Index		Name	Date

POLITECNICO DI TORINO
C.so Duca degli Abruzzi n.24 - 10129 - TORINO

POLITECNICO DI TORINO

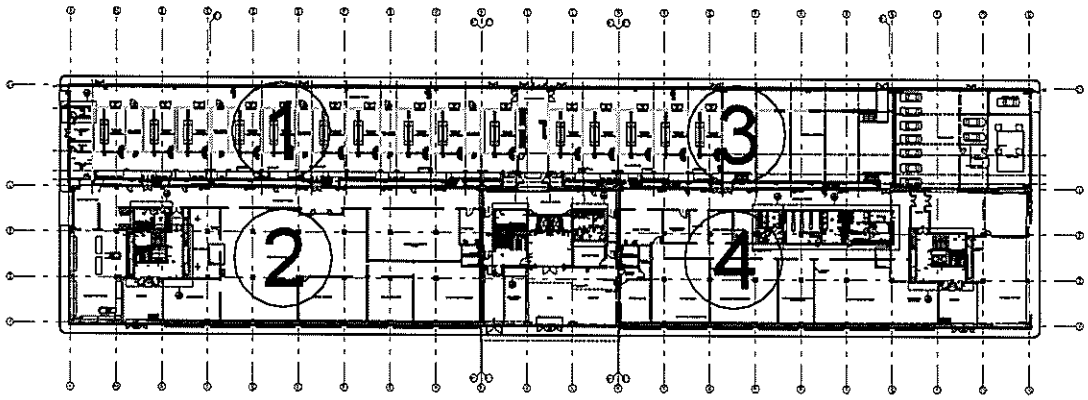
PROGETTO DI RADDOPPIO

MANICA DA 24 M: NEW RESEARCH CENTER - SPECIAL UTILITIES

PROGETTO ESECUTIVO

RESPONSABILE DEL PROCEDIMENTO
PROF. ING. FRANCESCO OSSOLA

left wing ◀ ▶ right wing



Description :
Bauteil:

SPECIAL CONTRACT DOCUMENT
AND TECHNICAL NORMS OF EXECUTION

Scale : Maßstab :		Name	Date	Contract-No : Auftrags-Nr.: 0602
	Drawn :			
	Checked :			Document No : Blatt-Nr.:
	Approved :			

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1. Project description (Politecnico)

See appendix

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2. Construction description (Studio Valle)
See appendix

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3. Description of technical equipment

General description of the planned technical equipment

3.1 Preliminary Remarks

Italiano

Il presente fascicolo contiene le prescrizioni tecniche generali e particolari per la realizzazione degli impianti meccanici previsti per gli edifici del "Diesel Development Center" del Politecnico di Torino.
Le scelte di progetto e le caratteristiche degli impianti sono state definite con la progettazione generale, tenendo presente sia le esigenze di servizio sia gliaspetti distributivi generali del complesso.

Gli impianti devono essere realizzati secondo le prescrizioni del presente fascicolo, dell'elenco prezzi unitari, degli elaborati grafici e della relazione tecnica descrittiva e di calcolo. Devono essere inoltre rispettate tutte le prescrizioni contenute nell'allegato: "Specifiche e standard di progettazione di General Motors", e le piu attuale legge italiani.

Politecnico di Torino intends to build a new test bench building on its university campus. The building will be constructed in the course of the planned research centre construction.

3.2 Operating Process

Operating Conditions
Only diesel engines will be tested on the test benches. The test operations are conducted for research and development purposes with the present focus on

- exhaust gas emission measuring
- engine performancies measuring
- fuel consumption measuring

All engines will be generally operated with exhaust gas after-treatment systems acc. to the latest automotive technology state. This means that diesel engines will be generally provided with diesel particulate filters or alternative emission reducing technologies.

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Basis data - Dyno´s

Basis data - HVAC

Caratteristiche termoigrometriche esterne di progetto:

- Località Torino - latitudine Nord 45°7'
- Temperatura esterna invernale = -8°C
- Temperatura esterna estiva = 34°C
- Umidità relativa invernale = 80%
- Umidità relativa estiva = 60%

3.3 Decription of HVAC (Heating-Ventilation-Air-Condition)

3.3.1 Construction design heating system supply
(Drawing No. 610-01)

Italian

L` impianto di riscaldamento alimenta acqua calda a tutti i sistimi di Ventilazione.

La Capacita di riscaldamento è:	
La parte sinistra	1259 kW
La parte destra	1310 kW
Totale	2569 kW

Temperatura mandata	70°C
Temperatura ritorno	50°C

Le Temperature sono constanti entro tutto l'anno.

Le dati base per l' aria:

Temperature in inverno:	- 8 °C
Temperature in estate:	34 °C
Umiditá relativa dell' aria in estate:	60 %
Umiditá relativa dell'aria in inverno:	80 %

English

Technical Description of the heating water supply with temperature 70°/50°C

The calculation of the heating capacity is based of the capacity to supply the Air Handling Units

The calculation of the capacity accounted that the requirement has a simultaneous factor of 1.

Hereafter the consumers of the left wing second floor

Preheater Combustion air	221 kW
Reheater Combustion air	93 kW
Heater Admixture air supply	341 kW
Heater Controllroom	214 kW
Heater Ground floor left wing	320 kW
Heater 1 Ventilation air utility area	35 kW
Heater 2 Ventilation air utility area	35 kW
Total	1259 kW

Hereafter the consumers of the right wing second floor

Preheater Combustion air	181 kW
Reheater Combustion air	77 kW
Heater Admixture air supply	136 kW
Heater Controllroom	136 kW
Preheater Chassis dyno	281kW
Reheater Chassis dyno	132 kW
Heater Soak area	111 kW
Heater Ground floor right wing	186 kW
Heater 1 Ventilation air utility area	35 kW
Heater 2 Ventilation air utility area	35 kW
Total	1310 kW

The total heating capacity amounts to 2569 kW
(See Drawing-No: 610-01)

The consumers will be supplied with a constant volume flow. The three-way mixing valve regulates the temperature of the ingoing heating flow. The temperature is dependent from the requirement from the Consumers.

Technical specifications

The heating flow temperatures (ingoing flow: 70℃ w inter and summer) are required constant in the whole year to supply the air handling units for the tests engineering.

3.3.2 Construction design chilled water supply 6℃/ 12℃
(Drawing No. 640-01)

Italian

L` impianto di raffreddamento e locato nel piano secondo e alimenta tutti i Sistemi di Ventilazione e le udenze dei banchi di prova.

L'acqua fredda è prodotta con 2 macchine frigorifera con una capacita totale di 3200 kW.

La Capacita di raffreddamento è 1736 kW
Temperatura mandata 6℃
Temperatura ritorno 12℃
(vedere disegno no. 640-01)

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La Capacita di raffreddamento è 1483 kW
Temperatura mandata 15℃
Temperatura ritorno 21℃
(vedere disegno no. 640-02)

In totale sono ca. 3200 kW di Capacita necessaria

Le Temperature sono constante entro tutto l´anno.

Le dati base per l' aria:
Temperature in inverno: - 8 ℃
Temperature in estate: 34 ℃
Umiditá relative dell' aria in estate: 60 %
Umiditá relative dell'aria in inverno: 80 %

English

Technical Description of the chilled water supply with temperature 6℃/12℃

The calculation of the cooling capacity is based of the capacity to supply the Air Handling Units and also the consumers in the test benches.
The generation of the chilling water supply is installed in the technical floor (second floor) with two refrigeration machine (1600 kW per machine).

The calculation of the whole capacity for chilled water with 6℃ to 12℃ had been accounted of followi ng simultaneous factors.

Air handling units	1,00
Rapid cooling device	0,07
Diesel fuel cooling	0,25
Charged air cooling device	1,00

Hereafter the consumers with 6℃/12℃

Cooling Combustion air supply (left wings)	315 kW (1,00)
Cooling Combustion air supply (right wings)	258 kW (1,00)
Cooling air supply chassis Dyno	369 kW (1,00)
Cooling air supply soak area	31 kW (1,00)
Dyno 1 rapid cooling device	80 kW (0,07)
Dyno 1 diesel fuel cooling	5 kW (0,25)
Dyno 1 charged air cooling device	40 kW (1,00)
Dyno 2 rapid cooling device	80 kW (0,07)
Dyno 2 diesel fuel cooling	5 kW (0,25)
Dyno 2 charged air cooling device	40 kW (1,00)
Dyno 3 rapid cooling device	80 kW (0,07)
Dyno 3 diesel fuel cooling	5 kW (0,25)
Dyno 3 charged air cooling device	40 kW (1,00)
Dyno 4 rapid cooling device	80 kW (0,07)
Dyno 4 diesel fuel cooling	5 kW (0,25)
Dyno 4 charged air cooling device	40 kW (1,00)
Dyno 5 rapid cooling device	80 kW (0,07)

Dyno 5 diesel fuel cooling	5 kW (0,25)
Dyno 5 charged air cooling device	40 kW (1,00)
Dyno 6 rapid cooling device	80 kW (0,07)
Dyno 6 diesel fuel cooling	5 kW (0,25)
Dyno 6 charged air cooling device	40 kW (1,00)
Dyno 7 rapid cooling device	80 kW (0,07)
Dyno 7 diesel fuel cooling	5 kW (0,25)
Dyno 7 charged air cooling device	40 kW (1,00)
Dyno 8 rapid cooling device	80 kW (0,07)
Dyno 8 diesel fuel cooling	5 kW (0,25)
Dyno 8 charged air cooling device	40 kW (1,00)
Dyno 9 rapid cooling device	80 kW (0,07)
Dyno 9 diesel fuel cooling	5 kW (0,25)
Dyno 9 charged air cooling device	40 kW (1,00)
Dyno 10 rapid cooling device	80 kW (0,07)
Dyno 10 diesel fuel cooling	5 kW (0,25)
Dyno 10 charged air cooling device	40 kW (1,00)
Dyno 11 rapid cooling device	80 kW (0,07)
Dyno 11 diesel fuel cooling	5 kW (0,25)
Dyno 11 charged air cooling device	40 kW (1,00)
Dyno 12 rapid cooling device	80 kW (0,07)
Dyno 12 diesel fuel cooling	5 kW (0,25)
Dyno 12 charged air cooling device	40 kW (1,00)
Dyno 13 rapid cooling device	80 kW (0,07)
Dyno 13 diesel fuel cooling	5 kW (0,25)
Dyno 13 charged air cooling device	40 kW (1,00)
Dyno 14 rapid cooling device	80 kW (0,07)
Dyno 14 diesel fuel cooling	5 kW (0,25)
Dyno 14 charged air cooling device	40 kW (1,00)
Dyno 15 rapid cooling device	80 kW (0,07)
Dyno 15 diesel fuel cooling	5 kW (0,25)
Dyno 15 charged air cooling device	40 kW (1,00)
Total without simultaneous	2848 kW
Total with simultaneous	**1736 kW**

The nominal pressure of the pipes is PN 16, the supply water pipe pressure amount 4 bar and the return water pipe pressure amount 3 bar. The differential pressure amounts consequently to 1 bar.

The consumers will be supplied with a volume flow-controller. The temperatures for those consumers are constant. The volume flow is dependent from the requirements from the consumers.

3.3.3 Construction design chilled water supply 15℃ /21℃ (Drawing No. 640-02)

Italian

La Capacita di raffreddamento è 1483 kW
Temperatura mandata 15℃
Temperatura ritorno 21℃
(vedere disegno no. 640-02)

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Le Temperature sono constante entro tutto l´anno.

Le dati base per l' aria:

Temperature in inverno:	- 8 ℃
Temperature in estate:	34 ℃
Umiditá relative dell' aria in estate:	60 %
Umiditá relative dell'aria in inverno:	80%

English

Technical Description of the chilled water supply with temperature 15℃/21℃

The calculation of the cooling capacity is based on the capacity to supply the Air Handling Units and also the consumers in the engine dyno test benches.

The calculation of the whole capacity for chilled water with 15℃ to 21℃ had been accounted of follow ing simultaneous factors.

Air handling units	1,00
Dyno - recirculation units 0,25	
CVS-Room	0,25

Hereafter the consumers

Cooling admixture air supply (left wing)	292 kW (1,00)
Cooling admixture air supply (right wing)	117 kW (1,00)
Cooling air supply controllroom (left wing)	122 kW (1,00)
Cooling air supply controllroom (right wing)	77 kW (1,00)
Cooling air supply Ground floor (left wing)	172 kW (1,00)
Cooling air supply Ground floor (right wing)	101 kW (1,00)
Dyno 1 - AHU recirculation units	158 kW (0,25)
CVS- room 1	40 kW (0,25)
Dyno 2 - AHU recirculation units	158 kW (0,25)
Dyno 3 - AHU recirculation units	158 kW (0,25)
CVS- room 2	40 kW (0,25)
Dyno 4 - AHU recirculation units	158 kW (0,25)
Dyno 5 - AHU recirculation units	158 kW (0,25)
CVS- room 3	40 kW (0,25)
Dyno 6 - AHU recirculation units	158 kW (0,25)
Dyno 7 - AHU recirculation units	158 kW (0,25)
CVS- room 4	40 kW (0,25)
Dyno 8 - AHU recirculation units	158 kW (0,25)
Dyno 9 - AHU recirculation units	158 kW (0,25)
CVS- room 5	40 kW (0,25)
Dyno 10 - AHU recirculation units	158 kW (0,25)
Dyno 11 - AHU recirculation units	158 kW (0,25)
Dyno 12 - AHU recirculation units	158 kW (0,25)
Dyno 13 - AHU recirculation units	158 kW (0,25)
Dyno 14 - AHU recirculation units	158 kW (0,25)
Dyno 15 - AHU recirculation units	158 kW (0,25)
Total without simultaneous	3451 kW

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Total with simultaneous **1483 kW**

The nominal pressure of the pipes is PN 16, the supply water pipe pressure amount 4 bar and the return water pipe pressure amount 3 bar. The differential pressure amounts consequently to 1 bar.

The consumers will be supplied with a volume flow-controller. The temperatures for those consumers are constant. The volume flow is dependent from the requirements from the consumers

3.3.4 Construction design cooling water supply 30℃ /50℃
(Drawing No. 630-01)

Italian

L` impianto di raffreddamento e colocato nel piano secondo e alimenta i Sistemi dei banchi di prova.

L'acqua fredda è prodotta con uno scambiatore di calore, che e locato ne secondo piano a sinistra.

La Capacita di raffreddamento è 1050 kW
Temperatura mandata 30℃
Temperatura ritorno 50℃
(vedere disegno no. 630-01)
A causa della simultaneità (25%) la temperatura ritorno è ca. 35℃

L'acqua di torre porta via la capacita di 1050 kW.
Temperatura mandata 27℃
Temperatura ritorno 36℃
(vedere disegno no. 630-01)

Le Temperature sono constante entro tutto l´anno.

Le dati base per l' aria:
Temperature in inverno: - 8 ℃
Temperature in estate: 34 ℃
Umiditá relative dell' aria: 60 %

English

Technical Description of the cooling water supply with temperature 30℃/50℃

The calculation of the cooling water (30/50℃) capa city is based of the capacity to supply the oil cooling device and the engine cooling device inside the dyno cells, which are based on the requirements of the customer.

The calculation of the whole capacity for cooling water with 30℃ to 50℃ had accounted of following simultaneous factors:

Engine cooling device 0,25
Oil cooling device 0,25

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The primary temperatures are 27/36℃
The secondary temperatures are 30/50℃

On account of this simultaneous it is cause, that the return temperature is approx. 35 ℃

Hereafter the consumers

Dyno 1 - engine cooling device	230 kW (0,25)
Dyno 1 - oil cooling device	50 kW (0,25)
Dyno 2 - engine cooling device	230 kW (0,25)
Dyno 2 - oil cooling device	50 kW (0,25)
Dyno 3 - engine cooling device	230 kW (0,25)
Dyno 3 - oil cooling device	50 kW (0,25)
Dyno 4 - engine cooling device	230 kW (0,25)
Dyno 4 - oil cooling device	50 kW (0,25)
Dyno 5 - engine cooling device	230 kW (0,25)
Dyno 5 - oil cooling device	50 kW (0,25)
Dyno 6 - engine cooling device	230 kW (0,25)
Dyno 6 - oil cooling device	50 kW (0,25)
Dyno 7 - engine cooling device	230 kW (0,25)
Dyno 7 - oil cooling device	50 kW (0,25)
Dyno 8 - engine cooling device	230 kW (0,25)
Dyno 8 - oil cooling device	50 kW (0,25)
Dyno 9 - engine cooling device	230 kW (0,25)
Dyno 9 - oil cooling device	50 kW (0,25)
Dyno 10 - engine cooling device	230 kW (0,25)
Dyno 10 - oil cooling device	50 kW (0,25)
Dyno 11 - engine cooling device	230 kW (0,25)
Dyno 11 - oil cooling device	50 kW (0,25)
Dyno 12 - engine cooling device	230 kW (0,25)
Dyno 12 - oil cooling device	50 kW (0,25)
Dyno 13 - engine cooling device	230 kW (0,25)
Dyno 13 - oil cooling device	50 kW (0,25)
Dyno 14 - engine cooling device	230 kW (0,25)
Dyno 14 - oil cooling device	50 kW (0,25)
Dyno 15 - engine cooling device	230 kW (0,25)
Dyno 15 - oil cooling device	50 kW (0,25)
Total without simultaneous	4200 kW
Total with simultaneous	**1050 kW**

The generation of the cooling water supply is installed in the technical floor (second floor). The installed heat exchanger has a capacity of 1050 kW.

The primary temperatures are 27/36℃
The secondary temperatures are 30/50℃

The capacity for the hydraulic ducts is:

Cooling water 30℃/50℃, the dimensioning of the mai n ducts is calculated with a simultaneous of 25 %, the dimensioning of the ducts to the dynos are calculated with 100%

The nominal pressure of the ducts is PN 16, the supply water pipe pressure amount 4 bar and the return water pipe pressure amount 3 bar. The differential pressure is consequencly amount 1 bar.

The consumers will be supplied with a volume flow-regulation. The temperature for those consumers is constant. The volume flow is dependent from the requirement from the Consumers.

The calculation of the capacity of cooling tower 27°/36°C

Chiller K6 (1600 kW+25% electrical capacity)	2000 kW
Chiller K6 (1600 kW+25% electrical capacity)	2000 kW
Cooling system K 30	1050 kW
Total required capacity cooling tower water	**5050 kW**
Total elected capacity cooling tower water (->RPA)	**5200 kW**

3.3.5 Combustion Air supply left wing
(Drawing No. 620-01)

Italian

L` impianto di condizionamento dell´ aria alimenta i banchi di prova con aria di combustione.

Il trattamento di aria è colocato nel secondo piano,nella parte sinistra, e supporta le banchi prova 1-10

Qui di seguito il trattamento dell` aria di combustione:

- filtrazione
- riscaldamento
- raffreddamento/deumidifazione
- riscaldamento
- ventilazione
- umidificazione

English

The AHU consists of one unit which is placed in the 2nd floor (technical floor) and the air duct system in which the combustion air is distributed to the test benches.

The calculation of the air volume flow takes account that the requirement of the test benches has a simultaneous factor of 1.

Dyno 1	1875 m³/h
Dyno 2	1875 m³/h
Dyno 3	1875 m³/h
Dyno 4	1875 m³/h
Dyno 5	1875 m³/h
Dyno 6	1875 m³/h
Dyno 7	1875 m³/h
Dyno 8	1875 m³/h
Dyno 9	1875 m³/h

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Dyno 10	1875 m³/h
Total	18750 m³/h

The air conditioning contains the following steps:

- filtering
- heating
- cooling / dehumidifying
- heating
- ventilation
- humidifying

Conditions of the fresh air

Temperature winter:	- 8 ℃
Relative humidity winter:	80 %
Temperature summer:	34 ℃
Relative humidity summer:	60 %

Data of combustion air for the test rooms
All test benches have the same data of supply

Volume flow combustion air:	1875 m³/h
Supply air temperature test room min:	18 ℃
Supply air temperature test room max:	27 ℃
Allowed deviation of temperature:	+/- 1 ℃
Absolute humidity min.:	9 g/kg dry air
Absolute humidity max.:	12 g/kg dry air
Allowed deviation of humidity:	+/- 5 % r. humidity

For all test benches the same air conditions are valid. The observance of the parameters relates to the duct entry into each engine dyno test benches.

The whole fresh air duct is connected to a central sound absorber.

Every duct (supply air - combustion air) to the dyno get an own fire flap, an own sound absorber and an own flow rate controller (see drawing No. 620-01).

All components of the ventilation systems (air conditioning Control room, combustion air, admixture air, etc.) had been dimensioned so that a maximum diffuse noise pressure level of 55 dB(A) in the control room mustn't exceed. According to the sound transmission from the test bench to the control room via the air ducts in the false floor a diffuse noise pressure level in the engine test bench has to be respected of:

Frequence	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	Σ
Diffuse noise pressure level dB (A)	74	85	96	96	96	94	90	82	102 dB (A)

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3.3.6 Construction design Admixture Air supply left wing (Drawing No. 620-02)

Italian

L` impianto di condizionamento dell´ aria alimenta i banchi di prova con aria aggiunta di combustione.

Il trattamento di aria è colocata nel secondo piano, nella parte sinistra, e supporta le banchi prova 1 -10 in piu i locali di CVS 1 - CVS 5

Qui di seguito il trattamento dell` aria di combustione:

- filtrazione
- riscaldamento
- raffreddamento/deumidifazione
- ventilazione

English

The AHU consists of one unit which is placed in the 2nd floor (technical floor) and the air duct system in which the admixture air is distributed to the test benches.

The calculation of the air volume flow takes account that the requirement of the test benches has a simultaneous factor of 1.

All dynos gets for the preparation mode 1670 m³/h, in the operation mode 2800 m³/h

All CVS-Rooms gets for the preparation mode 725 m³/h, in the operation mode 1400 m³/h

Dyno 1	2800 m³/h
CVS 1	1400 m³/h
Dyno 2	2800 m³/h
CVS 2	1400 m³/h
Dyno 3	2800 m³/h
CVS 3	1400 m³/h
Dyno 4	2800 m³/h
CVS 4	1400 m³/h
Dyno 5	2800 m³/h
CVS 5	1400 m³/h
Dyno 6	2800 m³/h
Dyno 7	2800 m³/h
Dyno 8	2800 m³/h
Dyno 9	2800 m³/h
Dyno 10	2800 m³/h
Total	35000 m³/h

The air conditioning contains by the following steps:

- filtering
- heating
- cooling/dehuminification
- ventilation

Conditions of the fresh air

Temperature winter:	- 8 ℃
Temperature summer:	34 ℃
Relative humidity summer:	60 %
Relative humidity winter:	80 %

Data of combustion air for the test rooms
All test benches have the same data of supply

Volume flow admixture air:	35000 m³/h
Supply air temperature test room min:	21 ℃
Allowed deviation of temperature:	+/- 1 ℃

The whole fresh air duct is connected to a central sound absorber.

Every duct (supply air - admixture air) to the dyno get an own fire flap, an own sound absorber and an own flow rate controller (see drawing No. 620-02).

All components of the ventilation systems (air conditioning Control room, combustion air, admixture air, etc.) had been dimensioned so that a maximum diffuse noise pressure level of 55 dB(A) in the control room mustn't exceed. According to the sound transmission from the test bench to the control room via the air ducts in the false floor a diffuse noise pressure level in the engine test bench has to be respected of:

Frequence	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	Σ
Diffuse noise pressure level dB (A)	74	85	96	96	96	94	90	82	102 dB (A)

3.3.7 Construction design air conditioning control room left wing (Drawing No. 620-03)

Italian

L` impianto di condizionamento dell´ aria alimenta la sala di controllo.

Il trattamento di aria è colocata nel secondo piano, nella parte sinistra, e supporta la sala di controllo con aria fresca condizionata.

Qui di seguito il trattamento dell` aria condizionata:

inverno:
- filtrazione
- recupero termico
- riscaldamento
- umidificazione (opzione)
- ventilazione

estate:
- filtrazione
- raffreddamento
- recupero termico
- deumidificazione (opzione)
- riscaldamento (opzione)
- ventilazione

English

The AHU consists of two separate units (supply air unit and extraction air unit) which is placed in the 2nd floor (technical floor) and the air duct system.

The calculation of the Air Handling Unit (AHU) to supply the control rooms with conditioned air bases on the requirements of the customer and the installed cooling loads of the rooms.

Control room (dyno 1-5)	11000 m³/h
Control room (dyno 6-10)	11000 m³/h
Total	22000 m³/h

The air conditioning contains by the following steps:

Winter
- filtering
- heat recovery recuperative
- heating
- humidifying (option)
- ventilation

Summer
- filtering
- cooling
- heat recovery recuperative
- dehumidifying (option)
- heating (option)
- ventilation

Conditions of the fresh air

Temperature winter:	- 8 ℃
Temperature summer:	34 ℃
Relative humidity summer:	60 %
Relative humidity winter:	80 %

Data
All test benches have the same data of supply

Volume flow supply air:	22000 m³/h

Summer:
Supply air temperature control room: 23 ℃
Allowed deviation of temperature: +/- 2 ℃

Winter:
Supply air temperature control room: 20 ℃
Allowed deviation of temperature: +/- 2 ℃

The whole fresh air duct is connected to a central sound absorber.

Every duct for the supply air get an own fire flap, an own sound absorber and an own flow rate controller (see drawing No. 620-03).

Supply Air Distribution inside the control room
To carry off the high cooling loads (7,5 kW per test bench generated by measuring technique) the supply air is injected by displacement outlets, which are placed on the floor, with are connected with the supply air in the false floor of the control room

Return Air from the control room
The return air is sucked off through return air grilles into the air duct which is placed near the dome lights.

Due to the employment of the displacement outlets, there is no induction in the supply air stream.

The air is warmed up by the internal heat sources and is lifted thermically up to the upper area of the control room.

All components of the ventilation systems (air conditioning Control room, combustion air, admixture air, etc.) have to be dimensioned so that a maximum diffuse noise pressure level of 55 dB(A) in the control room mustn't exceed.

3.3.8 Construction design recirculation air cooling
AHU test cells 1-15 (Drawing No. 620-04)

Italian

L` impianto della apparecchiatura di refrigerazione circolazione porta via il carico termico nei banchi prova.

Le apparecchiature sono collegati con le tubazione acqua fredda (15℃21℃)

English

The recirculation Unit carried off the high cooling loads in the test cell.

This AHU sucked in the loaded air in the test cell, cooled it and blew it out. The AHU is connected with chilled water 15℃21℃ (see plan 640-02)

In each test cells are installed 2 recirculation unit which a capacity of 79 kW each and a volume flow of 11800 m³/h.

3.3.9 Construction design air ventilation soak area (Drawing No. 620-05)

Italian

L` impianto di condizionamento dell´ aria alimenta seguenti locali:

Revisione vetture, Stazionamento, Entrata vettura, Filtro.

Il trattamento di aria è colocata nel secondo piano, nella parte destra, e supporta i locali (come sopra) con aria fresca condizionata.

Qui di seguito il trattamento dell` aria condizionata:

inverno:
- filtrazione
- Recupero termico
- riscaldamento
- ventilazione

estate:
- filtrazione
- Recupero termico
- raffreddamento/ deumidificazione
- ventilazione

English

The AHU consists of two separate units (supply air unit and extraction air unit) which is placed in the 2nd floor (technical floor) and the air duct system.

Soak area	8000 m³/h
Entrance Vehicle	2000 m³/h
Total	10000 m³/h

The AHU has to keep the surrounding air temperature of the vehicles which are placed in the area + 25 ℃ by an allowed control deviation of +/-2 K.

Other rooms are connected with this AHU for ventilation.
The main volume flow is supplied into the soak area, a particularly volume flow is supplied into the vehicle area, Filter, and the entrance vehicle.

In the vehicle area are placed two exhaust gas ventilations.
The volume flow of this ventilation is sucked from the air in the room. These exhaust gay ventilations did not operate permanent.

Conditions of the fresh air
Temperature winter: - 8 ℃

Temperature summer: 34 °C
Relative humidity summer: 60 %
Relative humidity winter: 80 %

Data of combustion air for the test rooms
All test benches have the same data of supply

Volume flow supply air: 10000 m³/h

Summer:
Supply air temperature: 25 °C
Allowed deviation of temperature: +/- 2 °C

Winter:
Supply air temperature control room: 25 °C
Allowed deviation of temperature: +/- 2 °C

The whole fresh air duct is connected to a central sound absorber.

