REV. Rev.	DATA EMISSIONE Issue Date	CODICE EMISSIONE Issue Code	DESCRIZIONE REVISIONE Revision Description	PREPARATO DA Issued by	CONTROLLATO DA Checked by		APPROVATO DA Approved by
00	04/02/2016	F	FIRST ISSUE	MP	NM		NM
				AUTORIZZAZIONE EMISSIONE Issue Authorization			

DOCUMENTO ESTERNO – STATO DI APPROVAZIONE
Incoming Document – Approval Status

L'APPROVAZIONE DA PARTE DI TM.E NON SOLLEVA IL FORNITORE DALL'OBBLIGO DI SODDISFARE GLI IMPEGNI CONTRATTUALI E DALLE RESPONSABILITA' CHE NE DERIVANO TM.E Approval does not exempt the supplier from observing contractual obligations and from his consequent	APPROVATO Approved	APPROVATO COME CORRETTO Approved as Corrected	NON APPROVATO Not Approved	NON RICHIEDE APPROVAZIONE Approval not Required

TM.E. S.p.A.
Termomeccanica Ecologia

Gruppo Termomeccanica

acea ambiente

A.R.I.A.
Acea Risorse e
Impianti per l'Ambiente

VENTILATORE ARIA PRIMARIA L1-S25-CO019-ARIA SECONDARIA L1-S25-CO010-DEODOROZZAZIONE L1-S50-CO010-RICIRCOLO FUMI L1S20-CO045-TIRAGGIO FUMI L1-S20-CO043/CO044

MANUALE USO E MANUTENZIONE - SUBFORNITORI

COMMESSA N° Job N°	CODICE CLASSIFICAZIONE DOCUMENTO Document Classification Code	IMPIANTO Plant	SISTEMA System	UNITÀ FUNZ. Functional Unit	TIPO DOC. Document Type
10182		SF	S25-S50-S20	L1	EQM

DERIVATO DA Derived from	SOSTITUISCE DOCUMENTO N° Substitute Document N°	EMESSO DA Issued by
-	-	INDUSTRIE CBI

INDEX

Giunti di trasmissione

Ventilatore	Tipo giunto	Item cliente
MB00239	SAMIFLEX A7CS	L1 S20-CO 043; L1 S20-CO 044
MB00257	SAMIFLEX A45CS	L1 S20-CO 045
MB00258	SAMIFLEX A6CS	L1 S25-CO 010
ZB00225	SAMIFLEX A6CS	L1 S25-CO 019

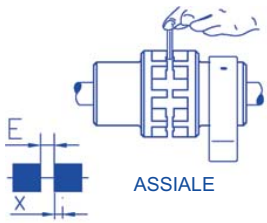
PTI S.R.L.

POWER TRANSMISSION INNOVATION

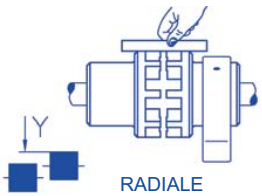
samiflex®

Giunto elastico

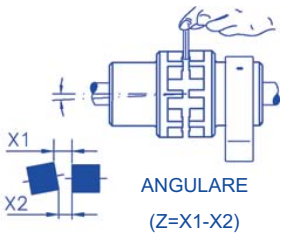
Tolleranze di allineamento



ASSIALE



RADIALE



ANGULARE
(Z=X1-X2)

Dimensioni di Montaggio (E) e tolleranze in "mm"

Tipo	A00	A0	A1	A2	A3	A4	A45	A5	A55	A6	A7	A8	A9	A10	A11	A12
E Montaggio	1,5	1,5	1,5	2,5	2,5	3,5	3,5	3,5	3,5	3,5	4	5	5	6	6	5
Assiale X	+0,3	+0,3	+0,5	+0,5	+0,7	+0,8	+1,0	+1,0	+1,0	+1,0	+1,0	+1,5	+1,5	+2	+2	+3
Radiale Y	0,1	0,1	0,1	0,1	0,15	0,20	0,20	0,20	0,20	0,20	0,30	0,30	0,30	0,40	0,40	0,60
Angulare Z	0,10	0,10	0,20	0,20	0,30	0,40	0,40	0,50	0,50	0,60	0,90	1,10	1,30	1,70	1,70	2,00

Selezione Giunto

Fattore F1

MACCHINA CONDOTTA / ESEMPI	MOTORE ELETTRICO	DIESEL E MOTORI A BENZINA P	
		4 - 6 CILINDRI	1 - 3 CILINDRI
Operatività uniforme, con piccolo masse in accelerazione. Pompe Idrauliche e centrifughe, Leggeri generatori di transmissione, ventilatori, Equipaggiamento di trasferimento.	1,5	1,8	2,5
Operatività uniforme, con medie masse in accelerazione. Macchine per la curvature di lamiere, Molini, Macchine tessili, Mixers, Agitatori.	1,8	2	2,8
Com Masse Medie in accelerazione e operatività irregolare. Rotative, Macchine da Stampa e colorazione, generatori, trituratori, Avvolgitrici, pompe per fluidi viscosi.	2,0	2,5	3
Con Masse medie in accelerazione, operatività irregolare e possibili shock. Betoniere, Magli, Macchine per cavi, Molini per lavorazione carta, Pupler, Pompe di compressione, Pompe di propulsione. Avvolgitori cavi, centrifughe.	2,5	2,8	3,5
Grandi Masse in accelerazione, Operativitità irregolare e pesanti. Escavatori, Molini Spappolatori, Pompe a pistoni, Presse, Macchine di foratura rotanti, Presse per Forge, Presse da stampa, Cesoie.	2,8	3	3,8
Grandissime Masse in accelerazione, Operatività irregolare, pesanti shocks. Compressori a pistoni e Puma senza variatori di velocità, Rulliere, Macchine per Saldatura, Presse per Mattoni, trituratori di rocce / Sassi.	3,0	3,5	4

Fattore F2

PERIODO OPERATIVITA' ORE / GIORNI			
PIU' DI FINO A	2	2 12	12 24
FATTORE F2	1	1,2	1,4

Fattore F3

AVVIAMENTI PER ORE					
PIU' DI FINO A	10	10 40	40 120	120 200	200
FATTORE F3	1	1,3	2	2,5	3

METODO

Dati necessary per la corretta selezione del size del giunto
- Kw della macchina motrice.
- R.p.m. della macchina motrice
- Coefficiente di servizio F, (vedi sotto).
- Diametri alberi macchina motrice e condotta

(1) Calcolare la Potenza nominale (Pn) in Nm.

$$Pn = \frac{7.160 \times H.P.}{r.p.m.} \qquad Pn = \frac{9.550 \times Kw}{r.p.m.}$$

(2) Usa I valori ottenuti dale tabelle F1, F2 e F3 per determinare il coefficient di servizio F.
F = F1 x F2 x F3
Calcolare la Coppia Max (Pc) Pc = Pn x F

(3) Nella Tabella dei Dati tecnici Giunti Samiflex verificare I valori di Coppia Nominale e Massima per ogni giunto .

(4) Selezionare Il giunto la cui Coppia Nominale è maggiore del valore (Pn) o la cui Coppia Max è maggiore del Valore (Pc)

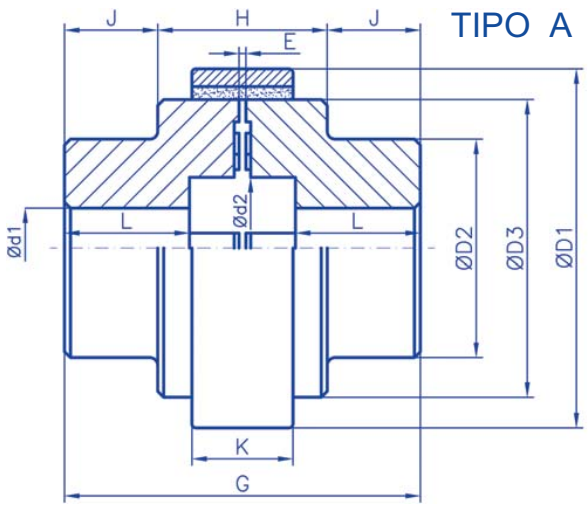
ESEMPIO

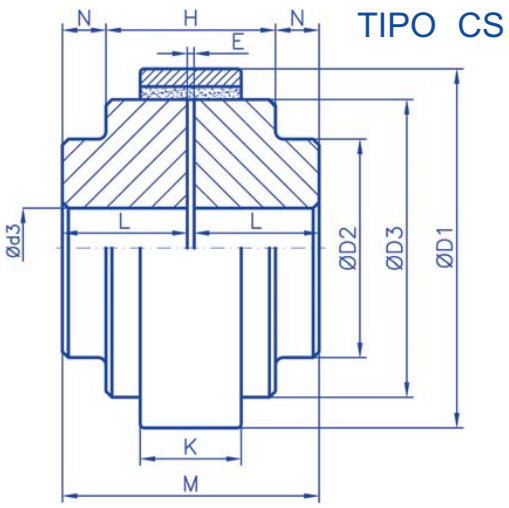
- Motore Elettrico – 55 Kw
- R.P.M. – 1.500
- Diam Albero motore – 65 mm.
- Diam Albero Pompa – 48 mm.
- Macchina Condotta – Pompa Centrifuga
- Periodo di funzionamento 24 Ore/ giorno

$$Pn = \frac{9.550 \times 55}{1.500} = 350 \text{ Nm}$$

F1 = 1,5
F2 = 1,4
F3 = 1
F = F1 × F2 × F3 = 1,5 × 1,4 × 1 = 2,1
Pc = Pn × F = 350 × 2,1 = 735 Nm
Selezionato A4
Coppia Nominale = 460 Nm
Max Coppia = 1.150 Nm
Max. Foro = 65 mm.

GIUNTO SAMIFLEX TIPO A & CS





Giunti Samiflex Tipo A

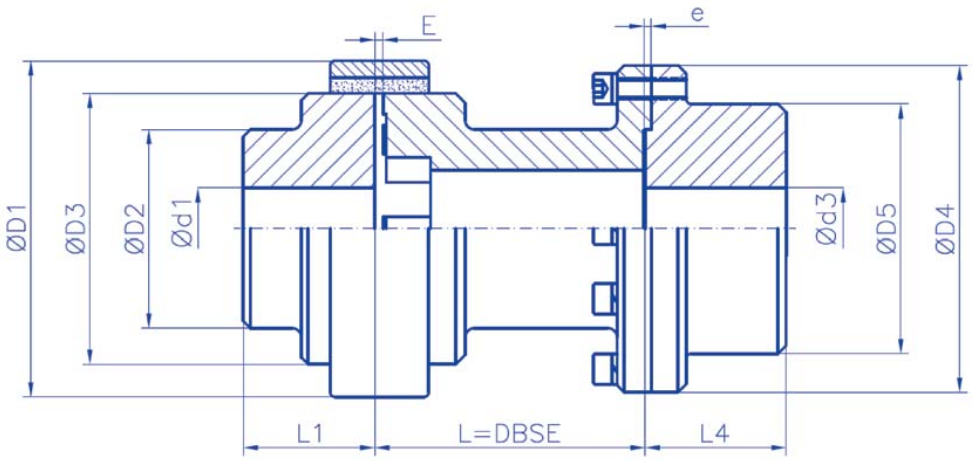
	Samiflex inserto STD Giallo Coppia (Nm)			Ø d1 (mm)		DIMENSIONI IN mm.									
Taglia	Nominale	Massima	r.p.m*	Pre Ø	Ø Max	G	L	Ød2	D1	D2	D3	K	J	H	E
A00	6.5	20	16.000	4	16	51	19	22	44	35	35	12	-	-	1,5
A0	22	55	11.000	8	24	73	28	32	65	52	52	16	-	-	1,5
A1	55	138	8.800	14	38	91	34	39	83	65	65	22	-	-	1,5
A2	110	275	6.500	17	44	127	47	45	111	80	86	32	36	55	2,5
A3	220	550	4.900	19	50	156	56	52	144	85	116	42	45	65	2,5
A3B	220	550	4.900	19	58	156	56	52	144	105	116	42	45	65	2,5
A4	460	1.150	3.800	24	65	180	63	70	182	110	150	51	47	85	3,5
A4B	460	1.150	3.800	24	70	180	63	70	182	135	150	51	47	85	3,5
A45	805	2.013	3.300	25	75	198	70	90	202	125	170	56	52	93	3,5
A5	1.150	2.875	3.000	29	85	216	77	89	225	140	190	59	57	101	3,5
A55	1.725	3.450	2.650	30	95	246	90	115	250	155	215	64	68	109	3,5
A6	2.300	4.600	2.450	39	110	260	95	112	265	180	233	67	70	119	3,5
A7	4.600	9.200	2.100	48	130	310	116	135	306	205	267	75	88	134	4
A8	8.625	17.250	1.750	63	150	382	147	157	363	242	326	85	114	154	5
A9	13.750	27.500	1.450	73	180	420	162	188	425	280	385	92	129	162	5
A10	27.500	44.000	1.175	96	210	482	188	218	523	330	483	102	145	192	6
A11	36.750	58.800	1.650	96	210	512	190	216	503	350	458	128	148	216	6
A12	100.000	160.000	1.175	100	300	709	250	380	710	500	650	210	175	359	5

Giunti Samiflex Tipo CS

	Samiflex inserto STD Giallo Coppia (Nm)			Ø d3 (mm)		DIMENSIONI IN mm.								
Taglia	Nominale	Massimo	r.p.m*	Pre Ø	Ø Max	M	L	D1	D2	D3	K	N	H	E
A1CS	55	138	8.800	14	28	73	34	83	65	65	22	-	-	1,5
A2CS	110	275	6.500	17	35	97	47	111	80	86	32	20,4	55	2,5
A3CS	220	550	4.900	19	42	115,5	56	144	85	116	42	24,7	65	2,5
A4CS	460	1.150	3.800	24	55	129,5	63	182	110	150	51	22	85	3,5
A45CS	805	2.013	3.300	25	65	143,5	70	202	125	170	56	25	93	3,5
A5CS	1.150	2.875	3.000	29	75	157,5	77	225	140	190	59	28,2	101	3,5
A55CS	1.725	3.450	2.650	30	85	184	90	250	155	215	64	37,2	109	3,5
A6CS	2.300	4.600	2.450	39	90	194	95	265	180	233	67	37,2	119	3,5
A7CS	4.600	9.200	2.100	48	110	236	116	306	205	267	75	51	134	4
A8CS	8.625	17.250	1.750	63	120	299	147	363	242	326	85	72,5	154	5

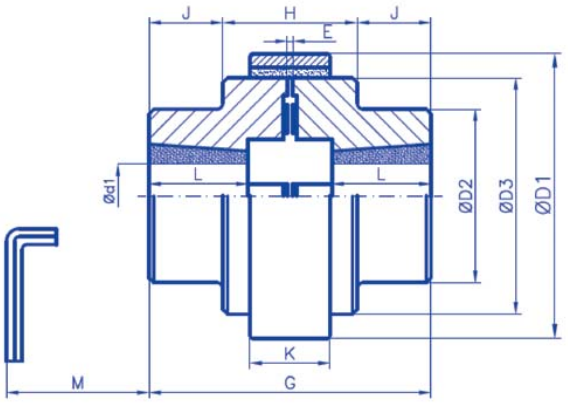
- *Max. Rpm riferito a giunti con Mozzi in Ghisa (GG25), ad eccezione delle taglie A11 e A12 che sono forniti in ferro (GG40) nella versione standard. Per velocità periferiche oltre v=30m/s si richiedono mozzi obbligatoriamente in ferro (GGG40) o acciaio (C0145) e bilanciamento dinamico (VDI 2060 G6.3). Per cortesía consultare il ns Ufficio técnico
- Per applicazioni in uscita da riduttori sono consigliati Inserti Samiflex con durezza 97 shore A (tipo HD "Ocra" e HDT "Rosso") che permettono un incremento rating di Coppia del 30%. Dispoinibili dalla taglia A4 fino alla taglia A11. Per cortesia consultare il ns ufficio tecnico.
- Per temperature operative superiori a 80°C , consigliamo Inserti Samiflex HT "Arancioni" o HDT "Rosso"(fino a 140°C), obbligatoriamente forniti con Anello in acciaio su taglia da A0 a taglia A4.Per cortesía consultare il ns ufficio técnico .
- I Giunti standard sono forniti con mozzi in Ghisa (GG25), Inserto std "GIallo" (95 Shore A) ed anello in Polyammide dalla taglia A0 alla taglia A4. Per le taglie superiori l' anello è fornito in acciaio.

GIUNTO SAMIFLEX CON SPAZIATORE TIPO CS

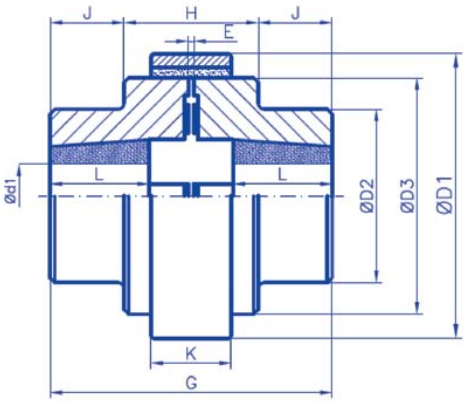


	Inserto 95° Shore A Coppia (Nm)		Foro Ø (mm.)				Dimensioni in mm.									
Taglia	Nominale	Massima	Pre Ø	Ø Max. d1	Ø Max d3	r.p.m	D1	D2	D3	D4	D5	E	e	L1	L4	L(DBSE)
A1CS	55	138	14	28	42	5.500	83	65	65	100	67	3.0	2.0	34	37	100 120 140
A2CS	110	275	17	35	48	5.000	111	80	86	120	83	3.0	2.0	47	54	100 120 140
A3CS	220	550	19	42	65	4.500	144	85	116	140	107	3.5	2.5	56	60	100 120 140
A4CS	460	1.150	24	55	85	3.500	182	110	150	178	140	3.5	2.5	63	65	120 140 180
A45CS	805	2.013	25	65	90	3.100	202	125	170	200	150	3.5	2.5	70	75	120 140 180
A5CS	1.150	2.875	29	75	110	2.900	225	140	190	225	179	3.5	2.5	77	79	140 180 200
A55CS	1.725	3.450	30	85	110	2.600	250	155	215	245	180	4.0	3.0	90	95	140 180 200
A6CS	2.300	4.600	39	90	120	2.500	265	180	233	265	198	4.0	3.0	95	95	180 200 250
A7CS	4.600	9.200	48	110	130	2.200	306	205	267	290	220	4.0	3.0	116	120	200 250 280

GIUNTO SAMIFLEX CON BUSSOLE CONICHE



TIPO TB
ESTERNE



TIPO TBI
INTERNE

Taglie	Bussole tipo	MIN Ød1 mm.	MAX. Ød1 mm.	L mm.	G mm.	E mm.	K mm.	H mm.	D1 mm.	D2 mm.	D3 mm.	J mm.	M mm.
A1 – TB/TBI	1108	9	28	27	77	1,5	22	-	83	65	65	-	29
A2 – TB/TBI	1210	11	32	32	97	2,5	32	55	111	80	86	21	38
A3 – TB/TBI	1610	14	42	32	107	2,5	42	65	144	85	116	21	38
A4 – TB/TBI	2012	14	50	38	130	3,5	51	85	182	110	150	22	42
A45 – TB/TBI	2517	16	60	50	158	3,5	55	93	202	125	170	32	50
A5 – TB/TBI	3020	25	75	56	173	3,5	59	101	225	140	190	36	55
A6 – TB	3535	35	90	95	259	3,5	67	119	265	180	233	70	67
A7 - TB	4040	40	100	107	292	4	75	134	306	205	267	79	70

MONTAGGIO E SMONTAGGIO GIUNTI

Una volta forati I mozzi (1) e (2) secondo le necessità, installare gli stessi sull 'albero facendo attenzione di aver preventivamente posizionato l'anello di ritenuta su uno di essi.

I denti dei mozzi devono essere posizionati in maniera allineata tra di loro evitando il contatto o la sovrapposizione, mantenendo la quota E. (osservare la configurazione), con lo scopo di assemblare l'elemento elsatico (3) così chè sia inserito nello spazio tra I denti dei mozzi allineati (vedi fig.1).

Procedere poi con il posizionamento delle apposite scanalature dell' elemento elastico in conicidenza della linea marcata sulla suerficie dell anello di ritenuta. (4).
Una volta che questa operazione è stata eseguita con l'aiuto degli strumenti di assemblaggio Samiflex o con un Martello soffice, far scorrere l'anello nello apposite sede (vedi fig.2).

Infine, è necessario assicurare l'anello di ritenuta sull'inserto usando I grani di fissaggio forniti con ogni giunto, assicurando che esse siano ben fissate sulla superficie esterna dell'anello di ritenuta così da evitare possibili superfici affilate.

Una volta che l'equipaggiamento è pronto per l'avviamento, tutte le apparecchiature di protezione devono essere debitamente installate al fine di ottemperare alle regole di sicurezza degli equipaggiamenti rotanti.

