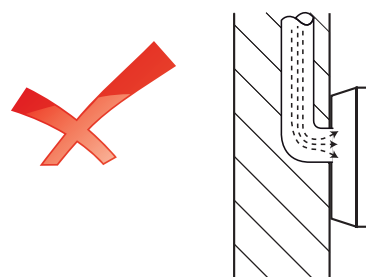


Fig. 13.l

13.2 Duct temperature and humidity sensors

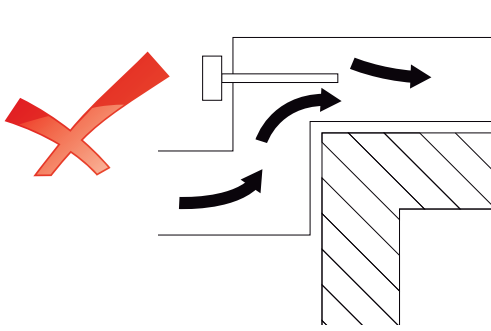


Fig. 13.m

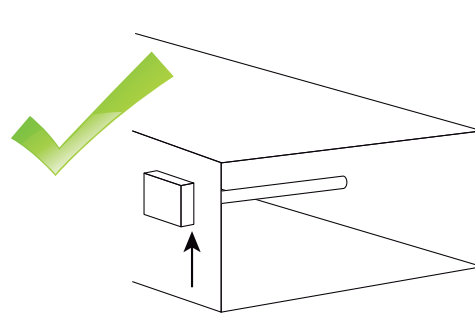


Fig. 13.n

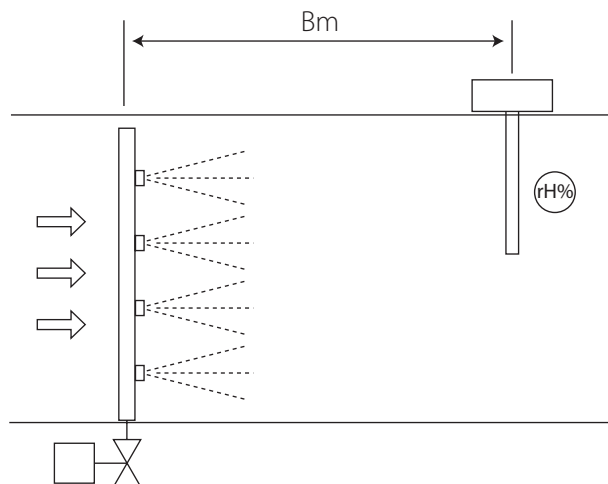
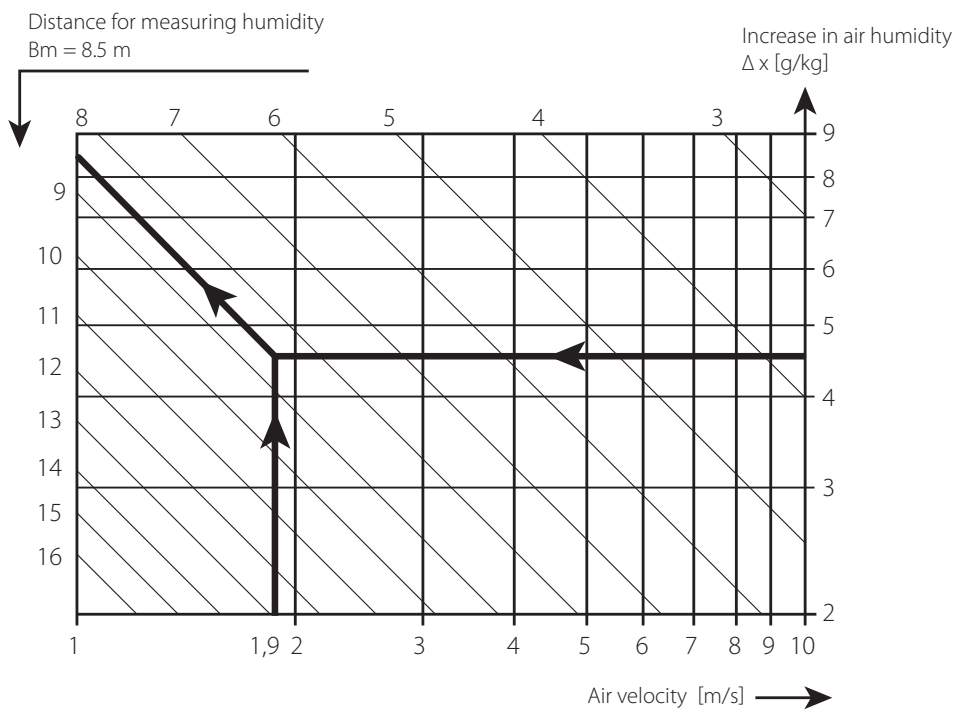


Fig. 13.o

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