Every duct for the supply air get an own fire flap, an own sound absorber and an own flow rate controller (see drawing No. 620-05).

3.3.10 Construction design air conditioning chassis dynamometer (Drawing No. 620-06)

Italian

L` impianto di condizionamento dell´ aria alimenta la sala di rulli.

Il trattamento di aria è colocata nel primo piano, nella parte destra, all di sopra della sala rulli, e alimenta la sala rulli con aria fresca condizionata.

Qui di seguito il trattamento dell` aria condizionata:

- filtrazione
- recupero termico
- riscaldamento
- raffreddamento
- riscaldamento
- ventilazione
- umidificazione

English

The AHU consists of two separate units (supply air unit and extraction air unit) which is placed in the 2nd floor (technical floor) and the air duct system.

The calculation of the Air Handling Unit (AHU) to supply the chassis dyno with conditioned air bases on the requirements of the customer and the installed cooling loads of the rooms.

Supply air unit: 22000 m³/h

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Extraction air unit: 16000 m³/h

The different air volume flow of 6000 m³/h is going out with the exhaust extraction (see plan 660-02)

The air conditioning contains by the following steps:

- filtering
- heat recovery recuperative
- preheating
- cooling/ dehumidifying
- reheating
- ventilation
- humidifying

Conditions of the fresh air

Temperature winter:	- 8 ℃
Temperature summer:	34 ℃
Relative humidity summer:	60 %
Relative humidity winter:	80 %

Data of combustion air for the chassis dyno

Volume flow supply air:	22000 m³/h
Supply air temperature test room min:	20℃
Supply air temperature test room max:	30 ℃
Allowed deviation of temperature:	+/- 1 ℃ steady st ate
Allowed deviation of temperature:	+/- 2℃ dynamic op eration (NEDC)
Absolute humidity min.:	9 g Water/kg dry air
Absolute humidity max.:	11g Water/kg dry air
Allowed deviation of humidity:	+/- 0,5 g/kg dry air

The whole fresh air duct is connected to a central sound absorber.

Every duct for the supply air get an own fire flap, an own sound absorber and an own flow rate controller (see drawing No. 620-06).

All components of the ventilation systems (air conditioning Control room, combustion air, admixture air, etc.) have to be dimensioned so that a maximum diffuse noise pressure level of 55 dB(A) in the control room mustn't exceed.

3.3.11 Construction design Admixture Air supply right wing
(Drawing No. 620-09)

Italian

L` impianto di condizionamento dell´ aria alimenta i banchi di prova con aria aggiunta di combustione.

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Specification

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Il trattamento di aria è colocata nel secondo piano, nella parte destra, e supporta le banchi prova 11 - 15.

Qui di seguito il trattamento dell` aria di combustione:

- filtrazione
- riscaldamento
- raffreddamento/deumidificazione
- ventilazione

English

The AHU consists of one unit which is placed in the 2nd floor (technical floor) and the air duct system in which the admixture air is distributed to the test benches.

The calculation of the air volume flow takes account that the requirement of the test benches has a simultaneous factor of 1.

All dynos gets for the preparation mode 1670 m³/h, in the operation mode 2800 m³/h

Dyno 11	2800 m³/h
Dyno 12	2800 m³/h
Dyno 13	2800 m³/h
Dyno 14	2800 m³/h
Dyno 15	2800 m³/h
Total	14000 m³/h

The air conditioning contains by the following steps:

- filtering
- heating
- cooling/dehumidification
- ventilation

Conditions of the fresh air

Temperature winter:	- 8 ℃
Temperature summer:	34 ℃
Relative humidity summer:	60 %
Relative humidity winter:	80 %

Data of admixture air for the test rooms
All test benches have the same data of supply

Volume flow admixture air:	14000 m³/h
Supply air temperature test room min:	21 ℃
Allowed deviation of temperature:	+/- 1 ℃

For all test benches the same air conditions are valid!

The whole fresh air duct is connected to a central sound absorber.

Every duct (supply air - admixture air) to the dyno get an own fire flap, an own sound absorber and an own flow rate controller (see drawing No. 620-09).

All components of the ventilation systems (air conditioning Control room, combustion air, admixture air, etc.) have to be dimensioned so that a maximum diffuse noise pressure level of 55 dB(A) in the control room mustn't exceed. According to the sound transmission from the test bench to the control room via the air ducts in the false floor a diffuse noise pressure level in the engine test bench has to be respected of:

Frequence	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	Σ
Diffuse noise pressure level dB (A)	74	85	96	96	96	94	90	82	102 dB (A)

3.3.12 Construction design Combustion Air supply right wing (Drawing No. 620-10)

Italian

L` impianto di condizionamento dell´ aria alimenta i banchi di prova con aria di combustione.

Il trattamento di aria è colocato nel secondo piano, nella parte destra, e supporta le banchi prova 11 - 15 in piu il banco prova chassis dyno come opzione.

Qui di seguito il trattamento dell` aria di combustione:

- filtrazione
- riscaldamento
- raffreddamento/deumidificazione
- riscaldamento
- ventilazione
- umidificazione

English

The AHU consists of one unit which is placed in the 2nd floor (technical floor) and the air duct system in which the combustion air is distributed to the test benches.

The calculation of the air volume flow takes account that the requirement of the test benches has a simultaneous factor of 1.

Dyno 11	1875 m³/h
Dyno 12	1875 m³/h
Dyno 13	1875 m³/h
Dyno 14	1875 m³/h
Dyno 15	1875 m³/h
Chassis dyno (optional)	6000 m³/h
Total	15375 m³/h

The volume flow of the Chassis dyno is in the operation mode 6000 m³/h and in the preparation mode

1500 m³/h.

The air conditioning contains by the following steps:

- filtering
- heating
- cooling / dehumidifying
- heating
- ventilation
- humidifying

Conditions of the fresh air

Temperature winter:	- 8 ℃
Temperature summer:	34 ℃
Relative humidity summer:	60 %
Relative humidity winter:	80 %

Data of combustion air for the test rooms
All test benches have the same data of supply

Volume flow combustion air:	1875 m³/h
Supply air temperature test room min:	18 ℃
Supply air temperature test room max:	27 ℃
Allowed deviation of temperature:	+/- 1 ℃
Absolute humidity min.:	9 g Water/kg dry air
Absolute humidity max.:	12 g Water/kg dry air
Allowed deviation of humidity:	+/- 5 % r. humidity

The whole fresh air duct is connected to a central sound absorber.

Every duct (supply air - combustion air) to the dyno get an own fire flap, an own sound absorber and an own flow rate controller (see drawing No. 620-10).

All components of the ventilation systems (air conditioning Control room, combustion air, admixture air, etc.) have to be dimensioned so that a maximum diffuse noise pressure level of 55 dB(A) in the control room mustn't exceed. According to the sound transmission from the test bench to the control room via the air ducts in the false floor a diffuse noise pressure level in the engine test bench has to be respected of:

Frequence	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**Σ**
Diffuse noise pressure level dB (A)	74	85	96	96	96	94	90	82	102 dB (A)

Specification

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3.3.13 Construction design air conditioning control room right wing (Drawing No. 620-11)

Italian

L` impianto di condizionamento dell´ aria alimenta la sala di controllo.

Il trattamento di aria è colocato nel secondo piano, nella parte destra, e supporta la sala di controllo con aria fresca condizionata.

Qui di seguito il trattamento dell` aria condizionata:

inverno:
- filtrazione
- recupero termico
- riscaldamento
- umidificazione (opzione)
- ventilazione

estate:
- filtrazione
- raffreddamento
- recupero termico
- deumidificazione (opzione)
- riscaldamento (opzione)
- ventilazione

English

The AHU consists of two separate units (supply air unit and extraction air unit) which is placed in the 2nd floor (technical floor) and the air duct system.

The calculation of the Air Handling Unit (AHU) to supply the control rooms with conditioned air bases on the requirements of the customer and the installed cooling loads of the rooms.

Control room (dyno 11-15)	11000 m³/h
Control room (chassis dyno)	3000 m³/h
Total	14000 m³/h

The air conditioning contains by the following steps:

Winter
- filtering
- heat recovery recuperative
- heating
- humidifying (option)
- ventilation

Summer

- filtering
- cooling
- heat recovery recuperative
- dehumidifying (option)
- heating (option)
- ventilation

Conditions of the fresh air

Temperature winter:	- 8 ℃
Temperature summer:	34 ℃
Relative humidity summer:	60 %
Relative humidity winter:	80 %

Data

Volume flow supply air: 14000 m³/h

Summer:

Supply air temperature control room:	23 ℃
Allowed deviation of temperature:	+/- 2 ℃

Winter:

Supply air temperature control room:	20 ℃
Allowed deviation of temperature:	+/- 2 ℃

The whole fresh air duct is connected to a central sound absorber.

Every duct for the supply air get an own fire flap, an own sound absorber and an own flow rate controller (see drawing No. 620-11).

All components of the ventilation systems (air conditioning Control room, combustion air, admixture air, etc.) have to be dimensioned so that a maximum diffuse noise pressure level of 55 dB(A) in the control room mustn't exceed.

Supply Air Distribution inside the control room
To carry off the high cooling loads (7,5 kW per test bench generated by measuring technique) the supply air is injected by displacement outlets, which are placed on the floor, which are connected with the supply air in the false floor of the control room

Return Air in the control room
The return air is sucked off through return air grilles into the air duct which is placed near the dome lights.

Due to the employment of the displacement outlets, there is no induction in the supply air stream.

The air is warmed up by the internal heat sources and is lifted thermically up to the upper area of the control room.

3.3.14 Construction design ventilation ground floor left wing (Drawing No. 620-07)

Italian

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L` impianto di condizionamento dell´ aria alimenta i locali a piano terra sulla sinistra.

Il trattamento di aria è colocata nel secondo piano, nella parte sinistra.

Qui di seguito il trattamento dell` aria condizionata:

inverno:
- filtrazione
- recupero termico
- riscaldamento
- ventilazione

estate:
- filtrazione
- recupero termico
- raffreddamento
- ventilazione

Le dati base per l'aria:

Temperature in inverno:	- 8 ℃
Temperature in estate:	34 ℃
Umiditá relative dell' aria in estate:	60 %
Umiditá relative dell' aria in inverno	80 %

English

The AHU consists of two separate units (supply air unit and extraction air unit) which are placed in the 2nd floor (technical floor) and the air duct system.

The calculation of the Air Handling Unit (AHU) to supply the control rooms with conditioned air bases number of air changes of 3/h. Only in the internal corridor the number of air changes is 1/h.

Supply air

Engine area Storage	4600 m³/h
Intern corridor axle 1	2450 m³/h
Washing are	2000 m³/h
Welding equipment	2500 m³/h
Engine assembly workshop	9900 m³/h
Machine tools	2700 m³/h
Calibration	1750 m³/h
Engine Components storage	4200 m³/h
Metrology Lab	3600 m³/h
Patch room	250 m³/h
Total	33950 m³/h

Extraction air

Engine area Storage	4600 m³/h
Intern corridor axle 1	2450 m³/h
Washing are	2000 m³/h
Welding equipment	2000 m³/h

Specification

Project: **0602** **Cittadella Politecnico**
WBS: **intro** **Introductory -state of design 2007-02-16-**

Engine assembly workshop	9900 m³/h
Machine tools	2600 m³/h
Calibration	1650 m³/h
Engine Components storage	3800 m³/h
Metrology Lab	3400 m³/h
Patch room	250 m³/h
Total	32650 m³/h

Extraction air (separate)	
Welding equipment	500 m³/h
Total	500 m³/h

Extraction air (separate)	
Machine tools	100 m³/h
Calibration	100 m³/h
Metrology Lab	200 m³/h
Total	400 m³/h

Extraction air (separate)	
Engine Components storage	400 m³/h
Total	400 m³/h

The ventilation contains the following steps:

Winter:
- filtering
- heat recovery recuperative
- heating
- ventilation

Summer:
- filtering
- heat recovery recuperative
- cooling
- ventilation

Conditions of the fresh air

Temperature winter:	- 8 ℃
Temperature summer:	34 ℃
Relative humidity summer:	60 %

Data:

Volume flow supply air:	33950 m³/h

Summer:

Supply air temperature control room:	26 ℃
Allowed deviation of temperature:	+/- 2 ℃

Winter:
Supply air temperature control room: 20 ℃
Allowed deviation of temperature: +/- 2 ℃

The whole fresh air duct is connected to a central sound absorber (2nd floor).

Every duct for the supply air get an own fire flap, an own sound absorber and an own flow rate controller (see drawing No. 620-07).

3.3.15 Construction design ventilation ground floor right wing (Drawing No. 620-12)

Italian

L` impianto di condizionamento dell´ aria alimenta i locali a piano terra sulla destra.

Il trattamento di aria è colocata nel secondo piano, nella parte destra.

Qui di seguito il trattamento dell` aria condizionata:

inverno:
- filtrazione
- recupero termico
- riscaldamento
- ventilazione

estate:
- filtrazione
- recupero termico
- raffreddamento
- ventilazione

Le dati base per l' aria:
Temperature in inverno: - 8 ℃
Temperature in estate: 34 ℃
Umiditá relative dell' aria in estate: 60 %
Umiditá relative dell'aria in inverno: 80 %

English

The AHU consists of two separate units (supply air unit and extraction air unit) which are placed in the 2nd floor (technical floor) and the air duct system.

The calculation of the Air Handling Unit (AHU) to supply the control rooms with conditioned air bases number of air changes of 3/h. Only in the internal corridor the number of air changes is 1/h.

Supply air
Thermal Chamber 500 m³/h
Air flow bench 3350 m³/h

Specification

Project: **0602** **Cittadella Politecnico**
WBS: **intro** **Introductory -state of design 2007-02-16-**

Labs area storage	550 m³/h
Elektronik Lab	3850 m³/h
RD & V Lab	1950 m³/h
Switch cabinet	300 m³/h
Patch room	250 m³/h
Hydraulic Lab	6450 m³/h
Intern corridor axle 1	2600 m³/h
Total	19800 m³/h

Extraction air

Thermal Chamber	50 m³/h
Air flow bench	2900 m³/h
Labs area storage	150 m³/h
Elektronik Lab	3000 m³/h
RD & V Lab	1650 m³/h
Switch cabinet	300 m³/h
Patch room	250 m³/h
Hydraulic Lab	4250 m³/h
Intern corridor axle 1	2600 m³/h
Total	15150 m³/h

Extraction air (separate)

Thermal chamber (3 x 150 m³/h)	450 m³/h
Total	450 m³/h

Extraction air (separate)

Machine tools	100 m³/h
Calibration	100 m³/h
Metrology Lab	200 m³/h
Total	400 m³/h

Extraction air (separate)

Engine Components storage	400 m³/h
Total	400 m³/h

The ventilation contains the following steps:

Winter:
- filtering
- heat recovery recuperative
- heating
- ventilation

Summer:
- filtering
- heat recovery recuperative

- cooling
- ventilation

Conditions of the fresh air

Temperature winter:	- 8 ℃
Temperature summer:	34 ℃
Relative humidity summer:	60 %
Realtive humidity winter:	80 %

Data:

Volume flow supply air:	19800 m³/h

Summer:

Supply air temperature control room:	26 ℃
Allowed deviation of temperature:	+/- 2 ℃

Winter:

Supply air temperature control room:	20 ℃
Allowed deviation of temperature:	+/- 2 ℃

The whole fresh air duct is connected to a central sound absorber.

Every duct for the supply air get an own fire flap, an own sound absorber and an own flow rate controller (see drawing No. 620-12).

3.3.16 Construction design ventilation utility area left and right wings (Drawing No. 620-08)

Left wing

Italian

L` impianto della unita di aria e per l'Aerazione del piano secondo sulla sinistra. L'unita di aria alimenta questo locale con aria fresca e in oltre porta via il carico termico.
Addizionale in questo locale ce anche una ventilazione di aria estrazione, che è colocate vicino le macchine frigorifere (refrigerante).

Qui di seguito il trattamento dell` aria:

inverno:
- filtrazione
- ventilazione

estate:
-filtrazione
-ventilazione

Le dati base per l' aria:

Temperature in inverno:	- 8 ℃
Temperature in estate:	34 ℃
Umiditá relative dell' aria in estate:	60 %
Umiditá relative dell aria in inverno:	80 %

Nel secondo piano sono locati inoltre due riscaldatori di aria ricircolo (vedere disegno 610-01) per riscaldare in inverno l'aria che è aspirata.

English

The ventilation system for the 2nd floor (technical floor) on the left wing, is needed for ventilation this area and support it with fresh air and to get out the thermical load in this area. Additionally a ventilation system is located in the near of the refrigerating machine

The Ventilation systems consist of:

Supply air	10000 m³/h
Extraction air	1300 m³/h
Extraction air (nearly the refrigerating mach.	8000 m³/h

The ventilation contains the following steps:

Winter:
- filtering
- ventilation

Summer:
- filtering
- ventilation

Conditions of the fresh air

Temperature winter:	- 8 ℃
Temperature summer:	34 ℃
Relative humidity summer:	60 %
Relative humidity winter:	80 %

Also in the the 2nd floor (technical floor) is located 2 separate recirculation heater (see plan 610-01). Those heaters are needed in winter when the outdoor air will be intake.

The whole fresh air and the extraction air duct is connected with a central sound absorber.

3.3.17 Construction design ventilation utility area left and right wings (Drawing No. 620-08)

Right wing

Italian

L` impianto della unita di aria e per l'Aerazione del piano secondo sulla destra. L'unita di aria alimenta questo locale con aria fresca e in oltre porta via il carico termico.

Specification

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Qui di seguito il trattamento dell` aria:

inverno:
- filtrare
- ventilazione

estate:
- filtrare
- ventilazione

Le dati base per l' aria:

Temperature in inverno:	- 8 ℃
Temperature in estate:	34 ℃
Umiditá relative dell' aria in estate:	60 %
Umiditá relative dell' aria in inverno:	80 %

Nel secondo piano sono locati inoltre due riscaldatori di aria riciclaggio (vedere disegno 610-01) per riscaldare in inverno l'aria che è aspirata.

English

The ventilation system for the 2nd floor (technical floor) on the right wing, is needed for ventilation this area and support it with fresh air and to get out the thermical load in this area. Additionally a ventilation system is located in the near of the refrigerating machine

The Ventilation systems consist of:

Supply air	10000 m³/h
Extraction air	10000 m³/h

The ventilation contains the following steps:

winter:
- filtering
- ventilation

Summer:
- filtering
- ventilation

Conditions of the fresh air

Temperature winter:	- 8 ℃
Temperature summer:	34 ℃
Relative humidity summer:	60 %
Realtive humidity winter:	80 %

Also in the 2nd floor (technical floor) is located 2 separate recirculation heater (see plan 610-01). Those

heaters are needed in winter when the outdoor air will be intake.

The whole fresh air and the extraction air duct is connected with a central sound absorber.

3.3.18 Construction design schematic drawing air supply converter room left wing (Drawing No. 620-13)

Italian

L` impianto della unita di aria e per l'Aerazione del locale con convertitori sopra la sala controllo. L'unita di aria alimenta questo locale con aria fresca e in oltre porta via il carico termico.

Qui di seguito il trattamento dell`aria:

inverno:
- filtrazione
- ventilazione

estate:
- filtrazione
- ventilazione

Le dati base per l' aria:

Temperature in inverno:	- 8 ℃
Temperature in estate:	34 ℃
Umiditá relative dell' aria in estate:	60 %
Umiditá relative dell' aria in inverno:	80 %

English

The ventilation system for the converter room on the left wing over the control room, is needed for ventilation this area and also supported it with fresh air and to get out the thermical load in this area.

The Ventilation systems consist of:

2 x AHU Supply air (2 x 7850 m³/h)	15700 m³/h
2 x AHU Extraction air (2 x 7850 m³/h)	15700 m³/h

The ventilation contains the following steps:

Winter:
- filtering
- ventilation

Summer:
- filtering
- ventilation

Conditions of the fresh air

Temperature winter: - 8 ℃
Temperature summer: 34 ℃
Relative humidity summer: 60 %

Every fresh air and extraction air duct is connected with a central sound absorber.

3.3.19 Construction design schematic drawing air supply converter room right wing (Drawing No. 620-14)

Italian

L` impianto della unita di aria e per l'Aerazione del locale con convertitori sopra la sala controllo. L'unita di aria alimenta questo locale con aria fresca e in oltre porta via il carico termico.

Qui di seguito il trattamento dell`aria:

inverno:
- filtrazione
- ventilazione

estate:
- filtrazione
- ventilazione

Le dati base per l' aria:
Temperature in inverno: - 8 ℃
Temperature in estate: 34 ℃
Umiditá relative dell' aria in estate: 60 %
Umiditá relative dell' aria in inverno: 80 %

English

The ventilation system for the converter room on the right wing over the control room, is needed for ventilation this area and also supported it with fresh air and to get out the thermical load in this area.

The Ventilation systems consist of:

1 x AHU Supply air (1 x 7850 m³/h) 7850 m³/h
1 x AHU Extraction air (1 x 7850 m³/h) 7850 m³/h

The ventilation contains the following steps:

Winter:
- filtering
- ventilation

Summer:
- filtering
- ventilation

Conditions of the fresh air

Temperature winter:	- 8 ℃
Temperature summer:	34 ℃
Relative humidity summer:	60 %
Relative humidity winter:	80 %

Every fresh air and extraction air duct is connected with a central sound absorber.

3.3.20 Construction design schematic drawing air supply converter room chassis dyno (Drawing No. 620-15)

Italian

L` impianto della unita di aria e per l'Aerazione del locale con convertitori della sala rulli. L'unita di aria alimenta questo locale con aria fresca e in oltre porta via il carico termico.

Qui di seguito il trattamento dell`aria:

inverno:
- filtrazione
- ventilazione

estate:
- filtrazione
- ventilazione

Le dati base per l' aria:

Temperature in inverno:	- 8 ℃
Temperature in estate:	34 ℃
Umiditá relative dell' aria in estate:	60 %
Umiditá relative dell 'aria in inverno:	80 %

English

The ventilation system for the converter room of the chassis dyno is needed for ventilation this area and also supported it with fresh air and to get out the thermical load in this area.

The Ventilation systems consist of:

1 x AHU Supply air (1 x 1500 m³/h)	1500 m³/h
1 x AHU Extraction air (1 x 1500 m³/h)	1500 m³/h

The ventilation contains the following steps:

Winter:
- filtering
- ventilation

Summer:
- filtering
- ventilation

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Conditions of the fresh air

Temperature winter:	-8 ℃
Temperature summer:	34 ℃
Relative humidity summer:	60 %
Relative humidity winter:	80 %

Every fresh air and extraction air duct is connected with a central sound absorber.

3.3.21 Construction design schematic drawing air supply calibration (Drawing No. 620-16)

Italian

L` impianto della unita di aria e per l'Aerazione dei seguenti locali nella autorimessa. L'unita di aria alimenta questi locali con aria fresca:

- "inflammable bottles"
- "calibration"
- "diesel barrels storage

Qui di seguito il trattamento dell`aria:

inverno:
- filtrazione
- ventilazione

estate:
- filtrazione
- ventilazione

Le dati base per l' aria:

Temperature in inverno:	- 8 ℃
Temperature in estate:	34 ℃
Umiditá relative dell' aria in estate:	60 %
Umiditá relative dell' aria in inverno:	80 %

English

The ventilation system is needed for ventilation in the following rooms of the parking house and supported them with fresh air.

- "inflammable bottles"
- "calibration"
- "diesel barrels storage"

The Ventilation systems consist of:

Supply air ("inflammable bottles")	1500 m³/h
Extraction air ("inflammable bottles")	1500 m³/h
Supply air ("calibration")	2400 m³/h
Extraction air ("calibration")	2400 m³/h
Supply air ("diesel barrels storage")	1500 m³/h
Extraction air ("diesel barrels storage")	1500 m³/h

The ventilation contains the following steps:

Winter:
- filtering
- ventilation

Summer:
- filtering
- ventilation

Conditions of the fresh air

Temperature winter:	- 8 ℃
Temperature summer:	34 ℃
Relative humidity summer:	60 %
Relative humidity winter:	80 %

Every fresh air and extraction air duct is connected with a central sound absorber.

3.3.22 Construction design schematic drawing air supply day-tank room (Drawing No. 620-17)

Italian

L`impianto della unita di aria e per l'Aerazione del locale "serbatoio Diesel giornalieri" nel secondo piano. L'unita di aria alimenta questo locale con aria fresca.

L'aria aspirata e dal locale tecnico. L'aria di "espulsione" va direttamente fuori.

English

The ventilation system for the day-tank room in the 2nd floor (technical floor) is needed for ventilation this area and also supported it with "fresh air" directly of the technical floor (left wing).

Extraction air	700 m³/h

The extraction air duct is connected with a central sound absorber.

3.3.23 Automatic Sprinkler system (Ddrawing 680-01)

Italian

L' impianto di sprinkler é diviso in 4 compartimenti. Queste zone sono allogati con un impianto distributore centrale che é colocato a piano terra (parte autorimessa). La Tubazione di sprinkler attraversa i cavedi

impianti fino i piani necessari.

La tubazione principale ha un diametro nominale di 200 ed é fornito con una stazione a valvole bagnato allarme (NAV). (campana idraulica)

English

Purpose of the facility
- Automatically actuation
- Extinguishing of fire

Consumers:
- Storage Areas: 32 mm/min sprinkler density at an effective area of 372m²
- Test Areas: 24 mm/min sprinkler density at an effective area of 86m² - 372m²
- Workshop areas: 12 mm/min sprinkler density at an effective area of 372m²
- Office areas: 5 mm/min sprinkler density at an effective area of 372m²
- Staircases and toilets: no sprinkler

Facility design:
- Zone 1+2 (Ground floor engine dynamometers including false floor, southern aera ground floor and mezzanine)
- Zone 3+4 (north eastern area groundfloor)
- Zone 7+8 (southern and north eastern area of the second floor, including rooms with false floor and suspended ceiling)
- Zone 9 (north western area parking house ground floor and underground connector)

The distributor is located in the north western parking house corridor. All pipes to the current zone have an alarm valve collector. The main distribution pipes of the zones 1+2, 3+4 and 7+8 will be transmitted via underground corridor to the engine test bench building.

Not visible rooms are equipped with waterflow detector. Those are splitted at current zones.

3.3.24 Exhaust extraction (Drawing 660-01)

The disposal of the exhaust gas air mixtures from the test field consists of 3 exhaust gas units with equal design.

Inside the test benches the exhaust gas is sucked off from the motor by an open collector system. The exhaust gas is blended with air from the test room.

Inside the exhaust gas collectors the exhaust gas of the motors is mixed with the return air from the exhaust gas analysis systems CVS.

The section ducts are regulated by an exhaust gas control flap in relation to the room conditions; air pressure in the test room (ΔpRaum = ca. -10 Pa).

The exhaust gas fan is rpm regulated by a constant negative air pressure in the system (approx. -1300 Pa). Therefore the operation condition for the exhaust gas control flap will be constant.

The emissions of the sound sources are reduced by sound absorbers.

Basic Data of the exhaust gas data of Dyno´s

Mass flow exhaust gas of test object	1438	kg/h
Mass flow mixture air	4111	kg/h
Mass flow exhaust gas test bench	5481	kg/h
Max. exhaust gas temperature test object	600	℃
Temperature of the mixture air	20	℃
Max. exhaust gas temperature test bench	170	℃
Volume flow exhaust gas by 20℃	4568	m³/h
Volume flow exhaust gas by 170℃	6995	Bm³/h

Bm³/h is the Volume flow by 170℃

Basic Data of the exhaust gas data of analysis room

Mass flow exhaust gas CVS	0…800	kg/h
Mass flow mixture air	1680	kg/h
Mass flow exhaust gas analysis	1680	kg/h
Max. exhaust gas temperature CVS		℃
Temperature of the mixture air	20	℃
Max. exhaust gas temperature CVS	135	℃
Volume flow exhaust gas by 20℃	1400	m³/h
Volume flow exhaust gas by 170℃	1950	m³/h

note: all test benches and CVS - room have the same boundery data

3.3.25 Electrical power distribution (Drawing 704-01)

General remark

The whole planning of the technical construction and installation was made of the basis that there are no explosion risks, caused by the Fuels and Materials in the building. There is no need for electrical classified equipment, because storage, handling and dispensing of Diesel don't cause EX-Zones, that is classified location.