Per lo smontaggio dell'elemento elastico, rivedere le istruzioni sopra per rimuovere l'anello di ritenuta, che darà la possibilità di sostituzione dell'elemento elastico qualora fosse richiesto.

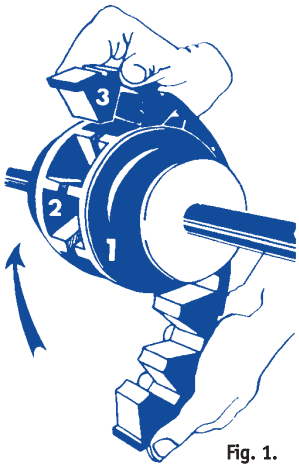


Fig. 1.

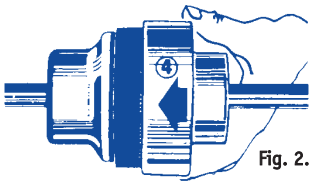


Fig. 2.

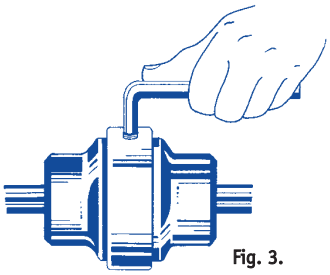


Fig. 3.

BENEFICI

• Montaggio e Smontaggio dell 'elemento elastico senza necessità di rimozione del motore o della macchina condotta. Questo beneficio permette l'ispezione dell'elemento ogni volta si renda necessario, semplicemente facendo scorrere l'anello di ritenuta. La sostituzione dell'inserto può essere eseguita in pochi minuti.

• I due mozzi lavorano indipendentemente tra loro sulla metà dell 'inserto.
Questo concetto consente la rotazione libera del motore (eventuale prova a vuoto) semplicemente rimuovendo l'elemento elastico.

• Questa possibilità è un gran aiuto, specialmente su applicazioni con motori a combustione, in quanto possono essere avviati senza carico.

• Per qualsiasi usura o strappo dell' elemento elastico, I mozzi non hanno contatto tra loro, questo implica che il giunto ha proprietà a prova di esplosione. Inoltre l'elemento elastico in poliuretano è a prova di incendio.

• L'inserto in poliuretano è l'elemento chiave diquesto giunto. La vita operativa è stimata in ca 25000 ore in condizioni di lavoro ottimale.

• Il giunto, di progettazione, permette facile allineamento. Dopo il montaggio, tutti I riferimenti possono essere controllati semplicemente sfilando l'anello di ritenuta e rimuovendo l'elemento elastico. Il giunto Samiflex è un prodotto che non necessita di lubrificazione rispettando l'ambiente.

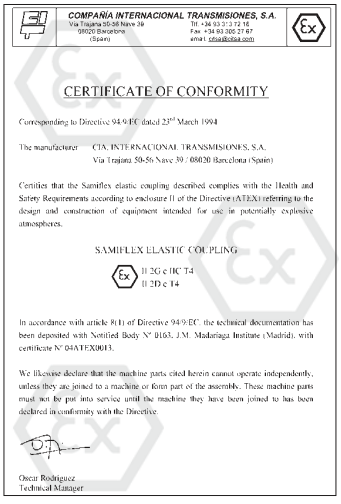
SUGGERIMENTI PER INSTALLAZIONE IN AREE PERICOLOSE

II 2G C IIC T4
II 2D C T4

In accordo con la direttiva ATEX 94/9/EC, i giunti di trasmissione per alberi sono classificati come unità che fanno parte dell equipaggiamento all'interno de gruppo dei Non- Materiali elettrici.
Il giunto elastico Samiflex è conforme alle richieste ATEX per il gruppo II, categoria 2G (Gas) e 2D (Polveri), gruppo explosion IIC e temperatura T4.
Le Istruzioni di montaggio per l'approvazione dei giunti Samiflex alla normativa ATEX sono pubblicate nel ns report 07/2003 e possono essere consultate sul ns. Sito www-citsa.com e www.samiflex.com


LABORATORIO OFICIAL J. M. MADARIAGA

1.- CERTIFICADO DE CUSTODIA DE EXPEDIENTE TÉCNICO


COMPAÑIA INTERNACIONAL TRANSMISIONES, S.A.

CERTIFICATE OF CONFORMITY

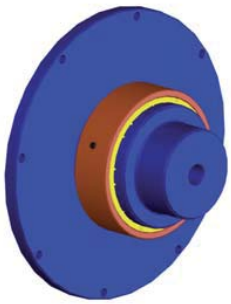

Certificado Nº. 220/08

Instituto de Certificación C.D.Q. S.L.

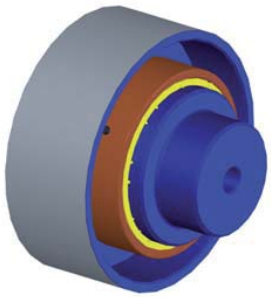
COMPAÑIA INTERNACIONAL TRANSMISIONES, S.A.
Via Trajana, 50-56 nave 39 - 08020 - BARCELONA -

UNE- EN- ISO 9001/08

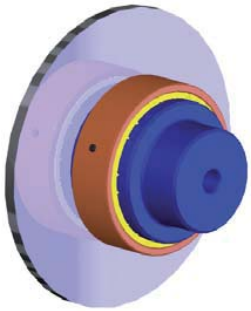
Diseño, montaje y comercialización de acoplamientos elásticos.



GIUNTO SAMIFLEX CON VOLANO



GIUNTO SAMIFLEX CON RUOTA FRENO



GIUNTO SAMIFLEX CON DISCO FRENO

samiflex®

PTI S.R.L. POWER TRANSMISSION INNOVATION

PTI S.r.l.
Sede Operativa e Uffici: Via Roma, 74 - 20060 Cassina de Pecchi (MI) - Italia
Sede Legale: Via Guido D'Arezzo, 15 - 20145 Milano - Italia
Phone: ++39 02 40705673 - Fax: ++39 02 42108624 - E-mail: info@pti-italia.com - www.pti-italia.com
P.IVA: 07991270963

Sensori di temperatura PT100

Ventilatore	Tipo sensore	Item cliente
MB00239	TT 50	L1 S20-CO 043; L1 S20-CO 044
MB00257	TT 50	L1 S20-CO 045

OPTITEMP TT 50 C/R Handbook

HART®-compatible, intelligent two-wire transmitter

KROHNE

IMPRINT

1.1 Intended use

TT 50 C

The TT 50 C is an intelligent, universal HART®-compatible 2-wire in-head transmitter for temperature, resistance or voltage measurements in an industrial environment.

The transmitter is optionally available in an intrinsically safe version for installation in potentially explosive areas. These devices are labeled with the "Ex" symbol (TT 50 C Ex) and are approved for use in zone 0, 1 and 2 and division 1 and 2.

All versions are intended for installation in a "B connection head" or larger according to DIN 43729.

TT 50 R

The TT 50 R is an intelligent, universal HART®-compatible 2-wire rail-mount transmitter for temperature, resistance or voltage measurements in an industrial environment.

All versions are intended for installation on a top-hat rail according to DIN 50022.

1.2 Certifications

1.2.1 EC directive compliance

CE marking

The device fulfils all applicable statutory requirements of the following EC directives:

- EMC Directive 2004/108/EC
- Devices for use in potentially explosive areas: ATEX Directive 94/9/EC

The manufacturer certifies successful testing of the product by applying the CE marking.

1.2.2 Ex approvals (TT 50 C Ex)

ATEX	II 1 G Ex ia IIC T4/T5/T6 T4: +85°C / +185°F, T5: +65°C / +149°F, T6: +50°C / +122°F	DEMKO 06 ATEX 141335X

INFORMATION!
See also "Certificates" in the download area of the manufacturer's website.

1.3 Safety instructions from the manufacturer

1.3.1 Copyright and data protection

The contents of this document have been created with great care. Nevertheless, we provide no guarantee that the contents are correct, complete or up-to-date.

The contents and works in this document are subject to copyright. Contributions from third parties are identified as such. Reproduction, processing, dissemination and any type of use beyond what is permitted under copyright requires written authorisation from the respective author and/or the manufacturer.

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We hereby expressly prohibit the use of the contact data published as part of our duty to publish an imprint for the purpose of sending us any advertising or informational materials that we have not expressly requested.

1.3.2 Disclaimer

The manufacturer will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect, incidental, punitive and consequential damages.

This disclaimer does not apply in case the manufacturer has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations.

Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.

The manufacturer reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.

1.3.3 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation and operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

1.3.4 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of underneath icons.

1.3.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.

DANGER!
This information refers to the immediate danger when working with electricity.

DANGER!
This warning refers to the immediate danger of burns caused by heat or hot surfaces.

DANGER!
This warning refers to the immediate danger when using this device in a hazardous atmosphere.

DANGER!
These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator's plant.

WARNING!
Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator's plant.

CAUTION!
Disregarding these instructions can result in damage to the device or to parts of the operator's plant.

INFORMATION!
These instructions contain important information for the handling of the device.

LEGAL NOTICE!
This note contains information on statutory directives and standards.

- **HANDLING**
  This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.

i **RESULT**
This symbol refers to all important consequences of the previous actions.

1.4 Safety instructions for the operator

WARNING!
In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel.
This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.

2.1 Scope of delivery

The scope of delivery always consists of the transmitter and its documentation.

2.2 General description

The TT 50 transmitters are intelligent 2-wire universal transmitters with one channel.

The transmitters are intended for:

- Temperature measurements with resistance thermometers
- Temperature measurements with thermocouples
- Temperature difference measurements with resistance thermometers
- Measurements with potentiometers
- Voltage measurements in a range -10…+500 mV

INFORMATION!
*The **TT 50 C** is optionally available for operation in potentially explosive areas (zone 0, 1 and 2 and division 1 and 2).*

The **TT 50 C / TT 50 C Ex** are designed for installation in a "B connection head" according to DIN 43729 or larger.

The **TT 50 R** is designed for installation on a rail according to DIN 50022.

The 2-wire universal transmitters are HART® 5-compatible. Configuration of the transmitter is possible with:

- HART® 5 protocol via 4…20 mA output circuit
- HART® 5 hand held terminal
- The third part PC software with a FSK modem for HART® 5 communication
- PC configuration software (HartSoft) with HART® modem

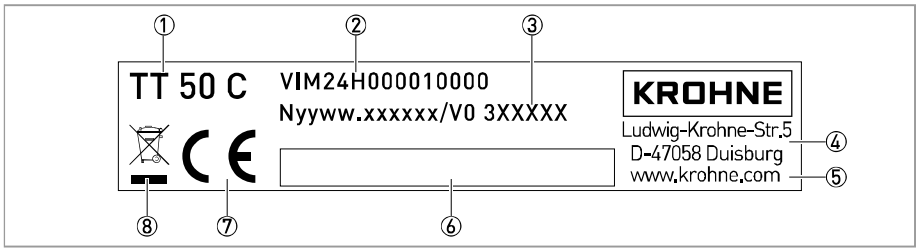
To configure the transmitter using an IBM-compatible PC, the "HartSoft" software is required. The Windows-based "HartSoft" software can be used to access all functions of the transmitter. It is also used for configuration, calibration, display and documentation.

2.3 Nameplate

INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order.
Check for the correct supply voltage printed on the nameplate.

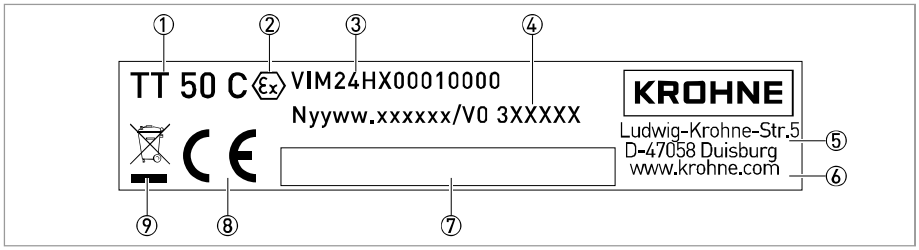
The transmitter can be identified by the information on the nameplates.

2.3.1 Example of a nameplate for an in-head transmitter (Non-Ex)

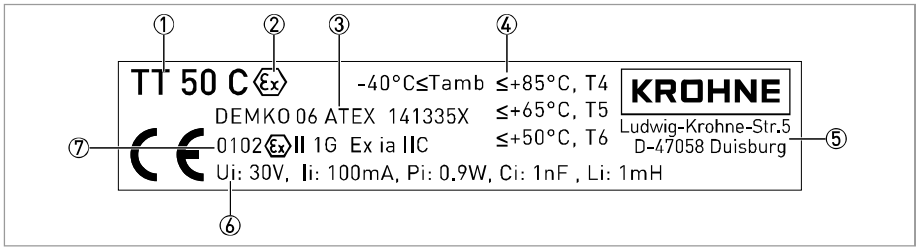


1 Product name
2 Part number
3 Year and week of manufacturing / batch number
4 Manufacturer and address
5 Website of manufacturer
6 Space for configuration data sticker
7 CE marking (EC conformity)
8 WEEE dustbin symbol

2.3.2 Example of namplates for an in-head transmitter (Ex)

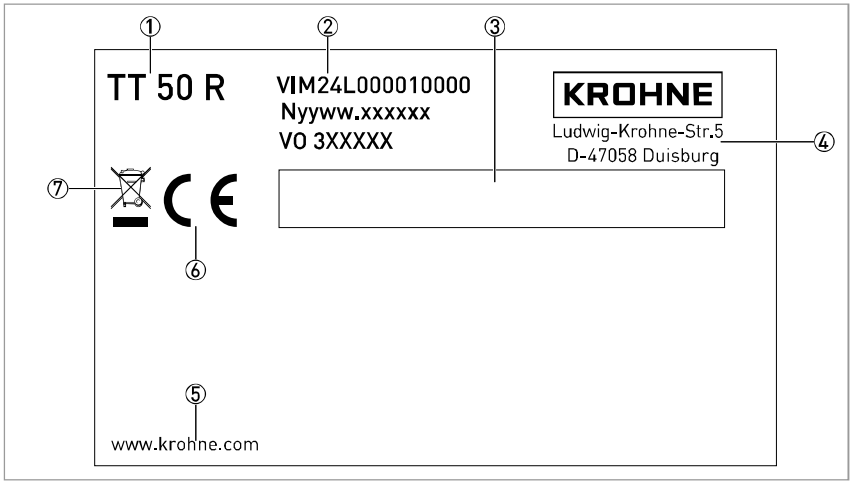


1 Product name
2 Symbol for Ex-approval
3 Part number
4 Year and week of manufacturing / batch number
5 Manufacturer and address
6 Website of manufacturer
7 Space for configuration data sticker
8 CE marking (EC conformity)
9 WEEE dustbin symbol



1 Product name
2 Symbol for Ex-approval
3 ATEX approval
4 Temperature classes
5 Manufacturer and address
6 Ex-relevant electrical data
7 Supplementary Ex-data

2.3.3 Nameplate for rail-mount transmitter



1 Product name
2 Top down: part number, year and week of manufacturing, batch number
3 Space for configuration data sticker
4 Manufacturer and address
5 Website of manufacturer
6 CE marking (EC conformity)
7 WEEE dustbin symbol

3.1 Notes on installation

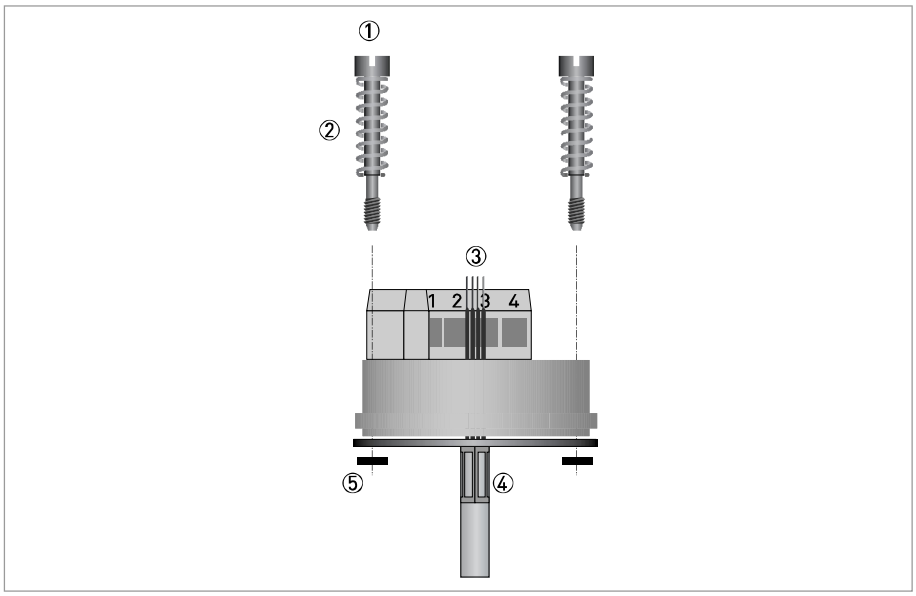
INFORMATION!
Inspect the cartons carefully for damage or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

INFORMATION!
Check the packing list to check if you received completely all that you ordered.

INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

3.2 In-head transmitter

These transmitters are intended for installation in DIN B connection heads or larger. The large Ø7 mm / 0.28" center hole facilitates the electrical connection of the measurement sensor and the installation. For detailed information refer to the chapter "Dimensions and weights".



1 Screw M4
2 Spring
3 Sensor connection cables
4 Protection tube
5 Lock washer

DANGER!

Never install or operate the TT 50 C in potentially explosive areas, it might cause an explosion that can result in fatal injuries! Only use the TT 50 C Ex in potentially explosive areas!

The Ex transmitter can be installed in potentially hazardous areas zone 0, 1 and 2. It must be supplied by an intrinsically safe power supply unit or Zener barrier placed outside of the potentially explosive zone.

The Ex transmitter must be installed in a housing with the protection rating IP20 or better according to EN 60529 / IEC 60529.

CAUTION!

The TT 50 C / TT 50 C Ex temperature transmitter has been developed for an ambient temperature of -40...+85°C / -40...+185°F. Please also note that the ambient temperature is also dependent on the temperature category. For detailed information refer to Ex data of the ambient temperature.

The process temperature is also transferred to the transmitter housing via the protective tube. If the process temperature is close to or exceeds the maximum specified ambient temperature of the transmitter, then the temperature in the transmitter housing can rise above the maximum permissible ambient temperature. Always check that the ambient temperature does not exceed the permissible range!

One way to decrease heat transfer via the protective tube is to make the protective tube longer or in general to install the transmitter farther away from the heat source. The same safety measures can be taken if the temperature is below the specified minimum temperature.

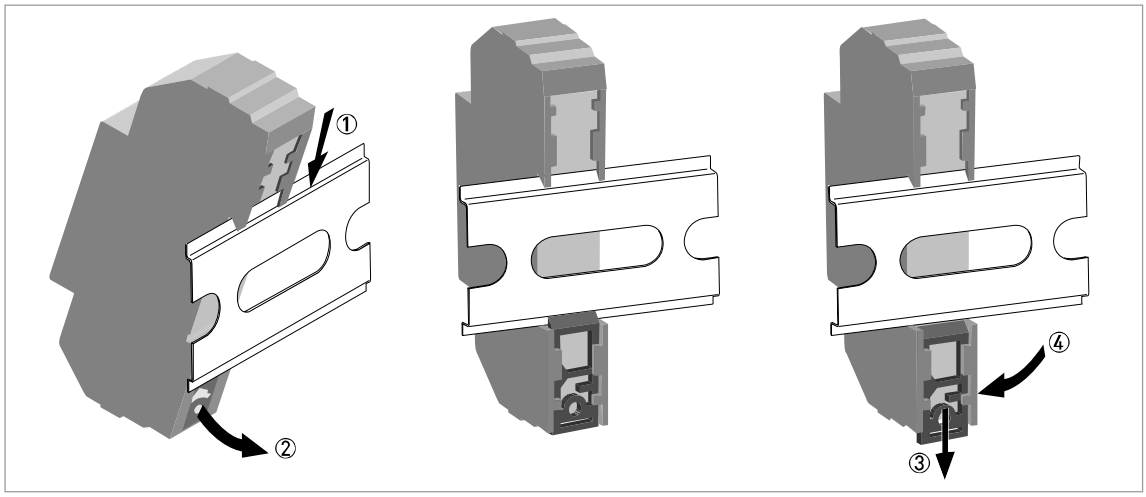
CAUTION!

The TT 50 C Ex may only be installed in a light metal housing, whose magnesium component does not exceed 6%.

3.3 Rail-mount transmitter

DANGER!
Never install or operate the TT 50 C in potentially explosive areas, it might cause an explosion that can result in fatal injuries!

The rail-mount transmitter is intended for installation on a rail according to DIN 50022.



1 Hook the upper groove of the transmitter onto the rail.
2 Press the lower part of the transmitter against the rail.
i When you hear a "click" from the snap fastener, the transmitter is fixed onto the rail (drawing in the centre).
3 To remove the transmitter, use a small screwdriver to push the snap fastener downwards.
4 Carefully move the lower part of the transmitter in the forward direction and then upwards.

4.1 Safety instructions

DANGER!
All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!

DANGER!
Observe the national regulations for electrical installations!

DANGER!
The transmitter is protected against polarity reversal. No damage will occur to the device if the polarity of the supply voltage is switched. The output will then indicate 0 mA.

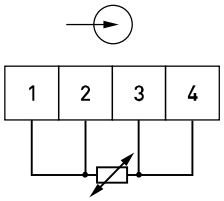
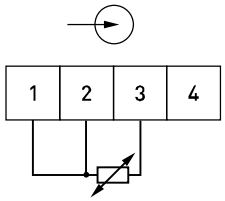
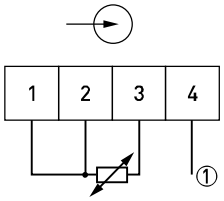
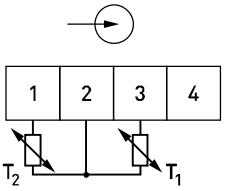
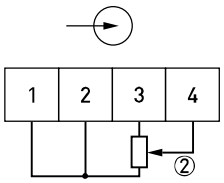
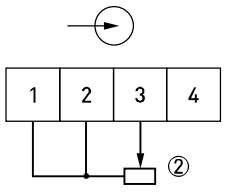
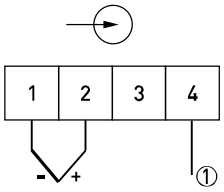
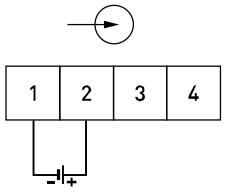
DANGER!
Always observe the corresponding chapters and the instructions in this manual when connecting devices with an Ex certificate!
Never install or operate the TT 50 C in potentially explosive areas, it might cause an explosion that can result in fatal injuries!
For the operation in potentially explosive areas the manufacturer offers the TT 50 C Ex. You may only connect this transmitter to sensors that meet the requirements for "simple equipment" in EN 60079-11:2007, section 5.7.

WARNING!
Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

4.2 Electrical connections (in-head and rail-mount)

The input and output signals and the power supply must be connected in accordance with the following illustrations. The in-head transmitter is easy to install with the connection head installation kit. To avoid measuring errors, all cables must be connected properly and the screws tightened correctly.

Pt10...1000, Ni100, Ni1000, 4-wire connection	Pt10...1000, Ni100, Ni1000, 3-wire connection
	
Pt100 "SmartSense", 3-wire connection	**Pt100, temperature difference, $T_1 > T_2$**
	
Potentiometer, 4-wire connection	**Potentiometer, 3-wire connection**
	
Thermocouple	**Voltage**
	

1 SmartSense wire
2 Maximum input

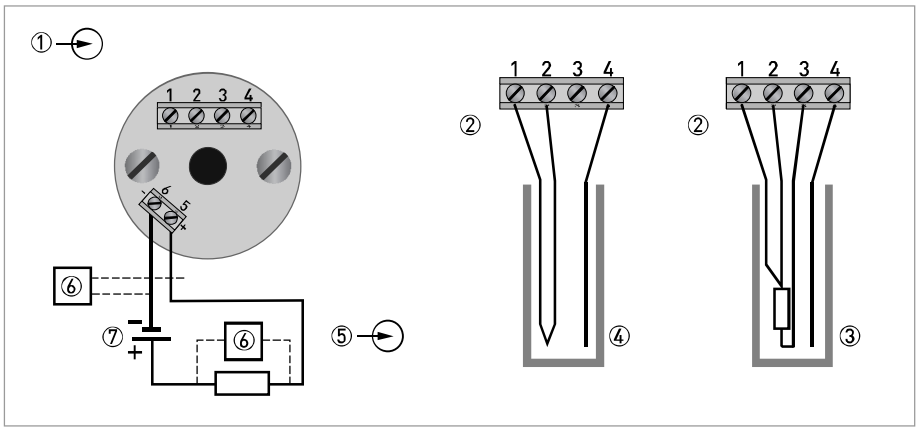
4.3 Connection diagram of in-head transmitter

DANGER!

Never install or operate this transmitter in potentially explosive areas, it might cause an explosion that can result in fatal injuries!

DANGER!

To enable HART® communication, the output circuit must have an output load of at least 250 Ω.



1 Input
2 SmartSense temperature sensor
3 Pt100 3-wire connection
4 Thermocouple
5 Output
6 Modem
7 Voltage supply 10…42 VDC

INFORMATION!

The HART® modem is connected parallel to the output load or parallel to the output of the transmitter.

4.4 Connection diagram of in-head transmitter (Ex)

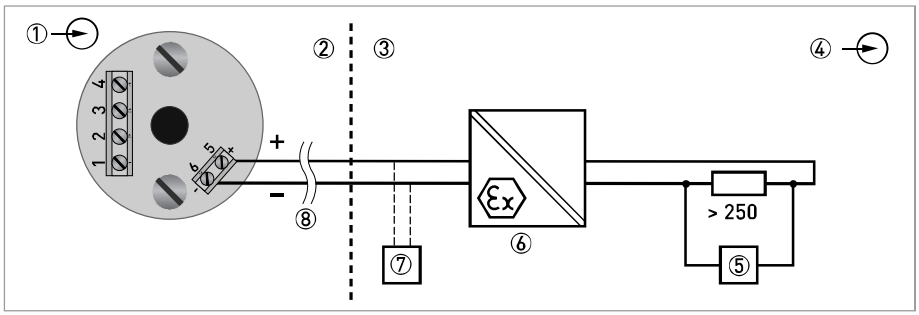
DANGER!

The Ex transmitter can be installed in potentially explosive areas of zone 0, 1 and 2. It may only be connected to sensors that meet the requirements for "simple equipment" in EN 60079-11:2007, section 5.7. During operations in potentially explosive areas always regard the relevant safety instructions and especially the following items:

- *The transmitter must be supplied by an intrinsically safe power supply unit or Zener barrier placed outside of the potentially explosive area.*
- *The output parameters of the Ex approved Zener barrier or voltage supply and the output parameters of the Ex approved HART unit or modem have to be less or equal than the input parameters of the transmitter (i.e. U_i, I_i, P_i, L_i, C_i).*
- *Only use an Ex approved HART® modem.*
- *Observe the maximum cable lenght of the output circuit to ensure reliable HART® communication with this transmitter (on page 19).*

DANGER!

To enable HART® communication, the output circuit must have an output load of at least 250 Ω.



1 Input
2 Potentially explosive area
3 Safe area
4 Output
5 Modem
6 Zener barrier or voltage supply 12…30 VDC (intrinsically safe)
7 Modem, Ex-approved
8 See section "Cable length"

INFORMATION!

The HART® modem is connected parallel to the output load or parallel to the output of the transmitter.

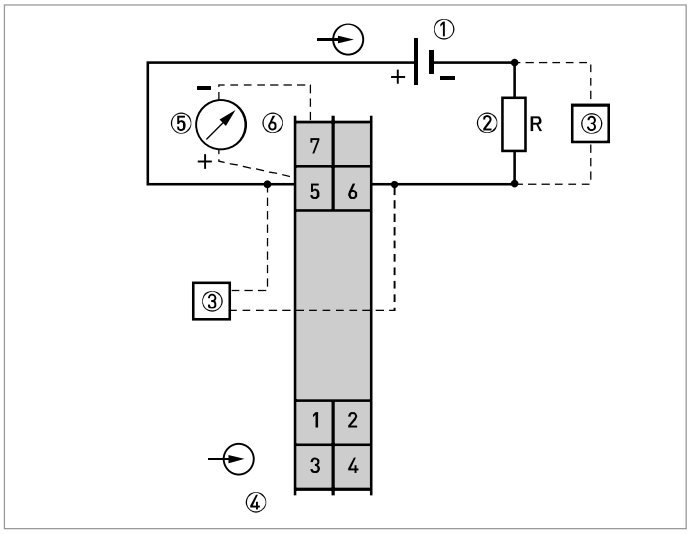
4.5 Connection diagram of rail-mount transmitter

DANGER!

Neither operate this transmitter in potenially explosive areas, nor connect it to a sensor located in a potentially explosive area! Otherwise the transmitter might cause an explosion that can result in fatal injuries!

DANGER!

To enable HART® communication, the output circuit must have an output load of at least 250 Ω.



1 Voltage supply 11...42 VDC
2 R_{Load}
3 Modem
4 Input
5 Measuring device
6 Test circuit

INFORMATION!

The HART® modem is connected parallel to the output load or parallel to the output of the transmitter.

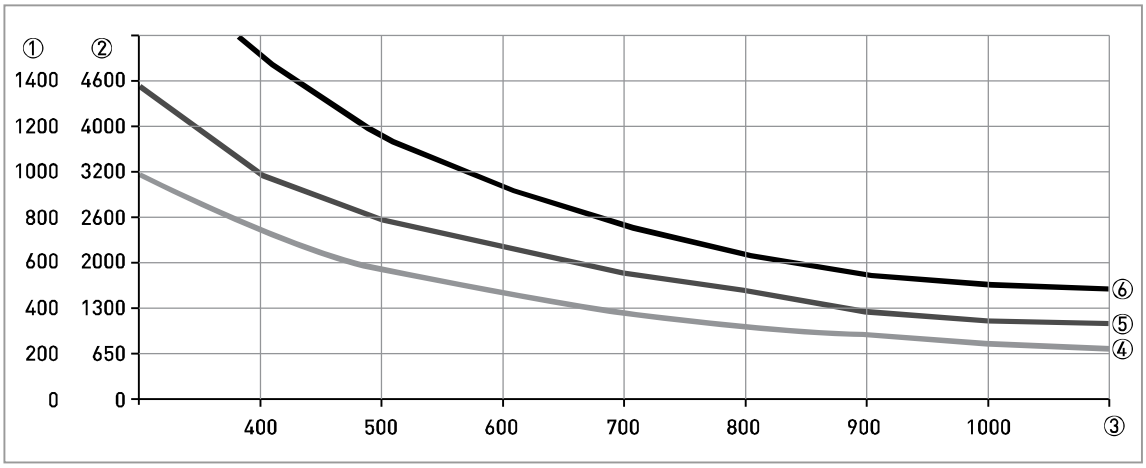
4.6 Cable length

In order to ensure reliable HART® communication, the maximum cable length of the output circuit must be observed.

DANGER!

In the Ex version, please note that the maximum cable length is determined by a resistance, an inductance and a capacitance of the cable. The total capacitance and inductance of the cable must be within the limits for the transmitter described in the Ex certificate.

To calculate the maximum cable length for the output circuit, determine the total resistance of the output loop (load resistance + approximate cable resistance). Find out the capacitance of the cable being used. In the following tables you can find the maximum cable length based on the typical values for 1 mm^2 cables. CN is the abbreviation for "Capacitance Number" which is multiple of 5000 pF present in the device.



1 Cable length [m]
2 Cable length [ft]
3 Load resistance and cable resistance
4 200 pF per m/ft
5 150 pF per m/ft
6 100 pF per m/ft

For multiple connections (multidrop mode), the following formula shall be used:

$L = [(65 \times 10^6) / (R \times C)] \times (Cn \times 5000 + 10000) / C$

with
L: cable length [m or ft]
R: load resistance (incl. the resistance of any Zener barrier) + cable resistsance [Ω]
C: cable capacitance [pF/m or pF/ft]
Cn: number of transmitters in the loop

5.1 HART® networks

DANGER!

Only connect an Ex approved HART® modem located in a safe area to a transmitter in a potentially explosive area.

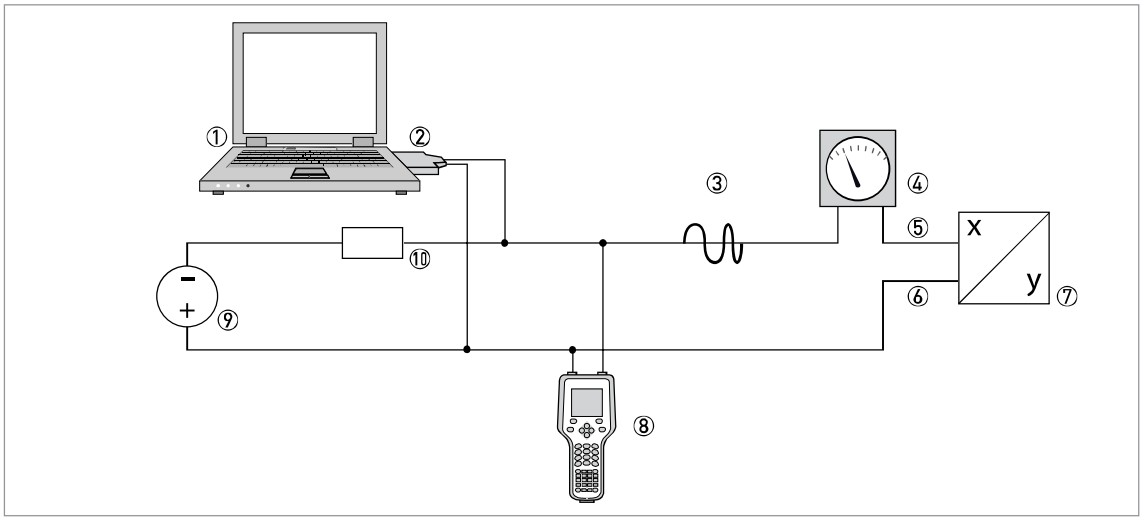
CAUTION!

In order to ensure reliable HART® communication with this transmitter, the loop resistance must be at least 250 Ω!

5.1.1 Point-to-point connection analog / digital mode

Point-to-point connection between the transmitter and the HART® master.

The current output of the device may be active or passive.



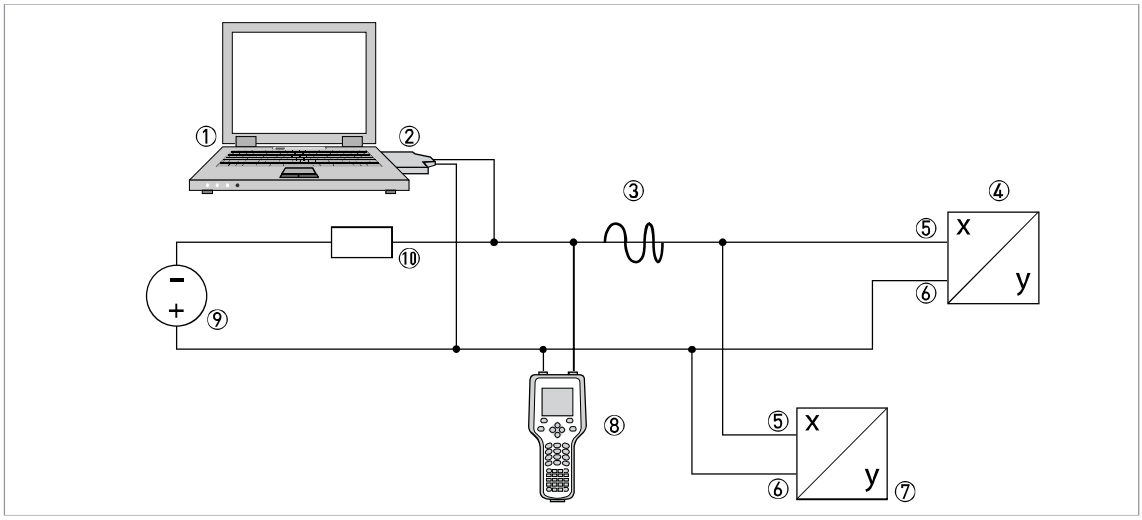
1 Primary Master
2 HART® modem
3 HART® signal
4 Analog indicator
5 Terminal 5
6 Terminal 6
7 Device with address = 0 and passive or active current output
8 Secondary Master
9 Power supply for devices (slaves) with passive current output
1 0 Load ≥ 250 Ω (Ohm)

5.1.2 Multi-drop connection (2-wire connection)

As a multipoint connection (Multidrop) with up to 15 devices in parallel (this transmitter or other HART®devices).

The current outputs of the devices must be passive!

Burst mode is not supported.



1 Primary master
2 HART® modem
3 HART® signal
4 Other HART® devices or this transmitter (refer also to 7)
5 Terminal 5
6 Terminal 6
7 Device with address > 0 and passive current output, connection of max. 15 devices (slaves)
8 Secondary Master
9 Power supply for devices (slaves) with passive current output
1 0 Load ≥ 250 Ω (Ohm)

5.2 Factory settings for configuration

DANGER!

Only connect an Ex approved HART® modem located in a safe area to a transmitter in a potentially explosive area.

The transmitter are delivered with either a factory settings or configured according to customers' specifications.

Menu	Parameter	Factory settings
Device Root menu		
-> Sensor	Type of sensor 1	RTD Pt100 α=0.003850
	Number of wires	3
	PV Lower range value	0
	PV Upper range value	100
	Digital units	°C
	Lock code	Unlocked
	Isolation resistance monitoring	Off
	Sensor break (Off/Down scale/Up scale)	Up scale
	Sensor short circuit (Off/Down scale/Up scale)	Off
	Span	0...+100°C / +32...+212°F

5.3 Configuration of transmitter

The transmitters can be configured by means of:

1. The PC with the help a HART-modem ("VIATOR") and the software "HartSoft".
2. A hand held communicator (secondary master) such as the field communicators FC 375 or FC 475 (Emerson)
3. EDD enabled device management softwares/systems (primary master) such as:

- PDM - Process Device Manager (Siemens)
- AMS - Asset Management Solutions (Emerson)

5.3.1 Configuration with PC and HART®-modem

Configuration with the PC requires a HART®-modem for connection to a USB-interface and the software "HartSoft". Therefore all models of the TT 50 series are HART®-compatible.

INFORMATION!
If you need "HartSoft", contact the manufacturer (the software is for free). The manual is available in the download area of the manufacturer's website.

5.3.2 Configuration with a hand held communicator FC375/FC475

The Field communicators FC375/FC475 are hand held communicators from Emerson Process Management for configuring HART® and Foundation Fieldbus devices. To be able to configure the transmitter with the FC375/FC475 you need a Device Description (DD) file.

The transmitter DD has to be installed on the FC375/FC475, otherwise the user will work with the transmitter as generic device loosing opportunity to control all features of the transmitter. For installing DD on the FC375/FC475 the "Easy Upgrade Programming Utility" is needed and the FC375/FC475 must have a system card with "Easy Upgrade" option (see details in the "375/475 Field Communicator User's Manual").

The transmitter DD for FC375/FC475 can also be downloaded from our website. For information about installing, follow the instructions in the attached "readme.txt" file.

For proper connection of the transmitter with the hand held communicator refer to *Connection diagram of in-head transmitter* on page 17 and refer to *Connection diagram of rail-mount transmitter* on page 19.

To configure the transmitter for potentially explosive areas refer to *Connection diagram of in-head transmitter (Ex)* on page 18.

5.3.3 Device management software

The transmitter can be configured via the PC software as AMS (Asset Management System) and Simatic PDM.

Asset Management Solutions Device Manager (AMS)

The AMS is a PC application from Emerson Process Management for configuring and managing HART® and Foundation Fieldbus devices. For adaptation to different devices AMS uses Device Descriptions (DD).

The transmitter DD has to be installed on the AMS system and a so called "Installation Kit HART AMS" is needed (available as download on the internet). For installing the DD with the installation kit refer to the "AMS Intelligent Device Manager Books Online" section "Basic AMS Functionality /Device Configurations / Installing Device Types / Procedures /Install device types from media". Please read also the "readme.txt", which is also contained in the installation kit.

The transmitter DD for AMS can also be downloaded from our website. For information about installing, follow the instructions in the attached "readme.txt" file.

AMS supports the "EDDL Process Variables Root Menu", the "Diagnostic Root Menu" and the "Device Root Menu" for online access to the device.

Process Device Manager (PDM)

The Simatic PDM is a PC application from Siemens for configuring HART® and PROFIBUS devices. For adaptation to different devices Simatic PDM uses Device Descriptions (DD).

The transmitter DD has to be installed on the PDM System and a so called "Device Install HART PDM" is needed (available as download on the internet).

For installing the DD on PDM refer to the "PDM Manual" section 13:"Integrating Devices".Please read also the "readme.txt", which is also contained in the "Device Install".

The transmitter DD for PDM can also be downloaded from our website. For information about installing, follow the instructions in the attached "readme.txt" file.

PDM supports the "EDDL Process Variables Root Menu", the "Diagnostic Root Menu" and the "Device Root Menu" for online access to the device. Furthermore it supports the "Offline Root Menu" for offline configuration.

5.4 Factory calibration of transmitter

The transmitters are delivered with a factory configuration Pt100 (α=0.00385), 3-wire connection 0...+100°C / +32...+212°F or configured according to customer's requirements. For detailed information refer to *Factory settings for configuration* on page 23.