This is also corresponding to the GM Standards, the NFPA (US National Fire Protection Agency) Codes and European ATEX Rules. Diesel Fuel is classified as Class II liquid and area are no more classified as hazardous.

According to the special utilities layouts, the Building Automation Control System (BACS) and the special installed devices (sensor, ventilation, alarm system, monitoring system, relief venting walls and explosion-proof-doors) there are no areas with explosion residual risk.

Distribution at all:
- supplying test equipment
- supplying facilities

Distribution:

Distribution testing equipment 2x1600kVA transformer
With two Low voltage main distributions

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Distribution facility 1x2500kVA
With one Low voltage main distribution

Low voltage-main distributions:

Basically equipped with switch-disconnectors 2500A for feed-in
Ready for to connect to bus bars-system (from top)
All outgoing feeders are equipped with circuit-breakers and integrated under voltage-releases.
All circuit-breakers can be released by under-voltage-releases.

Emergency lighting system:

The emergency lighting system is provided as central battery system.
The system will be mounted in steel cabinet incl. control-part and battery, which is located in separated room on the 2nd.floor (cbs-room).
The e-l-s is controlled by three phase monitoring relays from different cabinets (several interfaces for communication are provided e.g.status messages etc.)

Illumination:

The illumination will be realised in several switch-groups in one and three-phase-wiring mode. The switch groups can be taken from the circuit-drawings and from the installation plans. The type of lamps (light band-performance or surface-mounted lamps) are given in installation - plan with T1 up to T13 (incl. all types)

Ref. Normative for the electrical supply:

CEI EN 60079-10 (31-30) Classificazione dei luoghi pericolosi

CEI EN 60079-14 (31-33) Impianti elettrici nei luoghi con pericolo die esplosione per la presenza di gas

CEI EN 60079-17 (31-34) Verifica e manutenzione degli impianti elettrici nei luoghi con pericolo di esplosioe per la presenza di gas

CEI 31-35 Guida all'applicazione della norma CEI EN 60070-10 (31-30) Classificazione dei luoghi pericolosi

CEI 31-35; V1 Guida all'applicazione della norma CEI EN 60070-10 (31-30)

CEI 31-35; V3 Guida all'applicazione della norma CEI EN 60070-10 (31-30)

CEI 31-35/A Guida all'applicazione della norma CEI EN 60070-10 (31-30) - Esempi di applicazione

CEI 31-35/A;V1 Guida all'applicazione della norma CEI EN 60070-10 (31-30) Esempi di applicazione

CEI EN 50281-1-2 (31-36) - Costruzioni elettriche protette da custodie - Scelta, installaziane e manutenzione
CEI EN 50073 (31-42) - guida per la scelta, installazione, uso e manutenzione delle apparechiature per la rilevazione e misura dei gas combustibili o di

ossigeno

CEI CLC/'TR 50404 (31-55) Elettrostatica - Guida e raccomandazioni per evitare i pericoli dovuti all'eletticitá statica

CEI 64-8 Impianti elettrici utilizzatori a tensione nomianle non superiore a 1000 V in corrente alternata e 1500 'V in corrente continua

3.3.26 Compressed air supply system (Drawing 690-01)

Italian

Il systema dell'aria compressa viene colocato nel secondo piano. La capacita dell compressore e 150 m³/h e la pressione erogata e 6 bar.

English

The calculation of the compressed air capacity is based of the capacity to supply the workshop and preparation are in the ground floor, the dynos and the CVS, which are based on the requirements of the customer.

The generation of the compressed air supply is installed in the technical floor (second floor).

The capacity of the compressor unit is 150 m³/h compressed air with a pressure of 6 bar.

The dynos are equipped with a electric motorized valve.

For the dimensioning of the ducts and the capacity of the compressed air unit is calculated with and simultaneous of 10%.

3.3.27 Calibration gas supply system (Drawing 695-01)

The calibration gas supply system consists of following main parts:

Operation and calibration gas supply room with:
- o 3 operation gas types with 2 x 4 bottles 2 reducer stations from bottle pressure to middle pressure (10 bar overpressure) and an automatic switcher which will connect the stand-by battery if the pressure of the connected battery goes down.
- o 2 operation gas types (N2) with 4 bottles and a GM - rented N2 external tank, 2 reducer stations from bottle pressure to middle pressure (10 bar overpressure) and an automatic switcher which will change from external tank supply to the battery if the pressure of the tank goes down.
- o 24 calibration gases in which 5 reserve gases are included, with 2 x 1 bottles 2 reducer stations from bottle pressure to middle pressure (10 bar overpressure) and an automatic switcher which will connect the stand-by bottle if the pressure of the connected bottle goes down.
- o Compressed air as steering energy with a singular reducer station

Fuel gas supply room
- o 1 fuel gas with 2 x 4 bottles 2 reducer stations from bottle pressure to middle pressure (10 bar overpressure) and an automatic switcher which will change the supply battery if the pressure of the connected battery goes down.

Piping
- o All operation and the most calibration gases will be executed in stainless steel, Quality TCC

- Low doped calibration gases f.e.: CO-L and CO2-L will be executed in the quality finetron (Ra<0,4µm)
- Extreme sensible low doped calibration gases f.e.: HC-L and NO-L will be executed in the quality ultron (Ra<0,2µm)

2nd stage reducer panels:

- 1 panel placed in the control room at the wall with 30 types of gases at each CVS room for the left engine dyno, the right engine dyno and the CVS room. The engine dynos will be supplied with 20 types and the CVS rooms will be supplied with 30 types. Position according to the control room layout
- 1 panel placed in the control room at the wall with 20 types of gases at each engine dyno 11 - 15. The engine dynos will be supplied with 20 types each. Exact position according to the control room layout.
- 1 panel placed in the chassis dynamometer at the wall with 30 types of gases. Exact position according to the chassis dynamometer layout

Withdrawal panel

- Panel in the raised floor space with 20 gases for each rough analysis of each engine dynamometer with a clamp ring screwing for each gas type. The exact position according to the control room layout
- Panel in the raised floor space with 30 gases for each diluted analysis of each CVS room with a clamp ring screwing for each gas type. The exact position according to the control room layout
- Panel in the raised floor space with 30 gases for diluted analysis of the chassis dynamometer, and 2 x 20 gases for the rough analysis with a clamp ring screwing for each gas type in the chassis dynamometer. The exact position according to the chassis dynamometer layout.

Purging

- The systems will be purged via the exhaust analysis purge system

Monitoring: The availability of each gas type will be monitored via 2 contacts:

- Availability: green LED on a panel in each control room
- Bottles empty: red LED on a panel in each control room

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Following operation and calibration gas types are planned:

line NR.	kind of gas	detail
2	CO 50ppm	3
3	CO 100ppm	3
4	CO 200ppm	3
7	CO 2000ppm	3
11	CO 2%	3
12 b	CO 5%	3
14	compressed air	
15	CO2 1%	3
16	CO2 2%	3
17	CO2 2%	3
19	CO2 20%	3
22	CH4 50ppm	3
23	C3H8 50ppm	3
24	C3H8 100ppm	3
27	C3H8 1000ppm	3
32	Nox 25ppm	3
33	Nox 100ppm	3
37	Nox 2000ppm	3
40	Lambda	3
51	res.1	3
52	res.2	3
53	res.3	3
54	res.4	3
55	res.5	3
42	O2 100%	2
45	O2 10%	2
2 x 46	SL	2
48	N2 Super pure	1
2 x 49	N2 Super pure	1
2 x 50 b	H2He	2
	N2	4

Data
The calculation of the calibration gas supply system is based on the information's of GM PTE about the

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intended Exhaust Analysis benches:

1 rough exhaust analysis each test bench with EGR analyzer

1 CVS - diluted exhaust analysis each CVS room

1 CVS - diluted exhaust analysis chassis dynamometer

2 rough exhaust analysis chassis dynamometer one bench with EGR analyzer

	All numbers of consumption, of Analysers and the simultaneous factors are asumed by SBI. On base of this numbers the pipe dimens are calculated. All numbers have to be checked by the analysis engeneering IN = Litres at 1 bar abs m		Number of Test cells	analysers per test cell	numbers of analysers	consump-tion per analyser lN/h	conump-tion SF = 1 lN/h	Simul-taneous factor	consump-tion total lN/h	consump-tion total m3N/h	Σ m3/h
N_2	N2 Purge gas exepted FID	Engine Dyno dynamisch	10	5	50	60	3000	0,2	600	0,6	
		CVS	5	6	30	60	1800	0,2	360	0,36	
		Engine Dyno transient	5	5	25	60	1500	0,2	300	0,3	
		Chassis Dyno	1	16	16	60	960	0,2	192	0,192	
										1,452	1,452
N_2	N2 Zerogas exepted FID	Engine Dyno dynamisch	10	5	50	60	3000	0,2	600	0,6	
		CVS	5	6	30	60	1800	0,2	360	0,36	
		Engine Dyno transient	5	5	25	60	1500	0,2	300	0,3	
		Chassis Dyno	1	16	16	60	960	0,2	192	0,192	
										1,452	1,452
SA	Synthetic Air Burngas for FID's	Engine Dyno dynamisch	10	5	50	24	1200	1	1200	1,2	
		CVS	5	6	30	24	720	1	720	0,72	
		Engine Dyno transient	5	5	25	24	600	1	600	0,6	
		Chassis Dyno	1	16	16	24	384	1	384	0,384	
										2,904	2,904
SA	Synthetic Air Zerogas for FID's	Engine Dyno dynamisch	10	5	50	210	10500	0,2	2100	2,1	
		CVS	5	6	30	210	6300	0,2	1260	1,26	
		Engine Dyno transient	5	5	25	210	5250	0,2	1050	1,05	
		Chassis Dyno	1	16	16	210	3360	0,2	672	0,672	
										5,082	5,082
FG	HeH2 Fuelgas for FID's	Engine Dyno dynamisch	10	5	50	19,2	960	1	960	0,96	
		CVS	5	6	30	19,2	576	1	576	0,576	
		Engine Dyno transient	5	5	25	19,2	480	1	480	0,48	
		Chassis Dyno	1	16	16	19,2	307,2	1	307	0,3072	
										2,3232	2,3232
O2	O2 Ozonator	Engine Dyno dynamisch	10	5	50	15	750	1	750	0,75	
		CVS	5	6	30	15	450	1	450	0,45	
		Engine Dyno transient	5	5	25	15	375	1	375	0,375	
		Chassis Dyno	1	16	16	15	240	1	240	0,24	
										1,815	1,815
CAL	Calibration gases	Engine Dyno dynamisch	10	1	10	120	1200	0,2	240	0,24	
		CVS	5	2	10	120	1200	0,2	240	0,24	
		Engine Dyno transient	5	1	5	120	600	0,2	120	0,12	
		Chassis Dyno	1	4	4	120	480	0,2	96	0,096	
										0,696	0,696
			bottle / week	size litres	pressure bar	content lN	days/ week	shifts/ day	consump-tion lN/h	consump-tion m³N/h	
N2	N2 60 bar supply	Hydraulic bench 1	1	50	300	15000	3	1	625	0,625	
		hydraulic bench 2	1	50	300	15000	3	1	625	0,625	
		spray characteristic rig	1	50	300	15000	3	1	625	0,625	
										1,875	1,875

Within the gas piping will be dimensioned as follows:

Operation gases:
main supply pipe internal diameter 12 mm
subsidiary pipe internal diameter 10 mm

Calibration gases:

main supply pipe internal diameter 10 mm
subsidiary pipe internal diameter 8 mm

3.3.28 Fuel Supply system (Drawing 670-01)

General remark

The whole planning of the technical construction and installation was made of the basis that there are no explosion risks, caused by the Fuels and Materials in the building. There is no need for electrical classified equipment, because storage, handling and dispensing of Diesel don't cause EX-Zones, that is classified location.

This is also corresponding to the GM Standards, the NFPA (US National Fire Protection Agency) Codes and European ATEX Rules. Diesel Fuel is classified as Class II liquid and area are no more classified as hazardous.

According to the special utilities layouts, the Building Automation Control System (BACS) and the special installed devices (sensor, ventilation, alarm system, monitoring system, relief venting walls and explosion-proof-doors) there are no areas with explosion residual risk.

The fuel system to be installed will supply the 15 test Benches.

The installation of the fuel supply system is divided in several parts:

- Installation over secured place of 3 double-walled controlled buried tanks filling procedure over the shaft
- Installation of the fuel-pump in a second shaft on each tank
- Installation of double-walled, buried pipes from the buried tank
- Depot into the building, incl. installation of connection to the tanks and safety devices. The pipes are sloped towards the tank depot.
- Installation of the fuel pipes as single-walled pipes inside the building.
  Installation of a day-tank room in the building 2nd floor, with one 50 L and 3 x 150 L day-tank systems
  Installation of the distribution pipes from the day-tank to the test benches in the ground floor
  Installation of the test bench fuel consumption measuring system (FCMS)
  Supply of equipment for control and monitoring of the system,
incl. power switch cabinet.

Storage tanks:

A buried tank depot is installed to store the following fuel amounts:

Tank 1: special diesel 40.000 Litre
Tank 2: CSC Test diesel 20.000 Litre
Tank 3: standard diesel 40.000 Litre

All tank modules are provided for storage of fuel sorts.
Filling procedure according to the fuel vapour recycling principle is provided. Tank 2 allows to be filled with special fuels.

In a Barrel-Room a 200 L Barrel with special diesel is installed to fill the 50 L Day-Tank. A pump and safety devices are installed.

The barrel is placed in a monitored spilling tray.

Buried fuel pipes:
The buried tanks and the buried fuel pipes (double-walled) are provided with a leak-age alarm system. One pressure pipe and return pipe each has to be installed per fuel sort.

Pipe routing within the building
The pipes (pressure pipe, return (drain) / vapour recycling pipe) enter the building in first floor. From there the pipes run into a vertical shaft to the day tank room. From there pipes
(atmosphere-pressure pipe and vapour recycling pipe) are running to the test benches. The venting pipes from each day tank will be installed outside of the building.

Description of day tank room
Each day tank is outfitted with a level detector with 4 limits:
1. Minimum
2. Fill pump on
3. Fill pump off
4. Overload alarm (separate system)

The filling pipe is closed by a shut-off-valve outside the day tank room.
The return pipe (function: drain day tank) is closed by and manual and a automatic valve.
The venting pipe of each day-tank is closed with 2 check valves; the inlet air is going through humidity dryer.
The installation height of the day tank must be as high as possible in the room, to al-low the maximum possible
athmospheric-hight-pressure to the fuel running to the test benches. The room is vented by an explosion-proofed ventilation system and surveyed by a gas detection system.

Fuel pre-selection via solenoid valves
The fuel type will be selected at the operation panel of each test cell.
The fuel type selected at the operation panel of the corresponding test cell causes the pre selection of certain components. So the operating pumps and valves corresponds the level control were determined.
When the level in the filling unit drops under the switch level for the refilling signal, the valve will be opened and simultaneously the pump is activated and it supplies the fuel into the day-tank, until the probe signals the required filling level. Each pump can be addressed by different test benches.
The containers are additionally monitored with regard to maximum and minimum alarm.
Leakage Alarm Tank Shaft
The tank shaft (where the main fuel pumps are housed) is provided with a leakage alarm. It is monitored with the zero signals current principle, breaking of a wire as well as activation is transmitted potential-free. This is indicated by a LED at the switch cabinet. When the alarm is activated, the fuel pump is switched current less, but fuel supply to the test benches from the day tanks is not interrupted.

The message has to be acknowledged at the switch cabinet.

Addressing of fuel pumps
The fuel pumps can be addressed (ON/OFF) in two different ways:

1. Dependent on the filling level of the buried tank pump OFF when the minimum level in under run

2. depending on the filling level of the day tank:

Pump ON when the min level is reached
Pump OFF when the max level is reached

Monitoring minimum filling level of day tank
When the minimum filling level in the day tank is under run, it is signalled potential-free to the test bench and indicated at the switch cabinet by LED. When the mini-mum level is exceeded, the contact is automatically released.

3.3.29 Measuring and Control (MAC)

(schematic drawing 800-01; 800-03; 801-01; 801-02; 801-03; 801-04; 801-05; 801-11; 801-12; 801-13; 801-14)

Italian

Sistema di Misura
Lo sistema di Misura eroga, regola e controlla tutti gli impianti che appartengono ai banchi di prova.

Questo sistema e costituito a 3 livelli, il livello di campo, livello di automatizzazione e il livello di management.

In questo progetto ci sono seguenti attrezzamenti:
- 8 x stazioni di Automatizzazione
- 4 x stazioni di operazione
- 2 x Server (ridondante)
- 1 x Stazione di ingegnerizzazione

1 x stazione di operazione con banca di dati per memorizzazione a lunga durata.

English

BACS (Building Automation Control System) supplies, controls and rules all test stand related M.S. systems as well as all general utility systems of stories "ground floor", "mezzanina floor" and "second floor".

BACS will be constructed in 3 levels. The division will be accomplished in field, automation and management level.

Individual signals such as measuring values and positions will be registered in the field level and control signals issued to valves, flaps and motors.
The processing will be accomplished by transmission of values between input/output construction groups and automation station (see automation level) via BUS connection.
A connection of all field units of M.S. disciplines as well as of BACS sensors will be accomplished. Normally, the connection will be accomplished via star-shaped cable connection. Individual connections of field devices will be performed via a BUS connection (e.g. test stand computer via Profibus DP).

The measuring values and signals in the automation level will be processed in a program via individual automation stations and converted to calculated control signals.
The system specific program for control of connected technical systems will be memorized in the automation station. The automation stations are also exchanging data via their own network.
Furthermore, automation stations are communicating in a cyclic and event oriented manner with the superior management level.

The cyclic and event oriented data of automation stations will be processed via own network, memorized and displayed in the management level.
The operator of the building will be able to react on failures and alarms as well as maintenance messages, to change adjustments of rated values and control parameters and to accomplish manual system interventions.
The access to adjustments and data will be accomplished via password protected input.
Several so-called "Operation Stations" at important locations in the building will be provided for visualization.

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The connection of "Operation Station" will be accomplished via a further own or customer specific network independently from the automation level.
The management system has a redundant server for the data administration as well as an operation station for long-term memory of measuring values and events.
The programs of automation stations will be provided and administered with the so-called "Engineering Station" and pictures are generated for the "Operation Station".

4. Time schedule

- Overall time shedule of PT
  See apendix

- Time shedule for the construction period for the technical equipment of the 2.tender
  See apendix

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5. Drawing list
See appendix

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6. General contract conditions
See appendix

7. Additional contract conditions
Politecnico See appendix

7.1 Material testing

On request of the Contracting Agency or his representatives, special quality proofs and test reports shall be submitted free of charge for the material to be used.

All materials have to be approved by the supervision. Samples have to be provided on request free of charge. All materials have to be supplied originally packed.

7.2. Acceptance procedure

The inspection will be provided after completion of the entire service ready for operation as formal

inspection, notional inspection effects are excluded.

The inspection certificate will only be issued, if the following preconditions are met:

a) a written application of the contractor has been submitted
b) a common inspection with the Contracting Agency has been performed
c) the required inspection documents have been submitted

The contractor shall provide responsible employee with knowledge of the English and Italian language for inspection.

If major deficiencies are discovered, the Contracting Agency will decide whether the entire inspection can be performed or if a previous repair of deficiencies has to be performed prior to inspection.

Deficiencies already previously objected and not yet repaired will be explicitly considered as reserved.

A possible start of use and payment of the final invoice will not be considered as confirmation of the accuracy.

Possible partial inspections are only possible with the agreement of the Contracting Agency.

7.3 First cleaning

The term "initial cleaning" shall be considered as such work required for turning over the construction as "work" in a functional condition and completely cleaned as a "whole" by the contractor to the ordering party.

These services are part of the entire service of the contractor and shall be included in the unit prices.
The contractor shall coordinate the time for initial cleaning of his performed services with the Contracting Agency. Independent therefrom the discipline parts shall be protected against soiling and damage and/or kept clean oder be cleaned by third parties, especially floor coverings so that a value reducing damage will not be caused to materials and structural parts.

7.4. Prices

The unit prices of the offer are fixed prices. Wage and material price increases occurring in the period from offer award until final completion will not be reimbursed by the ordering party.

The prices of the specifications apply in case of subsequently ordered services, otherwise the offer shall be proven to be prepared on the calculation basis of the main specifications.

The agreed discount includes all Supplementary Offers and work on hourly basis.

The lump sum price / the unit prices include the costs for:

- The entire worksite mobilization including the required blockings with erection, dismantling and haul off, unless ascertained in discipline "worksite mobilization. An interruption or stoppage of the construction project due to the weather or occurrence of a catastrophe, no separate reimbursement will be granted for this period. The same applies for an extension of the construction period in comparison to the dates fixed. The included costs for worksite mobilization will neither change if the order total will increase due to quantities or additional services and a longer period than originally provided will thereby occur.
- The provision of all devices required for performance of work, unless included in discipline "worksite mobilization". The use of devices shall be selected by the contractor regarding the type and size in such a way that an economic, smooth performance of the project in the course of the required scope of service and the performance period provided will be guaranteed. The Contracting Agency may request the use of certain equipment and special systems or may also prohibit it, if such kind of a measure seems to be necessary in the course of his general work operation.
- The erection, maintaining and dismantling of all required work and protective scaffolds for the own services. The structural proof shall be provided for the stability of all auxiliary constructions as scaffolds, falseworks etc.
  The inspection of the plans is pointed out explicitly for realizing the scope of the required scaffolds.
- The connections and feed lines for temporary water and temporary power from the borrowing area to the place of use. However, no damages may be claimed due to possible interruptions and irregularities in the supply.
- The drainage of the storm- and surface water as well as securing measures against damages including such forces of nature.
- Cleaning of the worksite each working day of roads affected by driving traffic.
- The delivery and proper storage of the material required for performance of the service.
- The contractor himself will be responsible for a proper disposal of the arising waste. The proper disposal proofs shall be submitted by the contractor.
- The proper performance of all work specified in the specifications or which will be required additionally and incidental work not mentioned explicitly.
- The provision of documents of the contractor required for installation and performance of his services.
- The participation in regular coordination meetings shall be included.
- Work interruptions caused by the structural situation, weather influences or obstructions by other companies do not entitle for increased claims.
- Interfaces to other contractors shall be timely realized, dependencies shall be state in due time and forwarded to the supervision for coordination.
- Work interruptions due to these interfaces will not be reimbursed.
- If the listed quantities of a service summarized in a unit price increases or decreases during the construction period due to changes in performance or for other reasons, a change of the unit price agreed during ordering will not be performed in case of deviations up to 15%.
- Moreover, the Contracting Agency reserves the right to exempt individual items or parts of the specifications. This does not entitle the contractor for substitute claims in any way.

7.5 Performance dates

The dates indicated in the specifications are frame dates binding acc. to the contract, which have developed from the current work schedule. From the current aspect, the starting dates are the earliest dates, which however, may be rescheduled in the course of construction and schedule updating. The contractor will be obliged to perform the fine date coordination with the Contracting Agency und fix it in a fine schedule.

This fine schedule will be part of the contract after the approval by the Contracting Agency.
This fine schedule has to be broken down in individual processes in such a way that a comprehensive control

of the construction schedule will always be possible during the construction period with regard to the dates and capacities.

The contractor is obliged as well to meet all intermediate dates agreed during the construction period, which are demanded by the supervision in the course of construction progress.

The schedule shall always be updated acc. tot he construction progress in coordination with and with approval of the Contracting Agency.

Moreover, it is up to the Contracting Agency and the assigned architect to newly fix dates and periods in the course of periods of performance for reasons of the entire process. Those shall then be incorporated into the fine schedule and will become part of the contract.

The contractor is obliged to immediately start his work after submission of the appropriate preliminary services and to complete them within the originally provided period of performance.

The contractor shall timely coordinate the work self-dependently with other third parties involved in construction.

The contractual obligation will also be due if the services of previous contractors are not yet completely completed, however a start of work is possible in the completed sections of these previous contractors.

Due to a rescheduling of dates, periods and performance periods with delays up to 6 months, the contractor may not claim any increased costs and no liquid damages.

Neither unusual long frost and bad weather periods nor work interruptions due to structural situations will be accepted as reason for extension of the construction period. They do not justify a claim for reimbursement of the increased expenses.

If additionally instructed intermediate dates will result in a change of the price basis for the contractor, those have to be reported in writing to the Contracting Agency prior to performance of construction. The claim for reimbursement shall be indicated and confirmed by the Contracting Agency in writing.

The claim for reimbursement shall be indicated and assigned by the Contracting Agency in writing. The contractor shall immediately report each issue concerning him and putting the date at risk to the Contracting Agency in writing.

Contract dates fixed by date require no reminder by the Contracting Agency.

7.6 Cooperation with other companies

The contractor will be obliged for a cooperation with all other external companies regarding the date and work technical issues, which overlap with the services of the contractor or connect to his work.

Preliminary work of other companies required for contractor processing shall be initiated timely and reviewed reliably so that required subsequent work of third parties will not cause any interferences with the date, the price, the storage, personnel planning etc. Altitudes, datum etc. shall be secured. New measurements at the contractor's expenses have to be provided otherwise in case of removal and damage.

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8. special contract conditions (Politecnico)
See appendix

9. General Rules for all kinds of building and technical works

Application of these following regulations for technical and structural disciplines:

- Sound- damping doors and observation windows
- Raised floor
- Absorption paneling
- Cranes
- Wall and ceiling openings, fire protection measures
- Coating work
- Chimney
- Ventilation Systems
- Exhaust extraction
- Electrical supply
- Measuring and Control Systems
- Cooling tower water System
- Chilled and cooling water Systems
- Heating water Supply
- Fuel supply System
- Calibration gas supply
- Compressed air supply
- Sprinkler system
- Fire Detection System
- Air Monitoring System

9.1 Openings

All openings in roofs, ceilings, walls, pits, stair flights etc. belonging to the scope of service of contractor shall permanently be secured and maintained with railings or coverings until end of project. The review of already secured openings and possibly required repair belongs also to the securing. The costs for these measures shall be included in the unit prices.

9.2 Coordination meetings

The supervisor will hold construction conferences in appointed periods in order to determine the state of work and to discuss the measures required for the further progress of work. The contractor shall provide a completely informed and responsible Italian speaking representative. The representative shall also be able to speak English for the coordination conferences with SBI. The invitations will be made formless.

Following Documents are absolutely written in English language:

- Memo (Randum)
- Correspondence
- Workshop drawings,
- technical description for approval

9.3 Joint sealing

No silicone containing material shall be used for any kind of sealing.

9.4 General Technical Contract Conditions for Building works

Materials, components

- The services also include the delivery of the pertinent materials and components including unloading and storage on the worksite.

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- Materials and components, which have to be provided by the Contracting Agency, shall be requested by the contractor from the Contracting Agency in due time.
- Materials and components have to be suitable for the appropriate application and coordinated with each other.
- Materials and components subject to DIN EN-standards have to meet the DIN EN-quality and DIN- EN-regulations.
- Materials and components, for which certain technical specifications are not indicated in the service description, may also be used, if they meet the standards, technical provisions or other regulations of other countries, if the required level of protection will be achieved with regard to safety, health and functionality regularly and permanently.
- If a control, test sign duty or a proof of functionality e.g. by general approval by supervision is generally provided for materials and components, an equality can only be assumed, if the materials and components bear a monitoring and test sign or if the mentioned proof of functionality has been submitted

Provision

- Materials and components, which only have to be maintained by the contractor, i.e. which will not be installed into the buildings, may be used or unused each acc. to choice of the contractor.

Delivery

- Materials and components, which have to be supplied and installed by the contractor, i.e. which will be installed into the building, have to be unused.

Performance

- If traffic, supply and disposal systems are located in the area of the construction site, the provisions and instructions of the authorities in charge shall be observed. If the position of these systems can not be indicated, it shall be explored.

- The areas determined for maintaining of the traffic shall be kept free. The access to the facilities, supply and disposal companies, the Fire Department, the post office and the railway, to surveying points and suchlike may not be obstructed more than to the extend unavoidable due to performance.

- If noxious matter is discovered, e.g. in soil, bodies of water or components, the Contracting Agency shall be notified immediately. In case of imminent danger, the contractor shall immediately take the required safeguards. The further measures shall be jointly determined.

Incidental services
Incidental services are services belonging to the contract without explicitly being mentioned.