INFORMATION!
Should you for any reason require the re-calibration, send the transmitter back to the factory!

6.1 Spare parts availability

The manufacturer adheres to the basic principle that functionally adequate spare parts for each device or each important accessory part will be kept available for a period of 3 years after delivery of the last production run for the device.

This regulation only applies to spare parts which are subject to wear and tear under normal operating conditions.

6.2 Availability of services

The manufacturer offers a range of services to support the customer after expiration of the warranty. These include repair, technical support and training.

INFORMATION!
For more precise information, please contact your local representative.

6.3 Returning the device to the manufacturer

6.3.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems.

CAUTION!
Should you nevertheless need to return a device for inspection or repair, please pay strict attention to the following points:

- *Due to statutory regulations on environmental protection and safeguarding the health and safety of our personnel, manufacturer may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.*
- *This means that the manufacturer can only service this device if it is accompanied by the following certificate (see next section) confirming that the device is safe to handle.*

CAUTION!
If the device has been operated with toxic, caustic, flammable or water-endangering products, you are kindly requested:

- *to check and ensure, if necessary by rinsing or neutralizing, that all cavities are free from such dangerous substances,*
- *to enclose a certificate with the device confirming that is safe to handle and stating the product used.*

6.3.2 Form (for copying) to accompany a returned device

Company:		Address:
Department:		Name:
Tel. no.:		Fax no.:
Manufacturer's order no. or serial no.:		
The device has been operated with the following medium:		
This medium is:	☐	water-hazardous
	☐	toxic
	☐	caustic
	☐	flammable
	☐	We checked that all cavities in the device are free from such substances.
	☐	We have flushed out and neutralized all cavities in the device.
We hereby confirm that there is no risk to persons or the environment through any residual media contained in the device when it is returned.		
Date:		Signature:
Stamp:		

6.4 Disposal

CAUTION!
Disposal must be carried out in accordance with legislation applicable in your country.

7.1 Measuring principles

The kind of the measuring principle depends on the measuring insert that you combine with the transmitter. In matters of the thermometer type the manufacturer offers two different measuring inserts, either with a resistance thermometer or with a thermocouple. For more information refer to the handbook of the measuring inserts or the handbook of the industrial thermometers.

7.1.1 Resistance thermometer

The measuring insert with a resistance thermometer features a temperature-sensitive sensor made from a platinum RTD, whose value at 0°C / +32°F is 100 Ω. That is where the name "Pt100" comes from.

It is generally valid that the electric resistance of metals increases according to a mathematical function as the temperature rises. This effect is taken advantage of by resistance thermometers to measure temperature. The "Pt100" thermometer features a measuring resistance with defined characteristics, standardised in IEC 60751. The same is true for the tolerances. The average temperature coefficient of a Pt100 is 3.85 x 10^{-3} K^{-1} in the range from 0...+100°C / +32...+212°F.

During operation, a constant current I (≤ 1 mA) flows through the Pt100 RTD, which brings about a voltage drop U. The resistance R is calculated using Ohm's Law (R=U/I). As the voltage drop U at 0°C / +32°F is 100 mV, the resulting resistance of the Pt100 thermometer is 100 Ω (100 mV / 1 mA = 100 Ω).

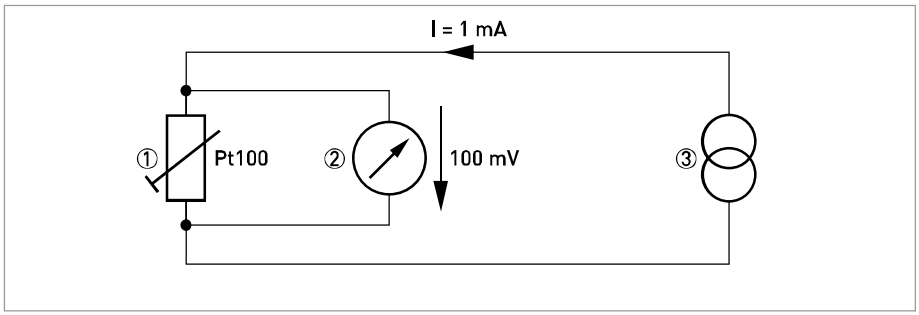


Figure 7-1: Pt100 resistance thermometer in 4 wire connection at 0°C / +32°F, schematic.

1 Pt100 RTD
2 Voltage meter
3 Current source

7.1.2 Thermocouples

The thermocouple features two electric conductors made from different metals, connected at one end. Each free end is connected to a compensation cable which is then connected to a millivolt meter. This circuitry forms a "thermal circuit". The point at which the two electric conductors connect is called the measuring point (hot junction) and the point at which the compensation cables connect to the conductors of the millivolt meter is called the reference junction (cold junction).

If the measuring point of this thermal circuit is heated up, a small electrical voltage (thermal voltage) can be measured. If, however, the measuring point and the reference junction are at the same temperature, no thermoelectric voltage is generated. The degree of thermoelectric voltage, also known as electromotive force (EMF), depends on the thermocouple material and the extent of the temperature difference between the measuring point and the reference junction. It can be measured using the millivolt meter with no auxiliary power.

Simply put, the thermocouple behaves like a battery, the voltage of which also increases as the temperature rises.

INFORMATION!
The characteristic curves and tolerances of commercially available thermocouples are standardised in IEC 60584.

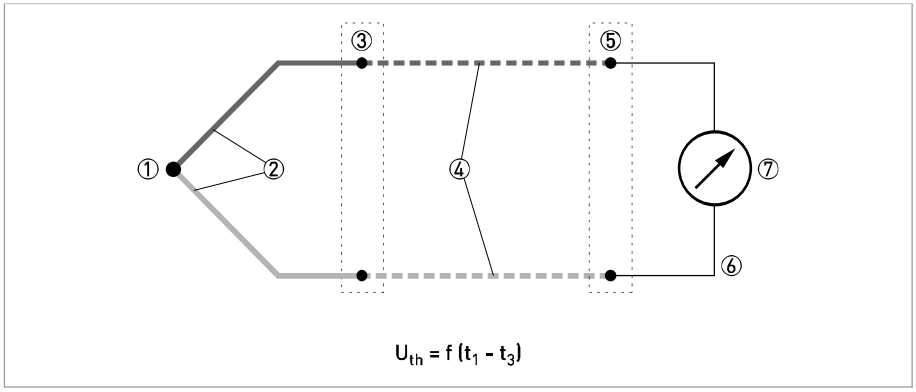


Figure 7-2: Thermocouple measuring circuit, schematic.

1 Measuring point t_1 (hot junction)
2 Thermocouple
3 Transition junction t_2
4 Compensation cable / extension cable
5 Reference junction t_3 (cold junction)
6 Copper conductor
7 Voltage meter U_{th}

7.2 Technical data

INFORMATION!

- *The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local representative.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Download Center).*

Measuring system

Application range	Temperature, resistance or voltage measurements of solids, liquids and gases in industrial environment.

Design

Versions	
TT 50 C	In-head transmitter which is intended for installation in a "B connection head" or larger according to DIN 43729. This transmitter is optionally available in an intrinsically safe version for installation in potentially explosive areas (TT 50 C Ex).
TT 50 R	Rail-mount transmitter which is intended for installation on a top-hat rail according to DIN 50022 / EN 60715.
Features	
HART® 5 compliance	The transmitter are fully compliant with the HART® 5 protocol. HART® 5 offers the possibility to receive diagnostic information such as sensor errors or sensor conditions.
Sensor isolation monitoring	The isolation resistance of thermocouples and RTD's as well as the cabling between sensor and transmitter is being monitored. If the isolation is below a user-defined level, this will be indicated in ConSoft and with a diagnostic HART® message, and the output signal can be forced upscale or downscale. This feature requires an extra lead inside the thermocouple or RTD.
Customized linearization	For resistance and mV inputs, the 50-point customized linearization can provide a correct process value, in a choice of engineering units, for a sensor with non-linear input/output relation.
Sensor break monitoring	User-definable output: 3.6...22.8 mA.

Measuring accuracy

Accuracy	RTD and thermocouple: for detailed information refer to *RTD and T/C accuracy table* on page 38.
	Resistance: ±0.1 Ω or ±0.1% of span
	Voltage: ±20 µV or ±0.1% of span
Temperature influence	RTD and thermocouple: for detailed information refer to *RTD and T/C accuracy table* on page 38.
	Resistance: ±0.01% of span per °C or °F
	Voltage: ±0.01% of span per °C or °F

Cold Junction Compensation (CJC)	**In-head transmitter:**
	Celsius: ±0.5°C within ambient temperature -40...+85°C
	Fahrenheit: ±0.9°F within ambient temperature -40...+185°F
	Rail-mount transmitter:
	Celsius: ±0.5°C within ambient temperature -20...+70°C
	Fahrenheit: ±0.9°F within ambient temperature -4...+158°F
Temperature influence CJC	±0.02°C per °C / ±0.02°F per °F
Sensor wire influence	RTD and resistance, 2-wire: adjustable wire resistance compensation.
	RTD and resistance, 3-wire: negligible, with equal wire resistance.
	RTD and resistance, 4-wire: negligible.
	Thermocouple and voltage: negligible.
Supply voltage influence	Negligible
Long-term drift	±0.1% of span per year

Operating conditions

Temperature	
In-head transmitter	**Operating and storage temperature:**
	Standard version: -40...+85°C / -40...+185°F
	Intrinsically safe version: for detailed information refer to *Temperature data for potentially explosive areas* on page 37.
Rail-mount transmitter	**Storage temperature:**
	-40...+85°C / -40...+185°F
	Operating temperature:
	-20...+70°C / -4...+158°F
Humidity	5...95% RH (non-condensing)
Protection category	
In-head transmitter	Housing: IP50
	Terminals: IP10
Rail-mount transmitter	Housing: IP20
	Terminals: IP00

Installation conditions

Mounting	In-head transmitter: DIN B-head or larger, DIN-rail (with adapter).
	Rail-mount transmitter: rail acc. to DIN 50022 / EN 60715, 35 mm / 1.38".
	For detailed information refer to chapter "Installation".
Weight	In-head transmitter: 50 g / 0.11 lb
	Rail-mount transmitter: 70 g / 0.15 lb
Dimensions	For detailed information refer to *Dimensions* on page 34.

Materials

Housing and flammability acc. to UL	In-head transmitter: PC + ABS (V0), polyamide (V2)
	Rail-mount transmitter: PC + glassfibre (V0)

Electrical connections

Power supply	In-head transmitter: 10...42 VDC
	Rail-mount transmitter: 11...42 VDC
	Intrinsically safe version: 12...30 VDC at maximum of 100 mA and 0.9 W.
Isolation	1500 VAC, 1 min
Connection	Single/stranded wires: max. 1.5 mm^2 / AWG 16

Inputs / Outputs

Input - RTD	
Pt100 (IEC 60751, α=0.00385)	-200...+1000°C / -328…+1832°F
Pt100 (JIS C 1604-8, α=0.003916)	
PT X ($10 \leq X \leq 1000$) (IEC 60751, α=0.00385	Corresponding to max. 2000 Ω
Ni100 (DIN 43760, α=0.006180)	-60...+250°C / -76...+482°F
Ni1000 (DIN 43760, α=0.006180)	-60...+150°C / -76...302°F
Sensor current	Circa 400 µA
Maximum sensor wire resistance	25 Ω/wire
Input - resistance / potentiometer	
Range, resistance	0...2000 Ω
Range, potentiometer	0...2000 Ω
Minimum span	10 Ω
Customized linearization	Up to 50 points
Sensor current	Circa 400 µA
Maximum sensor wire resistance	25 Ω/wire
Input - thermocouples	
T/C type B - Pt30Rh-Pt6Rh (IEC 60584)	+400...+1800°C / +752...+3272°F
T/C type E - NiCr-CuNi (IEC 60584)	-200...+1000°C / -328...+1832°F
T/C type J - Fe-CuNi (IEC 60584	
T/C type K - NiCr-Ni (IEC 60584)	-200...+1350°C / -328...+2462°F
T/C type L - Fe-CuNi (DIN 43710)	-200...+900°C / -328...+1652°F
T/C type U - Cu-CuNi (DIN 43710)	-200...+600°C / -328...+1112°F
T/C type N - NiCrSi-NiSi (IEC 60584)	-100...+1300°C / -148...+2372°F
T/C type R - Pt13Rh-Pt (IEC 60584)	-50...+1750°C / -58...+3182°F
T/C type S - Pt10Rh-Pt (IEC 60584)	
T/C type T - Cu-CuNi (IEC 60584)	-200...+400°C / -328...+752°F
Input impedance	>10 MΩ
Cold Junction Compensation (CJC)	Internal, external (Pt100) or fixed

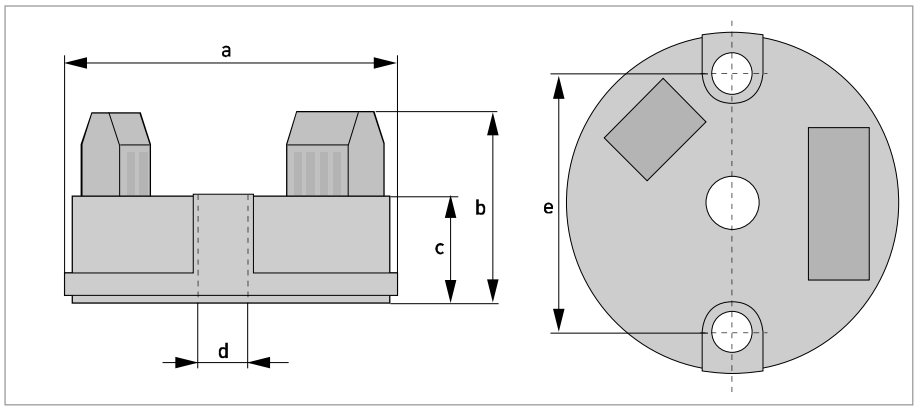
Input - voltage	
Range	-10...+500 mV
Minimum span	2 mV
Customized linearization	Up to 50 points
Input impedance	>10 MΩ
Maximum wire loop resistance	500 Ω
Output	
Output signal	4...20 mA, 20...4 mA or customized
	Temperature linear for RTD & T/C
HART® protocol	HART® 5
Adjustable output filtering	0...10 s (time constant)
Permissible load	Note: Communication according to HART® always requires a resistance greater than 250 Ω! For TT 50 C Ex and TT 50 R a greater load than the below-mentioned is allowed with a higher supply voltage, see output load diagram.
	TT 50 C: 610 Ω at 24 VDC and 23 mA
	TT 50 C Ex: 520 Ω at 24 VDC and 23 mA
	TT 50 R: 565 Ω at 24 VDC and 23 mA.
Configuration	
HartSoft	The PC configuration software "HartSoft" is a versatile and user-friendly tool for transmitter configuration, loop check-up and sensor diagnostics. It runs on Windows 2000, XP and Vista.
Alternatives	Hand held communicator, e.g. FC375/FC475 (Emerson)
	Management systems, e.g. AMS (Emerson) and PDM (Siemens)
	EDD enabled systems

Approvals and certifications

CE	The device fulfils the statutory requirements of the EC directives. The manufacturer certifies that these requirements have been met by applying the CE marking.
Intrinsically safe version	ATEX: II 1 G Ex ia IIC T4/T5/T6
Electromagnetic compatibility	Directive: 2004/108/EC.
	Harmonized standards: EN 61326-1:2006.

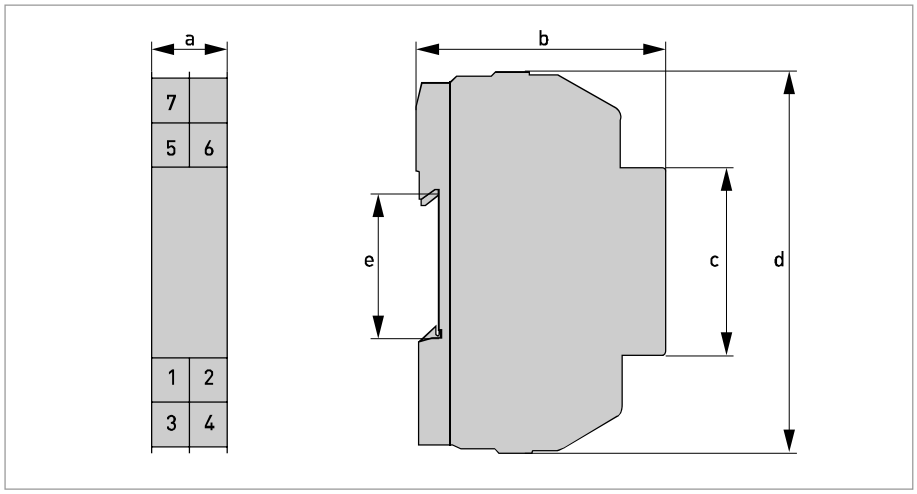
7.3 Dimensions

In-head transmitter (Non-Ex and Ex)



	Dimensions	
	[mm]	["]
a	44	1.73
b	26	1.02
c	16	0.63
d	7	0.28
e	33	1.30

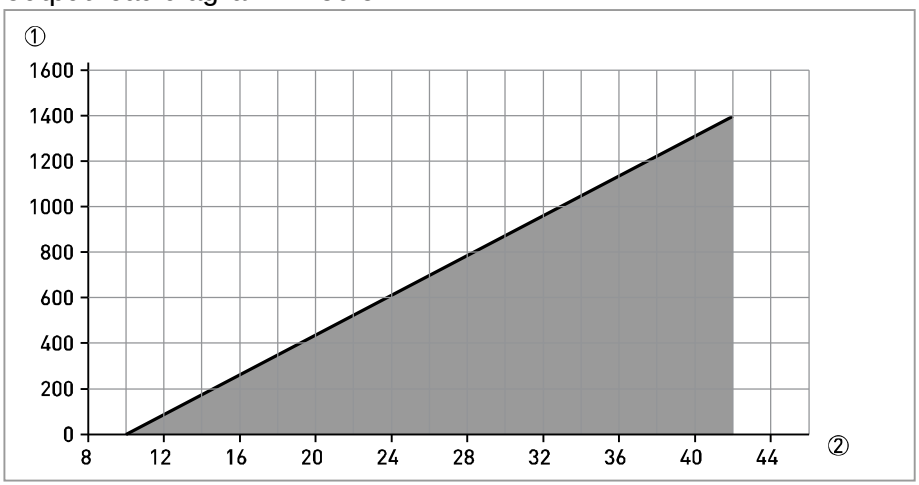
Rail-mount transmitter



	Dimensions	
	[mm]	["]
a	17.5	0.69
b	58	2.28
c	45	1.77
d	90	3.54
e	35	1.38

7.4 Output load diagrams

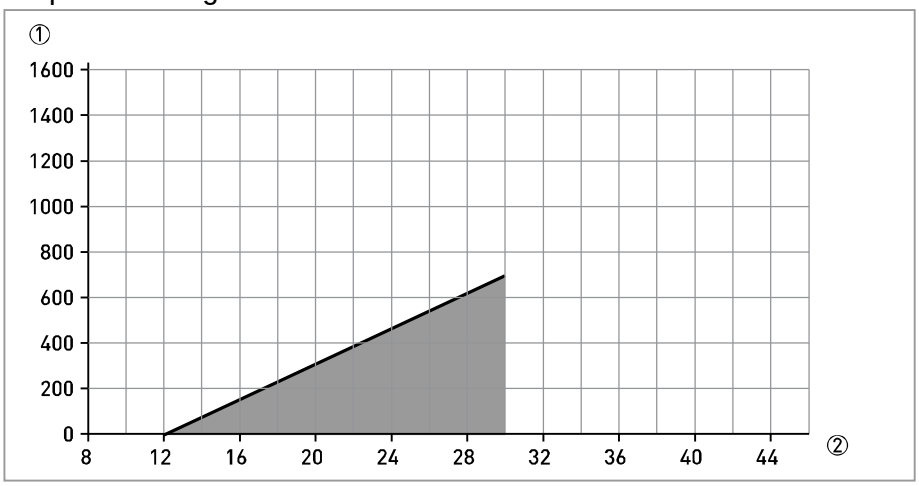
Output load diagram TT 50 C



1 R: total output load in Ω
2 U: supply voltage in VDC

Formula for the maximum permissible output load of the TT 50 C:
permissible R_{Load} [Ω] = (U-10)/0.023

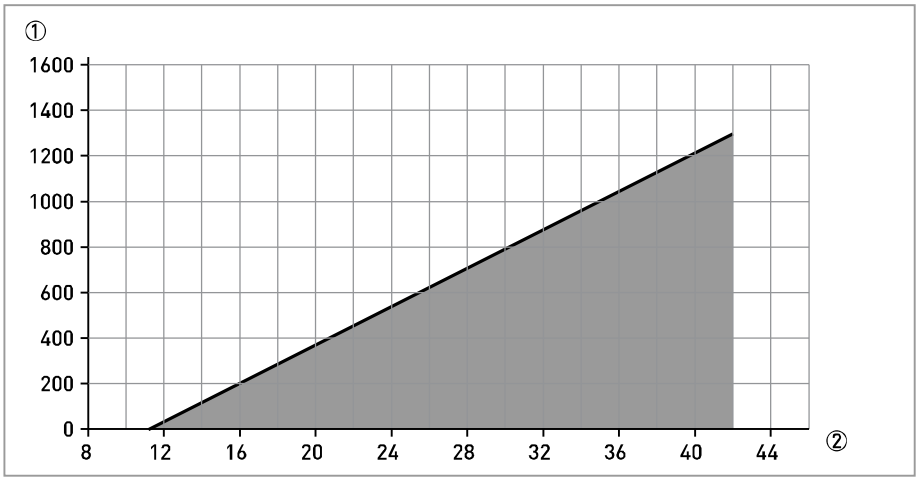
Output load diagram TT 50 C Ex



1 R: total output load in Ω
2 U: supply voltage in VDC

Formula for the maximum permissible output load of the TT 50 C Ex:
permissible R_{Load} [Ω] = (U-12)/0.023

Output load diagram TT 50 R



1 R: total output load in Ω
2 U: supply voltage in VDC

Formula for the maximum permissible output load of the TT 50 R:
permissible R_{Load} [Ω] = (U-11)/0.023

7.5 Temperature data for potentially explosive areas

In-head transmitter (Ex-version)

Temperature class	Ambient temperature T_a
T6	-40°C ≤ T_a ≤ +50°C / -40°F ≤ T_a ≤ +122°F
T5	-40°C ≤ T_a ≤ +65°C / -40°F ≤ T_a ≤ +149°F
T4	-40°C ≤ T_a ≤ +85°C / -40°F ≤ T_a ≤ +185°F

7.6 Electrical data for outputs and inputs

In-head transmitter (Ex-version)

Ouput (supply)		Input (sensor)	
Max. voltage to transmitter	U_i = 30 VDC	Max. voltage from transmitter	U_o = 30 VDC
Max. current to transmitter	I_i = 100 mA	Max. current from transmitter	I_o = 25 mA
Max. power to transmitter	P_i = 900 mW	Max. power from transmitter	P_o = 190 mW
Internal inductance	L_i = 1 mH	Max. inductance (input loop)	L_o = 19 mH
Internal capacitance	C_i = 1 nF	Max. capacitance (input loop)	C_o = 31 nF

7.7 RTD and T/C accuracy table

INFORMATION!

- *Conformance level 95% (2σ)*
- *CJC = Cold Junction Compensation*

Accuracies in °C

Input type	Temp. range	Min. span	Accuracy	Temp. influence (Dev. from ref. temp. 20°C)
	[°C]	[°C]	[°C]	
RTD Pt100	-200...+1000	10	±0.2°C or ±0.1% of span	±0.01% of span per °C
RTD Ni100	-60...+250	10	±0.2°C or ±0.1% of span	±0.01% of span per °C
T/C type J	-200...+1000	50	±0.3°C or ±0.1% of span 1	±0.01% of span per °C
T/C type K	-200...+1350	50	±0.5°C or ±0.1% of span 1	±0.01% of span per °C
T/C type S	-50...+1750	300	±2.0°C or ±0.1% of span 1	±0.01% of span per °C
T/C type B	+400...+1800	700	±2.0°C or ±0.1% of span 1	±0.01% of span per °C

1 CJC error is not included

Accuracies in °F

Input type	Temp. range	Min. span	Accuracy	Temp. influence (Dev. from ref. temp. 68°F)
	[°F]	[°F]	[°F]	
RTD Pt100	-328...+1832	50	±0.4°F or ±0.1% of span	±0.006% of span per °C
RTD Ni100	-76...+482	50	±0.4°F or ±0.1% of span	±0.006% of span per °C
T/C type J	-328...+1832	122	±0.5°F or ±0.1% of span 1	±0.006% of span per °C
T/C type K	-328...+2462	122	±0.9°F or ±0.1% of span 1	±0.006% of span per °C
T/C type S	-58...+3182	572	±3.6°F or ±0.1% of span 1	±0.006% of span per °C
T/C type B	+752...+3272	1292	±3.6°F or ±0.1% of span 1	±0.006% of span per °C

1 CJC error is not included

KROHNE product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature meters
- Pressure meters
- Analysis products
- Measuring systems for the oil and gas industry
- Measuring systems for sea-going tankers

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Tel.:+49 (0)203 301 0
Fax:+49 (0)203 301 10389
info@krohne.de

The current list of all KROHNE contacts and addresses can be found at:
www.krohne.com

KROHNE

Sensori di vibrazione

Ventilatore	Tipo sensore	Item cliente
MB00239	TR-27	L1 S20-CO 043; L1 S20-CO 044
MB00258	TR-27	L1S25-CO 010
ZB00225	TR-27	L1 S25-CO 019

VIBRATION TRANSMITTER

TR-27

FUNCTION

The integrated transmitter TR-27 measures the absolute vibrations of any rotating machine support and it is able to interface directly in 2 wires technique (current loop 4 ÷ 20 mA) to an acquisition system (PLC or DCS).

GENERAL DESCRIPTION

The transmitter, secured directly on machinery, generates an electric signal (4÷20 mA) which is proportional respectively to vibration velocity or acceleration. The transmitter is made of an AISI 316L steel body with machine connection thread; the connection to the acquisition system is effected by means of an integral cable.
It is available both a standard version (PVC shielded cable and nickel-plated brass cable gland) and a special version for aggressive environment (EFTE shielded armoured cable and AISI 316L steel cable gland).

NOTE: The transmitter is available in different configuration versions and does not need any set-up or maintenance.

TECHNICAL CHARACTERISTICS

Composition	• AISI 316L stainless steel integrated transmitter body
POWER SUPPLY	• 24 Vdc (10 ÷ 35 Vdc) current loop 4 ÷ 20 mA (2 wires) • Maximum load – see Figure 1
External connections	• Standard: PVC shielded cable with nickel-plated brass cable gland • Special: EFTE shielded and armoured cable, with AISI 316L steel cable gland
Environmental	• Transmitter - 50°C ÷ + 120°C • IP 68 (submersible depth 70 mt) • Standard cable: -20°C ÷ + 80°C • Special cable: -50°C ÷ + 150°C - resistance UV
Measure type	• Omnidirectional seismic (absolute vibration)
Dynamic field	• ± 18 g
Transverse sensitivity	• < 5 %
Linearity	• ± 2% - 75 Hz
Dynamic performances	• ±3% / 10Hz-1kHz - see Figure 2 • -3db / 1,5Hz - 2kHz
Insulation	• $\geq 10^8$ Ω between signal and case
Application axis	• Any
Standard machine connection thread	• M8x1,25 • ¼"-18NPT • ¼''-28UNF • M6x1
Maintenance	• No maintenance is needed
Electrical connections	• Bipolar shielded cable, conductors typical section 2x1mm²
Parameters to be defined when ordering	• Measuring field • Machine connection thread • Version • Cable length
Mounting torque	• 5÷10 N-m

CEMB
BALANCING MACHINES

TR-27

Figure 1
Maximum load on current loop

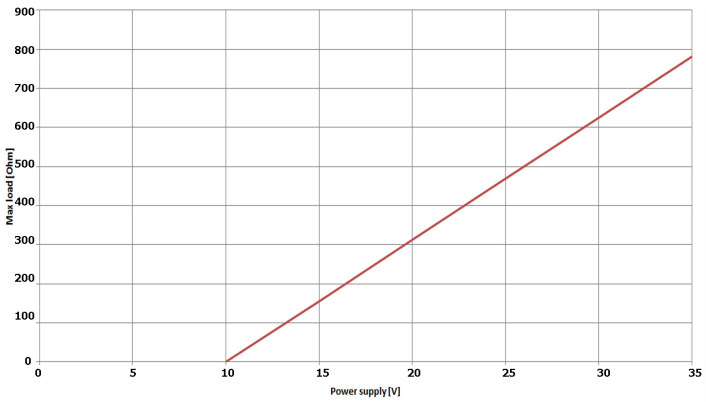
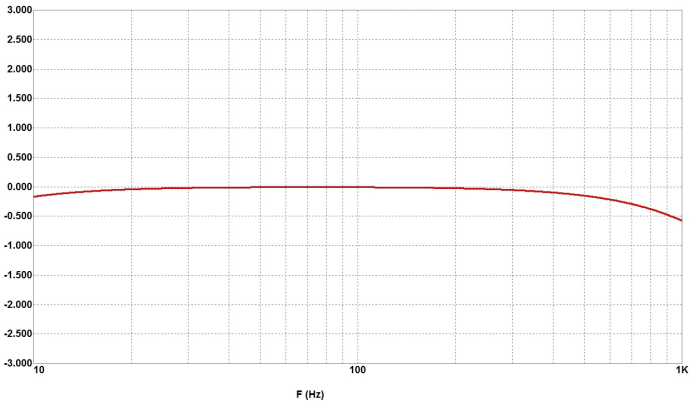


Figure 2
Frequency response [db]



ORDER INFORMATION

	A		B		C		D
TR - 27 /	☐	/	☐	/	☐	/	☐

A: MEASURING FIELD

0	0 ÷ 10 mm/s RMS
1	0 ÷ 20 mm/s RMS
2	0 ÷ 50 mm/s RMS
3	0 ÷ 100 mm/s RMS
4	0 ÷ 1 g RMS
5	0 ÷ 5 g RMS
6	0 ÷ 10 g RMS
7	0 ÷ 25 mm/s RMS
S	special to be defined

B: MACHINE CONNECTION THREAD

0	M8x1,25
1	¼'' - 18NPT
2	¼'' - 28UNF
3	M6x1

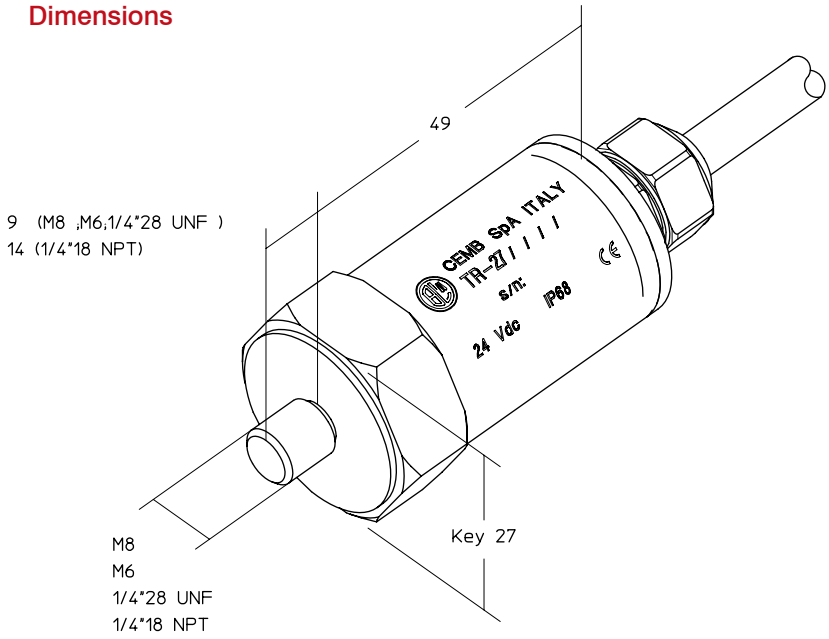
C: VERSION

0	Standard
1	Special

D: CABLE LENGTH

XX	length in meters

Dimensions



PURCHASE ORDER EXAMPLE:

TR - 27 / 1 / 0 / 1 / 05

1= Measuring field 0÷20 mm/S RMS
0= Machine connection thread M8x1,25
1= Special version
05= Cable length 5 meters

CEMB
BALANCING MACHINES

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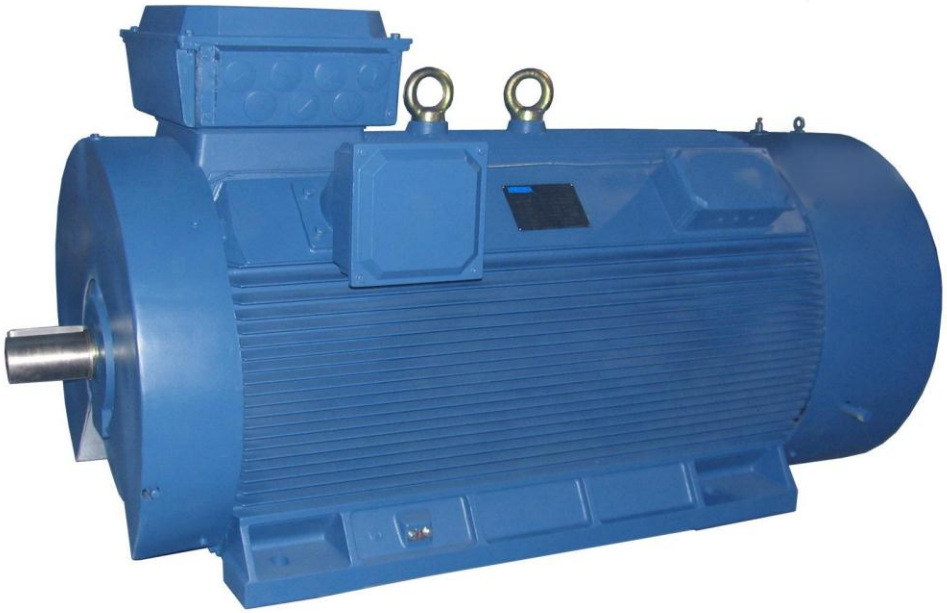
ASTM59820 03/15

Installation, Operation & Maintenance Motor Manual

Inveruno (Mi) - Italy - +39 02 97288320

Installation, operation and maintenance manual



(Read this manual carefully before use)

FELM srl Motors

3-Phase Induction Motors
Installation, operation and maintenance manual

Contents

1. Safety specification

NOTE!
These instructions must be followed to ensure safe and proper installation, operation and maintenance of motors. They should be brought to the attention of anyone who installs, operates or maintains this equipment. Ignoring these instructions may invalidate the warranty.

1.1 Confirm that the parameters on the nameplate meet your requirements.
1.2 Confirm that the motor is not damaged.
1.3 Remove transport shaft locking device if fitted. Re-install it before transportation once more.
1.4 Only lift the motor using the eyebolts or the lifting lugs integrated with the motor frame. Alternatively, follow any otherwise stated separate lifting instructions.
Check that the eyebolts or the lifting lugs integrated with the motor frame are undamaged before lifting. Lifting eyebolts must be tightened before lifting. If necessary the position of the eyebolt must be adjusted with suitable washers.
If there is more than one lifting lug, they must be used together to share the weight.
The centre of gravity of motors with the same frame may vary due to different outputs, mounting arrangements and auxiliary equipment.
To move a motor with packing, a sling must be used to lift the motor under the base, or eyebolts or lifting lugs integrated with the motor frame should be used.
1.5 After installation, confirm that the mounting (IM) is in line with the identification on the nameplate. Check that the drain holes are at the lowest position. If there are any questions, please contact Felm Co..

2. Safety considerations

NOTE!
Obey the safety precaution measures as follows.

2.1 The motor is intended for installation and use by qualified personnel, familiar with relevant safety requirements.
If the motor is not installed, operated and maintained correctly, it could become a danger to health and human life.

NOTE!
Safety equipment necessary for the prevention of accidents at the installation and operating site must be provided in accordance with the local regulations.

2.2 Before maintenance is carried out, all electrical supplies connected with the motor and its auxiliary parts must be turned off. Confirm that the motor is already at a standstill.
2.3 Earth connections must be carried out according to local regulations before the motor is connected to the mains supply.
Any protection devices must also be earthed to prevent accidents in service.
2.4 Any fitted thermal protection devices should not be left open circuit and should always be used. The protection devices can ensure the life of motor.
2.5 Depending on the operating conditions and environment, the most suitable degree of protection must be chosen to prevent any damage and accidental contact with internal rotating parts or with live parts.
2.6 There should be no possibility of contact with live parts. In the case of auto-starting, auto-shutting down and remote starting, there must be a warning notice to state that the motor could start unexpectedly.

2.7 Before starting, confirm that all shaft keys are fitted firmly.
2.8 In order to prevent overload, it is advisable to install a device to monitor the winding temperature. Felm Co. can install winding temperature monitors, if they are not already fitted as standard ,with leads to connect directly with a controller to provide thermal protection.
2.9 No phase failure in service. It is recommended to install a phase failure protection device.
2.10 Coupling halves and pulleys must be fitted using suitable equipment and tools that do not damage the bearings. Never fit a coupling half or pulley by hammering into place, or remove it using a lever pressed against the body of the machine.
2.11 Within the vicinity of the noise source, ear defenders must be worn.
For more information about noise limits, please contact Felm Co. or reference the relevant product standard of Felm Co.
2.12 Protect against the ingress of water.
2.13 When a motor is used with a variable speed mechanism, make sure that it does not exceed the maximum safety speed of the motor and operate without overload.
(At lower speeds, the ventilation of totally-enclosed fan-cooled motors will decrease. A separate fan motor should be added to avoid any overheating at low speed.) If there is any doubt, please contact Felm Co.
2.14 Confirm safety measures to avoid accidents in brake failures.
2.15 Some Felm motors provide continuous operation re-greasing nipples. These machines are intended for lubrication during operation by qualified personnel who are familiar with relevant safety requirements. Any rotating parts or live parts should be integrally protected.

NOTE!
These safety considerations must be followed to avoid injury from electrical and mechanical hazards.

3. Environmental requirements and operating conditions

3.1 Environmental requirements

3.1.1 Normal ambient temperatures limits are -15℃to 40℃ if standard performance is to be achieved.
3.1.2 Maximum altitude 1000 meters above sea level.
3.1.3 Relative humidity should be less than 95%.

NOTE!
If there is any deviation from these maximum environment conditions, such as normal ambient temperatures lower than -15℃ or higher than 40℃, or the relative humidity is more than 95%, or the altitude above sea level is more than 1000 meters, or high vibration situations, the suitability of motors for operation must be checked. Any questions, please contact Felm Co.

3.2 Operating conditions

3.2.1 The deviation between supply frequency and rated frequency should be no more than 1%. The deviation between supply voltage and rated voltage should be no more than 5% (except special designs according to prior agreement).
3.2.2 The open-drip-proof motors (IP23, IP21) are suitable for operating indoors in clean, dry, and non-corrosive well ventilated conditions.

NOTE!
If open-drip-proof motors (IP23, IP21) operate outdoors, adverse weather conditions will affect the standard performance of the motors.

3.2.3 The totally-enclosed fan-cooled motors (IP44, IP54, IP55) are suitable for operating in relatively dirty, humid, and dusty environments.
3.2.4 The outdoor anticorrosive motors are suitable for operating outdoors or in corrosive air, and high humidity environments.

3.2.5 For the water-cooled motors and the motors with water-cooled bearings, the ambient temperatures should be no less than 0℃, to avoid the cooling water freezing.
3.2.6 Foundations must be even, and sufficiently rigid to withstand possible short circuit forces. They shall be dimensioned so as to avoid the occurrence of vibration due to resonance.
3.2.7 The installation space should be large enough to facilitate heat dissipation and maintenance.

NOTE!
Check that the motor has sufficient airflow. Ensure that no nearby equipment, surfaces or direct sunshine, radiate additional heat to the motor.
If there are other ventilators, ensure they do not affect the ventilation of the motor. If it is affected, the wind power of the ventilator must be adjusted or change the ventilating path of the motor to ensure that it can ventilate effectively.

4. Transportation and storage

4.1 Transportation

4.1.1 The motors are provided with adequate protection before leaving the factory. Ensure that the same protection is kept to protect from damage and scratching during transportation.
4.1.2 Some medium and large motors are fitted with cylindrical-roller bearings, angular contact bearings and/or sleeve bearing and must be fitted with shaft locking devices during transportation.
4.1.3 Upon receipt of the motor, a check must be made immediately for external damage and if found, take photographs and inform the forwarding agent without delay. It is important to inform the transportation company and the supplier with evidence of damage as soon as possible. Check that it will meet the customer's requirement for products and service.
4.1.4 When motors are not put into operation immediately, adequate protection measures should be undertaken to assure best performance.
4.1.5 For motors with packing, check the following points upon receipt：Is there any damage？Are all accessories in good order？If there is any doubt, please take photographs and inform the supplier immediately.
4.1.6 For motors with packing, lift the motor using the lifting lugs only, or a forklift must be used to carry the motor under the base of the pallet.
4.1.7 The forklift should not be used to carry from the motor base or any other position.

4.2 Short period storage (not exceeding 3 months)

4.2.1 The motors should always be stored in clean, dry, vibration free, dust free and corrosive free conditions.
4.2.2 The motors should always be stored on a smooth foundation surface and entirely free from vibration and easy for handling.
4.2.3 The storage place should not be located in uncertain environments, and not located near to a boiler or a freezer.
4.2.4 The best temperature of the storage place is 5℃ to 50℃. If the motor is equipped with space heaters, they should be energized at the voltage shown by the space heater nameplate attached to the motor.