Accordingly, incidental services are especially:

- Equipment and clearing for the worksite including devices and suchlike.
- Provision of worksite mobilization including devices and suchlike.
- Measurements for performance and billing of the work including provision of the measuring devices, gauges, staking signs and suchlike, maintaining the gauges and staking sings during performance of construction and provision of the workforce.
- Protective- and safety measures acc. to the accident prevention regulations and official provisions.
- Lighting, heating and cleaning of the recreation and sanitary rooms for the employees of the contractor.
-Delivery of operating materials.

" -Provision of small devices and tools.
- Disposal of waste from the area of the contractor as well as removal of soilings caused by the work of the contractor.
-Disposal of waste from the area of the Contracting Agency up to a quantity of 1m³, if the waste is non-contaminated.

Billing

The service shall be determined by means of drawings, if the performed service meets corresponds to these drawings. If such drawings do not exist, the service shall be measured.

9.5 General Technical Contract Conditions for Construction Services and Steel construction works

General technical specifications for building works; Steel construction works

Materials, components
- The contractor shall submit a certificate of compliance acc. to DIN EN 10204 "Metal products - types of test certificates - to the Contracting Agency. If it has been agreed instead to submit certificates or compliance or test reports indicating the scope and the inspecting authority and that inspection test certificates 3.1.A, 3.1.B or 3.1.C shall be submitted, those shall be prepared acc. to DIN EN 10204. Certificates of compliance, test reports and factory certificates have to be usually issued by the manufacturing plant, in justified cases they may be issued by the processing plant.

- If inspection test certificates are demanded, the contractor shall ensure that the Contracting Agency will be timely informed when the material will be ready for testing, that the person of the Contracting Agency performing the test will have access to the manufacturing and/or processing plant, and that the workforce, machines, devices etc. as well as the completely finished sample pieces will be provided for performance of the test.
- If inspection test certificates are requested, only materials may be used for performance, which are provided with a test symbol by the person of the Contracting Agency performing the test and thus will be released for used.

Performance - Specifications

- The contractor shall supply drawings and calculations of strength - in case of composite components also for the concrete - and reinforced concrete parts, which are in composite contact, in three copies signed by him to the Contracting Agency.
- If the contractor delivers further construction documents for the purpose of stock taking e.g. sketches, tables, drawings which are true to scale and/or suitable for microfilm, the following information shall be provided on them:

o Dimensions
o Materials
o Connections and connecting agents
o Special finishes

- Calculations of strength to be supplied by the contractor have to be signed by him and the author with full name. Welding plans have to be signed accordingly by the contractor and the specialized welding engineer.
- The Contracting Agency shall return the construction documents supplied by the contractor - if they require the approval of the Contracting Agency and have not been objected - in one copy with an approval note 3 weeks after submission the latest. Objections shall be immediately notified to the contractor.
- The responsibility and liability to which the contractor is incumbent upon will not be restricted by the fact that the Contracting Agency approves the construction documents. The Contracting Agency, however, expresses

by it approval that the construction documents meet their requirements.

Manufacturing
-The Contracting Agency shall provide the substructures manufactured for bearing of the steel structure in true alignment and height at the time agreed to the contractor. He shall thereby mark a bench mark, the center lines of the structure and the abutment, pier or column axes. The Contractor shall convince himself about the correct alignment and marking of the substructure prior to installation. He shall immediately report concerns to the Contracting Agency.
-The contractor shall align the steel structures and stuff and grout the bearings, supporting bases and anchorages. Stuffing and grouting may only be started after joint determination of the position of the bearings, supporting bases and anchorages by the contractor and the Contracting Agency. the determination shall be stated in a common record; it will not be considered as inspection. Auxiliary equipment for positioning of the bearings true to the plans, which are disturbing in the final extension, supporting bases and anchorages during installation e.g. wedges, shall be removed by the contractor, if the padding has reached the required strength.

Corrosion protection work
-The steel construction services also include the surface treatment and application of a prime coating.
-The contractor shall prepare the surfaces not in contact with concrete in the finished condition acc. to DIN EN ISO 12944-4 "coating materials - corrosion protection of steel structures by coating systems - Part 4: Types of surfaces and surface pretreatment" and apply a prime coating acc. to DIN EN ISO 12944-5 "coating materials - corrosion protection of steel structures by coating systems - Part 5: coating systems" and DIN EN ISO 12944-7 "coating materials - corrosion protection of steel structures by coating systems - Part 7: coating work".

Secondary services
- Secondary services are services belonging to the contract without being explicitly mentioned in the contract. Accordingly, secondary services are especially
-Determination of the condition of the road, the terrain surface, the drainage ditch etc.
-Protection of substructures against soilings by the work of the contractor until inspection.
-Provision of the required samples, labor, machines and tools required for testing during provision and for inspection after completion of the steel structures.
-Weighing the steel components or delivery of the weighing calculations for billing.
-Provision of the covering and protective devices of opening and maintaining for joint use by other contractors beyond the own period of use. The completion of own use shall be immediately notified to the Contracting Agency.
-Provision of scaffolds for the own use.
-Provision and maintaining of temporary provisions (e.g. auxiliary structures and supporting scaffolds) including delivery of the required structural and graphical documents.
-Leakage tests, if those are required for proving the functionality.

Billing

Billing acc. to weight will be determined acc. to calculation. The weight of form pieces e.g. cast or forging parts, however, will be determined by weighing.

Billing - Weight determination by calculation

For determination of the dimensions applies:
- in case of flat steels up to 180 mm width as well as in case of sectional and bar steels the largest length
- in case of flat steels exceeding 180 mm width and in case of sheet metals the surface of the smallest circumscribed polygon of straight lines and lines bent to the exterior, in case of upturned flat steels, however, the line bent to the interior instead of the tendon

- in case of cut, notched or drawn carriers the full cross section
- cutouts and recessed corners have to be measured over.

The following shall be taken as basis in case of calculation of the weight:

- the weight acc. to DIN-standard in case of standardized profiles,
- the weight of the profile book of the manufacturer in case of other profiles
- the weight of 7.85 kg per m³ surface and mm thickness in case of sheet metals, wide flat steels and strip steels,
- the density of 7.85 kg per m³ in case of fittings of steel and the density of 7.85 kg per m³ in case of case iron (gray cast iron)

Connecting agents, e.g. screws, rivets, welding seams will remain unconsidered.

- Rolling tolerances and cutting loss will remain unconsidered.

Billing - Weight determination by weighing
All components shall be weighed. Only the measured number has to be weighed of the same kind of components.

9.6 General Technical Contract Conditions for Metal construction works

Materials, components
DIN EN standards are listed the following for the most common standardized materials and components.

Steel
- DIN 1623-2 flat steel products of steel - cold rolled strip and sheet metal - Technical terms of delivery - General structural steels
- DIN EN 10025 Hot rolled products of non-alloyed structural steels Technical terms of delivery
- DIN EN 10130 Cold rolled flat products of soft steel for cold forming - Technical terms of delivery (includes amendment A1:1998)
- DIN EN 10223-2 Steel wire and wire products for fences - Part 2: Steel wire mesh with hexagonal meshes for agricultural purposes, insulations and fences
- DIN EN 10223-6 Steel wire and wire products for fences - Part 6: Steel wire mesh with square meshes

Aluminum and aluminum alloys

- DIN 17611 Anodic oxidized products of aluminum and aluminum wrought alloys - Technical terms of delivery

- DIN EN 573-3 Aluminum and aluminum alloys - Chemical composition and form of semi-finished products - Part 3: Chemical composition

- DIN EN 573-4 Aluminum and aluminum alloys - Chemical composition and form of semi-finished products - Part 4: Form of manufacture

- DIN EN 1706 Aluminum and aluminum alloys - cast iron pieces - Chemical composition and mechanical properties

Anti-corrosive steels

- DIN 17455 Welded circular pipes of anti-corrosive steels for general requirements - Technical terms of delivery

- DIN 17457 Welded circular pipes of austenitic anti-corrosive steels for special requirements - Technical terms of delivery

- DIN EN 10028-1 Flat products of pressure tank steels - Part 1: General requirements

- DIN EN 10028-7 Flat products of pressure tank steels - Part 7: Anti-corrosive steels

- DIN EN 10088-2 Anti-corrosive steels - Part 2: Technical terms of delivery for sheet metal and strip for general use

- DIN EN 10088-3 Anti-corrosive steels - Part 3: Technical terms of delivery for semi-finished products, rods, rolled wire and profiles for general use

Synthetic materials
- DIN 16901 Synthetic formed components - tolerances and inspection conditions for length linear dimensions
- DIN 16927 Boards of polyvinylchloride without softener - Technical terms of delivery

Connecting elements
Connecting elements, dowels and suspensions have to consist of corrosion and aging resistant materials.

- DIN 267-2 Mechanical connecting elements - Technical terms of delivery - Performance and accuracy

- DIN EN 20898-2 Mechanical properties of connecting elements - Part 2: Nuts with fixed test forces - standard threads (ISO 898-2:1992)

- DIN EN ISO 898-1 Mechanical properties of connecting elements of carbon steel and alloyed steel - Part 1: Screws (ISO 898-1:1999)

Sealing, separating and coating materials
Sealing, separating and coating materials have to be weathering and aging resistant.

- DIN 18545-1 Sealing of glazings with sealants - requirements to glass rebates
- DIN 18545-2 Sealing of glazings with sealants - Part 2: Sealants, designation, requirements, testing

Aluminum semi-finished products, sheet metals and profiles
- DIN EN 485-2 Aluminum and aluminum alloys - strips, sheet metals and plates - Part 2: Mechanical properties

- DIN EN 754-1 Aluminum and aluminum alloys - drawn rods and pipes - Part 1: Technical terms of delivery

- DIN EN 754-2 Aluminum and aluminum alloys - drawn rods and pipes - Part 2: Mechanical properties

- DIN EN 755-1 Aluminum and aluminum alloys - extruded rods, pipes and profiles - Part 1: Technical terms of delivery

- DIN EN 755-2 Aluminum and aluminum alloys - extruded rods, pipes and profiles - Part 2: Mechanical properties

- DIN EN 12020-1 Aluminum and aluminum alloys - extruded precision profiles of alloys EN AW-6060 and EN AW-6063 - Part 1: Technical terms of delivery

Performance

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The following especially applies for performance:

The contractor shall especially notify concerns regarding the following items during his test in case of:

- missing datum points per floor,
- unsuitable condition of the existing components,
- missing or insufficient fastening possibility,
- missing possibilities for cleaning and maintenance of windows and facade surfaces without danger,
- major dimension deflections than approved.

- Prior to the start of manufacturing, the contractor shall supply drawings and/or descriptions for components. They require the release by the Contracting Agency.

- Design, dimensions, installation, fastening and construction connections of the components as well as the installation sequence have to be shown on the documents.

Structural requirements

Cutting and sawing edges shall be deburred.

The following applies for welding seams:

- DIN EN ISO 9692-3 Welding and associated processes - recommendations for join forms - Part 3: Metal inert gas welding and Wolfram inert gas welding of aluminum and aluminum alloys (ISO 9692-3:2001)

- DIN EN 29692 Arc welding, inert gas welding and gas welding -welding seam preparation for steel (ISO 9692:1992)

- Projecting welding beads of butt seams have to be removed from surfaces remaining exposed if they are structurally unnecessary.
- The surfaces of rebates have to be smooth and may not be provided with obstructing spots, if the beads serve for bearing of fillings, sealings and suchlike.
- The structures for glazings shall be formed in such a way that each pane can be exchanged individually.
- Filling elements, e.g. glass, panels have to be fastened safely and durably. A firm seat shall be ensured until curing during embedding of curing sealants.
- Precipitation and condensation water shall be drained by structural measures.
- Cast work pieces have to be free from form sand residues and be properly deburred.

Connecting elements
- During assembly of different materials, connecting agents of anti-corrosive materials shall be used. In aluminum construction such are also permitted made of aluminum, if they satisfy the structural requirements and correspond to the used materials.
- Soldering connections have to be cleaned from cleaning and flux residues.
- Screwed connections shall be secured against self-consistent loosening
- Glued connections may only be provided at the site in case of suitable conditions e.g., temperature, humidity, free of dust, grease and solvent.

Fastening to the structure
- The type of fastening of components to the structure will be generally left up to the contractor. Fastenings to bearing structures by welding to steel or screws may only be performed with approval of the Contracting Agency. Anti-corrosive materials shall be used for fastening in wet rooms.

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- The anchorages of the components in the structure shall be installed in such a way that the transmission of forces into the structure will be ensured. Frames have to be provided with at least 4 anchorages.
- The anchors of the corners and/or edges may be max. 200 mm apart from frames and profiles and have an interval of max. 800 mm amongst each other.
- The components shall be secured in their position until curing of the connecting agents. Materials damaging the fastenings (anchors) may not be used.
- Connections and fastenings shall be provided in such a way that they will bear the movements from the components and the structure.
- Joints between the structures and components serving as room bordering, e.g. windows, window walls, doors, shall be sealed. For sealing of exterior wall joints, the regulations acc. to the European Guidelines "Sealing of exterior wall
- joints in architecture with joint sealing compounds" shall be applies analogously.

Surface protection
- The metal construction services also include the surface pretreatment and application of a prime coating. European Guidelines Surface pretreatments and prime coating on metal components of steel and aluminum requiring a strength calculation or structural approval shall be provided acc. to the European Guidelines.
- The composition of the used protective coatings shall be notified to the Contracting Agency.
- If surfaces of components require a corrosion protection, however, if they will not be accessible anymore after the application, the contractor shall provide the components with a permanent corrosion protection previously.
- Galvanized sheet metals have to meet DIN EN 10147 "Continuously hot-dip galvanized strip and sheets of structural stee- Technical terms of delivery. The zinc layer may not break or flake off also in case of required bending. Galvanized steel parts shall be are acc.to DIN EN ISO 1461 "Zinc coatings (individual galvanizing) applied on steel by hot dip galvanizing - Requirements and tests (ISO 1461:1999)
- If galvanized parts are welded, the zinc layer in the welding zone shall be removed. The welded area shall be cleaned and well coated with zinc dust coating material. The layer thickness in dry condition has to be at least 1.5 times the galvanizing layer.
- In case of use of galvanized rods, pipes and sheet metals, the unprotected surfaces arisen by machining shall be protected against corrosion. Cutting edges up to 1.5 mm thickness may remain untreated.
- Structures of hollow profiles, which shall be coated on all sides, have to be provided with appropriate inlet and outlet borings.
- The inner surfaces of hollow profiles and pipes will remain untreated during thermal spraying. A pore-filling, opaque, swelling-resistant and well adhesive coating, on which a further coating can be applied, will be applies onto the surface directly after thermal spraying.
- Anodic oxidation on aluminum shall be performed acc. to the European Guidelines "Anodic oxidized products of aluminum and aluminum wrought alloys - Technical terms of delivery ".
- In case coatings with thermal curing on components of aluminum, the minimum layer thickness has to be . In case of coatings with thermal curing on components of zinc and galvanized steel, the minimum layer thickness has to be . In case of strip coated aluminum, the minimum layer thickness has to be .
- The layer thickness of anti-drumming materials has to be at least .

Windows
- The European Guidelines "Windows - joint permeability, driving rain tightness and mechanical stress - Requirements and testing" applies for requirements to windows".
- Window wings shall be fitted in such a way that they will tightly closed and are already well workable before glazing.
- Turn-tilt-wings have to have a malfunction blocking. Wing wings have to have arresting devices in case of a turning of 180°, a prelocking shall be provided in case of 15-opening angles.
- The glass rebate height has to correspond to Table 1. The glass rebate width has to correspond at least to the dimensions of the pane thickness plus
    - o 2 mm x 3 mm in case of straight panes and/or
    - o 20 mm in case of bent panes for providing a proper sealing of the panes.

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The rebate dimensions for the special glazing's shall be provided acc. to the provisions of the manufacturer.

Table 1

Pane length	*Minimum glass rebate height*	
	Single-pane glass	*Insulation glass*
mm	*mm*	*mm*
up to 1000	10	18
more than 1000 up to 2500	12	18
more than 2500 up to 4000	15	20
more than 4000 up to 6000	17	-
more than 6000	20	-

- Glass beads shall be installed on the room side.
- The fastening spots of glass beads fastened spotwise and of glass holders have to be provided with intervals acc. to Table 2 .

Table 2

Type of fastening	Interval of the fastening spots of the corners	Interval between the fastening spots
Glass holders (clips)	50-100	max. 200
Glass beads	50-100	max. 350

- Connection strips may only be used for fastening of the panes if the type of the structure of the metal component ensures that the supporting of the pane will not be put at risk despite the load of the metal components by the pane. In case of large-surface panes, connection strips may not be stressed by the supporting of the pane.
- Exterior sealing of infill elements into the frame or wing shall be performed with sealing profiles acc. to the European Guidelines "Non-cell elastomer sealing profiles in window and facade construction - Technical terms of delivery". The corners have to be vulcanized and glued.
- Exterior window sills shall be upturned in the jamb area or provided with end pieces. Joints shall be formed with labyrinth sealings. The thermal elongation shall be considered.
- Windows and window doors have to be easily opening and closing. The provided further surface treatment shall be considered. The closed wings have to be tightly fitting. The wings may not be rubbing at any point.
- Wearing parts of hardware have to be exchangeable.

Doors
- In case of doors with bottom rebate, the rebate height has to be at least .
- In case of doors without bottom rebate, the dimension between the upper side of the floor and the lower side of the door may not exceed 8 mm.
- In case of exterior doors where precipitation water may occur, the base or the threshold shall be formed in such a way that no water may penetrate to the interior.
- In case of doors with a lowerable floor sealing, the door frame shall be reinforced in the pressure spot area.
- Door handles and knobs on locks with a pin dimension of less than have to be offset.
- Distance rails at door frames shall be removed after installation of the frames.

Panelings, suspended metal ceilings
- Panelings, suspended ceilings and suchlike have to be plane. If required, compensation pieces shall be used, especially in case of suspended ceilings.
- Suspended metal ceilings shall be dimensioned and performed acc. to the European Guidelines "Light

ceiling panelings and suspended ceilings - proof of load bearing capacity of substructures and suspension of metal".
- Panelings in front and suspended ceilings below drive units and operation elements for supply lines have to be removable.
- Paneling elements supported by a clamping device may not fall out of the holder if they are stressed.

Roofings, canopies, stationary sun protection structures
- The fastening points of the individual structure parts shall be padded with sound insulation for reduction of a noise transmission into the structure.
- All bearings and joints shall be provided easily operating in case of sun protection structures with adjustable parts.
- For fixing the intervals of the cantilevers amongst each other, the border profile shall be connected safely with the cantilever. Expansions of the border profile may not put the fixed seat of the lamellas at risk. Expansion joints shall be installed acc. to requirement.
Frames
- Frames of cold-formed sheet metals shall be provided with at least 1.5 mm sheet metal thickness.
- Openings for latches, bolts, closure and safety bolts have to be covered in such a way that no construction material e.g. mortar, may penetrate into the closure slits.
- Masonry anchors shall be placed in such a way that the forces acting from hinges and closures will be transferred onto the structure. The position and form of the anchorages shall be designed analogously acc. to the European Guidelines "Fire protection closures - Installation of fire stop doors in solid walls of masonry or concrete - anchor position, anchor forms, installation".
- Frames with floor-high supporting profiles for light construction walls have to be provided with connection possibilities for these walls and adjustable fastenings to the ceiling and to the floor.
- Corner frames have to be provided with at least one, U-frames with at least two space angle rails for their installation. The spacer rails have to be easily demountable. They may only be removed after curing of the grouting compound. Spacer rails above the floor surface have to be demountable without residues.
Door leaves
- The determinations apply for door leaves not requiring test certificates or approval documents acc. to the regulations of the supervision.
- Door leaves have to be distortion and bending resistant. Door leaves with recesses e.g. for light openings shall be braced in frame type.
- The sheet metal thickness has to be at least 2 mm in case of single-wall make and at least 1.5 mm in case of double-wall make without infill material.
- Double wall door leaves shall be reinforced in the closure and hinge areas in such a way that the acting forces will be transferred safely. They shall be formed in such a way that no splash or precipitation water may penetrate into the intermediate spaces of the door leaves.
- Hardware for door leaves of aluminum, other non-iron metals and anti-corrosive steel has to be corrosion-resistant.

Gates, flaps
- Gates have to be arrest able in the completely opened position. The wings have to be distortion- and bending resistant. Closure rods have to lock the wings and run in special guidings.
- Wings of folding gates and folding sliding gates have to parallel to each other in open condition.
- Sliding wings with upper slide rails have to be readjustable.
- Manually operated smoke flaps have to be easily running. The operation force shall not exceed 300 N.

Folding grilles
- The main rods in extracted and retracted condition have to be vertically at folding grilles.
- The space of the vertical rods may not be more than in extracted condition.
- Folding grilles have to be provided with a lower and upper guiding. In case of lower guiding folding upwards, not projecting parts may remain in the floor area after opening.
- Folding grilles have to be equipped with casters at the bearing guiding rods. At least each 6th rod has to be provided with a caster. Folding grilles up to 2400 mm height shall be equipped with two grille rows, higher

ones with three grille rows.

Platforms, catwalks, coverings, grilles
- Stationary working platforms shall be provided acc. to DIN EN ISO 14122 - 2 "Safety of machines - stationary accesses to mechanical systems - Part 2: working platforms and catwalks (ISO 14122-1: 2001)
- Insertable covering plates and grilles in frames have to be placed flush and distortion-free. Coverings and grilles have to be secured in their position.
- Frames have to be dimensioned acc. to the provided stress at their self-supporting side.
- Coverings, grilles, platforms and catwalks have to be formed skid-resistant and step-resistant in the area of accessible surfaces.

Handles and hinges of tiltable parts placed in accessible areas have to be installed in foldaway type..

Secondary services
Secondary services are services belonging to the services of the contract without being explicitly mentioned.

Accordingly, secondary services are especially:

- Erection and dismantling as well as provision of scaffolds,
- Submittal of plans for anchor holes to be recessed for fastening of the doors, gates and suchlike or marking of the anchor holes for their subsequent provision.
- Provision of individual sample pieces, if they can be used during performance.
- Delivery of connecting elements, e.g. anchors, screws.
- Use and fastening of doors, gates, frames, windows and suchlike including connecting elements.

Billing - General
The determination of the service - regardless whether they are performed acc. to drawing or acc. to quantity measurement - shall be based on the following:
- For windows, doors and suchlike, which are provided with opening dimensions up to the non-plastered, non-insulated and/or non-paneled components limiting them.
- For wall and ceiling panelings
    - o the dimensions of the surfaces to be paneled up to the non-plastered, non-insulated and/or non-paneled components limiting them, in case of surfaces without limiting components
    - o the dimensions of the paneling in case of facades.

- Their dimensions for other metal components.
- The dimensions of the smallest circumscribed rectangle in case of billing of single components acc. to surface dimensions (m²).
- Completely or partially lined jambs of openings, recesses and niches exceeding 2.5 m² single size will be reimbursed separately.
- Back surfaces of niches will be separately billed with their dimension independent from their single size.
- In case of billing acc. to linear dimensions (m), the largest length will be taken as basis also in case of diagonally cut and notched profiles. In case of bent profiles, the exterior angled length will be taken as basis.
- In case of billing acc. to weight (kg), the following principles shall be applied, it shall be assumed the weight acc. to DIN-standards for standardized profiles and the weight of the profile books of the manufacturer for sheet metals and hinges in case of other profiles, of steel 7,85 kg, of stainless steel 7,9 kg, of aluminum 2,7 kg, of copper, brass 9 kg per 1 m2 surface and 1 mm thickness, in case of formed pieces of steel, the density of 7.85 kg/dm³ and in case of cast iron (gray cast iron) the density of 7.25 kg/dm³.
- The weight may be determined by weighing in case of small iron parts up to 15 kg single weight.
- Connecting agents, e.g. screws, rivet, welding seams will remain unconsidered.
- 5% will be added to the weights for galvanizing in case of galvanized steel structures.

It will be deducted:
- In case of billing acc. to square dimensions (m²):

Openings, recesses and niches in walls and ceiling of more than 2.5 m² single size, in floors more than 0.5 m² single size.

- In case of billing acc. to linear dimensions (m):
Interruptions of more than 1 m single length

9.7 General technical contract conditions for construction services glazing work

Materials, components
The DIN EN - standards are listed the following for the most common, standardized materials and components.

Glass products
- DIN EN 572-2 Glass in construction - basic products lime sodium glass - Part 2: Floatglas

- DIN EN 572-3 Glass in construction - basic products of lime sodium glass - Part 3: Polished wire glass

- DIN EN 572-4 Glass in construction - basic products of lime sodium glass - Part 4: Drawn flat glass

- DIN EN 572-5 Glass in construction - basic products of lime sodium glass - Part 5: Ornamental glass

- DIN EN 572-6 Glass in construction - basic products of lime sodium glass - Part 6: Wire ornamental glass

- DIN EN 572-7 Glass in construction - basic products of lime sodium glass - Part 7: Structural profile glass with or without wire insert

- DIN EN 1863-1 Glass in construction - Partially prestressed lime sodium glass - Part 1: Definition and description

- DIN EN 12150-1 Glass in construction - Thermally prestressed lime sodium single-pane safety glass - Part 1: Definition and description

- DIN EN ISO 12543-2 Glass in construction - laminated glass and laminated safety glass - Part 2: Laminated safety glass (ISO 12543-2:1998)

- DIN EN ISO 12543-5 Glass in construction - laminated glass and laminated safety glass - Part 5: Dimensions and edge finish (ISO 12543-5:1998),

- DIN EN ISO 12543-6 Glass in construction - Laminated glass and laminated safety glass - Part 6: Appearance (ISO 12543-6:1998)

- Moreover, the following requirements apply for glass products:

- The surface of float glass has to be plane, clear, transparent, clearly reflecting and distortion-free.
- Single, non-disturbing small bubbles and unobtrusive scratches are permitted.

- Wire mirror glass has to be ground plane on both sides, polished and be transparent. Unobtrusive scratches, small bubbles and deviations in the wire net insert may only be existing to the commercial extend.

- In case of glass with wire net insert, the insert has to support the fragments in case of a breaking of the glass.

- In case of laminated safety glass, the individual layers have to be connected durably enough that no glass fragments will loose in case of breaking.

Light permeable synthetic panels

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Light permeable synthetic panels have to be durably light permeable and impact-resistant.

Performance

- Exterior glazings have to be rain tight and be able to bear wind loads acc. to the European Guidelines "Load assumptions for structures - live load, wind loads of constructions non-susceptible to vibrations."
- The glazing units have to be secured until installation of the glass beads on all sides by strip pieces with elastic intermediate layers on all sides in case of frame structures where the glass beads can not be directly applied after installation of the glazing units.

Edge finish
The glass edge finish has to be performed acc. to the European Guidelines "Flat glass in construction - Glass edges, - terms, edge forms and performance".

During his test, the contractor shall especially announce concerns for glazings not meeting the legal regulations or regulations of the supervision, insufficient strength of frames, posts, bolts, rungs and hardware, especially regarding the ratio of the weight of the panes and under wedging points, insufficient fastening of frames,
unevennesses of the glass seating, non-removable glass beads, connecting strips and holders not suitable for a safe fastening of the panes, frame and glass beads on which the required preparation for fastening has not been performed or the fastening agents are missing frames to which the glass beads can only be installed subsequently and the required holding elements for pane securing are missing, insufficient thickness of the instructed glass,
insufficient formation, dimensioning and treatment of the glass rebates and glass beads, glazings with bent panes, if the glass rebate width is not at least 20 mm larger than the glass thickness, glazing systems with free glass rebate space, if openings to vapor pressure compensation are missing or if those are insufficiently dimensioned.

Wedging
- Glazings have to be wedges in such a way that the glass edge will not be overstressed. The glass edges may not be in contact with the frame at any point. Wedges of aging-resistant and durably pressure stable materials shall be used in case of glazings. The panes have to be wedges acc. to the opening type. The wedges have to be wider than the thickness of the glazing unit.
- In case of systems with vapor pressure compensation, this may not be obstructed by the wedging. Wedging bridges shall be used, if necessary.
- In case of sealant-free glass rebate space, the wedges shall be secured against moving and slipping.