4.2.5 The best relative humidity of the storage place is less than 75%. Keep the temperature of motors above dew point from condensation.
Anti condensation heaters, if fitted, should preferably be energized and checked periodically. Since moisture can be very detrimental to electrical components, the motor temperature should be maintained above the dew point temperature by providing either external or internal heat, if not fitted with a heater.
Incandescent light bulbs can be placed inside open ventilated motors to provide heat. However, if used, they must not be allowed to come in contact with any parts of the motor winding because of the concentrated hot spot that could result.

4.2.6 For motors stored outdoors, the plastic packing must be discarded. Waterproof covers must be used to protect against the ingress of water but not to affect the ventilation. Motors should be placed on a rigid foundation to prevent moisture and dust.
4.2.7 Protect against the ingress of insects.
4.2.8 Store in the original packing, which must be opened with enough holes to maintain effective ventilation but not to affect the protection against rain.
4.2.9 Ensure that water is filled into the cooling pipes of water-cooled motors and water-cooled bearings, to protect against corrosion or possible fractured pipes.
Add the mixture of water and glycol anti-freeze into the pipes to prevent fractured pipes.
The proportion of glycol should be no less than 50%. After adding the mixture, the entrance and exit of pipes should be sealed to prevent the loss of the mixture.

4.3 Long period storage (exceeding 3 months)
Check the following points in addition to the requirement of short period storage：
4.3.1 The storage period is not too long, and motors are not piled too high to damage them.
4.3.2 Insulation resistance should be measured once every two months and the value should be recorded.
4.3.3 The humidity should be measured once every two months and recorded. If the humidity is more than recommended, change the storage place.
4.3.4 The paint of motor surfaces should be checked once every three months. If there is rust, it must be cleaned and repainting must be done.
4.3.5 The shaft extensions and flanges should be checked for rust once every three months. If there is rust, it must be cleaned carefully with emery cloth and the antirust compound must be re-applied.
4.3.6 Motors with rolling bearings will have been filled with the correct lubrication before leaving the factory, and they do not need to be re-filled during storage. Turn the shaft by hand at least ten revolutions once a month to check for free rotation.
4.3.7 Motors with sleeve bearings will have the lubrication drained before leaving the factory, but they need to be re-filled with the correct lubrication during prolonged storage periods to avoid rusting. Turn shafts by hand at least ten revolutions in both directions of rotation once a month to check for free rotation.
4.3.8 If the storage of motors with sleeve bearings exceeds one year, the sleeve bearings must be dismantled and antirust measures must be applied.
4.3.9 After long periods of storage, check the bearings. Change the rusting bearings and fill with lubrication.
4.3.10 Measure insulation resistance before starting and when winding dampness is suspected. Resistance should exceed 1M ohm. If the 1M ohm resistance value is not achieved, the winding is too damp and must be dried in an oven. If after oven drying, the 1M ohm resistance value is still not achieved, the motor must be rewound.

Oven drying method :
Dismantle the motor and put the stator frame containing the winding into an oven. For wound-rotor motors, the rotor should also be put into the oven at the same time. Oven temperature should be less than 100℃. Keep good ventilation inside and outside the oven. When insulation resistance exceeds the 1M ohm or insulation resistance value gets steady, oven drying is sufficient.

Alternatively, stall the rotor with a low voltage applied to the winding, ensure that the measured current is only 1/3 to 1/2 of rated current. Winding temperature should be less than 100℃. When insulation resistance exceeds the 1M ohm or insulation resistance value gets steady, drying is sufficient.

4.4 Storage after installation
After installation or after operating for a period, if the motor will be not in operation for a long period, protect the motor as measures stated in 4.3. Otherwise the motor should be in operation once every two months.

5. Installation and calibration

5.1 Check before installation

5.1.1 Check all rating data on the nameplate, especially voltage and winding connection (star or delta).
5.1.2 Measure insulation resistance before commissioning and when winding dampness is suspected. Resistance should exceed 1M ohm (measured with a Megger). If this reference resistance value is not achieved, the winding is too damp and must be oven dried. Oven temperature should be less than 100℃.
5.1.3 Check the motor for damage and loose fixings. Turn the shaft by hand to check free rotation.
5.1.4 Check the mounting arrangement. Apart from the basic type of construction IM B3, the motors can also be supplied in various other types of construction. The basic type of construction IM B3 can also be used as IM V5 by additional support and/or by changing the bearing arrangements to carry the axial force.
5.1.5 Clean dust and other foreign bodies from the motor.
5.1.6 After a long period of storage, check the lubrication and replace it if necessary.

5.2 Foundation

NOTE!
The best foundation design can ensure safe operation and convenient maintenance. The space around the motor foundation should be large enough to facilitate heat dissipation and necessary maintenance.
Ensure cooled air flow through the surface and parts of the motor without any restriction. Ensure that any other devices or heating elements do not to affect the cooling of the motor.
Foundations should be strong and free of vibration.

5.2.1 Foundations must be even, and sufficiently rigid to withstand possible short circuit forces. If motors are connected with other equipment, both should be installed on foundations made in concrete. A suitable type of construction should be chosen for frequent shock loading.
5.2.2 Foundations should be 2mm lower than the base of the driven equipment for installation adjustment to attain the correct alignment.
5.2.3 The foundation must be suitable for each footplate area. The foundation surface must be bigger than the footplate areas.
5.2.4 Any height differences between the motor and the driven machine should be adjusted with shims. The surface for the shims must be a larger area than that of the feet. The amount of the shims should be less than 3mm.
5.2.5 Select an appropriate foundation surface for any soleplate or common bed which will be considered more reliable for motor operation.

NOTE!
Foundations must be even, and sufficiently rigid to withstand possible short circuit forces. Incorrect alignment can lead to bearing failure, vibration and even shaft fracture, as well as accidents.

5.3 Installation

5.3.1 Preparation for installation
5.3.1.1 A number of steel shims may be required of 0.1mm, 0.2mm, 0.5mm, 1.0mm thickness.
5.3.1.2 Simple tools, such as lever, jack and bolts.
5.3.1.3 Measurement instruments, such as micrometer for adjusting installation of shaft coupling.
5.3.1.4 Before mounting the motor, the foundation surface must be clean.
5.3.1.5 Check the position and height of the mounting holes.
5.3.1.6 Remove transport locking device if fitted. Re-install it before transportation once more.
5.3.2 Consideration before installation
5.3.2.1 The fixing bolts for mounting must be set into the concrete firmly.
5.3.2.2 The studs must be clean from concrete, paint, and dirt.
5.3.2.3 The concrete surface must be clean from oil, grease and dirt.

5.3.2.4 The anti-rust protection applied to the shaft extension and the feet must be removed by a cleaning spirit.
5.3.2.5 Fasten the steel studs to the holes. Stainless steel studs should be used where water or moisture is expected to cause rust. Shockproof locking washers should be used where vibration is expected.
5.3.2.6 Ensure that the drain holes are at the lowest position after installation. When the drain holes are open, measures must be taken to protect against the ingress of dirt or insects etc.
5.3.2.7 After long periods of storage or the motor is repaired, the insulation resistance must be checked before starting. This includes stator windings, rotor windings of slip-ring motors, and other auxiliary devices.
5.3.2.8 Lift the motor using only the eyebolts or lifting lugs integrated with the motor frame. Any smaller lifting lugs for auxiliary devices are not suitable for lifting the motor.
5.3.2.9 If there is more than one eyebolt or lifting lug, they must be used together to share the weight.
5.3.2.10 If slings are used on the lifting lugs, keep the slings the same length and not twisted before lifting.

NOTE!
Do not lift the motor with two ends of the same sling. If there are two eyebolts or lifting lugs, lift the motor with two separate slings.

5.3.3 Installation
5.3.3.1 Installation of shaft coupling
(1) The shaft coupling of the motor must be separately dynamically balanced. As standard, balancing of the motor has been carried out using **half key.** If required with **full key** balance, please contact Felm Co.
(2) Before installing the coupling, the shaft and the coupling bore must be greased. Do not paint the surface with molybdenum disulfide.
(3) Basically, the coupling should be heated and pushed onto the shaft extension with only light axial force. To avoid bearing damage, do not hammer the coupling.
(4) When the coupling and the driven machine are coupled together, it is recommended that a flexible coupling be used, for either rolling bearings or sleeve bearings.
(5) There must be adequate space between the couplings of motors with rolling bearings and of the driven machines.
(6) For motors with the sleeve bearings, the couplings must be spaced apart an adequate distance to prevent that axial force of the driven machine being exerted on the coupling which could cause serious stresses to be exerted on the bearings.
(7) Before installing the coupling, it should be balanced using half a shaft key to achieve an overall balance condition.
(8) After the couplings of the motor and the driven machine are coupled together, a guard must be fitted around the couplings.
(9) For motors with sleeve bearings, during installation, check the indicator is located in the groove on the shaft and ensure that the magnetic centre of the stator and the rotor are in line.

NOTE!
There must be enough space left between the couplings of motor and of the driven machine to prevent axial force caused by heat expansion which could lead to bearing failure.

5.3.3.2 Installation of pulleys
Most motors are not suitable for V-belt connection unless specially designed for such service. Any V-belt drive must be specially designed according to the supplier's instructions for use with motors.
(1) Flat belts are not suitable for 2 pole motors above 4 KW and 4 pole motors above 30 KW for power transmission.
(2) The length of the pulley should not be greater than the shaft extension, otherwise this can lead to shaft fracture.
(3) The fan end of a double shaft extension motor should be connected with a direct coupling only.
(4) Ensure the parallelism of the motor shaft and the driven shaft. And ensure the square ness of

the motor shaft and the belts.
(5) The belt pulley must be dynamically balanced before installation.
(6) The motor shaft must be painted with cosmoline before installation of the belt pulley.
(7) Cylindrical roller bearings are more suitable for motors with V-belt drives. Do not exceed the maximum belt forces (i.e. radial bearing loading) stated in the relevant bearing manuals. It is important to make sure that the chosen motor will meet your requirements.
(8) The diameter ratio between motor and driven pulleys should not be greater than 5 to 1 for flat belts, and 8 to 1 for V-belt. It is also advisable to limit the belt velocity to under 32 m/min to minimize belt abrasion and vibration.
(9) Place the pulley and belt as close as possible to the motor body to reduce the bending moment and prevent shaft fractures.

5.3.3.3 Gear Drives
(1) Make sure the loading capacity of the shaft and bearings is appropriate for the size and installation position (overhung) of the gear drive. If necessary, please contact us to ensure the shaft and bearings will meet your requirements.
(2) Pay close attention to ensure the parallelism of shafts.
(3) The teeth of gears should be correctly and precisely matched, the force conveyance centers should lie on the same line.
(4) There should be no slip, jumping, vibration or unusual noises during operation.

5.3.3.4 Thermal effects.
In aligning the motor (and rotor) axially with the driven equipment, consideration should be given not only to the end-play indicator position but also to axial shaft expansion and increase in shaft centerline height due to thermal expansion effects.
(1) Shaft height growth (change in shaft centerline elevation) for TEFC motor can be calculated as follows：
Δ=(0.00045)×(motor foot to shaft centerline dimension) mm

NOTE!
Thermal effects of the driven machine must be considered at the same time in order to calculate the total thermal effects.

(2) A space must be left between couplings according to the load. Shaft length growth for motor can be calculated as follows:
Δ=(0.0005)×(motor frame length dimension) mm

NOTE!
Ensure the couplings, except rigid couplings, can move free axially. Thermal effects will lead to axial shaft expansion.

5.3.3.5 Installation on rigid foundation
(1) Clean the surface of the foundation.
(2) The foundation must be even. The tolerance should be no more than 0.1mm.
(3) Motors connected with other equipment should be installed on a soleplate or common bed which will be considered more reliable for motor operation. It is better to embed the soleplate or common bed in concrete together.
(4) Put the motor on the foundation carefully to prevent damage.
(5) Check the mounting surface. Each motor footplate area must be rigid on the foundation to prevent misalignment during operation.
(6) For large motors and high voltage motors, the footplate must be pinned after installation. These motors have one dowel hole per foot at the drive end. Deepen the holes by drilling through to the steel foundation. After that, the holes should be tapered with a reaming tool. Suitable tapered dowel pins should be fitted to the holes to ensure the exact alignment, and to allow easier re-installation after any possible removal of the motor.
(7) All shims and footplates must be welded after installation to prevent any unexpected change in position during motor operation.

5.3.3.6 Installation on concrete foundation
(1) Clean the surface of foundation.
(2) The foundation must be strong enough to ensure stability.
(3) Make sure the concrete is completely dry, then tighten the bolts.
(4) Use rigid and solid soleplate or common bed as the surface of the foundation. The tolerance of the surface should less than 0.1mm.
(5) Check the mounting surface. Each motor footplate area must be rigid on the foundation to prevent misalignment during operation.
(6) For large motors and high voltage motors, the footplate must be pinned after installation. There should be holes in the footplate for locating.
(7) All shims and footplates must be welded after installation to prevent any unexpected change in position during motor operation.

5.3.3.7 Installation of vertical motors
(1) If motors are to be connected with a pump, and both are installed on the same foundation, the foundation of the motor/pump must be rigid and firm to provide adequate support. There must be no vibration due to inadequate foundations.
(2) All mounting surfaces must be clean and level.
(3) The foundation must be leveled at least at 4 points (up to H180), 8 points (for H200 and above) and guaranteed to be below 0.04mm (1.5mil) flatness and level.
(4) Make sure the above requirements are acceptable, before setting the motor on the mounting foundation.

5.3.3.8 Adjustment of installation
The motor shaft and the driven shaft should be aligned within limited tolerances in both radial and parallel alignment. In excess of the limited tolerances will lead to bearing failure.
(1) Before adjustment, the couplings of the motor and the driven machine must be coupled together and be convenient for adjustment.
(2) For large motors with foot fixing, adjustment bolts must be installed in the feet of the motor before adjustment.
(3) Adjustment bolts may also be installed in the driven machine for high accuracy installation.
(4) It is necessary to use high accuracy instruments to measure installation for high accuracy adjustment.
(5) All measured data must be recorded to be referenced later.

6. Connection

6.1 Connection of Coolers

6.1.1 Connection of air-to-air coolers.
Generally, the air-to-air cooler is supplied with the motor. It is not installed by the user, but the user is required to keep its ventilation clear. If the air-to-air cooler is sent to the user separately, install it according to the manufacturer's instructions.
6.1.2 Connection of ventilation ducts.
Motors designed for cooling airflow to and/or from the machine with air ducts have connection flanges as specified in the dimensional drawing. Clean the air ducts thoroughly before connecting them to the motor, and check for possible obstructions in the ducts. Seal the joints with appropriate gaskets. Check for possible leaks in the air ducts after they have been connected.
6.1.3 Connection of air-to-water coolers.
Motors equipped with an air-to-water heat exchangers have flanges specified in the dimensional drawing. Connect the flanges and seal the joints with appropriate gaskets. Prior to starting the motor, the water has to be turned on.
6.1.4 Connection of direct water-cooled motor.
Steel frame water-cooled construction is only to be used with a closed fresh water circulation. The water cooling circuit flanges are made according to the customer's specifications, and are defined on the dimensional drawing.
The cooling water circulates in ducts integrated in the motor frame. The material of the frame and ducts is carbon steel. This material is prone to corrosion in saline and foul water. The corrosion products and fouling deposits might block the water flow in the ducts.
This is why it is important to use pure and inhibited water in the cooling system. In most cases, normal tap water, i.e. water for domestic consumption fulfils all these requirements. If normal tap water does not fulfill these requirements, the cooling water must also have added an agent for protecting the cooling system against corrosion or fouling and when necessary, against freezing.
Standard values for the cooling water to be used in the cooling system :

- pH 7.0 - 9.0
- Alkalinity ($CaCO_3$) > 1 mg/kg
- Chloride (Cl) < 20 mg/kg
- Sulphate < 100 mg/kg
- $KMnO_4$-concentration < 20 mg/kg
- Al-concentration < 0.25mg/kg
- Mn-concentration < 0.05 mg/kg

6.2 Connection of sleeve bearings

6.2.1 Motors with flood lubrication systems are equipped with oil pipe flanges, and possibly with pressure gauges and flow indicators. Install all necessary oil pipes and connect the oil circulating units.
6.2.2 Install the oil supply system near the motor at an equal distance from each bearing.
6.2.3 Install and connect the oil inlet pipes to the bearings.
6.2.4 Install the oil outlet pipes downwards from the bearings at a minimum angle of 10°. The oil level inside the bearing will increase if the slope of the pipes is too small, the oil will flow too slowly from the bearing to the oil container, and this can result in oil leaks or disturbances in the oil flow.
6.2.5 Fill the oil supply system with appropriate oil with the correct viscosity. The correct type of oil and viscosity is indicated on the dimensional drawing. If in any doubt of the cleanliness of the oil, use a mesh to filter unwanted debris from the oil.

6.2.6 Turn the oil supply on, and check the oil circuit for possible leaks prior to starting the machine. The normal oil level is obtained when half of the oil sight glass is covered.

NOTE!
The sleeve bearings are delivered without lubricant. Running the motor without lubricant will result in immediate bearing damage.

6.3 Main supply wiring

6.3.1 Safety regulations of supply wiring.
(1) All interconnecting wiring for controls and grounding should be in strict accordance with national standard and local regulations.
(2) All interconnecting wiring should be finished by qualified personnel, familiar with relevant safety requirements.
(3) De-energize all equipment, including auxiliary equipment. Verify that all parts are isolated from their respective supply. Install an obvious notice board on the switch to provide a safeguard against accidental re-energizing of the equipment.
(4) Connect all parts to protective earth.
(5) Cover or provide barriers against live parts in the surrounding area.

6.3.2 Power
The rated conditions of operation for the motor are as shown on the nameplate. Within the limits, given below, of voltage and frequency variation from the nameplate values, the motor will continue to operate but with performance characteristics that may differ from those at the rated conditions：
(1) +/- 10% of rated voltage.
(2) +/- 5% of rated frequency.
(3) +/- 10% combined voltage and frequency variation so long as frequency variation is no more than +/- 5% of rated frequency.
Operating the motor at voltages and frequencies outside of the above limits can result in both unsatisfactory motor performance and damage, and even failure of the motor.

6.3.3 Main supply wiring
(1) Motors are available with terminal boxes rotatable through 4 x 90°. The terminal box can be adjusted according to the requirement of the user but must be sealed.
(2) Note nameplate markings and connection diagram in the terminal box. The 6 terminals are marked with letters U1, V1, W1 and U2, V2, W2 or the 3 terminals are marked with letters U, V, W. The 6 terminals may be connected △ or Y according to the connection diagram, or a star delta type starter. The 3 terminal are connected according to A-U, B-V, C-W.

NOTE!
Check the phase sequence from the connection diagram, the standard phase sequence is for clockwise rotation looking from the drive end of the motor.
For counter-clockwise rotation, the phase sequence is in accordance with the order instructions.

(3) It is important to verify that the supply voltage and the frequency are the same as the values indicated on the nameplate of the motor before starting.
(4) For multi-speed motor, the connection diagrams received with the motor have to be studied before starting the installation work to determine the rotation direction at different speeds. Any question, please contact Felm Co..

(5) In order to ensure continuous and trouble-free running, it is therefore important that the length of the insulation and creepage distances between input cables and terminal-box are sufficient. Stripping, splicing and insulating of the high-voltage cables must be performed in accordance with instructions by the cable manufacturer.

NOTE! The stripped, spliced cables must be insulated to avoid any accident.

(6) The space between the cable entries and the cables must have a cable gland installed and be insulated. Unused cable entries must be properly sealed. The plastic plugs provided with the motor are for transport purposes only.
(7) The inside of the main terminal box must be free from dirt, moisture and foreign debris. The box itself, cable glands, and unused cable entrance holes must be closed in a dust-tight and watertight manner according to the manufacturer's instructions.

6.4 Auxiliary terminal boxes
6.4.1 Thermal protection connections could be located in an auxiliary terminal box on the motor. Auxiliary terminal boxes are attached to the frame of the motor according to the number of accessories and customer needs, and their positions are shown on the dimensional drawing of the machine.
6.4.2 Various protection device wiring must be according to the wiring regulations and safety standard.
6.4.3 Auxiliary devices such as thermistors, thermocouples, PT 100 resistance temperature detectors, and anti-condensation heating elements will generally terminate on terminal blocks located in the auxiliary terminal box on the motor. The maximum voltage is 750V.
6.4.4 Caution must be exercised anytime contact is made with the incoming space heater circuit as space heater voltage is often automatically applied when the motor is shutdown.
6.4.5 Connect the instruments and auxiliary equipment according to the connection diagram in the auxiliary terminal box.
6.4.6 The inside of the auxiliary terminal box must be free from dirt, moisture and foreign debris. The box itself, cable glands, and unused cable entrance holes must be closed in a dust-tight and watertight manner according to the manufacturer's instructions.

6.5 Connection of rotor supply of slip-ring motors
6.5.1 To gain access to the rotor circuit through the sliprings for slip-ring type motors. The cable should be connected with proper terminations. The cable can be directly connected with the brush holder rocker or the rotor terminal board.
6.5.2 Study the connection diagram delivered with the motor carefully before connecting any cables.

6.6 Connection of external blower motors
6.6.1 AC motors fed with frequency converters are generally equipped with an external blower to ensure their normal operation at different speeds.
6.6.2 The external blower motor is normally a three phase induction motor. A connection box is usually located on the frame of the blower motor.

6.6.3 The connection of the external blower motor is the same as the main power cable connections.
6.6.4 Earth connections must be carried out according to local regulations before the external blower motor is connected to the supply.
6.6.5 The warranty does not cover damaged bearings due to improper cabling or earth connection.

NOTE!
The external blower motor must be connected to a protective earth according to local regulations.

6.7 Earth connections.
6.7.1 Earth connections must be carried out according to local regulations before the motors are connected to the mains supply.
6.7.2 The motors usually have a protective earth terminal in the terminal box. However, larger motors also have an external earth terminal on the frame, foot or flange. These terminals must be connected to a protective earth at the same time.
6.7.3 The motor must be grounded by a proper cable connection to the electrical system ground point.

6.8 **Requirements for motors with frequency converters**
In frequency converter applications the motor frame external earth must be used for equalizing the potential between the motor frame and the driven machine, unless the two machines are mounted on the same metallic base.
For motor frame sizes above H280, it is necessary to use 1 x70 mm flat copper conductor or at least two 50 mm^2 round copper conductors. The distance of the round conductors must be at least 150 mm from each other.

7. Commissioning

7.1 Check before starting

When the motors are installed, ensure the wiring is according to the diagram. Also, the following points should be noted to achieve the normal operation of the motor.
7.1.1 Check that the motor is properly anchored to the foundation. Check for cracks in the foundation and the general condition of the foundation.
7.1.2 Check the tightness of the fixing bolts.
7.1.3 Make sure all wiring, including auxiliary equipment, is correct.
7.1.4 Ensure the sizes of cable wires are appropriate and all connections are well made for the currents they will carry.
7.1.5 Ensure all connections are properly insulated for the voltage and temperature they will experience.
7.1.6 Make sure that all cable joints outside the terminal box are insulated.
7.1.7 Make sure that frame and terminal box are grounded.
7.1.8 Ensure the capacity of fuses, switches, magnetic switches and thermo-relays etc. are appropriately rated and the contactors are in good condition.
7.1.9 Make sure that the starting method is correct.
7.1.10 Check the assembly of the main terminal box and the cooling system.
7.1.11 Check that the lubrication system is commissioned and is running before the rotor is turned. See **8.2** for more information.
7.1.12 Check the connection of oil and cooling water pipes and check for leaks when running.
7.1.13 Check pressure and flow for oil and cooling water.
7.1.14 Check that the mains cable is not stressed in any way.
7.1.15 Ensure that heater voltage is not applied when the motor is operation, especially when the heater voltage is often automatically applied when the motor is shutdown.

7.2 Measurement of insulation resistance

Before a motor is started up for the first time, after a long period of standstill or within the scope of general maintenance work, the insulation resistance of the machine must be measured. The insulation resistance of both stator and rotor windings must be measured.

For new motors with dry windings, the insulation resistance should be very high. The resistance can, however, be extremely low if the motor has been subjected to incorrect transportation and storage conditions and humidity, or if the motor is operated incorrectly.

The insulation resistance measurement provides information about the humidity and dampness of the insulation. Based upon this information, correct cleaning and drying actions can be necessary.

7.2.1 Results of measurement of insulation resistance.

(1) If the measured value is considered too low the winding must be cleaned and/or dried. If these measures are not sufficient, please contact with Felm Co.

(2) Motors which are suspected to have moisture problems should be dried carefully independent of the measured insulation resistance value.

(3) The insulation resistance value will decrease when the winding temperature rises. The resistance is halved for every 10 K temperature rise above the dew point.

(4) The insulation resistance indicated in the test report is normally considerably higher than the values measured on site, because the insulation resistance is very high for new machines with dry windings when leaving the factory.

7.2.2 Minimum values for insulation resistance.

Generally, the insulation resistance values for dry windings should exceed the minimum values significantly. Definite values are impossible to give, because resistance varies depend on the motor type and local conditions. In addition, the insulation resistance is affected by the age and usage of the motor.

7.2.2.1 Calculation method of minimum values for insulation resistance.

After temperature rise test, the following formula should be applied to minimum values for insulation resistance：

$$R = \frac{U1}{1000 + P/100} \quad (M\Omega)$$

Where

R-insulation resistance (MΩ);

U1-rated voltage (V)

P-rated power(kW)

7.2.2.2 The control value of insulation resistance.

The normal value of insulation resistance for a low-voltage motor is more than 10MΩ.

The normal value of insulation resistance for a high-voltage motor is more than 100MΩ.

If the values of insulation resistance are lower than these two values, a check should be made of the motors particularly for moisture and dust.

For a slip-ring motor, the normal value of insulation resistance for a low-voltage motor and a high-voltage motor is more than 10MΩ.

7.2. 3 Stator winding insulation resistance measurement.

The insulation resistance is measured using an insulation resistance meter (megger).

Different meters are used according to the different rated voltages .

(1) For rated voltages up to and including 1,140V, measure with a 500VDC megger.

(2) For rated voltages above 1,140V, measure with a 2,500VDC megger.

NOTE!
During or after measuring, the terminals must not be touched together immediately as they may carry residual dangerous voltages. Furthermore, if the supply cables are connected, make sure that the power supplies are clearly disconnected and that the rotor is not turning before insulation resistance measurement is taken.

No matter what meters are used, the test time must last 1 minute, after which the insulation resistance value is recorded. Before the insulation resistance test is conducted, the following actions must be taken:
(1) Verify that all power supply cables are disconnected.
(2) Verify that the frame of the motor with the stator windings being tested is earthed.
(3) Make sure that auxiliary devices are earthed.
(4) The insulation resistance measurement should be carried out in the terminal box. The test is usually performed to the whole winding as a group, in which case the meter is connected between the frame of the motor and the winding.
(5) If necessary, the tester is connected between the frame of the motor and one of the windings. The frame and the two phases not measured should be earthed.
(6) The winding temperatures should be measured. After a long time of shut down before the test, measure the temperature of the enclosure instead of that of the winding.
(7) After the insulation resistance measurement the winding phases must be earthed briefly in order to discharge them.

7.2. 4 Insulation resistance measurement for a motor with slip rings.
Insulation resistance measurements for a motor with slip rings should be carried out same as general motors.
(1) Verify that all supply cables are disconnected from the main supply.
(2) Verify the slip ring unit connection cables are disconnected from their supply.
(3) Verify that the shaft, the frame of the motor and the rotor windings are earthed.
(4) The carbon brush connections should be checked to be in good order.
(5) The winding temperatures should be measured. After a long time of shut down before the test, measure the temperature of the enclosure instead of that of the winding.

The insulation resistance of the rotor winding should be measured. Take note and measure as follows:
(1) Verify that the frame of the motor and the stator windings are earthed.
(2) Verify that the shaft is earthed.
(3) The rotor winding can generally be connected in a star connection. If each phase must be measured separately, the rotor winding phases not been tested should be earthed.
(4) After the insulation resistance measurement the winding phases must be earthed briefly in order to discharge them.

7.2.5 Insulation resistance measurement for auxiliaries
(1) The test voltage for the space heater should be 500 VDC.
(2) The insulation resistance measurement for PT-100 detectors is not recommended.
(3) For the motors which are equipped with insulated bearings, if both the shaft ends are insulated from the frame, disconnect the earth terminal. If both the shaft ends are not insulated from the frame, separate the bearing sleeve or end-shield from the bearing.

7.3 Commissioning and Start-up

7.3.1 First test start

NOTE!
There is 5-8 times starting current when direct-on-line starting, and the starting torque is directly proportional with the square of the voltage when auto-transformer starting. For star delta starting the starting current and starting torque will be approximately one third of the direct-on-line values. Set auto-transformer starting for under-voltage and use direct-on-line starting for heavy loads. The load on the motor must in any case be as small as possible.

7.3.1.1 The first start should last only about one (1) second. The objective of the first start is to check the direction of rotation of the motor. The motor should turn in the same direction as is shown with an arrow located on the frame or the fan cover. The motor may be operated in both directions of rotation when there is no indicator arrow.
7.3.1.2 The direction of rotation of an external blower motor is indicated by an arrow near the blower motor.
7.3.1.3 It should also be verified that the rotating parts do not touch any stationary parts.
7.3.1.4 If the desired direction of rotation for some reason is different from the one specified on the motor, the cooling fans of inner and/or outer cooling circuits, must be changed by the manufacturer, as well as the stamp on the nameplate.
7.3.1.5 To alter the direction of rotation, interchange the connection of any two line cables.
7.3.1.6 Motors with slip rings cannot be operated without a starter.
7.3.1.7 If possible, the first start is made with an uncoupled coupling between the motor and driven machine.
7.3.1.8 Without a coupling between the motor and driven machine, it is normal that there is shaft over-run during shutting down.
7.3.2 Running unloaded.
7.3.2.1 During running the motor for the first time, if the machine functions as expected, the motor can be left running unloaded for a longer time.
7.3.2.2 During the first one or two hours of running, it is important to keep a close surveillance of the motor in case of any changes in vibration or temperature levels. If any abnormal sounds occur, shut down the motor, and find the reason for the changes. If necessary, consult the manufacturer of the motor.
7.3.2.3 The motor may be direct-on-line starting, star delta starting or auto-transformer starting.
7.3.2.4 If the motor rotor fails to start turning within one or two seconds, shut off the power supply immediately. Investigate thoroughly and take corrective action before attempting a restart.

7.3.3 Running loaded.
7.3.3.1 Initially run the motor unloaded prior to coupling to other machines.
7.3.3.2 If the motor rotor fails to start turning within one or two seconds, shut off the power supply immediately. Investigate thoroughly for something wrong in the connections or wiring, and take corrective action before attempting a restart.
7.3.3.3 If the rate of rise in temperature is excessive or if the motor exhibits excessive vibration or noise, it should be shut down immediately and a thorough investigation made as to the cause before it is operated again.
7.3.3.4 Any abnormal noise or vibration should be immediately investigated and corrected. Increased vibration can be indicative of a change in balance due to mechanical failure of a rotor part, a stator winding problem or a change in motor alignment.
7.3.3.5 Ensure the voltage and frequency of the power source are identical to the ratings shown on the nameplate. Check current balance of all the 3-phases of the windings.
7.3.3.6 The number of recommended consecutive starts of direct on line supplied motors depends essentially on the load characteristics (torque curve vs. rotational speed, and load inertia), and on the motor type and design. Too many and/or too heavy starts will cause abnormally high temperatures and stresses on the motor, thus accelerating the ageing of the motor insulation and resulting in an abnormally short lifetime, or even a premature motor insulation failure.

(1) The motor can be restarted if the initial start should fail. Two starts are generally permissible when the motor is cold.
(2) Let the motor cool down for 60 minutes before restarting, fully loaded. Let the motor cool down for 30 minutes before restarting, unloaded. Two inching starts can be regarded as one normal start.
(3) The load characteristics of the application are needed for determining the starting frequency. As a guideline, the maximum number of evenly spaced starts in a typical application is 800 starts per year.

7.3.3.7 For the motors with PT-100 resistance temperature detectors, the temperatures of the bearings, stator windings and cooling air should be recorded when the motor is running. After running the motor for some time, the cooling system should be checked. Verify that the cooling fluid, where applicable, and air is circulating without any obstruction. Record the temperatures of the cooling system, inlet and outlet.
The winding and bearing temperature may not reach a stable temperature until after several (4-8) hours, when running at full load.
The stator winding temperature depends on the load of the motor. If full load cannot be obtained during or soon after commissioning, the present load and temperature should be noted and included in the commissioning report.

7.3.3.8 If the bearing temperature rise and motor operation appear to be normal, operation should continue until the bearing temperatures stabilize.
(1) The temperature limit on roller bearings is no more than 95℃.
(2) The temperature limit on sleeve bearings is no more than 90℃.
If the rate of rise in temperature is excessive or if the motor exhibits excessive vibration or noise, it should be shut down immediately and a thorough investigation made as to the cause before it is operated again.
For the motors without PT-100 resistance temperature detectors, the temperature of the end-shield should be measured instead of that of the bearing. The temperature of the end-shield is usually 10℃ lower than that of the bearing.
7.3.3.9 Any abnormal temperature rise, noise or vibration should be immediately investigated and corrected. Increased temperature rise can be indicative of a change in balance due to mechanical failure of a rotor part, a stator winding problem or a change in motor alignment.
7.3.3.10 Starting time is longer for the motors with large inertia. However, if starting time is longer than usual or if there is difficulty in starting, or there is abnormal noise, do not run the motor and contact with Felm Co.
7.3.3.11 If the capacity of the mains transformer is not big enough to start several motors at the same time, they should start respectively from larger motors to smaller ones.
7.3.3.12 During the running and any investigations, protection devices should not be disconnected.
7.3.3.13 During the first several days of running, it is important to keep a close surveillance of the motor in case of any changes in vibration or temperature levels or abnormal sounds occur.

7.3.3.14 If available, and after the motor has been running for several hours, measure the vibrations or SPM-values from the SPM-nipples, and record the values for future reference use.
If not equipped with SPM monitor, check the motor with a vibration measurement instrument. The measurement place should be on the frame or the end shield of the motor at each end, but avoid locating on thin plate such as fan-covers.
After installation, the vibration value of the motor will be a little higher than it was before leaving the factory. For check purposes refer to the following:

Foundation	Frame size	Vibration velocity(mm/s)
Rigid	Up to H355	3.5
Rigid	Up to 355 for 2P	4.5
Rigid	Above H355	4.5
Rigid	Above H355 for 2P	5.0
Flexible	Up to H355	4.0
Flexible	Up to 355 for 2P	5.0
Flexible	Above H355	5.0
Flexible	Above H355 for 2P	6.0

If the vibration values are not in accordance with the values in the table, please check the motor. Any questions, contact Felm Co.

7.3.3.15 Check that the carbon brushes on the slip rings are not sparking.
Ensure that the slip ring surfaces are smooth. If not, the slip rings must be smoothed on a lathe.
7.3.3.16 During the first period of running, the heat-exchange system should be checked. Verify that the cooling fluid, where applicable, and air is circulating without any obstruction.

7.3.3.17 High temperatures may arise on the motor surfaces under normal operating conditions, so touching should be prevented or avoided.

NOTE!
If the motor exhibits excessive vibration or noise, it should be shut down immediately and a thorough investigation made as to the cause before it is operated again.
Any mechanical failure of a loose bolt, a rotor part, a stator winding problem or a change in motor alignment can cause abnormal noise or vibration.

7.3.4 Shut down.
7.3.4.1 The shutdown of the motor depends on the application, but main guidelines are the same.
7.3.4.2 Reduce the load of the driven equipment, if applicable.
7.3.4.3 Open the main breaker.
7.3.4.4 When the motor is not in operation, anti-condensation heaters have to be switched on where applicable.
7.3.4.5 For motors with water-cooling, the cooling water supply must be switched off in order to avoid condensation inside the motor.

8. Lubrication

It is essential to use grease of good quality and with the correct soap base and grade. This will ensure a long and trouble free lifetime of the bearings.

8.1 Re-greasing for rolling bearings

8.1.1 Bearings of ZZ types are usually permanently greased for the smaller machines.
8.1.2 Re-greasing facilities are provided for larger motors (H200 and above) and other specific motors. It is necessary to carry out the lubrication at regular intervals.
8.1.3 In the case of a newly installed motor, or a motor which has been out of service for more than 2 months, inject new grease into the bearings immediately after start-up. New grease must be

injected when the motor is running, and should be injected until old grease or excess new grease is discharged through the lubrication exit valve in the bottom of the bearing housing. See 8.1.5. The temperature of the bearings will initially increase because of the excess grease. After a few hours, the excess grease will be discharged through the lubrication exit valve and the temperature of the bearing should return to normal running temperature.

8.1.4 Change the grease at regular intervals. The time between re-lubrication depends upon the severity of operating conditions and, hence, must be determined by the motor user. Two or three changes a year is typical, but special conditions such as high ambient temperature may require more frequent changes. The re-lubrication interval should never be longer than 12 months.
The recommended lubrication intervals are as follow.

Rated power(kW)	Speed (rpm)	The recommended lubrication intervals		
		Normal conditions	Severe conditions	Extreme conditions
<18.5	1500	5 years	3 years	1 year
18.5-90	1500	1 year	6 months	3 months
90-200	1500	3 months	3 months	1 month
200-630	1500	3 months	1 month	15 days
<18.5	3000	5 years	3 years	1 year
18.5-90	3000	1 year	6 months	3 months
90-200	3000	3 months	1 month	1 month
200-630	3000	3 months	1 month	15 days

NOTE!
Normal conditions refer to motors operated at rated power or below in a clean environment within normal ambient temperature, with a duty cycle of no more than 8 hours per day.
Severe conditions refer to motors operated at rated power or below in a dirty/dusty environment with light shock loading and/or vibration, with a duty cycle of 24 hours per day.
Extreme conditions refer to motors operated in a very dirty/dusty environment with heavy shock load and vibration, and extremes of high ambient temperatures.

8.1.5 Re-greasing method (See Annex 1)
(1) Before re-greasing, the grease nipples should be thoroughly cleaned to prevent any accumulated dirt from being carried into the bearing with the new grease. The exit grease relief valve or plug should be opened to allow the proper venting of the old grease. Use a grease gun to pump grease through the grease nipple into the bearings.
(2) After re-greasing, operate the motor for 10-20 minutes to allow any excess grease to vent out. Close the grease inlet and outlet plug if fitted.

8.1.6 Types of grease.
Grease with the correct properties is available from all major lubricant manufacturers. If the brand of grease is changed and its compatibility is uncertain, consult the Felm Co.
Chevron SRI-2 grease is standard for FELM motors except some special models for which special grease will be confirmed according to the specification. Please use identical grease or its equivalents when maintaining and re-lubricating.

NOTE!
If re-lubrication is to be performed by the authorized personnel when the motor is running, rotating parts and live parts must be protected.
Please refer to the grease types, lubrication intervals and the amounts on the lubrication nameplate, if attached to the motor.

8.2 Lubrication for sleeve bearings

8.2.1 For motors with sleeve bearings, they should be lubricated before running, because no oil lubrication is provided on leaving the factory.
8.2.2 Install the oil supply system near to the motor, which should be turned on first before starting the motor.
8.2.3 The rotation of the oil ring should be verified through the inspection window on top of the bearing when the motor is running. If the oil ring is not rotating, the motor must be stopped immediately, as a stationary oil ring will result in bearing failure.
8.2.4 Verify that no rotating parts are rubbing against any stationary parts.
8.2.5 Verify through the oil sight glass that the oil level inside the bearing is correct. The correct oil level is in the middle of the oil sight glass, but as long as the oil level is within the oil sight glass, the level is acceptable.
8.2.6 For flood-lubricated motors, the oil supply pressure is adjusted with the pressure valve and orifice. The normal supply pressure is 120 kPa ± 20 kPa. This gives the correct flow of oil to the bearing. Using higher supply pressure gives no additional benefit, but can cause bearing oil leakages.
8.2.7 Check the temperature and the oil level of the bearings continuously in the beginning. This is particularly important for self-lubricating bearings. If the temperature of the bearing suddenly rises, the motor should be stopped immediately, and the reason for the temperature rise must be found before the motor is re-started. If no logical reason is found from the measurement equipment, it is recommended that the bearing is opened, and its condition verified. If the motor is under warranty, the manufacturer Felm Co must always be contacted before any action is taken.
8.2.8 An oil check should be performed a few days after the first test run of the machine, just before the first oil change, and subsequently as required. If the oil is changed just after the commissioning, it can be used again after removing wear particles by filtering or centrifuging.
8.2.9 The oil reservoirs of self (not flood) lubricated bearings should be drained and refilled approximately every six (6) months. More frequent changes may be needed on high-speed (3000-rpm) motors or if severe oil discoloration or contamination occurs.

9. Inspection and maintenance

A rotating electrical machine often forms an important part of a larger installation and if it is supervised and maintained properly, it will be reliable in operation and guarantee a normal lifetime.

9.1 The purpose of inspection and maintenance

9.1.1 To ensure that the motor will function reliably without any unforeseen actions or interventions.
9.1.2 To estimate and plan service actions in order to minimize down time.
9.1.3 The purpose of this inspection is to do a quick check to identify any problems which are starting to develop before they cause failures and unscheduled maintenance breaks.