Sealing of glazing systems

- The European Guidelines "Sealing of glazings with sealants" apply for glazing systems with sealants
- Openings for vapor pressure compensation have to be provided at glazings with sealing profiles. The profile joints shall be provided tightly at sealing profiles

Glass structures of non-prestressed glass
Panes joining plane or in an angle and free-standing glass edges have to be ground to the dimensions rectangularly to the pane surface and/or the miter angle acc. to the European Guidelines. The glass edges have to be provided with ground chamfers, which will change the thickness only in a minor scope. In case of free-standing glass edges, the exposed glass edges and chamfers have to be ground. The joints between the joint surfaces have to be dimensioned in a way that dimension changes of the components to be connected can be borne, except at connections with UV-hardening adhesives. They shall be filled completely and regularly with glass connecting agents and smoothed.

Glass structures of prestressed glass

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Fastening elements and hardware party may not be in direct contact with glass and metal

Structural profile glass
Structural profile glass shall be installed into the frame structure in such a way that forces from the structure will not act onto the glazing. For avoiding damage to the glazing and the structure, the drainage of arising condensation water shall be ensured.

Glazings with lead, brass and light metal profiles
In case of synthetic glazings with lead, brass and light metal profiles, the intersection points of the metal enclosures on both sides have to be connected by tin-plating in case lead, by soldering in case of brass, by intermediate pieces in case of light metal. The panes shall be sealed in the metal enclosures. The lead enclosures shall be pressed to the panes after sealing. The panes composed in sections shall be stably sealed. Bracings shall be installed in case of stress by wind loads.

Synthetic glazings in the pane intermediate space of a multi-pane insulation glazing may not be provided with mastic.

Light permeable synthetic panels
Light permeable synthetic panels shall be installed and fastened in such a way that their temperature-specific dimension changes will be borne in the frame structure.

Secondary services
Secondary services are services belonging to the services of the contract without being explicitly mentioned. Accordingly, secondary services are:

- In case of repair glazing, glazing of panes or glass residues as well as cleaning of the glass rebate.
- Erection and dismantling as well as provision of scaffolds.
- Delivery of glass samples up to 0,05 m² single size
- Delivery and installation of steel wire inserts and wind irons in case of lead glazings as well as reinforcing inserts in case of light metal and brass glazings, which correspond to the appropriate metal.
- Unhinging and hinging of window and door wings as well as connecting of composite wings.
- Removal of adhesive strips without residues, labeling, spacer disks or suchlike as well as residues of sealants or glass connecting agents.

Billing
The following applies in case of billing acc. to square dimensions (m²):

During determination of the performed service, the panes including glass rebate height will be measured and the dimensions will be rounded to centimeters divisible by 3.
Panes of less than 0.25 m² will be billed with 0.25 m². In case of multi-pane insulation glass, edge length of at least will be taken as basis. Minimum surfaces of 0.5 m² will be taken as basis in case of prestressed glass and laminated safety glass.

In case of glazings with structural profile glass and light-permeable synthetic panels, the rungs and the mobile wings will be measured over.

In case of lead, brass and light metal glazings, the metal enclosures will be measured over. In case of rectangular panes, the dimensions of the smallest circumscribed rectangle will be billed.

In case of billing acc. to number (pieces), the following applies:
- The deviations will not be considered during billing, if the size of the glazed panes deviates less than 20 mm from each of these dimensions for width and height indicated in the service description.

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9.8 General Technical Contract Conditions for Construction Services and Room ventilation systems

Materials, components
If required by the application, the materials and components have to be corrosion-protected.
Collecting device for water drainage shall be supplied for components where condensation and overflow water has to be expected.
Mechanical components and heat transmitters have to be provided with type and power signs.
Signage to components, e.g. signs, scales, notes have to be provided in Italian language acc. to the "Law on units in metrology".
DIN-standards and other technical rules are listed the following for the most common standardized materials and components.

Ventilators
DIN 24163-1 Ventilators; power measurement, standard characteristic lines VDMA 24169-1 Room ventilation systems, structural explosion protection measures on ventilators for transporting combustible gases, vapors or fogs included in the atmosphere. If ventilators are driven by three phase current motors of construction B3, the motors have to meet DIN EN 50347 "threephase current synchronous motors for general use with standardized dimensions and power - construction sizes 56 to 315 and flange sizes 65 to 740".

Air filters
DIN EN 779 Particle air filters for the general room ventilation systems - determination of the filter capacity series DIN EN 1822 [1 2 3 4 5] suspended matter filters (HEPA and ULPA)
Air filters have to be equipped with pressure difference measuring equipment.

Central room ventilation units
- The drive motors have to be easily mountable and demountable. Sufficient space for retensing of the V-belts has to be provided. The electric connection has to be easily accessible.
- The cases of the central room ventilation units have to sufficiently stiff acc. to the operating conditions; the walls may not flutter during operation.
- The case of the central room ventilation units have to be sufficiently air tight. Appropriate cable screwed connections have to be provided for cable entry.
- Operating doors as well as inspection and maintenance openings have to be provided in such a size and number that all important components - especially mobile ones - can be easily and safely services. Air heaters and air coolers have to be demountable. In case of bearing damage, a repair has to be possible.

Air pipes with accessory
- Shut-off devices against fire and smoke in air pipes are subject to the duty of labeling with test signs.

Air pipes of metal materials
- DIN EN 1505 Ventilation of buildings - air pipes and fittings of sheet metal with rectangular cross section - dimensions

- DIN EN 1506 Ventilation of buildings - air pipes and fittings of sheet metal with round cross section - dimensions

- DIN EN 12237 Ventilation of buildings - air pipes - Strength and tightness of air pipes with round cross section of sheet metal

- DIN EN 13180 Ventilation of buildings - air pipes - Dimensions and mechanical requirements for flexible air pipes

For air pipes of aluminum, materials acc. to DIN EN 573-1 "aluminum and aluminum alloys - chemical composition and form of semi-finished products" shall be used and for air pipes of anti-corrosive steels,

materials acc. to DIN EN 10088-3 "anti-corrosive steels - Part 3: Technical terms of delivery for semi-finished products, rods, rolled wire, drawn wire, profiles and blank steel products of corrosion resistant steels for general application and the standards of the series DIN EN 10088 [1 2 3 4 5] "non-rusting steels - technical terms of delivery" shall be used.

Measuring and control systems, building automation
Series DIN EN 60051 [1 2 3 4 5 6 7 8 9] Directly acting indicating electrical measuring devices and their accessory - measuring devices with scale display.

Electrical measuring devices have to correspond to the accuracy class E-1.5 acc. to DIN EN 60051-1 "Directly acting indicating electrical measuring devices and their accessory - measuring devices with scale indication - Part 1: Definitions and general requirements for all parts of this standards.

DIN EN 60529 (VDE 0470-1) protective types due to cases (IP-Code)

Chillers
- DIN EN 1736 Chillers and heat pumps - flexible pipeline parts, vibration absorbers and compensators - requirements, construction and installation

- DIN EN 14705 Heat exchangers - procedure for measurement and evaluation of thermal-technical characteristic power data of wet cooling towers.

Performance
- The components of room ventilation systems shall be coordinated with each other in such a way that the required performance will be achieved , the operational safety will be provided and an economical and efficient operation will be possible and corrosion procedures will be mostly restricted.
The air and structure borne sound generated and transmitted by the room ventilation systems may not exceed the approved or agreed values.

- Prior to the start of installation work, the contractor shall furnish all information to the Contracting Agency required for an unobstructed installation and proper operation of the system. The contractor has to provide the installation and workshop design required for performance acc. to the design documents and calculations of the Contracting Agency and - if required - shall coordinate them with the Contracting Agency.
- Especially the following belongs to that:
o Installation plans
o Workshop drawings
o Circuit diagrams
o Foundation plans

- The contractor shall furnish the information about the
o quantities of the built-in parts,
o current consumption and - if required - the start-up current of the electrical components and
o other requirements for installation
in due time to the Contracting Agency.

The contractor shall especially consider the following during review of the plan documents and calculations provided by the Contracting Agency amongst other regarding the condition and function of the system

- the heat demand;
- the cooling load;
- the air flow rate;
- the air pipe calculation;

- the air temperatures;
- the air humidities;
- the measuring and control equipment;
- the openings for technical and hygienic work in the air pipe network;
- the sound protection;
- the fire protection;

- Especially, the contractor shall claim concerns during his review in case of :

o discrepancies in the design documents and calculations supplied by the Contracting Agency
o recognizable inaccurate performance, completion not in due time or missing of foundations, slits and breakthroughs,
o insufficient measures for sound, thermal and fire protection,
o unsuitable construction or unsuitable cross section of the chimneys, supply air and exhaust air shafts
o insufficient connection power for energy sources,
o insufficient space for the components,
o missing benchmarks,
o unsuitable climate conditions
o changes of conditions notified to him, which were the basis of the design.

- In case of unsuitable climate conditions, e.g. in case of sealing tape adhesive work temperatures of less than 5℃, special measures shall be taken in coordi nation with the Contracting Agency.
- In case of changes which may interfere with existing electrical protective measures on existing systems, e.g. installation of insulation pieces, the contractor shall inform the Contracting Agency that it has to be examined by an approved electrician whether the provided work will interfere with the protective measures.
- Chiseling, milling and drilling work at the structure may only be performed with the agreement of the Contracting Agency.
- Materials which may act disturbing onto systems parts, e.g. gypsum or chloride containing quick binding agents in direct connection with metal parts may not be used.

Requirements
The penetration of water drips into the system parts shall be prevented by suitable measures as far as possible. The following system section shall be drained, if required. Condensation water shall be drained.

Ventilators
For existing ventilator parts of fragmenting materials, a sufficient fragment protection installed on the unit shall be provided.

Air heater, air cooler, hot air generator
- Air heater and air coolers shall be installed in such a way that an easy and complete drainage and ventilation will be possible.

- Air coolers shall be installed in such a way that a proper condensation water drainage will be possible.

- Electrical air heaters shall be equipped with flow and overtemperature protection devices.

Air filters
Air filters shall be installed in such a way that the quality classes acc. to DIN EN 1822-1 and DIN EN 779 will also be met in installed condition.

Air humidification equipment
- The required shut-off and control equipment shall be provided. They have to be easy to clean.

- Air humidification equipment with water connection shall be installed in such a way that they might be

connected to water supply networks and - if required - also to sewage networks observing DIN EN 1717 "Protection of potable water against contamination in potable water installations and general requirements to safety equipment for prevention of potable water contamination by back flowing Technical rules of DVGW", Standards of series DIN EN 12056 [1 2 3 4 5 6] "Gravity drainage systems inside buildings " and DIN 1986-100 "Drainage systems for buildings and sites - Part 100: Additional regulations for DIN EN 752 and DIN EN 12056 [1 2 3 4 5 6]".

Central room ventilation systems
- In case of interior belt drive, the repair switch has to be arranged acc. to DIN EN 60947-3 (VDE 0660-107) and the standards of the series DIN EN 60204 [1 2 3 4 5 6] (series VDE 0113 [1 2]) .
- Connection lines shall be installed in such a way that no obstructions will be created at the operating doors and openings for technical and hygienic work on the central unit.

Air pipes with accessory
- All connections of air pipes have to be air-tight and stable acc. to the operating conditions.

- If required, the air pipes have to be provided with lockable measuring openings.

- It has to be possible to dismantle air outlets without damaging the structure.

- The position of built-in parts in air pipes, which have to be accessible for inspection and

- maintenance work, have to be realizable or marked by signs, if required.

Measuring and control equipment, building automation

- Actuating elements of the control process, which will be installed into the system and do not belong to the contractual service, shall be dimensioned and supplied by the contractor. The dimensioning of the actuating elements shall be coordinated with the person responsible for the concerned system.

- Transducers shall be installed at suitable points in such a way that the measured value will be recorded correctly.

- Indicating devices have to be well legible, devices to be operated well accessible and operable.

- During testing and initial operation of the electrical cabling performed by him as well as the control and regulating system provided by him, the contractor shall provide a skilled employee familiar with systems of this type.
If the electrical cabling or the control and regulating technology does not belong to the contractual services, provision of a skilled employee during testing or initial operation is a special service.

Insulation and fire protection
Parts of the room ventilation system, which shall be provided with a coating, shall be installed in such a way that this service can be performed properly.

Indication, permit, approval and testing
The graphical and other documents required for officially instructed announcements or applications as well as certificates shall be provided by the contractor to the Contracting Agency in the number acc. to the duty of indication, permission or approval.
This does not apply, if the test provisions for the system parts provide a durable marking instead of a certificate.

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Adjustment of the system
The contractor shall adjust the system parts in such a way that the planned functions and capacities will be achieved and the legal regulations will be met.
The compensation of the air flow rates shall be provided acc. to the mathematically determined adjustment values. Measured values shall be documented.

The operation and maintenance staff or the system shall be introduced once by the contractor.

Inspection test
An inspection test acc. to DIN EN 12599 - "Ventilation of buildings - test and measuring procedures for turn-over of the installed room ventilation systems" shall be performed. Additional function measurements require a special agreement.

VDI 6031 "Inspection test on room ventilation systems - function inspection test of room cooling surfaces" applies for inspection of room cooling surfaces.

Documents to be enclosed

The contractor shall prepare the following documents and submit them to the Contracting Agency during inspection the latest:
- System diagram
- electrical one-line diagrams and wiring plans acc. to DIN EN 61082-1 and DIN EN 61082-3 "Documents of electrical engineering",
- summary of the most important technical data,
- copies of the instructed test and manufacturer certificates,
- all operating and maintenance instructions required for a safe and efficient operation.

Secondary services
Secondary services are services belonging to the service acc. to the contract without being explicitly mentioned.
Accordingly, secondary services are especially:

- Review of the documents of the Contracting Agency and services.
- Erection and dismantling as well as provision of the scaffolds,
- Delivery and installation of type and performance signs as well as possibly delivery of an operation manual.
- Installation of connecting and fastening elements as well as pertinent components e.g. flanges, profile connectors, screws, plug connectors, without special requirements, sealings, bracings for air pipes.
- Provision of measuring openings without special requirements up to 35 mm diameter.
- Protection of structural and system parts against soilings and damage during the work on room ventilation systems by loose covering, suspension and wrapping.
- Delivery of the operating materials and utilities required for the test operation.
- Measures for fire, sound, thermal, moisture and irradiation protection Provision of air tight connections to adjoining components.

Billing

- The determination of the service - regardless whether they are performed acc. to drawing or quantity measurement - shall be based on the dimensions of the system parts. Part lists may be inspected.

- In case of billing acc. to square dimensions, the air pipes and air pipe fittings will be calculated acc. to exterior surface determined by the largest circumference and the largest length without consideration of the thermal insulation. Cutouts for air outlets and sockets will not be deducted.

- In case of billing acc. to linear dimensions, the air pipes including elbows, formed parts and connecting pieces will be measured in the center axis. Elbows up to the intersection of the center axes will be thereby measured. Elbows and other formed parts will be additionally calculated.

- Cover of openings will be calculated additionally.

- In case of billing acc. to weight, it shall be calculated acc. to the following principles:

- It shall be estimated as follows: -8 kg/m² per 1 mm thickness in case of sheet steels and strip steels,
- the weight acc. to the information in the DIN-standards with surcharge of 2% for rolling tolerances in case of standardized profiles,
- the weight acc. to the information in the profile books of the manufacturer in case of other profiles.
- In case of galvanized components or galvanized structures, 5% will be added for galvanizing to the weights determined acc. to the above mentioned principles.

9.9 General Technical Contract Conditions for Construction Services Systems for Heating and chilled water

Materials, components

If required by the application, the materials and components have to be corrosion-protected.
Mechanical components and heat transmitter have to be provided with type and performance signs. Signage to components, e.g. signs, scales. Especially the following Technical Rules apply for the use of materials and components.

Pipes, formed and connecting pieces
Pipes of steel
- DIN EN 10220 Seamless and welded steel pipes - General tables for dimensions and linear dimensions

- DIN EN 10242 Thread fittings of malleable cast iron

- DIN EN 10255 Pipes of non-alloyed steel with suitability for welding and thread cutting - Technical terms of delivery

- DIN EN 10305-2 Precision steel pipes - Technical terms of delivery - Part 2: Welded cold-drawn pipes

- DIN EN 10305-3 Precision steel pipes - Technical terms of delivery - Part 3: Welded pipes and pipes rolled to dimensions

Fittings and pumps
Fittings for heating systems / chiller systems

- DIN 3352-1 Gate valves, general information

- DIN 3352-5 Gate vales of steel, with interior or exterior spindle thread, isomorphic construction series

- DIN 3844 Heating fittings, straight way valves PN 16 of copper alloy with sleeve connection, dimensions, materials

- DIN EN 1171 Industrial fittings - Gate valves of cast iron

- DIN EN 12288 Industrial fittings - Gate valves of copper alloys

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Measuring and control equipment, Building automation
- DIN EN 215 Thermostatic radiator valves - Requirements and testing

- DIN EN 14597 Temperature control equipment and temperature limiter for heat generating systems
- Series DIN EN 60051 [1 2 3 4 5 6 7 8 9] Directly acting, indicating electrical measuring devices and their accessory - measuring devices with scale display -

- DIN EN 60529 Protective types due to cases (IP-Code)

Performance
- The components of the heating system and water heating system shall be coordinated with each other in such a manner that the required capacity will be provided, the operational safety will be given and an economical and efficient operation will be possible and corrosion processes will be mostly restricted.
- This especially applies for the heat generator, heating equipment, exhaust gas systems, provided fuels or energy types and the properties of the heat carrier. Influences by temperature, pressure, exhaust gas and suchlike shall be considered.

- Circulating pumps, fittings and pipelines shall be coordinated by calculations to each other in such a way that also a sufficient water quantity distribution will be ensured in case of the alternating operating conditions to be expected and the approved sound pressure level will not be exceeded. If e.g. an exorbitant differential pressure has to be expected during heavy-duty operation, suitable countermeasures shall be taken.

- In case of control valves in two-pipe heatings, it is a precondition for hydraulic compensation that the valves have an appropriately high resistance in the ratio to the maximally possible differential pressure at the circulating pump and at the differential pressure limiting equipment upstream to the system section.

- Prior to the start of installation work, the contractor shall provide all information to the Contracting Agency required for an unobstructed installation and proper operation of the system. Acc. to the design documents and calculations of the Contracting Agency, the contractor shall prepare the installation and workshop drawings required for performance and, if required, coordinate them with the Contracting Agency.
- Especially the following belongs to that:
  - o Installation drawings
  - o Workshop drawings
  - o Circuit diagrams
  - o Foundation plans

The contractor shall provide information to the Contracting Agency about the following in due time:

- Quantity of the built-in parts,
- Power consumption and - if required - the start-up current of the electrical components and
- other requirements for installation.

- During review of the design documents and calculations supplied by the Contracting Agency, the contractor shall especially the following concerning the condition and function of the system:

  - o the heat capacity of the heat generator and heating surfaces,

  - o the cross sections and design of the exhaust gas lines,

  - o the safety equipment,

  - o the pipeline cross sections, pump dimensioning and network hydraulics,

o the measuring and control equipment,

o the sound protection,

o the fire protection

- The contractor shall notify concerns determined during his review especially regarding the following items in case of:

o discrepancies in the design documents and calculations supplied by the Contracting Agency
o realizable insufficient performance, completion not in due time or missing of foundations, slits and breakthroughs,
o insufficient measures for sound, thermal and fire protection,
o insufficient connection capacity for energy carriers
o insufficient space for the components
o insufficient preconditions for bearing of the reaction forces
o missing reference points,
o unsuitable climate conditions changes of preconditions discovered by him on which the design was based

- In case of changes, which might impair the existing electrical protective measures to existing systems, e.g. installation of insulation pieces, the contractor shall inform the Contracting Agency that it has to be examined by an approved electrician whether the provided work will impair the protective measures.

- Chiseling, milling and drilling work to the structure may only be performed with agreement of the Contracting Agency.

- Materials which might act destructive to the system parts e.g gypsum or chloride-containing quick binding agents in direct connection with metal parts may not be used.

- Reaction forces from expansion compensators or vibration absorbers shall be borne by pipeline fixed points; an axial guiding of the pipeline shall be ensured specific to the construction type.

- If occurring reaction forces have to be transferred into the structure, the forces shall be determined by the contractor and notified to the Contracting Agency prior to performance of the service.

Requirements-Heat generator / cold generator
The capacity of heat generators, e.g. of boilers, heat transmitters, heat pumps, which are not subject to the regulations of the Energy Saving Ordinance (EnEV), shall be adjusted to the calculated heating load and the provided operating conditions. The coincidence factors belong to that as well.

Requirements-Water heater
DIN EN 12828 Heating systems in buildings - design of hot water heating systems

Requirements-Pipelines
The pipes shall be installed in such a way that they may expand without causing damage. Pipes running parallelly and above each other and pipes crossing each other may not touch each other also in case of expansions. Moreover, pipelines may be installed in such a way that operating doors, control flaps and suchlike will be freely accessible and operable.
Sealings shall be adjusted to the provided flow liquid.
Detachable connections of which the tightness is not permanently ensured have to be accessible.
In case of line passages through ceilings and walls, the concerns regarding sound, thermal and fire protection

as well as air tightness shall be considered.

Requirements-Fittings and pumps
Fittings with the same functions shall be performed in the same type. Possibilities for limitation of the flow quantity have to be provided for hydraulic compensation at hot water heatings at any room heating surface. For avoiding cavitation damage and suction of air, circulating pumps shall be installed in heating systems in such a way that a non-approved negative pressure may not be provided at any point in the heating system.

Requirements-Measuring and control equipment, Building automation
- Actuating elements of control process of heating systems installed in systems not belonging to the contractual service shall be dimensioned and supplied by the contractor. The dimensioning of the actuating elements of the control process shall be coordinated by the contractor for the concerned system.

- Transducers shall be installed at suitable points in such a way that the measured value will be recorded correctly.

- Indicating devices have to be well legible, device to be operated easily accessible and operable.

- During testing and initial operation of the electrical cabling provided by him as well as the control and regulating systems provided by him, the contractor shall provide a skilled employee familiar with systems of this type.

Requirements-Thermal insulation
- Parts of heating and water heating systems and cold systems, which shall be provided with a thermal insulation, shall be installed in such a way that it may be installed properly.

Requirements-Announcement, permission, approval and review
The graphical and other documents as well as certificates required for the officially instructed announcements and applications shall be provided by the contractor to the Contracting Agency in the instructed number acc. to the announcement, permission or approval duty. This does not apply, if the test provisions for the system parts provide for a durable marking instead of a certificate.

Pressure test
- After installation and prior to closing of masonry slits and wall and ceiling breakthroughs and - if required - prior to application of the screed or another covering, the contractor shall perform a pressure test on the system.
- The technical systems shall be tested with a pressure corresponding to the activation pressure of the safety valve.
- Protocols shall be prepared about the pressure test. They have to include the following information: -- Date of the test,
- System data as place of erection, maximally allowed operating pressure referring to the lowest point of the system,
- Test pressure referring to the activation pressure of the safety valve
- Duration of the stress of the test pressure, Confirmation that the system is tight and that no permanent form deformation has occurred on any component.

Adjustment of the system
- The contractor shall adjust the system parts in such a way that the planned functions and services will be provided and the legal regulations will be met. The hydraulic compensation shall be provided with mathematically determined adjustment values in such a way that - in case of operation acc. to the regulations - i.e. e.g. also after room temperature lowering or operating breaks of the heating system - all heat consumers will be supplied with heating water acc. to their heat demand and/or for the cold and chilled water consumers.

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- The adjustment shall be provided for inspection. The final adjustment of the control-specific values shall be provided at the end of the first heating period after completion of the building.
- The operation and maintenance staff for the system shall be introduced once by the contractor.

Inspection test
- An inspection test and a function measurement shall be performed.

Examination on completeness
The completeness test consists of the following individual examinations:
- Comparison of the delivery with the service description with regard to the scope as well as with regard to the materials and - if required - the properties and spare parts;
- Examination on observance of the technical and official provisions;
- Examination whether all documents required for operation of the system have been provided.

Function test
The function test of the complete system shall be performed in the course of trial operation.
It includes:
- the safety equipment,
- the cold water generator
- the control and switch equipment.
-Dirt trap and filter shall be cleaned after the trial operation.

Documents to be enclosed
The contractor shall prepare the following documents and submit them to the Contracting Agency during inspection the latest:
- system diagram
- electrical one-line diagrams and connection diagrams acc. to DIN EN 61082-1 and DIN EN 61082-3 "Documents of electrical engineering "
- Summary of the most important technical data;
- Copies of the instructed test and manufacturer certificates;
- Maintenance and operation manuals acc. to DIN EN 12170 "Heating systems in buildings - Operation, maintenance and handling manual - heating systems requiring qualified operating personnel " and DIN EN 12171 "Heating systems in Buildings - Operation, maintenance and handling manual - heating systems requiring not qualified operating personnel";
- Protocols concerning the pressure test;
- Protocol concerning the introduction of the maintenance and operating personnel"
- Protocol concerning the exhaust fume measurement.

Secondary services
Secondary services are services belonging to the contract without being explicitly mentioned.

Accordingly, secondary services are especially:

- Marking of slits and breakthroughs, also if those shall be provided by another contractor.

- Review of the documents of the Contracting Agency

- Protection of components and system parts against soiling and damage during work on mechanical systems by loose covering, suspension or wrapping.

- Installation of rosettes on wall and ceiling passages.

- Testing of the electrical cabling and the control and regulating system as well as provision of a skilled

employee during initial operation of the control and regulating system

- Delivery of the operating means and liquids required for the pressure test, initial operation and trail operation.

- Documentation of the hydraulic compensation by means of measuring devices and the comparison with the mathematically determined adjustments

- Measures for fire, sound, thermal, moisture and irradiation protection.

Billing
- The determination of the capacity - regardless whether it will be performed acc. to the drawings or acc. to quantity measurement - shall be based on the dimensions of the system parts. Part lists may be inspected.
- In case of billing acc. to linear dimensions, the pipelines including their elbows as well as formed, fitting and connecting pieces will be measured in the center axis. Pipe elbows up to the intersecting point of the center axis will be thereby measured. Fittings and formed pieces will be additionally calculated.
- In case of billing acc. weight, it shall be calculated acc. to the following principles:

It shall be estimated:
- 8 kg/m² per 1 mm thickness in case of sheet steel and strip steel, in case of standardized profiles the weight acc. to the information in the DIN-standards with a surcharge of 2% for rolling tolerances, in case of other profiles the weight acc. to the information in the profile books of the manufacturer.

- In case of galvanized components or galvanized structures, 5% for galvanizing will be added to the weights determined acc. to the above mentioned principles.

9.10 General Technical Contract Conditions for Construction Services Gas, water and sewage plumbing works inside of buildings

Materials, components
-If required by the application, materials and components have to be corrosion protected. Signages to components, e.g. signs, scales, notes have to be provided in German language and acc. to the "Law on units in metrology".

-Especially, the following Technical Rules apply for the use of materials and components:

-DIN EN 12056- Gravity drainage systems inside buildings - Part 1: General principles and performance requirements.

Measuring and control equipment, Building automation

-Series DIN EN 60051 [1 2 3 4 5 6 7 8 9] Directly acting indicating electrical measuring devices and their accessory - measuring devices with scale display.

-Electrical measuring devices have to meet the accuracy class E-1.5 acc. to DIN EN 60051-1 "Directly acting indicating electrical measuring devices and their accessory - Measuring devices with scale display - Part 1: Definition and general requirements for all parts of this standard".

-DIN EN 60529 (VDE 0470-1) Protective types due to cases (IP-Code)

Performance

-The components of gas, water and drainage systems shall be coordinated with each other in such a way that the required service will be provided, the operational safety will be given and an economical and efficient

operation will be possible as well as hygienic requirements and corrosion processes will be mostly restricted.

-Prior to the start of installation work, the contractor shall indicate all information required for an unobstructed installation and proper operation of the system. Acc. to the design documents and calculations of the Contracting Agency, the contractor shall provide the installation and workshop drawings required for performance and - if required - coordinate them with the Contracting Agency.

- Especially the following belongs to that:

o Installation plans
o Workshop drawings,
o Circuit diagrams
o Foundation plans

- The contractor shall provide information to the Contracting Agency in due time regarding the
o weight of the built-in parts,
o power consumption and - if required - the start-up current of the electrical components and
o other requirements for installation.