9.2 Notice for inspection and maintenance

9.2.1 Before working on any electrical equipment, general electrical safety precautions are to be taken into account, and local regulations are to be respected in order to prevent personnel injury.
9.2.2 Personnel performing maintenance on electrical equipment and installations must be properly qualified. The personnel must be trained in, and familiar with, the specific maintenance procedures and tests required for rotating electrical machines.
9.2.3 Motors for hazardous areas are specially designed to comply with official regulations concerning the risk of explosion. Safety precautions should be taken into account when inspection and maintenance takes place.
9.2.4 These instructions and recommendations should be read carefully and be used as a basis when planning the maintenance program.
9.2.5 An essential part of preventative maintenance is to have a selection of suitable spare parts available. The best way to have access to critical spare parts is to keep them on stock.

9.3 The levels of inspection and maintenance

9.3.1 Routine inspection

The purpose of routine inspection is to ensure the normal operation of the motor.

9.3.2 Regular inspection

The purpose of regular inspection is to prevent motor failure.

9.3.3 Maintenance intervals

After a period of running, the motors must be maintained. Owing to the varied time and circumstances, which motors are used, it is difficult to set the items and periods for regular inspection and maintenance. However, as a guide it is recommended to be performed periodically once a year. Motors operated in bad conditions should have the maintenance interval shortened. Generally, the scope of inspection is determined by the following factors：

(1) Ambient temperature and operating conditions.
(2) Starting and stopping frequency.
(3) Easily worn parts.
(4) Supply voltage and frequency variation.
(5) The vibration of the driven machine.
(6) The important position of motor in the operational system of the plant.

9.4 Routine checks during running of the motor

NOTE!
Any changes in vibration or temperature levels or abnormal sounds which occur, the motor should be shut down immediately to check. During the running, it is important to keep a close surveillance of the temperature of bearings, at least once a day.

9.4.1 The surfaces of the motor should be kept smooth and clean.

The motor exterior should be kept clean and should periodically be inspected for rust, leaks, oil, water and other dirt.

9.4.2 Check that the connections are tight and there is no leakage in the system. Verify that the cooling fluid, where applicable, and air is circulating without any obstruction. Check the condition of the fan-cover to ensure good air circulation over the motor.

9.4.3 The vibration levels of the driving/driven machine system should be monitored when the motor is running. If any changes in vibration or temperature levels or abnormal sounds occur, shut down immediately to check.

9.4.4 Check that the windings indicator of sleeve bearing motors is located in the groove on the shaft, indicating that the magnetic centre of the stator and the rotor are in line. If they are not then friction between shaft and bearing occurs, and the motor should be shut down immediately.

9.4.5 If any of the following abnormal conditions occur, the motor should be shut down immediately to check.

(1) Heavy vibration,
(2) The driven machine damaged
(3) Bearing worn or overheated
(4) Bearing misalignment, axial vibration
(5) Speed reduced suddenly
(6) Friction between stator and rotor, enclosure overheated.
(7) Smell of burning.
(8) Personnel accident.

9.5 Regular checks

9.5.1 Many processes leading to damage can be prevented or at least slowed down with appropriate maintenance and regular checks.

(1) The tightness of all fastenings should be verified regularly.

(2) Check the condition of connections, mounting bolts and assembly bolts.

(3) Check that the carbon brushes are in good condition and that they can move freely in the brush holders. Follow the wear of the carbon brushes and change them before the wear limit is reached. Verify that the brushes are not sparking.

(4) Check all earth connections.

(5) Check the condition of shaft seals and replace if necessary. If you are not familiar with which type of seals are fitted, please contact Felm Co.

(6) Check the alignment of shaft couplings.

(7) Check that water, grease, oil, or dust has not been permitted to enter the motor housing.

(8) Check the condition of bearings and replace if necessary.

(9) Check the condition of painting and repaint if necessary.

9.6 Maintenance

Maintenance is important in preventing motor failure and lengthening the service life. Generally speaking, there should be light maintenance once a month, and overall maintenance once a year.

9.6.1 The light maintenance should include:

(1) Clean the motor.

(2) Measure the insulation resistance of the motor.

(3) Tighten the electrical connections, mounting bolts and earth connection bolts.

(4) Clean the starter and insulation terminals.

(5) Remove carbon dust from the slip rings and brush gear.

(6) Check the condition of fan-covers and ensure good air circulation over the motor.

9.6.2 The overall maintenance should include:

(1) All the items of light maintenance.

(2) Clean the interior of the motor.

(3) Check the condition of bearings and replace if necessary. It is suggested that replacement of the bearings once a year under normal conditions (operating about 8,000 hours/year).

(4) If it is not necessary to replace the bearings, clean the bearings and replace the grease.

(5) Clean and replace other parts of motor as required.

9.7 Maintenance method

9.7.1 Clean the exterior of the motor.

(1) Totally enclosed air-to-air cooled and totally enclosed fan cooled motors (IP 44 and above) require special cleaning considerations. The external fan must be cleaned thoroughly since any dirt build-up which is not removed can lead to unbalance and vibration. All of the tubes of the air-to-air heat exchanger should be cleaned using a suitable tube brush having synthetic fibre bristles (not wire of any type).

(2) If the motor is equipped with fan-covers, they should be replaced (disposable type) or cleaned and reconditioned (permanent type) at a frequency that is dictated by conditions.

(3) On open ventilated motors (ODP motor with IP 23 and below), screens and louvres over the inlet air openings should not be allowed to accumulate any build-up of dirt, lint, etc. that could restrict free air circulation.

NOTE! Screens and louvres should never be cleaned or disturbed while the motor is in operation because any dislodged dirt or debris can be drawn directly into the motor.

9.7.2 Clean the interior of the motor.

After a motor is in operation for a long time, accumulation of dust, carbon powder and grease etc., on the inside is unavoidable, and may cause damage to the motor. Regular cleaning and examination is necessary to assure top performance. Points to note during cleaning：

(1) Vacuum cleaning can be used, both before and after other methods of cleaning, to remove loose dirt and debris. It is a very effective way to remove loose surface contamination from the winding without scattering. Vacuum cleaning tubes should be non-metallic to avoid any damage to the winding insulation.
(2) If using compressed air or a blower, it must be noted that compressed air should be free of moisture. Maintain air pressure at 4 kg/cm^2, since high pressure can cause damage to coils.
(3) Surface contamination on the winding can be removed by wiping using a soft, lint-free wiping material.
(4) If the contamination is oily, the wiping material can be moistened (not dripping wet) with a safety type petroleum solvent.
(5) In hazardous locations, a solvent such as inhibited methyl chloroform may be used, but must be used sparingly and immediately removed. While this solvent is non-flammable under ordinary conditions, it is toxic and proper health and safety precautions should be followed while using it.
(6) The proper health and safety precautions should be followed while cleaning the motor. When using a solvent such as inhibited methyl chloroform to clean the motor, ensure good air circulation around the motor.
(7) For radial ventilation motors, the ventilation route should not be allowed to accumulate any build-up of dirt, lint, etc. that could restrict free air circulation and lead to higher temperature rise.

9.7.3 The cleanliness of rolling bearings.
Rolling bearings will need to be washed periodically after operating a long time.
(1) The bearings should be washed, dried and pre-greased with a suitable high quality bearing grease before assembly.
(2) No dirt or foreign debris should be allowed to enter the bearings at any time during the maintenance.
(3) To replace bearings they should be heated using an induction heater to a controlled temperature of 90° C.
(4) The bearings must be removed by using pullers and re-fitted by heating, or using other special tools for the purpose. Do not hammer the bearing as this will cause bearing damage.

9.7.4 The cleanliness of sleeve bearings.
(1) The importance of cleanliness :
- Check the oil visually with respect to colour.
- Check the oil visually with respect to deposits.
- The original viscosity must be maintained within a tolerance of ±15%.
- Smell the oil. Strong acid or burnt smell is not acceptable.

(2) The method of cleaning.
When any of the conditions mentioned above (1) occurs, a suitable oil change and cleaning of the bearing must be carried out.
Mineral oil must be used to clean the bearing.
(3) Caution during cleaning.
Be careful during cleaning. Any slight knock and impact will damage the bearing surface.

10. Motor troubleshooting chart

Your motor service and any troubleshooting must be handled by qualified persons with proper tools and equipment.

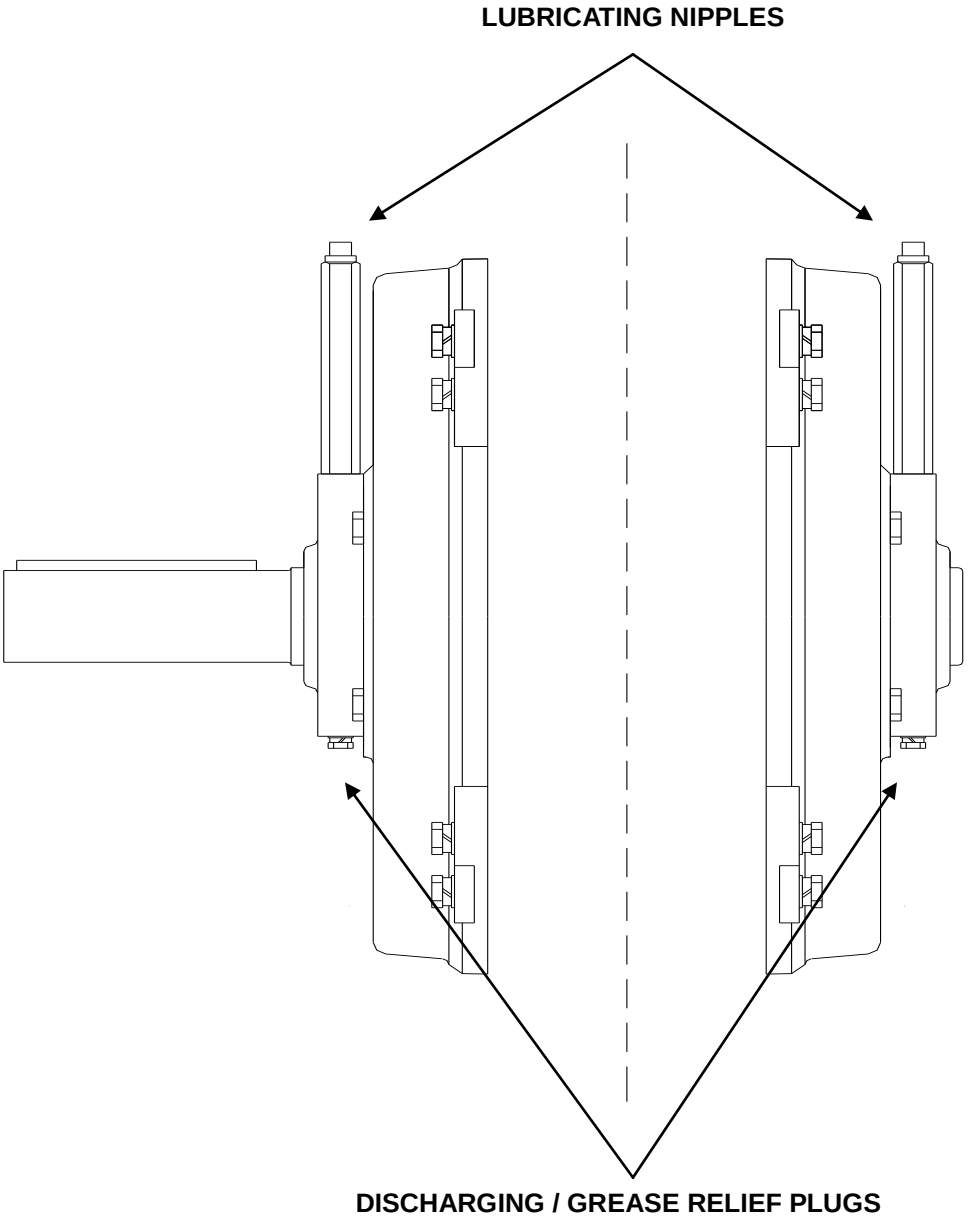
No	TROUBLE	CAUSE	REMEDY
1	Motor fails to start	Power-off	Check wiring. Switch-on. Change fuse. Check leads.
		Stator winding failure	Check windings short circuit or broken.
		Motor may be overloaded	Reduce load.
		Wrong wiring	Check wiring connections.
2	Motor does not reach full load speed	Voltage too low at motor terminals because of line drop.	Check connections. Check conductors for proper size.
		Poor contact of control switches or short circuit of starting switches.	Check and repair control switches.
		Phase failure of power.	Check power and connections.
		Poor contact of power line.	Check power connections.
		Windings earthed or short circuited.	Factory repair.
3	Motor trips out when reaching full load	Insufficient capacity of switches and fuses.	Replace switches and fuses if wiring permits.
		Under-voltage.	Check power source.
		Overload.	Lighten load.
4	Live enclosure	Connection between the wiring of power lines and earth connections.	Correct the wiring.
		Insulation contains moisture or is aged.	Dry out or replace winding.
		Connection between live leads and enclosure.	Check leads near enclosure and insulate them.
5	Motor surface overheating	Overload.	Lighten load or replace motor.
		Ambient temperature exceeds 40° C.	Replace with higher insulation class, or lower ambient temperature.
		Under-voltage.	Check power line, transformer capacity and source voltage.
		Over-voltage.	Check power source.
		Fuse blown (Single-phase operation).	Replace the specified fuse
		Ventilation duct clogged.	Remove the foreign matter in the ducts.
		Friction between rotor and stator.	Factory repair or replace motor.
		Unbalanced three-phase voltage.	Check circuit or consult power company.
6	Motor speed falls suddenly	Sudden overload.	Check load and mechanical connection.
		Single-phase operation.	Check starter switch, fuses and circuits and repair.
		Voltage drop.	Check control circuit and power source.
7	Electro-magnetic noise	Occurrence from first operation of motor.	May be normal.
		Sudden sharp noise.	Check short circuit of windings.
		Friction between rotor and stator.	Should be repaired at factory.
8	Mechanical noise	Wind noise.	Noise caused by air flowing through ventilation ducts, maybe normal.
		Loose belt pulley or loose coupling.	Adjust key and the position of belt or couplings and lock the screw.
		Loose screw on fan-cover.	Lock fan cover screws tightly.

		Friction between fan and end-shield, fan-cover.	Adjust the distances between fan and end-shield, and fan-cover.
		Rubbing as a result of ingression of foreign matters.	Clean motor interior and ventilation ducts.
		Caused by driven machine	Check the driven machine.
9	Bearing noise	Even sound.	May be normal.
		Light rumbling sound.	Re-grease.
		Obvious bearing sound.	Clean bearings and re-grease.
		Broken ball or rough races.	Replace the damaged bearing.
10	Vibration abnormal	Improper installation.	Tighten the mounting screws.
		Motor mounting bed is not strong enough.	Reinforce mounting bed.
		Unsymmetrical centers between belt pulleys.	Align central points.
		Central points of couplings do not lie on the same level.	Adjust the central points of couplings to the same level.
		Unbalanced rotor.	Balance rotor again.
		Unbalanced fan or broken fan blade.	Replace fan or balance fan again.
		Short circuit of windings of stator or rotor.	Factory repair.
		Mounting bed vibration caused by near machines.	Eliminate the vibration source near motor.
11	Bearing overheating	Damaged bearing.	Replace the damaged bearing.
		Poor lubrication.	Change grease.
		Misalignment between motor and driven machine shafts.	Adjust belt tension or align couplings.
		Friction between bearing and bearing housing or shaft.	Replace the damaged shaft or end-shield.
		Improper assembly.	Re-assembly motor.

11. Handling for discarded motors

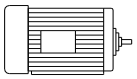
Scrap motors must be recycled according to the local regulations.
The material content used in the manufacturing of the motor is as follows: cast iron, steel, copper, aluminium, insulation materials. For metals that account for a large part of the product, the choice of base metals that facilitate material recycling is necessary. The nonmetals should be either incinerated or disposed of in landfills. Attention should be paid to ensuring that such processes do not adversely affect the environment. Motor products, manufacturing processes and even logistics have been designed to take environmental aspects into account.

ANNEX 1



ANNEX 2

1) NAME PLATE



FELM S.R.L.

INVERUNO
ITALY

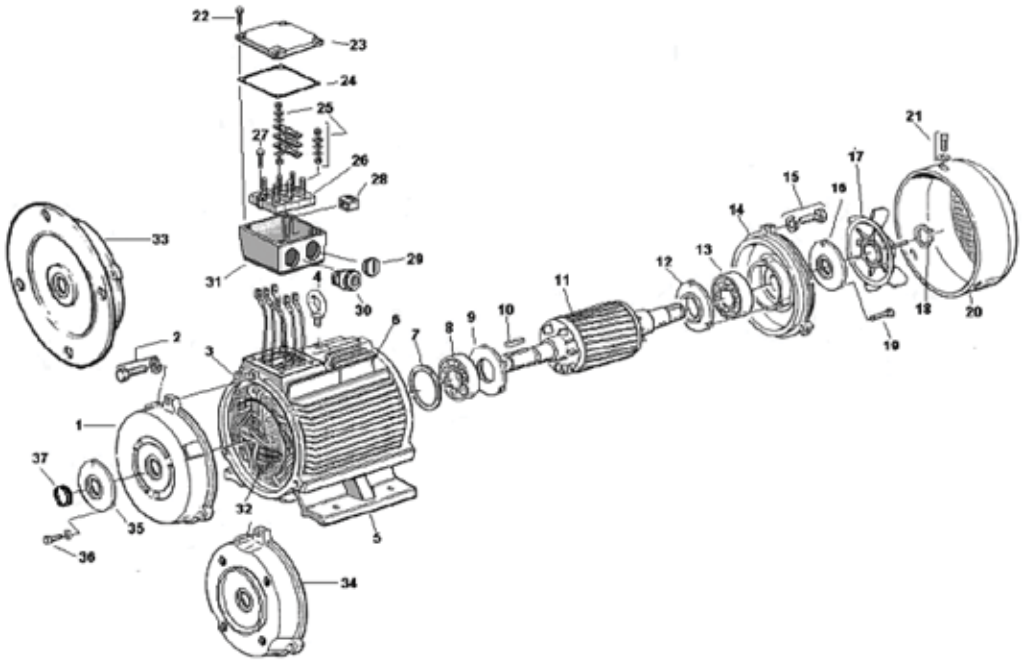
CE

3 ~ MOT.Nr.	IEC 60034-1	IP	Rtg
TYPE	COS ϕ		Ins.cl.
conn.	V	A	
rpm	kW	Hz	kg
Brgs. DE	:NDE		PTC

2) REFERENCE STANDARDS

ELECTRICAL	MECHANICAL
IEC/EN 60034-1	IEC 60072
IEC/EN60034-2	IEC/EN 60034-5
IEC 60034-8	IEC/EN 60034-6
IEC 60034-12	IEC/EN 60034-7
	IEC/EN 60034-9
	IEC 60034-14

LISTA COMPONENTI – RICAMBI MOTORI IN GHISA
LIST OF COMPONENTS - SPARE PARTS CAST IRON MOTORS



1 Scudo lato DE (B3) - Shield B3 DE
2 Bullone fissaggio scudo DE - Fixing bolt shield DE
3 Carcassa statore - Stator frame
4 Golfare - Eye bolt
5 Piede (in fusione)- Feet (in casting)
6 Targa dati - Nameplate
7 Ranella anti allentamento - Spring washer
8 Cuscinetto lato DE - Bearing DE
9 Coperchietto interno cuscinetto DE dalla taglia 180 - Inner Bearing cap DE from size 180
10 Chiavetta - Key
11 Pacco rotore - Rotor Core
12 Coperchietto interno cuscinetto NDE dalla taglia 180 - Inner bearing cap NDE from size 180
13 Cuscinetto NDE - Bearing NDE
14 Scudo NDE - Shield NDE
15 Bullone fissaggio scudo NDE - Fixing bolt shield NDE
16 Coperchietto esterno cuscinetto NDE dalla taglia 180 - Outer bearing cap NDE from size 180
17 Ventola - Fan
18 Anello elastico - Circlip
19 Bullone coperchietto cuscinetto NDE - Bolt bearing cap NDE
20 Calotta copri ventola - Fan cover
21 Vite calotta copri ventola - Fan cover screw
22 Vite scatola morsetti - Terminal box screw
23 Coperchio scatola morsetti - Terminal box cover
24 Guarnizione scatola morsetti - Terminal box gasket
25 Dadi fissaggio cavi - Connection fixation nuts
26 Basetta - Terminal board
27 Dadi fissaggio basetta - Terminal board holder bolt
28 Morsetti termistori (PTC) - Terminal block (PTC)
29 Tappo protezione - Blinder
30 Pressacavo - Cable gland
31 Scatola morsetti - Terminal box
32 Avvolgimenti - Windings
33 Flangia B5 - Flange B5
34 Flangia B14 - Flange B14
35 Coperchietto esterno cuscinetto DE - Bearing cap DE outside
36 Bullone di fissaggio Fixing bolt
37 Tenuta - Seal