- During review of the design documents and calculations supplied by the Contracting Agency, the contractor shall especially consider the following regarding the condition and function of the system amongst other:
o Safety equipment,
o Pipeline cross sections, pump dimensioning and network hydraulics,
o Measuring, control and regulating equipment,
o Sound protection
o Fire protection
o Thermal protection

- During his review, the contractor shall claim concerns especially in case of discrepancies in the design documents and calculations supplied by the Contracting Agency and changes of preconditions notified to him on which the design was based.
- The contractor shall initiate the approvals and inspections required for performance.
- The technical connection conditions of the mains provider shall be observed.
- Pipelines with non-longitudinally force-locking connections, e.g. bell connectors, connections of sleeveless pipes where internal pressure is provided acc. to the plan or where it might occur due to special operating conditions, especially in case of direction changes, shall be secured against sliding apart.
- Reaction forces of expansion compensators or vibration absorbers shall be borne by pipeline fixed points; an axial guiding of the pipeline shall be ensured due to the construction type.
- If occurring reaction forces have to be transferred into the structure, the forces shall be determined by the contractor and notified to the Contracting Agency prior to performance of the service.
- In case of changes which might interfere with the existing electrical protective measures to the existing systems, e.g. installation of insulation pieces, the contractor shall inform the Contracting Agency that it has to be examined by an approved electrician whether the protective measures will be impaired by the provided work.
- Chiseling, milling and drilling work on structures may only be performed in agreement with the Contracting Agency.
- Materials, acting destructive on system parts, e.g. gypsum or chloride-containing quick binding agents in direct connection with metal parts, may not be used.

-Prior to commissioning of the completed systems, the contractor shall perform a test for efficiency.

Requirements-Potable water installations
Series DIN EN 806 [1 2 3] Technical rules for potable water installations

DIN EN 1717 Protection of potable water against contamination in potable water installations and general requirements to safety equipment for prevention of potable water contamination by back washing - Technical Rules of DVGW

Requirements-Drainage systems
Series DIN EN 12056 [1 2 3 4 5 6] Installation and testing of sewage lines and ducts
DIN EN 1610 Gravity drainage systems inside buildings

Requirements-Measuring and control equipment, Building automation
- Actuating elements of control processes installed in systems shall be dimensioned and supplied by the contractor. The dimensioning of the actuating elements shall be coordinated by the contractor with the person responsible for the concerned system.

- Transducers shall be installed at suitable points in such a way that the measured value will be recorded correctly.

- Indicating devices have to be well legible, devices to be operated easily accessible and operable.

Introduction
The operating and maintenance staff for the systems shall be introduced once by the contractor.

Documents to be enclosed
The contractor shall prepare the following documents
and submit them to the Contracting Agency during inspection the latest:

- System diagrams
- Electrical one-line diagrams and connection diagrams acc. to DIN EN 61082-1 and DIN EN 61082-3 "Documents of electrical engineering",
- Summary of the most important technical data,
- Copies of the instructed test and manufacturer certificates,
- All operation and maintenance manuals required for a safe and efficient operation
- Protocols concerning the leakage test,
- Protocols concerning the introduction of the maintenance and operating staff.

Secondary services
Secondary service are service belonging to the contract without being explicitly mentioned.
Accordingly, secondary services are especially:

- Marking of slits and breakthroughs also if they will be performed by a different contractor.

- Erection and dismantling as well as provision of scaffolds and working platforms, which are not placed higher than 2m above terrain or floor.

- Setting and adjustment of the systems and system parts as well as function test.

- Delivery and installation of wall and ceiling passages without special requirements.

- Protection of components and system parts against contamination and damage during work on

- water and drainage system by loose covering, suspension or wrapping.

- Erection and dismantling as well as provision of scaffolds.

- Chiseling, drilling and milling work for fastening of the brackets and holders as well as provision of slits and breakthroughs.

- Installation of rosettes on walls and ceiling passages.

- Integration, connection and drilling to existing pipelines, shafts and system parts.

- Delivery of operating means and liquids required for the pressure test, initial operation and trial operation.

Billing
- The determination of the service - regardless whether it will be performed acc. to drawings or quantity measurement - shall be based on the dimensions of the system parts.

- In case of billing acc. to linear dimensions, the pipelines including their elbows as well as formed, fitting and connecting pieces will be measured in the center axis. Pipe elbows will be thereby measured up to the intersection point of the center axes. Fittings and formed pieces will be additionally billed.

9.11 General Technical Contract Conditions for Construction Services Low-voltage installation and medium-voltage installation with nominal voltages up to and including 36 kV

Performance
-Especially the following applies for performance: the standards of Group 01 (energy systems) and Group 08 (information technology) of the DIN-VDE-standards and/or the European Standards, which replace some standards of this groups, and the technical connection conditions of the mains provider.
- The electrical operating means and systems shall be coordinated to each other in such a way that the required function will be provided, the operating

-safety will be given and an efficient energy consumption and economical operation will be possible.

-Prior to the start of installation work, the contractor shall indicate all information to the Contracting Agency required for an unobstructed installation and proper operation of the system. Acc. to the design documents and calculations of the Contracting Agency, the contractor shall prepare the installation and workshop drawings required for performance and - if necessary - coordinate them with the Contracting Agency. Especially the following belongs to that:

- o Circuit diagrams
- o Addressing plans
- o Assembly drawings of distributions,
- o Piece lists
- o Wiring diagrams and seizure,
- o Function descriptions.

-During review of the design documents and calculations regarding the condition and function of the system supplied by the Contracting Agency, the contractor shall especially ensure the completeness of the documents.

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-During his review, the contractor shall especially claim concerns in case of discrepancies in the design documents and calculations supplied by the Contracting Agency,
-realizable inaccurate performance or completion not in due time and/or missing of e.g. slits, breakthroughs,
-insufficient space for electrical components.
-The contractor shall prepare all operating and maintenance manuals and required as-built drawings required for the safe and efficient operation of the system and submit them and single project-specific data to the Contracting Agency.
-Prior to commissioning of the completed system, the contractor shall perform an examination on operativeness and an examination acc. to the Italian and/or European standards. The records of the test results and the documentation shall be handed over to the Contracting Agency prior to inspection.
-The operating staff for the system shall be introduced once by the contractor. Also information for the type and scope of maintenance belongs to that.

Erection of electrical systems
-The required length allowances for proper cable and line connections shall be provided.

-Conduits shall be installed without pull wires.

-Gypsum may not be used as fastening agent in connection with cement-containing mortar as well as in wet rooms and in outdoor areas.

-Chiseling, milling and drilling work on structures may only be performed with agreement of the Contracting Agency.

Secondary services
Secondary services are services belonging to the contract without being explicitly mentioned.

-Accordingly, secondary services are especially:
- Erection and dismantling as well as provision of scaffolds

-Chiseling, milling and drilling work for insertion of dowels, anchor screw and for installation of flush-mounted, switch and branch boxes.

-Marking of slits and breakthroughs.

-Insertion of dowels, anchor screws and suchlike.

Billing
-The determination of the service - regardless whether it will be performed acc. to drawing or quantity measurement - shall be based on the dimensions of the system parts.

-Cables, lines, wires, pipes and components of installation systems will be measured acc. to the really installed length of the center axis. Cutting loss will thereby not be considered.

-Electrical operating means and electrical components will be measured over and billed separately.

Ref. Normative for the electrical supply:

CEI EN 60079-10 (31-30) Classificazione dei luoghi pericolosi

CEI EN 60079-14 (31-33) Impianti elettrici nei luoghi con pericolo die esplosione

per la presenza di gas

CEI EN 60079-17 (31-34) Verifica e manutenzione degli impianti elettrici nei luoghi con pericolo di esplosioe per la presenza di gas

CEI 31-35 Guida all'applicazione della norma CEI EN 60070-10 (31-30) Classificazione dei luoghi pericolosi

CEI 31-35; V1 Guida all'applicazione della norma CEI EN 60070-10 (31-30)

CEI 31-35; V3 Guida all'applicazione della norma CEI EN 60070-10 (31-30)

CEI 31-35/A Guida all'applicazione della norma CEI EN 60070-10 (31-30) - Esempi di applicazione

CEI 31-35/A;V1 Guida all'applicazione della norma CEI EN 60070-10 (31-30) Esempi di applicazione

CEI EN 50281-1-2 (31-36) - Costruzioni elettriche protette da custodie - Scelta, installaziane e manutenzione

CEI EN 50073 (31-42) - guida per la scelta, installazione, uso e manutenzione delle apparechiature per la rilevazione e misura dei gas combustibili o di ossigeno

CEI CLC/'TR 50404 (31-55) Elettrostatica - Guida e raccomandazioni per evitare i pericoli dovuti all'eletticitá statica

CEI 64-8 Impianti elettrici utilizzatori a tensione nomianle non superiore a 1000 V in corrente alternata e 1500 'V in corrente continua

9.12 General Technical Contract Conditions for Construction Services Lightning protection systems

Performance
-During his review, the contractor shall especially claim concerns in case of an unsuitable condition of the buildings and building parts.

-The contractor shall prepare and supply: The concept drawings required for performance showing the required information acc. to DIN VDE 0185-1 (VDE 0185 Part 1) and DIN VDE 0185-2 (VDE 0185 Part 2),

- o the other documents for the instructed approval announcements,
- o the drawings for the performed services (as-built plans).

- During his review, the contractor shall especially claim
-The contractor may only work acc. to the drawings approved by the Contracting Agency and - if required - by the authority in charge.

Testing
After completion of the lightning protection system, the contractor shall perform an inspection test or have it performed and submit a written report about the result of the review to the Contracting Agency. The grounding resistances shall be indicated in the report.

Secondary services
Secondary services are services belonging to the contractor without being explicitly mentioned. Accordingly, secondary services are especially:

-Erection and dismantling as well as provision of scaffolds
-Provision of ladders, roof stands, roof ladders, belts and suchlike.
-Insertion and fastening of the supports and suchlike including chiseling work required for this and delivery of the fastening agents.
-Corrosion protection of the lightning protection systems
-Installation of collecting devices, line supports, connections, separating points, ground entries and suchlike.

Billing

The determination of the service - regardless whether they are performed acc. to drawing or acc. to quantity measurement - shall be based on the dimensions of the system parts, unless lump sum

9.13 General Technical Contract Conditions for Construction Services Building Automation installations in buildings

Materials, components
The most common, standardized materials and components are listed in DIN EN 60529 "Protective types due to cases (IP-Code)".

Standard references
-DIN EN 60529 protective types due to cases (IP-Code)

-DIN EN 61082-1 Documents of electrical engineering - Part 1: General rules

-DIN EN 61082-2 Documents of electrical engineering - Part 2: Function-related circuit diagrams

-DIN EN 61082-3 Documents of electrical engineering - Part 3: Connection plans, connection table and connection lists

-The following quoted documents are required for use of this document. Only the referenced edition applies in case of dated references. In case of undated references, the latest edition of the document referenced applies (including all amendments).

-DIN EN ISO 16484-2 Systems of building automation (GA) - Part 2: Hardware

-DIN EN ISO 16484-3 Systems of building automation (GA) - Part 3: Functions

Performance
-The equipment and systems of the building automation shall be coordinated with the technical systems in such a way that the required functions will be provided and operational safety will be given as well as an efficient operation will be possible.

-Prior to the start of installation work, the contractor shall provide all information required for the unobstructed installation and proper operation of the system. Acc. to the design documents and calculations of the Contracting Agency, the contractor shall prepare the installation and workshop drawing required for performance and - if required - coordinate them with the Contracting Agency. Especially the following belongs to that:

oAutomation diagrams with illustration of the major functions based on the system diagrams acc. to the

system design,

-Circuit diagrams acc. to DIN EN 61082-1 and DIN EN 61082-2 "Documents of electrical engineering",

-Automation station seizure plans including addressing, one-line diagram with entry of the location of the operating equipment and set of controllers,
-function descriptions,
-installation plans with installation locations of the field devices,
-cable lists with function allocation and power information,
-piece lists

-During review of the design documents and calculations supplied by the Contracting Agency, the contractor shall especially consider the following items with regard to the condition and function of the system:
oCompleteness of the building automation function lists,
- o Completeness of the dimensioning data and parameters,
- o Function descriptions,
- o Measuring range information of measuring and limit value transducers,
- o System diagrams
- o Addressing concept
- o Dimensioning of hydraulic actuating elements,
- o fire protection technical requirements.

- During his review, the contractor shall especially claim concerns
- in case of discrepancies in the design documents and calculations
- supplied by the Contracting Agency, realizable insufficient performance or completion not in due time or missing of e.g. slits, breakthroughs,
- insufficient space for components,
- insufficient overvoltage protection,
- perturbations by electromagnetic fields.

Chiseling, milling and drilling work on the structure may only be performed in agreement with the Contracting Agency.

Requirements
The following applies for performance of the systems of the building automation:

- DIN EN ISO 16484-2 Systems of building automation (GA) - Part 2: Hardware
- DIN EN ISO 16484-3 Systems of building automation (GA) - Part 3: Functions

- Transducers shall be installed at such points and in such a way that the measured value will be recorded correctly.
- Indicating devices have to be well legible, devices to be operated have to be easily accessible and operable.
- Devices to be serviced have to be accessible.

Announcement, permission, approval and review
The graphical and other documents as well as certificates required for the officially instructed announcements and applications shall be provided to the Contracting Agency in the instructed number acc. to the announcement, permission or approval duty.
This does not apply if the review provisions for system parts provide a durable marking instead of a certificate.

Initial operation and setting

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- The system parts shall be set in such a way that the required functions and services will be provided and the legal regulations will be met. For this purpose all physical inlets and outlets shall be examined individually, the instructed parameters shall be set and the required input and output as well as processing functions shall be ensured.

- The initial operation and setting of the system and system parts shall be performed - if required - together with the involved disciplines. Initial operation and setting shall be proven by protocols with measuring and setting values.

- The operating staff for the system shall be introduced once by the contractor. Also the information for type and scope of maintenance belongs to that.

Inspection test
- An inspection test consisting of completeness and function test shall be performed.
- The function test includes especially:
  - o Review of the submitted initial operation protocols,
  - o Random testing of the automation functions, e.g. control, safety, optimization and communication functions,
  - o random individual testing of signals,
  - o switch commands, measured values, actuating commands, metered valued, derived and calculated values,
  - o testing of the system response time,
  - o testing of the self-monitoring of the system,
  - o testing of the system behavior after mains outage and mains return.

Documents to be enclosed
Within the scope of his services, the contractor shall prepare the following documents and submit them to the Contracting Agency in orderly and updated form during inspection the latest:
- Automation diagrams
- Circuit diagrams acc. to DIN EN 61082-1 and DIN EN 61082-2,
- Automation station seizure plans including addressing,
- Connection plan acc. to DIN EN 61082-3 "Documents of electrical engineering - Part 3: Connection plans, connection tables and connection lists",
- General plan with entry of the locations of the operation equipment and set of controllers,
part lists,
- function descriptions
- operating manuals and maintenance information required for a safe and efficient operation spare part lists
- project-specific programs and data on data carriers,
- protocols about the introduction of the operating staff,
- protocol about the introduction of the operating staff,

The documents shall be submitted in single-colored illustration and in triplicate, drawings and lists acc. to the choice of the Contracting Agency also in one copy, reproducible, or on data carriers. DP-programs shall be supplied in duplicate on data carrier.

Secondary services
- Secondary services are services belonging to the contract without being explicitly mentioned.

- Accordingly, secondary services are especially:

- Marking of slits and breakthroughs, also if these will be performed by a different contractor.

- Erection and dismantling as well as provision of the scaffolds.
- Drilling, chiseling and milling work for the use of dowels and for installation of built-in parts, e.g. flush-

mounted boxes.

- Delivery and installation of type and performance signs.

- Delivery and installation of special fastening structures, e.g. brackets, supporting scaffolds.

- Examination of electrical cablings or pneumatic piping of the control or regulating system.

- Delivery and fastening of function, designation and information signs.

- Delivery of the operating means required for initial operation, setting and trial operation.

Billing
- The determination of the service - regardless whether it will be performed acc. to drawing or acc. to quantity measures - is based on the dimensions of the system parts. If the service is determined from drawings, updated building automation function lists and system protocols shall be inspected.

- The services shall be billed separately acc. to system components of the hardware acc. to
- DIN EN ISO 16484-2 as well as separately acc. to functions including software and services acc. to DIN EN ISO 16484-3.Technical processing, programming as well as initial operation and setting belong to the services.

- Cables, lines, wires, pipes and cable ducts shall be billed acc. to the really installed length, e.g. from clamping point to clamping point. Cutting loss will remain unconsidered.

- reimbursements are agreed for the entire service or parts of the service. Lines, ground conductors and arrestors will be calculated acc. to the really installed length. Cutting loss will not be considered thereby.

9.14 General Technical Contract Conditions for Insulation works on technical installations

Materials, components

- The Italian and/or European standards for "Insulation work on mechanical and technical systems - provision of thermal and cold insulation" applies for the most common materials and components.

- The thermal conductivity with the average temperature as reference temperature and the gross density of the insulation materials have to be proven by a test certificate of an accepted test institute on request of the Contracting Agency.

Performance
During his review, the contractor shall especially claim concerns, if the preconditions acc. to the Italian and/or European standards are not met.

Secondary services
Secondary services are services belonging to the contract without being explicitly mentioned.

Accordingly, secondary services are especially:

- Erection and dismantling as well as provision of scaffolds

- Removal of minor contamination of the base.

- Protection of the services being performed and which have been performed against damage by weather

influences. Subsequent installation of parts of the insulation, e.g. by welding seams, to temporary suspensions and abutments.

Billing
- The determination of the service - regardless whether it is performed acc. to drawing or acc. to quantity measurement - shall be based on:
    - o their dimensions in case of insulation material layers,
    - o the dimensions of the coating in case of insulations with coating
    - o their dimensions in case of coatings.

If the service is determined from drawings, part lists may be inspected.

- Lengths shall be measured in the axis direction in the appropriate longest provided distance, e.g. above the exterior elbow in case of pipelines and round ducts, above the exterior edge in case of angular ducts.
- Flange and screwed connections will be measured over.
- The length to the center of the flange pair will be measured at end spots at flanges, to the welding spot in case of welded built-in parts.

Billing acc. to linear dimensions:
- At conical pipes, half the length will be allocated to dimensions and insulation thicknesses of the following pipes.
- At insulation material layers and coatings on
    - o Pipelines
    - o Elbows
    - o conical elbows
    - o bends
    - o fittings
    - o Y-tubes
    - o Cutouts
    - o facings, rosettes, covers,
    - o inserts,
    - o flattenings
    - o rain deflectors
    - o supporting structures
    - o cones
    - o socket
    - o end spots

will be measured over and billed separately acc. to number.

- In case of pipe bundles which individually insulated pipes, the insulation of each individual pipe, the common coating, however, will only be billed once.
- Billing acc. to square dimensions:
    - o In case of exterior insulation, surfaces will be determined acc. to the largest surface of the completed coating, acc. to the surfaces prior to application of the insulation materials in case of interior insulation.
    - o Cutouts, which can only be provided during or after installation, will be measured over independent from their seize and billed separately acc. to number.
    - o In case of insulation material layers and coating to devices, receptacles, columns and tanks, fittings, jacket necks, circle rings, cones, transition pieces, flattenings, device sockets, additional separations of the coatings and end spot formations of coatings as joint caps and suchlike will be measured over and billed separately acc. to number.
    - o The exterior surface will be billed in case of insulation material layers and jacketing on ducts.
    - o The surface of the insulation material layer or the jackets of duct elbows and other fittings to ducts will be determined by the largest circumference and the largest length. Cutouts, facings,

inserts and flattenings will be measured over and billed acc. to number.

Billing acc. to volume Volumes will be billed acc. to the backfilled space.

It will be deducted
- In case of billing acc. to linear dimensions: Interruptions of the thermal insulation layer and jackets by walls, ceilings or other structural parts of more than 270 mm length and length of two or more built-in parts placed one behind the other with thread connections.

- In case of billing acc. to square dimensions:

o Recesses and cutouts exceeding 0.5 m² single surface, except cutouts, which will only be prepared during or after installation of the insulation material layers or coatings.
o In case of billing acc. to volume. Volume of pipes with an exterior diameter of more than 120 mm and/or a rectangular cross section of more than 125 cm².

9.15 General Technical Contract Conditions for Scaffolding works

Materials, components
- The service also includes reloading and haul off of the pertinent materials and components.

- The following DIN-standards are listed for the most common standardized materials and components.

- DIN EN 39 System-independent steel pipes for use in supporting and work scaffolds - Technical terms of delivery

- DIN EN 74-1 Clutches, centering pins and base plates for work scaffolds and supporting scaffolds - Part 1: Pipe clutches - requirements and test procedures

- DIN EN 1004 Mobile work platforms of prefabricated components - materials, dimensions, load assumptions and safety-technical requirements

- DIN EN 1065 Structural supports of steel with extraction devices - product determinations, dimensioning and proving by calculation and tests

- Series DIN EN 1263 [1 2] Protective nets (catch nets, safety nets)

- DIN EN 1298 Mobile work platforms - Rules and determinations for preparation of an assembly and utilization manual

- Series DIN EN 12811 [1 2 3 4] Temporary structures for constructions

- DIN EN 12812 Supporting scaffolds - requirements, dimensioning and concept

- DIN EN 12813 Temporary structures for constructions - supporting towers of prefabricated components - special dimensioning procedures

Performance and provision for use

- Work shall be performed with greatest care in the vicinity of structures, lines, cables, drainages and suchlike as well as in the vicinity of trees, plant population and vegetation surfaces to be maintained.

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- For scaffolds apply in case of work scaffolds, protective scaffolds e.g. catch scaffolds, roofer catch scaffolds, protective roofings and mobile scaffolds, the standards of the series DIN 4420 [1 2 3 4] and series DIN EN 12810 [1 2] as well as series DIN EN 12811 [1 2 3 4],
- in case of supporting scaffolds DIN EN 12812,
- in case of mobile working platforms DIN EN 1004 and DIN EN 1298.

- During his review, the contractor shall claim concerns especially in case of
- In case of work scaffolds as self-supporting scaffolds with length-oriented scaffold layers (facade scaffolds), all working layers shall be equipped with scaffold coverings, in case of stationary scaffolds with surface-oriented scaffold layers (room scaffolds), one working layer shall be equipped with scaffold coverings.
- Scaffolds shall be provided without scaffold lining.
- The contractor is not responsible for lowering of the supporting scaffolds. The contractor shall submit the operation manual for lowering systems to the Contracting Agency.
- The scaffolds shall be left in a condition suitable for use acc. to contract. They shall be maintained in this condition during the contract period.
- If scaffold parts get damaged or go missing during the period for provision for use, the contractor shall inform the Contracting Agency immediately in writing, prior to dismantling of the scaffolds the latest.
- Anchorage elements, e.g. dowels installed into the construction to be provided with scaffolds, shall be left there after dismantling of the scaffolds.
- The provision for use starts with the date agreed in the contract, in case of preliminary use with the day of the first use.

Secondary services
Secondary services are services belonging to the contract without being explicitly mentioned.

Accordingly, secondary services are especially:
- Protection of structural and system parts and their accesses against damage during assembly, reconstruction and dismantling of the scaffolds.
- Submittal of the type approvals or approvals.
- Insertion of base plates and installation of padding bolts under the scaffold base points at work and protective scaffolds.
- Erection of a ladder corridor per scaffold up to 50 m length; erection of an additional ladder corridor per further started 50 m scaffold length.
- Installation of the anchorage elements required for fastening of the scaffolds and dismantling of the parts to be left in the construction during dismantling of the scaffold.
- Once introduction and delivery of operation manuals for lowering systems, climbing platforms and mobile working platforms.
- Delivery of structural calculations and drawings required for proofs.
- Erection and dismantling of the scaffolds section by section.
- Cleaning and clearing of the scaffolds from coarse soilings, waste and residues of any type, if proper dismantling or reuse is not possible without these preliminary services.

Billing
- The determination of the service - regardless whether it will be performed acc. to drawing or acc. to quantity measurement - shall be based on the dimensions of the surfaces to be provided with scaffold.
- The height of the scaffolds will be calculated from their standing area.

Working scaffold, suspended and climbing platforms
Room scaffolds
- In case of billing of room scaffolds in interior rooms acc. to cubic dimensions, the cubics of the space provided with scaffolds will be calculated.
- In case of room scaffolds as work and protective scaffolds, which have a free covering edge, the length and

width of the free scaffold sides shall be calculated, if the dimensions of the scaffolds are due to their application.
- The height will be calculated from the standing area of the scaffold continuously up to the highest point of the surface to be treated, maximally up to above the uppermost covering area.

Supporting scaffolds
- In case of billing of supporting scaffolds acc. to cubic dimensions, the volume of the space provided with scaffolds will be calculated.
- In case of self-supporting support scaffolds not restricted by components, the length and width of the scaffold to the free scaffold sides up to the covering edge shall be calculated, if the dimensions of the scaffolds are due to their application. Formwork surfaces will be considered as covering surfaces.
- In case of supporting scaffolds for bridges, the width between the exterior sides of the superstructure and the length between the abutments will be calculated without deduction of intermediate piers and supports.
- The height will be calculated from the stand area of the scaffold to the upper side of the carrier layer of the scaffold.

Suspended scaffolds
- In case of billing of suspended scaffolds in front of wall surfaces acc. to square dimensions, the height of the upper side of the lowermost scaffold layer to the uppermost point of the surface provided with scaffolds will be calculated.
- In case of billing of surface-oriented suspended scaffolds, the dimensions of the covering will be calculated, if the dimensions of the covering will be determined by the application of the scaffold.

Bracket scaffolds, cantilever scaffolds, stand scaffolds
In case of billing of bracket scaffolds, cantilever scaffolds and stand scaffolds acc. to linear dimensions, the length of the largest total width at the scaffold exterior side will be calculated.

Provision for use
- If scaffolds are completely or partly used prior to the agreed day, the provision for use of the scaffold or of the used scaffold section will be calculated from the first day of use.
- The provision for use ends with the release for dismantling provided by the Contracting Agency. However, it will earliest end three working days after receipt of the notification concerning the release by the contractor.
- The period for provision for use will be calculated per started week, except for support scaffolds.
- In case of support scaffolds, the period of the provision for use as well as the agreed period of provision during erection and dismantling will be calculated acc. to calendar days.

10. Additional technical contract conditions

10.1 Rispetto della Normativa vigente

Le seguenti normative in lingua italiana valgono in addiziona o che si sostituiscono alle seguente normative e contrattuali in lingua inglese

Gli impianti, le forniture ed i materiali oggetto dell'appalto, nel loro complesso e nei singoli componenti, dovranno risultare conformi alla legislazione ed alla normativa vigente al momento della esecuzione dei lavori stessi, in particolare:

- D.M. 19.09.2005 - n. 192 e Legge 10 del 9/01/91 e relativi regolamenti e decreti successivi;
- Normative I.S.P.E.S.L.;
- Normative UNI - CIG;
- D.M. 1/12/75;
- Norme C.E.I. vigenti alla data di presentazione dell'offerta;
- Norme E.N.P.I.;
- Legge 615 del 13/07/66 e relativo regolamento d'esecuzione;
- Legge n. 46 del 5/03/90 e relativo regolamento;
- Normative del Ministero dell'Interno per gli impianti termici e combustibili liquidi e/o gassosi;
- Disposizioni dei Vigili del Fuoco;
- Leggi, regolamenti e circolari tecniche che venissero emanate in corso d'opera.
- Normative, Leggi, Decreti Ministeriali regionali o comunali.

Inoltre, per tutti i componenti per i quali è prevista "l'omologazione" secondo le prescrizioni vigenti, dovranno essere forniti i relativi certificati. Qualora il fornitore non fosse in possesso, per determinati apparecchi, del certificato di omologazione, dovrà essere fornita una dichiarazione, sottoscritta dal fornitore, nella quale lo stesso indica gli estremi della richiesta di omologazione e garantisce che l'apparecchio fornito soddisfa a tutti i requisiti prescritti dalla specifica di omologazione. Si richiamano, a titolo indicativo, le più ricorrenti Norme UNI e C.E.I. a cui far riferimento in questo appalto; l'elenco non ha carattere esaustivo:

- Legge n. 10 del 9 gennaio 1991 - Norme per la progettazione, l'esercizio e la manutenzione degli impianti termici.
- D.P.R. 26 agosto 1993 n. 412 - Regolamento recante norme sulla progettazione, l'installazione, l'esercizio e la manutenzione degli impianti termici degli edifici al fine del contenimento dei consumi di energia, in attuazione dell'art. 4 della legge 9 gennaio 1991. n. 10.
- D.M. 6 agosto 1994 - Recepimento delle norme UNI attuative del decreto del Presidente della Repubblica 26 agosto 1993, n. 412, recante il regolamento per il contenimento dei consumi di energia negli impianti termici degli edifici, e rettifica del valore limite del fabbisogno energetico normalizzato.
- UNI - CTI 10339 - Impianti aeraulici ai fini del benessere. Generalità classificazioni e requisiti. Regola per la richiesta di offerta, l'offerta, l'ordine e la fornitura.
- D.M. 2.4.98 - Modalità di certificazione delle caratteristiche e prestazioni energetiche degli edifici e degli impianti ad essi connessi.
- LEGGE 179 del 16.6.97 - Modifiche alla legge 549 recante misure a tutela dell'ozono stratosferico.
- UNI - CTI 10381/1 - Impianti aeraulici - Classificazione, progettazione, dimensionamento e posa in opera delle canalizzazioni.
- UNI - CTI 10381/2 - Impianti aeraulici - Classificazione, dimensioni e caratteristiche costruttive delle canalizzazioni.

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- UNI 7357 - Calcolo del fabbisogno termico per il riscaldamento degli edifici.
- UNI 10344 - Riscaldamento degli edifici - calcolo dei fabbisogni di energia.
- UNI 8447/1 - Calcolo degli apporti di energia solare ottenibili mediante sistemi attivi o passivi.
- UNI 8477/2 - calcolo degli apporti di energia solare valutazione dell'energia raggiante ricevuta.
- UNI 10412 - Impianti di riscaldamento ad acqua calda. Prescrizioni di sicurezza.
- UNI 10375 - Metodo di calcolo della temperatura interna estiva degli ambienti.
- D.M. 12.4.96 M.I. - Approvazione della regola tecnica di prevenzione per la progettazione, la costruzione e l'esercizio degli impianti termici alimentati da combustibili gassosi.
- D.M. 19.2.97 - Modificazioni al D.M. 12.4.96 relative alla approvazione della regola tecnica di prevenzione incendi per impianti termici alimentati da combustibili gassosi.
- UNI 8364/84 - Impianti di riscaldamento - Controllo e manutenzione.
- UNI 9317/89 - Impianti di riscaldamento - Conduzione e controllo.
- D.M. 26.8.92 - Norme di prevenzione incendi per l'edilizia scolastica.
- Norma UNI10339: Impianti areaulici ai fini di benessere. Generalità, classificazione e requisisti. Regole per la richiesta d'offerta, l'offerta e la fornitura.
- Norma UNI EN 832:2001: Prestazione termica degli edifici - Calcolo del fabbisogno di energia per il riscaldamento - Edifici residenziali
- UNI 10779/98 - Progettazione, installazione ed esercizio reti di idranti.
- UNI 804 - Apparecchiature per estinzione incendi - Raccordi per tubazioni flessibili.
- UNI 805 - Apparecchiature per estinzione incendi - Cannotti filettati per raccordi per tubazioni flessibili.
- UNI 807 - Apparecchiature per estinzione incendi - Cannotti non filettati per raccordi per tubazioni flessibili.
- UNI 808 - Apparecchiature per estinzione incendi - Girelli per raccordi per tubazioni flessibili.
- UNI 810 - Apparecchiature per estinzione incendi - Attacchi a vite.
- UNI 813 - Apparecchiature per estinzione incendi - Guarnizioni per raccordi e attacchi per tubazioni flessibili.
- UNI 814 - Apparecchiature per estinzione incendi - Chiavi per la manovra dei raccordi, attacchi e tappi per tubazioni flessibili.
- UNI 7421 - Apparecchiature per estinzione incendi - Tappi per valvole e raccordi per tubazioni flessibili.
- UNI 7422 - Apparecchiature per estinzione incendi - Requisiti delle legature per tubazioni flessibili.
- UNI 9485 - Apparecchiature per estinzione incendi - Idranti a colonna soprassuolo odi ghisa.
- UNI 9486 - Apparecchiature per estinzione incendi - Idranti sottosuolo di ghisa.
- UNI 9487 - Apparecchiature per estinzione incendi - Tubazioni flessibili antincendio di DN 45 e 70 per pressioni di esercizio fino a 1,2 Mpa.
- UNI 9488 - Apparecchiature per estinzione incendi - Tubazioni semirigide di DN 20 e 25 per naspi antincendio.
- UNI EN 671-1 - Sistemi fissi di estinzione incendi - Sistemi equipaggiati con tubazioni - Naspi antincendio con tubazioni semirigide.
- UNI EN 671-2 - Sistemi fissi di estinzione incendi - Sistemi equipaggiati con tubazioni - Idranti a muro con tubazioni flessibili.
- UNI 9489 - Impianti fissi di estinzione automatici a pioggia (sprinkler).
- UNI 9490 - Alimentazioni idriche per impianti automatici antincendio.
- UNI 9491 - Impianti fissi di estinzione automatici a pioggia. Erogatori sprinkler.
- Norme N.F.P.A. (National Fire Protection Association) - U.S.A. 13
- UNI 9182 - Impianti di alimentazione e distribuzione acqua fredda e calda - Criteri di progettazione, collaudo e gestione.
- UNI 12056 - Sistemi di scarico delle acque usate - Criteri di progettazione, collaudo e gestione.
- UNI 8065 - Trattamento delle acque negli impianti termici ad uso civile.
- UNI 5364/76 - Impianti di riscaldamento ad acqua calda - Norme per la presentazione dell'offerta e per il collaudo.
- UNI 8863 - Tubi senza saldatura e saldati in acciaio non legato tubi serie normale, media e pesante.
- UNI 4715 - Pitture, vernici e smalti, proprietà e e metodi di prova.
- UNI 1288 - Tubi di acciaio senza saldatura di acciaio non legato, filettati, con manicotto di giunzione, tubi serie leggera.

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- UNI 7616 - Raccordi di polietilene ad alta densità per condotte di fluidi in pressione, metodi di prova.
- UNI 7611 - Tubi di polietilene ad alta densità per condotte di fluidi in pressione: tipo, dimensioni e caratteristiche.
- UNI 7612 - Raccordi di polietilene ad alta densità per condotte di fluidi in
- pressione: tipi, dimensioni e requisiti.
- UNI 7613 - Tubi di polietilene ad alta densità per condotte di scarico interrate: tipi, dimensioni e requisiti.
- UNI 7615 - Tubi di polietilene ad alta densità: metodi di prova (D.M. 7.6.73 e D.M. n. 10.5.74).
- UNI 6462 -Tubi di polietilene a bassa densità: metodi di prova.
- UNI/ISO 4437 - Tubi di polietilene per condotte gas interrate.
- Prescrizioni e raccomandazioni delle U.L.S.S.
- Prescrizioni e raccomandazioni dell'Enel (e/o Azienda distributrice dell'energia elettrica)
- Prescrizioni e raccomandazioni della Telecom
- Prescrizioni e raccomandazioni del locale Comando dei Vigili del Fuoco
- Prescrizioni e raccomandazioni General Motors.

In mancanza di dati di calcolo, condizioni ambientali e di benessere, caratteristiche costruttive, rese e funzionamento delle principali apparecchiature,
ecc., o in mancanza di normativa specifica o in fase di attuazione e perciò non impegnativa e/o in caso di controversie, si dovrà fare riferimento alla normativa
internazionale

Prescrizioni acustiche
I livelli di rumore prodotti dai vari componenti degli impianti tecnologici oggetto del presente appalto devono risultare tali da non creare disturbo a chi opera negli
edifici nè ad eventuali insediamenti abitativi esterni all'area. Per la misura e la valutazione della rumorosità prodotta negli ambienti dagli impianti e dal disturbo emesso da elementi esterni si farà riferimento alle seguenti normative:

- Legge Quadro 26.10.1995 n. 447 "Legge quadro sull'inquinamento acustico"
- D.P.R. 30.03.2004 n. 142 "Disposizioni per il contenimento e la prevenzione
- dell'inquinamento acustico derivante dal traffico veicolare"
- D.M. del 16.03.1998 "Tecniche di rilevamento e di misurazione
- dell'inquinamento acustico"
- D.P.C.M. del 05.12.1997 "Determinazione dei requisiti acustici passivi degli edifici". La ditta esecutrice dovrà provvedere a mettere in atto tutti gli accorgimenti necessari a contenere i livelli di rumore, entro i limiti prescritti eventualmente provvedendo anche a far eseguire rilievi di rumorosità interna ed esterna in assenza di funzionamento degli impianti realizzati, se ritenuto necessario dai suoi tecnici.

Tali misure non esonerano la ditta stessa dalle responsabilità collegate al rispetto di quanto sopra prescritto. E' comunque obbligo della Ditta far rientrare i valori di rumorosità indotta dagli impianti entro i limiti suesposti, e ciò senza alcun onere aggiuntivo per la Committente, anche se per ottenere i risultati richiesti fossero necessari interventi di correzione acustica per gli impianti (sostituzione ventilatori o altri componenti, inserimento di attenuatori acustici, ecc.).

Requisiti dei Materiali delle Forniture
Tutti i materiali, i componenti, le apparecchiature, le forniture in genere e quanto altro utilizzato, fornito e posto in opera nel presente Appalto devono essere nuovi, prodotti dalle primarie case costruttrici e devono risultare corrispondenti al servizio a cui sono destinati ed alle caratteristiche prestazionali richieste dall'opera compiuta di cui fanno parte integrante.
L'Appaltatore deve indicarne la provenienza e posarli in opera soltanto ad accettazione avvenuta da parte della Direzione Lavori.
Quanto rifiutato, deve essere allontanato dal cantiere a cura dell'Appaltatore.

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Tutti i materiali e le forniture devono essere muniti di MARCHIO DI QUALITÀ secondo le UNI EN ISO 9001 e/o essere prodotti da Aziende certificate, e, per quanto utile, possedere Marchio CE secondo le Direttive CE 392/89 e
successive modifiche ed integrazioni, ed essere conformi ai disposti di cui all'art. 6 del D. Lgs. n° 626/94.
Qualora non fosse possibile avere il Marchio di Qualità (forniture e/o apparecchiature prodotte con processi rispondenti alle UNI EN ISO 9001), i relativi materiali e le forniture, anche di provenienza e/o origine speciale, possono essere ammessi dopo essere stati sottoposti a prove e/o esami, il cui esito risulti positivo, condotti secondo norme e/o procedure unificate, standardizzate e/o omologate, nazionali o, in caso di carenza di queste ultime, europee o di paesi terzi.

Non sono ammesse deroghe e/o prove sostitutive per la rispondenza al Marchio CE.

Certificazioni e campionature

L'Appaltatore deve produrre, per i materiali e/o le forniture da impiegare, tutti i certificati di idoneità, omologazione, di qualità rilasciati da istituti nazionali e/o esteri legalmente riconosciuti.
L'Appaltatore deve presentare le campionature di tutti i materiali, i prodotti, componenti e/o accessori relativi ai sistemi e/o subsistemi edilizi prescritti e descritti nei successivi articoli nel presente Capitolato Speciale di Appalto.
Le campionature devono essere approvate per accettazione dalla DL.
Tale procedura, verificata dal Progettista ed approvata dalla DL, verrà adottata nelle prove, nei controlli e nei collaudi al ricevimento.

Tale procedura prevede:
- accettazione materiali e forniture in cantiere,
- identificazione materiali e forniture,
- segregazione materiali e forniture rifiutate.

Rifiuto dei Materiali, delle Forniture e delle opere
La DL ha la facoltà di rifiutare, in qualsiasi momento, anche se già in opera, materiali e forniture che non abbiano i requisiti prescritti, che abbiano subito
deperimenti e danneggiamenti dopo la loro introduzione in cantiere o che, per qualsiasi causa o motivazione, non risultassero conformi alle prescrizioni del Condizioni Contrattuali.

L'Appaltatore, in base alla procedura menzionata all'articolo precedente e quelli seguente, deve provvedere a rimuovere dal cantiere i materiali rifiutati, e le forniture, anche se
già in opera, e sostituirli con altri idonei, nonchè a demolire, se del caso, le opere stesse, e a ricostruirle secondo le specifiche tecniche richieste e conseguire le caratteristiche prestazionali volute dal presente Appalto; risultano a carico dell'Appaltatore tutti gli oneri
conseguenti.

Principle:
These definitions apply for all products, devices and systems of all disciplines and all specs sections.

All national and international standards and regulations are to be met.

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10.2 General Construction documents

The contractor shall provide a general drawing concerning his service after provision of local measurement and acc. to drawings of the supervisor.

Information concerning influence of elements existing or still to be installed due to this service shall be stated.

Provision of detail and workshop drawings showing constructions, dimensions, fastening type, sealing material, corrosion protection, trailing loads etc. after approval of individual services.

If certain official requirements are to be fulfilled for the accomplishment of services, e.g. structural proof, fire protection class, welding proof etc, these documents with drawings shall be submitted in time to the supervisor for approval.

Workshop work shall not start until approval of prepared documents.
Transport and protection measures
The built-in part shall be transported orderly to worksite, unloaded and possibly stored intermediate (storage period shall not exceed 1 week).

Protection and safeguarding of service shall be provided. The construction parts shall be inspected by the supervisor after the transport to the installation location and possibly arisen damages shall be repaired prior to installation.

Installation
The installation of service shall be accomplished in such a manner that earlier services will not be affected in their function.
The approval of the supervisor shall be available for the fastening to existing components. The connection shall be accomplished in such a manner that no corrosion damages are arising.

Secondary services
The following listed items shall be included in the unit prices.

Process, function, date, occupation plans and other drawings required as amendment to existing drawings and for fulfilment of requested services.

Worksite mobilization with billets, storage and office rooms, workshops as far as required for the operation of worksite and requested by the Contracting Agency.

10.3 Fire protection measures - Technical regulations and implementation rules

Compliance with DIN EN 13501 forms the basis for accomplishment of the fire protection services. Furthermore, the regional building regulations each applicable including the provisions for institution of DIN EN 13501 as well as the acknowledged rules of structural engineering of the Italian regulation are to be met. Official test certificates if they contain information required for provision of the construction parts. In addition, all currently valid standards, accompanying standards and guidelines regarding the provision and installation of construction parts are to be followed. Compliance with the following conditions is a matter of this offer for performance of the specified fire protection work if nothing different is explicitly given in the specifications.

The specified service must be provided as described in the items including delivery, transport of all required materials to and within the construction site, required assembly in the factory and on site in complete workmanlike and proper state-of-the-art performance with provision of all necessary scaffolds up to 10 m working platform height.

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1. Smoke-tight separations
a) hermetically separated against cold and hot smoke gases
b) good possibility of retrofitting at any time
c) certificate of compliance with the order after accomplishment

2. Smoke-tight combination separation (electrical engineering and mechanical) by smoke stop doors as in 1., however, with required structural constructions of galvanized sheet steel profiles, if required.

3. Cable separation
a) Fire separation EI 90 acc. to DIN EN 13501
b) Building authority approval of IfBt Berlin
c) good possibility of retrofitting at any time
d) certificate of compliance with the order after provision of the separation

4. Cable and pipe separation in module system
a) Fire rating of 90 minutes must be proven.
b) Explosion-proof design must be proven by impact test.
c) Watertightness must be proven
d) Gastightness must be proven.

5. Separation of pipes and shut-off devices (fire flap)
a) Fire separation acc. to fire-proof walls and ceilings acc. to DIN EN 13501.
b) Fire protection mortar, mortar group M10, DIN EN 998-2
c) Fire protection mortar must be filled around pipes and shut-off devices without hollow spaces even in very tight spaces.
d) Incombustible pipes shall be wrapped wall-deep with aluminum-laminated mineral foam strips of construction class A2 acc. to DIN EN 13501 prior to mortar filling. No mineral fiber!
e) As regards fire dampers, soft, insulating material as e. g. mineral fiber, hard foam, fire-proof spackling compound, etc. must not be used for filling the joints.

6. Separation of combustible pipes
a) Fire protection EI 90 acc. to DIN EN 13501
b) Fire protection collars in divided design due to already existing plastic pipes.
c) Fire protection collars shall be mortared acc. to factory specifications or fastened with steel dowels and standard flanges in the masonry or in concrete.
d) Fire protection collars shall be protected against bursting acc. to factory specifications.
e) If available, a building authority approval shall be submitted.

7. Combination separation above fire stop doors (possible services of item 3 - 6)
a) Fire separation EI 90 acc. to DIN EN 13501
b) certificate of compliance with the order after provision of the separation

8. Separations during the construction phase
a) Fire protection cushions with asbestos-containing material must not be used
b) due to best possible absence of dust, the classing of the fire protection cushions must be made of foil
c) Test certificates on fire rating of at least 90 minutes are to be submitted
d) with insertion into the breakthroughs, the fire protection cushions need to be well "toothed" for exact sealing purposes.

9. Expansion joint separations
a) Fire protection EI 90 acc. to DIN EN 13501
b) Mineral foam of least construction class A 2 acc. to DIN EN 13501 shall be used.

c) Features of the mineral foam to be verified by test certificates: 20 kg/cbm, melting point 1500 degrees C.
d) No other insulation materials may be used.
e) Permaplastic sealing

10. Protective covering of cables - short circuit delay
a) All-around coating of used cables, cable bundles or cable trays, incl. brackets with protective cable covering compound.
b) Only solvent-free material may be used.
c) The cable capacity may not be constricted.
d) Coating shall prevent fire spread along the cable as well as short circuits in case of fire load.

11. Cable protection - with fire rating (EI 90)
a) In case of fire rating requirement of 90 minutes (e. g. emergency current routes), trays (suspension rods, brackets and other fastening materials, if required) shall be paneled all around with asbestos-free, incombustible fire-proof panels in tested constructions acc. to factory instructions (acc. to DIN EN 13501).
b) For trays installed on, at or under concrete, this paneling shall be provided on two or three sides acc. to factory instructions.

12. Mechanical - ventilation ducts
a) Fire protection EI 90 acc. to DIN EN 13501.
b) Test report of an official material testing institute.

13. Mechanical - fire dampers
a) Fire protection EI 90 acc. to DIN EN 13501.
b) Building authority approval.
c) Approved also for light-weight construction walls.

14. Fire stop walls
(with T 90 - 1 door and possible services of item 3 - 13)

a) Fire protection 90 minutes fire rating
b) Certificate of compliance with the order after accomplishment

15. Dismantling property-furnished suspended ceiling systems,
intermediate storage on storage places planned for this and reinstallation after completion of the fire protection work.

10.4 Scope of services and delivery - Technical regulations and implementation rules

Scope of services and delivery

The scope of services to be offered shall include delivery, installation ready for operation and initial operation of the technical system

Further additional technical contract conditions

If applicable, the following regulations, guidelines and standards also form the basis of the offer and the tender procedure as integral part of the contract:

DIN EN 806-1, 806-2, 806-3, Drinking water supply systems
DIN EN 1717 Drinking water supply systems

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DIN EN 13238 Fire behavior of building components
DIN EN 1363-2 Fire behavior of building materials Building components
DIN EN 1366-1, 1366-2 Fire behavior of building materials Building components
DIN EN 12828 Heating systems in Buildings - Design of water-based heating systems
DIN EN 15423 Ventilation for buildings - Fire precautions for air distribution systems in buildings
DIN EN 12056 Gravity drainage systems inside buildings
DIN E 752 Gravity drainage systems outside buildings
DIN EN 1986-100 Drainage systems for buildings and real estates
DIN EN 12831 Standard heating load
DIN EN 378-1; -2, and 3 Cooling systems and heat pumps
DIN 18 421 Thermal insulation work

The appropriate accident prevention regulations; the standard and guidelines for pipelines, flanges and fixtures; the standard and guidelines for regulation, control and monitoring systems.

1. Documentation:
In consideration of above-mentioned regulations, the contractor shall submit sample documentation for inspection documents and circuit diagrams with the proposed structure in advance for approval.

2. Documents check
The contractor shall check all documents made available by the Contracting Agency for possible discrepancies regarding his disciplines. The Contracting Agency shall be informed about assumed or found deficiencies.

3. Recess drawings
As far as possible, chases and breakthroughs will have already been provided in the structure.
The contractor is obliged to check the recess drawings and the chases and breakthroughs existing in the structure for number and size and to announce discrepancies. In case of alternative proposals or deviations in design, the existing recesses are to be kept in mind. The recesses for modified line routing shall be given by means of recess drawings. Resultant costs are compensated with the bid price.

4. Assembly design
Work executed with non-approved drawings will need to be changed free of charged if requested by the Contracting Agency.

5. Coordination
Supported by the site supervision, coordination meetings are to be held with the other companies involved in the construction. All kind of pipeline work and/or duct installation etc. is to be coordinated with the construction work so that smooth construction phasing will be given. Damage, modifications or delays resulting from insufficient coordination with the companies involved in the construction must be borne by the contractor.

6. Specialized supervision
As soon as the contract has been awarded, the contractor will name the supervising engineer responsible for the construction site to the local specialized supervision. In addition, he commits to deploy his supervising engineer
for the coordination meetings arranged by the local specialized supervision. Project language is Italian and English.

7. Assembly drawings
On basis of the execution drawings made available by the engineer office, the contractor prepares the assembly drawings and submits these to the site supervision in triplicate for approval. Resultant costs shall be included into the unit prices. Deviations from the execution drawings shall be marked clearly.

8. Shop and detail drawings
In addition to the assembly drawings, the contractor is obliged to prepare respective shop and detail drawings for the section solid building services engineering and for clear presentation and submit them with the required copies for approval. Resultant costs shall be included into the unit prices.

9. Updating drawings
After the contract has been awarded, the contractor shall check the execution and as-built drawings he has been provided with and shall adjust them acc. to the local conditions. The assembly design shall be updated with resultant modifications. Resultant costs shall be included into the unit prices.

10. Drawing formats
For the assembly drawings, uniform formats (possibly DIN formats) incl. uniform letting and drawing head shall be chosen in coordination with the Contracting Agency or his specialized consultant engineer. Furthermore, the drawing documents need to be suitable for microfilming. For the entire plan documents, respective plan lists shall be updated regularly. Resultant costs shall be included into the unit prices.

11. Approval
All plan documents to be prepared by the contractor - as mentioned above - shall be submitted to the Contracting Agency in due time incl. respective explanations and prospectus documents for approval. As soon as the Contracting Agency or his consultant engineer, the contractor will get back one set of plan documents showing the respective note of approval for his files. After approval and possible correction by the contractor, the assembly drawings shall be submitted to the site supervision in duplicate, one of these in color. Resultant costs shall be included into the unit prices.
The Contracting Agency's approval of the plan documents submitted by the contractor does not release the contractor from his responsibility and liability

12. Modified site plans
Modified site plans incl. forms and explanations for the building servicing facilities that might be required by the local authorities shall also be prepared by the contractor in due time and shall be submitted to the authorities with the required numbers of copies.
The activity shall be documented for the Contracting Agency by submitting each two sets of the submitted documents. Resultant costs shall be included into the unit prices.

13. Total costs
Total costs for delivery and removal of tools and materials, freight costs, site monitoring, instruction of the operating staff, initial operation, measurements etc. i. e. all services necessary for complete provision and restoration of the systems shall be included into the unit prices and will not be reimbursed separately, provided that nothing different is given in the specifications.

14. Transport and placement conditions
All construction parts can be stored intermediately on the respective assembly level. Quantity and period of storage must be coordinated with the site supervision. For transport, own hoisting devices will be required. Access to the first floor is given at ground level. Via an insertion opening in the facade of the third floor, major construction parts can be put into the building. General access is given via a staircase.

15. Fastening systems
For fastening building servicing system parts, e. g. ducts, pipelines etc., a uniform fastening system shall be provided. Lines shall be properly mounted on the structure free of vibration. As far as required by the purpose, only fastening material in noise-reduced design may be installed.

The contractor is obliged to define the fastening system prior to the start of work, however, in consideration of all sound- and vibration-related requirements.

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For fastening on the building body, only metal safety dowels may be used, as war as this is allowed. All screws are to be provided in cadmium-plated design. For suspended hanging, only threaded rods, e. g. M 8 up to M 14, galvanized, may be used. Perforated strip suspensions are not allowed. Shooting fastening bolts is forbidden. All required performances are compensated with the unit prices.

16. Corrosion protection
If liable to rust, all black steel parts of the building services system shall be derusted and provided with a double prime coat and with final enameling acc. to the directions of the Contracting Agency.
Resultant costs shall be included into the unit prices.

17. Enameling of equipment
The Contracting Agency can request application of the final enamel on equipment, cabinets etc. not until completion of assembly on site whereas coloring of the individual equipment components, cabinets etc. can be given by the Contracting Agency on basis of the technical key colors acc. to RAL.
If application of the final enamel is not provided on site, coloring of the individual devices shall be defined together with the Contracting Agency or his specialized representative prior to ordering.

18. Protection of system components during the construction period
The contractor has to see that during the construction period all devices, ducts and pipelines are properly protected and that no dust can penetrate.
Resultant costs shall be included into the unit prices.

19. Thermal insulation
In the course of the assembly design, the contractor has to prepare an execution plan for the required thermal and/or cold insulation and to submit that to the site supervision in triplicate.
The costs for this shall be included into the unit prices.

20. Assembly heights
The costs for scaffolds shall be included into the unit prices.

21. Color marking of pipelines and ducts
All pipelines shall be provided with color marking tapes at least every 5.0 m
Furthermore, the pipelines will be provided with direction arrows every 5.0m showing the flow direction of the medium.

22. Potential equalizations
For galvanic ally separated system components, the electrical contractor shall be informed about the potential equalizations in due time and/or these shall be shown on the assembly drawings.
Resultant costs shall be included into the unit prices.

23. Pressure tests
All systems shall be separated by pressing and shall be kept this way 24 hours. The site supervision shall be informed prior to the accomplishment of pressure tests which might also be required as partial pressure test.
Resultant costs shall be included into the unit prices. Pressure tests shall be recorded; these records shall be submitted to the site supervision as soon as possible.

24. Pipe disinfection
Prior to their release, the newly provided pipe networks of the water supply system for drinking water shall be disinfected. For the disinfection, it is important to bring all water-carrying parts of the system in contact with chlorine as long as it is required for complete disinfection of the system. Subject to the site supervision's approval, section-wise disinfection of the system is possible.
Resultant costs shall be included into the unit prices.

For this, the following method shall be applied:

- The pipes shall be thoroughly flushed with water from an existing water supply system.
- The pipes shall be filled with water showing a minimum content of 10 g/m3 free residual chlorine. During the filling with the chlorine-water mix, all tapping points of the pipeline networks shall be opened occasionally until the solution leaks completely.
- The over-chlorinated water shall be kept in the closed pipe system for more than 6 hours. Flowing back of the over-chlorinated water into the main lines or extraction shall be avoided.
- The over-chlorinated water will be flushed out of the pipes and the pipes need to be thoroughly flushed with water of the existing water supply line.
- Having flushed the chlorine solution thoroughly, water samples shall be taken by an authorized test institute for bacteriological examination.

25. Further services:
- Adjusting pieces

Adjusting pieces in pipelines will not be reimbursed separately. They shall be included into the individual pipeline unit prices.

- Recesses

Marking, recalculation of recesses like ceiling and wall breakthroughs as well as milling of wall chases.

- Flushing

After completed assembly, all pipelines shall be cleaned and flushed adequately. The site supervision shall be informed about performance of this activity in written form. Costs for above secondary services shall be included into the unit prices.

26. Inspection

The formal final inspection which has to be applied for in written form cannot be provided before the contractor has submitted the as-built drawings and inspection documents as well as the hydraulic balancing and/or adjustment of the requested air volume flows incl. documentation to the engineer office and these have been reviewed and approved by them. As long as the above documents are not available, the services are considered not finished. If the inspection gets delayed due to the contractor's default, the Contracting Agency will be entitled to use the services subject to inspection even without provided inspection and this irrespective of further warranty obligation of the contractor.

The contractor has to prepare for arrangements that might be required. The required inspection measurements will be conducted by the contractor in presence of the site supervision. A record on the test shall be prepared which shall be added to the turn-over documents.

If portions of the construction project are put in operation due to the necessity of motor development, this won't be an inspection declaration of the Contracting Agency. The rule of formal inspection will not be affected, however, the contractor can, if possible, ask for a real partial inspection, but at least a technical partial inspection.

Initial operation of the systems:
Switching the system on and off for setting, deficiency removal, initial operation as well as tests and inspections is not the equivalent with the start of warranty.

For inspection, all execution and inspection documents incl. documents about the initial operation shall be prepared. The above documents shall be submitted completely to the Contracting Agency for discovery and review NLT 15 workdays prior to the inspection.

The individual systems will be put into operation right after completion, possibly even with still open construction site, as coordinated with the Contracting Agency and the specialized department. It is

guaranteed that the systems are reliable in operation and that all protections are made for the prevention of risks and that the systems can be properly operated by the persons deployed for that.
The contractor commits to perform necessary operation of the system that might be required by the Contracting Agency between initial operation and inspection at the expense of the Contracting Agency. The decision on existing necessity is made by the Contracting Agency only.

Rounds for controlling the system shall be provided at least 2-3 times a day. The most important operating data like turn on and off times and temperatures shall be documented on tally sheets. Breakdowns / failures and executed repair work shall be recorded as well.

For systems that completely or partially need to be examined by an expert prior to the initial operation, the inspection will take place as soon as the test charts are available. Commissioning of experts for the test shall be provided by the contractor in due time.

27. Deficiencies
Deficiencies found shall be removed within 14 workdays after completion.
If the found deficiencies have not been removed after an additional period of 8 days, the Contracting Agency will be entitled to have the deficiencies removed by a third party at the expense of the contractor without special notice.

28. Preparation of the turn-over
The operating staff of the Contracting Agency shall be instructed. The systems will be operated in presence of the contractor until proper function is assured and the instructed staff can take on control.
In due time before the agreed time of turn-over, the test run shall be started. The work and time shall be coordinated with the supplier of the BAC system.

29. Declared - actual quantities
Having completed the assembly design of each contract section, the contractor shall prepare a comparison of declared and actual quantities. For this, accumulating increased/decreased costs shall be listed.

30. Initiation of authorities
The contractor has to clarify official regulations, requirements or permits required for some systems with the responsible agencies in due time; the respective documents shall be prepared and submitted. Licensing fees will be paid by the Contracting Agency.

31. Materials
Basically, pipelines as well as flanged sealings shall be provided acc. to the construction and factory specifications of General Motors. In case of fuel-carrying pipelines, sealing's in fixtures and pipelines are basically to be made of VITON.

32. Pipe passages
For wall and ceiling breakthroughs, sliding pipes are to be provided which will be concreted by others. The intermediate space shall be closed airproof and fire-retardant acc. to the construction and material regulations. Resultant costs shall be included into the unit prices.

33. Pipe fastening
Fixed points may only be arranged as coordinated with the designer or with the consent of the structural engineer. Forces shall be determined in due time and shall be submitted to the structural engineer. As regards the suspension spacing, the pipelines shall be dimensioned acc. to their strength. The pipeline suspensions shall be dimensioned and tested for their strength. If requested, the structural calculations und proofs shall be submitted to the site supervision and the structural engineer.

34. Comparison

The records on the setting and measurement provided in the course of the adjustment work shall be entered in a diagram and shall be marked with the respective measured air masses.

35. Pressure equipment guideline
Pressure equipment and assemblies shall be provided, tested and delivered acc. to the pressure equipment guideline 97/23/EG. Pressure equipment shall be designed in such a manner that the maximum possible test terms of the regulation on operational reliability are met.

Pressure equipment must correspond to a set of rules and regulations completely complying with the current Italian status of the art.

The following documents are to be submitted:

- attestation of conformity showing all information acc. to the pressure equipment guideline 97/23/EG and/or the manufacturer's statement and type test risk analysis
- operating instructions acc. to pressure equipment guideline 97/23/EG (including assembly, initial operation and maintenance instructions).
- confirmation of testing prior to initial operation
- details on max. test terms as well as scope of tests on basis of the order specification

36. Leakage test
The leakage test of air-carrying system components shall be conducted, documented and submitted to the site supervision.

Note:
All above-mentioned items are object of this invitation to tender and thus component of the contract.

Costs for compliance with these items shall be included into the unit prices.

10.5 Special technical contract conditions

Measurements and billing of the items listed in the available specifications will be provided acc. to drawing measurements. Isometric drawings, layouts and sectional drawings required for this are to be made available by the contractor (resultant costs shall be included into the unit prices) and serve the Contracting Agency for measurement review.

Billing of the listed services will be provided acc. to the unit prices of the specifications. For intermediate calculations, the accomplished services are to be given. Together with the final invoice, the measurement drawings shall be submitted showing clearly each performance so that the final invoice will be comprehensible at any time. Any final invoice without measurement drawings will be returned undealt.

All offered equipment and system components need to comply with the status of the art by means of the respective technical documents (e. g. family of characteristics, pressure, flow rate, capacity, sound capacity, degree of efficiency).

Prior to ordering the equipment objects and built-in construction parts, repeated consultation with the Contracting Agency will be mandatory.

Particular attention is paid to proper impact sound insulated installation of all lines and objects.

Fastening of pipelines, apparatuses etc. shall be cemented appropriately deep in the masonry. Wooden dowels and plaster must not be used. All suspensions shall be made of profiled strips sufficiently stable acc. to the load; in addition, metal straddling dowels, rapid core drill anchors and/or glue-type dowels are to be

used. Shooting apparatuses are not allowed.

Sensitive fixtures (equipment objects, built-in construction parts etc.) need to be supplied packed and protected in such a manner that they cannot either be soiled or damaged during the installation and the construction period.

10.6 Welding regulations for pipelines

Coverage
High-pressure hot water lines of more than 110°, co mpressed air lines of more than 10 bar, lines for heating oil, high-pressure steam lines of more than 0.5 bar, lines for all types of gas in all pressure levels, lines for combustible liquids, other pipelines acc. to special written stipulation and/or details in the specifications.

Qualification proof and test group
Only welders with official qualification proof are allowed to perform welding work. The test certificates are to be submitted to the site supervision without having been asked.

Accomplishment and quality
Welding seams are to be provided acc. to the latest version of the Italian rules.

Checking welding connections
The Contracting Agency reserves himself the right to have the welding spots tested at his own expenses. If the tests show that more than 10% of the welding spots are imperfect, i.e. that they need to be mend or renewed, all

welding spots will be tested at the contractor's expenses. Immediate workmanlike removal of deficiencies incl. all secondary services and repeated checking of the repaired welding spots will also need to be borne by the contractor.

Licenses
Welding certificates of deployed welders and the test certificates and licenses shall be submitted to the specialized supervision prior to start of work. Only qualified welders may be deployed.

Note:
All above-mentioned items are object of this invitation to tender and thus component of the contract. Costs for compliance with these items shall be included into the unit prices.

10.7 Central technical prefaces for electrical engineering systems and consumers

Principle:
These definitions apply for all products, devices and systems of all disciplines and all specs sections.

All national and international standards and regulations are to be met.

The following standards will be stressed in particular:

- EN 55011 (ISM equipment - industrial, scientific and medical radio frequency equipment)
- IEC/EN 61000 (EMC - electromagnetic compatibility)
- EN 61800 (PDS - power-drive systems)
- EN 60204 (safety of machinery)
- EN ISO 16484 (building automation and control systems)
- EN 50178

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Mains type:
A mains type TN-S shall be met in the entire building.
I. e. connection of the N and protective conductor must not be provided in any switch cabinet or field device.

A power supply system 3x 400V 50 Hz with ± 10 tolerances acc. to the national determinations is available.
The phase order of all low voltage systems including three-phase plug sockets is L1-L2-L3 (right-handed rotating field).

Electromagnetic compatibility - EMV:

1) The consumers "test-stand converter" and "cooling machines" will be fed by the low voltage main distribution (NSHV) no. 1 and 2.

This is a net of second environment (industrial power supply systems) EN61000-6-2 and EN61000-6-4.

a) If the product is delivered as power-drive systems (PDS), the product standard EN 61800-3 is to be met. Appropriate systems of category 3 for above-mentioned environment shall be offered.
b) Consumers and generator-like working converters, if these do not come onto the market as PDS, shall be offered acc. to the specialized standard series EN 61000 and EN 55011 for the above-mentioned environment.

The resistance to jamming shall be realized acc. to the acceptance criteria "A". I. e. that the consumers in the fix jamming range work without restrictions and without noticeable change of the operating values.

Jam emitting of the consumers into above-mentioned system shall be limited to the limit values of category C2.

2) All other consumers (products) will be fed by the low voltage main distribution (NSHV) no. 3.

This is a net of first environment (public power supply systems) EN61000-2-x and EN 61000-3-2 and EN 61000-3-12.

The resistance to jamming shall be realized acc. to the acceptance criteria "A". I. e. that the consumers in the fix jamming range work without restrictions and without noticeable change of the operating values.

Jam emitting of the product into the supply system of above-mentioned environment shall be limited to the limit values defined for this.

If the product falls into the definition of standard EN 55011, the product shall be offered in class B (suitable for inhabited area and/or public supply systems).

Suitability of the products for use in above-mentioned environment shall be proven by certificates of nationally or internationally approved authorities or institutes.

Definitions:
- definition EMERGENCY-OFF see EN 50418

- one main switch is power supply disconnection unit acc. to EN 60204-1 section 5.3.2 a) thru c)
- main switch with EMERGENCY-OFF function (color marking red / yellow)
- band switches shall make interventions possible without turning off the entire system (color marking - not red / yellow)
- repair switches are in general sense as band switches (color marking - not red / yellow)

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General requirements
Suppliers shall inform themselves on the local conditions and shall coordinate the arrangement and erection of assemblies and switch cabinets with assistance of the Contracting Agency.

The supplier shall submit a document showing all kind of medium and feeding required in due time.

All documents like installation drawings, execution and mounting drawings, schedules and personnel deployment plans shall be submitted for approval in due time prior to start of work.

Prior and during performance, schedule and safety coordination shall be provided together with the coordinator appointed on site.

The documents made available by the Contracting Agency may neither be copied without permission nor made available to third parties nor be evaluated in a different way.

During the warranty period, a customer service employee of the supplier must be available for repair work at short notice.

This term must be component of the offer as binding schedule assurance.

The standard hard- and software of the system manufacturer must not be modified.

With the Contracting Agency, the supplier shall coordinate interfaces with other systems.

Couplings via I/O level shall be provided potential-free.

In case of point-to-point couplings, the receiver will supply the sender with the required operating voltage.

Equipment selection
Only products in original condition without any modification may be used.

Switching units shall be selected in such a manner that they show an equal electrical and mechanical working life subject to the switching frequency or an extensive adaptation to the working life of the machine is given.

Meeting the limit value guidelines of the manufacturers of operating means is mandatory.

Control units need to be dimensioned for a constant current of at least 2.

Physical ambient and operation conditions
The mains interruptions generated by the equipment shall be limited to the limit values of EN 50178.

In case of temperatures deviating from the details of EN 60204, appropriate measures will need to be coordinated with the Contracting Agency.

Mains supply and equipment for disconnection and switching off
Selectivity shall be met.

Terminals for the connection to an external protective grounding system shall be provided.

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If main switches have an EMERGENCY-OFF function, they shall be dimensioned for the switching capacity required and shall be provided with the color marking red / yellow.

It must be possible to secure a main switch with at least 3 padlocks, shackle thickness 8 mm.

Generally, separation of handling and switch axis of a main switch may not be possible.

Preferably, the main switch shall be installed in the switch cabinet side wall with the following exceptions:
a) Line-up installation of switch cabinets, the main switch will be screwed on the mounting panel by means of a bracket. The switch cabinet door will be recessed whereas the requested protective type must be given.
b) Casing with removable lid (plastic): the main switch shall be equipped with lid locking, i. e. the lid may can be removed only with the main switch in OFF position and if it is not locked.
c) In exceptional cases, main switches for important protective purposes may be located in the switch cabinet (e. g. for sprinkler release), that means for systems that may not be switched off accidentally under no circumstances. On the cabinet door, a sign "main switch inside" as well as respective lettering on the switch will be required.

Band and repair switches
On main current side, they need to switch 3-phase and the associated auxiliary current circuit 1-phase.

Lettering shall be provided IAW their function and their shut-off range (Formica sign at least 100x50mm or other lettering system agreed with the Contracting Agency.

Turning on again may not cause an automatic start.

Protection against electric shock
Inside the casing, a protective degree of at least IP 2X or IP XXB must be given.

Over-current safety devices
With using several series safety devices, selective shut-off behavior must be given.

Protection from overloading of motors
Thermal protection up to a current strength of 25 Ampere shall be provided with circuit breakers for motor protection.

For existing thermal earth contacts or PTC elements, these shall be included into the protective system.

Automatic restarting of a motor after response of the overload protection shall be avoided.

Converter-fed three-phase motors being operated in continuous operation with rated frequency shall be dimensioned accordingly or equipped with external cooling.

Control circuits
The connection terminals of transformers need to be of the same type and quality as the relays or line-up terminals.

Control transformers must have primary taps for 95% and 105% of the rated voltage.

With direct voltage, a residual ripple of max. 5% shall be kept.
In order to facilitate troubleshooting, auxiliary circuits must be subdivided (e. g. in functional groups) and secured accordingly. Where necessary, the respective circuits shall be locked.

Transformers, rectifiers and switching gear may only be loaded up to 70% of the permitted rated capacity.

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24VDC and 24VAC 50 Hz are permissible as control voltage.
In exceptional cases, 230VAC 50 Hz can be used. For this, a technical statement shall be submitted to the Contracting Agency.

Solenoid valves, electric lifting magnets, couplings and brakes shall be operated with 24VDC.

Operation
All regulating units need to be dimensioned for an operating time of 100%.

Electric lifting magnets shall be dimensioned in such a manner that they will be loaded with 80% of the listed holding load only.

Solenoid valves must be connected with plug-type connectors.

Outside the electronic control, control units may not be circuit-like connected among each others. Exceptions: safety-relevant functions and protective locking.

The contacts of the control units must guarantee for a reliable contact without additional wiring even with the low currents of the control inputs.

Control units must transmit and/or process signals with positive potential.

Operator interface
Command and control units as e. g. position sensors and hand-operated control units must not be used for direct switching of magnets, couplings and brakes.
Switching functions in safety circuits form an exception from this.

For position and proximity switches, valves etc., the activated condition shall be shown at the device and/or the plug by LEDs.

With more than 5 signaling lights, a lamp test circuit shall be planned.
The push button color is blue.

The use of luminous push buttons is limited to the application type "confirmation".

Colors of the signaling lights and push buttons in coordination with the Contracting Agency.

Electronic equipment of machines
The power supply outlets required for the operation of programming equipment shall be installed within the switch gear combination close to the electronic operating means.

The number of slots for input/output assemblies shall be chosen in such manner that after the initial operation, 10% for standard machines, 20% for special machines, however, at least 1 slot remains free for each one input and/or output assembly.

For programmable controls, EN 61131 is valid with all parts.

The assembly and installation regulations of the controls manufacturers shall be kept as minimum requirements.

Control configurations (central and local assembly) shall be provided machine-specific and required

coordination with the customer.

Memory capacities of the program storages (for application programs) shall be dimensioned in such a manner that at least 10% in case of standard machines

and at least 20% in case of special machines remain free as a reserve per central unit.

It must be possible to plug the programming devices in and out even during operation.

Switch cabinets: arrangement, structure and casing
The size of the switch gear combinations (switch cabinets, casings, installation rooms) shall be dimensioned in such a manner that at least 10% space reserve remains after the initial operation for later upgrading of standard machines and at least 20% for special machines. In detail, the reserve includes the devices of the individual functional groups as well as terminal strips, wiring ducts, hinged frames, slots and program storages.

Switch gear combinations need to have ring eyes for transport of the equipped units.

The transport width shall be planned subject to the transport ways. 3 meter is the maximum value for the width.

Construction parts and interior components need to be made of materials showing at least low flammability.

Color of the switch cabinets: RAL 3035, the base is platinum gray acc. to RAL 7036.

All driving and regulating units (couplings, brakes, motors, solenoid valves and lifting magnets) as well as the corresponding junction boxes and plug-type devices shall be mounted in such a manner that in built-in condition testing and maintenance can be accomplished easily also without special tools. Accessibility to other machine components that need to be serviced may not be restricted by this.

Switch gear, e. g. contactors, time relays, protective equipment as well as line-up terminals shall be mounted on mounting rails acc. to EN 50 022.

Control units will be considered easily accessible if they can get replaced within 10 minutes without special tools.

Assemblies and devices may not be arranged on several levels or at the side walls.
No switch gear may be arranged behind hinged frames. Hinges frames may be equipped only from one side (from the front). It must be possible to lock hinged frames in the final position.

Excluded from the prohibition of side wall installation are main switches (side wall installation is standard) and switch cabinet cooling equipment, if necessary.

Switches, push buttons and alarms shall be provided with front fastening and rear connection. The devices shall be connected by means of terminal blocks.

Electrical operating means - except for line-up terminals - in switch gear combinations need to be arranged in such a manner that within a group that the counting numbers increase from the left to the right and from the top to the bottom. This applies for modifications and spare areas as well.

The spacing between the devices and the wiring ducts need to be at least 20 mm.

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Aisle widths and escape ways in front of the switch gear combinations shall be dimensioned acc. to national standards.

The base area (at least 1m wide) in front of the switch cabinets shall be provided insulated. Material: non-slip rubber insulating mat acc. to EN 60112.

If switch cabinet cooling is required, only circulating air heat exchangers (air/air) or cooling aggregates, each with temperature control, may be used. With opening the switch cabinet doors, switch cabinet cooling shall be interrupted by means of door switch. Filter fan and water-air heat exchanger may only be used after consultation. The condensation water shall be drained outside at the switch cabinet and shall be disposed by means of an appropriately dimensioned device.

Functions of ventilation and air-conditioning units shall be controlled, failures and/or breakdowns shall be reported.

The electronic controls need to be installed separated from devices emitting heat and from magnetic fields acc. to the manufacturer's instructions.

If nothing different is given in the specification, casings and installation spaces with installed electronic controls (e. g. SPS) shall be equipped with switch cabinet cooling.

The entire power loss per switch gear combination shall be determined acc. to IEC 60890:1987 (+ Corrigendum 1988 + A1:1995) by means of the manufacturer's directions and shall be entered on the equipment arrangement plan. Acc. to the defined total power loss, respective cooling measures shall be defined.

Completely installed switch cabinets need to met at least protection degree IP54.

Installed position and proximity switches need to show an overall protective type of at least IP65.

The doors (per wing max. 600 mm wide) need to have an opening angle of at least 165°and be designed i n such a manner in-line installation of the switch cabinets is possible. The opening angle of the doors must be given also after erection of the switch cabinets.

Recesses in doors and side walls may not affect the stability and protective type of the switch cabinet.

For the storage of the electrical documents, the insides of the doors shall be provided with sheet metal pockets. The pockets need to be designed in such a manner that DIN A3 documents are widely enclosed. Permanent fastening shall be provided.

With more than 800 mm height, door locks need to be provided with slide rods and handhold, from 1600 mm on with additional center locking mechanism.

Switch cabinet dimensions: different subject to place of installation (height in particular), see specification

Locking: if nothing different is given in the specification, door locking shall be accomplished in square 7 mm.

Conductors, cables and lines
For wiring in the switch gear combinations, flexible (stranded) conductors (wires) must be used.

Outside of switch gear combinations, stranded lines shall be used. One-wire insulated conductors (wires) are not allowed. This does not apply for additional protection and potential equalization conductors.

Conductors, cables and lines with low-flammability insulation must be used.

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Flexible metallic electrical conduits or metal-clad lines may only be used in exceptional cases, e. g. as protection against hot and/or cutting particles. This does not apply for shielded lines.

In wet areas of oils, emulsions and similar agents, PUR lines or lines with at least equal features are to be used.

Wiring, installation
Installation is included in the delivery of the machine.

On switch gear, a maximum of only two conductors may be connected per terminal.

On each line-up terminal, only one conductor may be connected per connection point.

Loose terminals may not be used.

Numbering of the terminals will be provided increasingly from the left to the right and/or from the bottom to the top.

All connections must be clamped and/or plugged. Soldered connections are not allowed; data and measuring lines are excepted from this. All line ends in screwed connections must be provided with individual wire end sleeves or cable lugs (crimp connections). Here, two or more conductors may not be combined.

The plug-in screw terminals of all devices need to be provided with pressure piece, wire clamps or clamping lug for protection of the conductor, i. e. direct contact between screw and conductor is not allowed.

Cross connections on adjoining line-up terminals may be provided by connecting webs only. Wire bridges are not allowed.

Within the wiring ducts, no terminals, line connectors or other electrical operating means may be used.

Protective-conductor terminals shall be additionally marked with their consumer affiliation. This marking can be applied on the input line.

Wire colors, wire marking
The entire courses of conductors, cables and lines of circuits not being switched off by the main switch shall be marked in
"orange" (external voltage).

The colors listed in EN 60204-1 shall always be met.

If no information is given there, the DESINA stipulations may be taken as orientation (in coordination with the purchaser); exception: lines for sensor/actor: yellow is not allowed.

Wiring within casings
Wiring must comply with the circuit diagram; i. e. the wiring sequence has to comply with the drawing sequence in the individual drawing sections from the top to the bottom and from the left to the right.

In case of duct wiring, a wiring duct shall be arranged in front of the terminal strip.

Wiring systems other than duct wiring may only be used upon written approval.

All lines in switch gear combinations coming from the outside, terminals and/or junction boxes shall be run on line-up terminals or terminal plug-in adapter.

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A profiled rail shall be installed in the switch cabinet for fastening incoming and/or outgoing lines.

Wiring outside casings
On all factory-mounted systems, system components, assemblies and devices, all screwed connections shall be checked prior to initial operation at the place of installation and shall be retightened, if necessary.

Connection lines for portable consumers with 3 AC 500 V may not be longer than 3 m.

An individual line shall be run to every device. Looping through is not allowed, except for bus systems.

Project-related exception: "For accomplishment of a two-phase frost protection on air handling systems, the actuating signal of the valve may be looped via the frost guard. Further exceptions need the Contracting Agency's approval."

For protection against penetration of moisture and/or mechanical damage, line entries in casing and operating means from the top are not allowed. For lateral line entry in moist and/or wet surrounding, a drip elbow shall be inserted in the line.

Each machine and/or each main switch area shall be provided with individual installation ways. Band switches are part of the main switch area.

Data, bus and measuring lines shall be installed separated from high voltage lines and/or shall be shielded sufficiently.
These as well as telecommunication lines shall be installed in separate, yellow enameled cable trays.

If standard cable trays subsequently become date/telecommunication lines, they shall be marked yellow across the entire routing at least every 3 m, if overall enameling cannot be provided any more.

Only metal line ducts are allowed.

Lines liable to breaking which get moved under standard operating conditions need to be pluggable on both sides.

Mobile electrical components of a machine shall be connected via plug/receptacle combinations.

All actors and sensors shall be connected pluggable (applies for machines and systems delivered as unit).
Project-related exception: "System components and assemblies of the technical building equipment distributed as well as managed and controlled by the building's measuring and control system will be connected directly."

On each terminal/connection points of a plug/receptacle combination, only one conductor may be connected to.

In lines of switch gear combination to terminal boxes and/or switch gear combinations or terminal boxes among themselves, 10% reserve wires need to be available per cross section and

destination after the initial operation. The space reserve shall be distributed evenly across all fields.

Non-used conductors (wires) shall be individually run on designated terminals and/or plug-in contacts. If this technically cannot be accomplished, e. g. in plug/receptacle combinations, surplus conductors shall be insulated.

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Line ducts, connection boxes and other boxes
Ducts may only be filled by max. 70 %, in case of standard machines up to max. 90 %.

Rigid metallic electrical conduits and their connections shall be screwed. Angle and T-pieces are not allowed.

Flexible metallic electrical conduits and their connections: with the impact of liquids (e. g. cooling lubricants, oils), a protective hose installation may only be used if the penetration of liquids into casing and operating means in case of defective protective hoses can be avoided definitely.

Line ducts shall be provided with hinged lids and quick-release lock. Opening and closing must be possible without additional tools.

Connection boxes shall be used if
- lines need to be branched
- splitting of lines is required or purposeful with regard to transport or relocation of the machine
- a transition between flexible and high-flexible line must be provided
- individual units with fix (cast) connection lines (e. g. transducers, proximity switches) get connected
- one central connection must be provided for one assembly or also for the entire machine

Junction or connection boxes must be arranged in such a manner that
- the opening will be in the plumb line
- the opening will be accessible without dismantling other machine components
- the bottom edge of the box will be at least 400 mm above the access level and the top edge max. 2000 mm

In connection boxes, only terminals may be applied.

No lines may be looped through connection boxes.

Junction boxes of devices must not be used as connection boxes.

In plastic casings, only non-metallic screw connections may be used.

Junction and other boxes need to have a protection degree of at least IP54.

Electric motors and corresponding equipment
Maintenance-free motors shall be used, three-phase motors preferably of the construction types IM B3, IM B5 or IM B35. Other motors may only with written approval of the purchaser.

Basically, four-pole three-phase motors shall be used (1500 min -1).

Prior to delivery, comparison with the valid stock list shall be conducted in order to avoid a too high diversity of storage types.

Basically, rolling bearing with permanent lubrication shall be used.

Insulation of the motors must at least comply with the heat class "F" acc. to DIN IEC 85.

Three-phase motors of more than 3 kW shall be provided for rated voltages in delta connection so that they are qualified for star-delta starting.

If there are several motors with more than 30 kW available at one machine, they shall be turned on timely sequenced.

Drives with V-belts shall be switched in such a manner that their slipping off will be avoided (e. g. star/delta

connection, soft starting).

A rotary direction arrow must be applied clearly next to the motor.

For motors, only protection degree IP44 or higher is permitted.

Attention shall be paid to good and riskless accessibility to drives mounted on platforms. The installation of lifting platforms must be possible, if necessary.

The rated output of the electrical motors shall be adjusted to the mechanical power requirement of the machine. If due to the power shifting, a major motor must be chosen, over-dimensioning must not exceed 30 %.

If a motor is installed in such a way that its capacity sign cannot be seen directly, a second capacity sign must be applied next to the motor which can be seen clearly.

Accessories
For the supply of accessories (e. g. printers, data terminals, data output devices), grounded receptacles (at least 2 each) shall be installed in addition to the data interfaces. Receptacle color: orange

Plug connections for data interfaces shall be provided with captive covers.

The protective degrees of the accessory shall be adjusted to the ambient conditions.

Per cabinet field, the cabinet lighting shall be switched via a separate door position switch.
However, switch cabinet lighting shall only be used if requested in the order. Connection to the lighting main.
Project-related exception for chillers: "Connection via short-circuit-proof lines picked up in front of the main switch are allowed (identification as external voltage). All other TGA switch cabinets are already connected to the lighting main."

If accessory is connected via a transformer or a power supply unit, only secondary voltages of AC 50 Hz 230 V and DC 24 V as well as AC 50 Hz 24 V are permitted.

The protection of light circuits will be provided with circuit breakers.

Identification, danger signs and reference signs (operating means identification)
Terminal boxes are to be marked with danger signs.

Function designation of command and signal devices must be provided directly above.

The type plate of the switch gear combination shall be applied outside close to the power supply connection and/or the main switch.

Reference signs (operating means identification)
The identification signs must not be applied directly on the device and must not get lost with replacement of the devices.

The identification must be permanent and applied in such a manner that it can be seen with completely assembled equipment. This device identification shall be repeated on panelings and cover hoods.

All devices outside installation rooms need to be identified with identification signs in engraved, embossed or etched design. These signs must not be fastened by gluing.

Within installation rooms, identification signs to be pushed on the line ends above the devices shall be used.

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The identification method with signs applied next to the device can be used further on if this method seams to be appropriate.

For this, suitable, self-adhesive plastic or paper signs may be used.

Terminal boxes shall be marked outside with identification signs showing the terminal strip number.

Each cable and line end shall be equipped with a clear and permanent identification sign.

Within the installation rooms, each conductor (single wire) shall be provided with a permanent and captive number (connection identification). This may only be set aside if explicitly mentioned in the specification.

All in- and outputs of electronic controls shall be identified with addresses.
With replacement of assemblies, the identification must remain captive on the slot.
The address might (possibly due to its length) also be the terminal number. However, this only in coordination with the Contracting Agency.

Technical documentation
Technical documents shall be compiled in ring binders and shall be provided with a table of contents. The binder format has to meet the paper format.

Schematic diagrams shall be prepared in the language of the country and in English.

Approval of documentation: if no determinations were made in the general part, the following determinations will apply. Not later than 4 weeks prior to the start of construction, the supplier has to submit the electrical documents to the purchaser in duplicate for approval. The electrical equipment must not be prepared by the supplier until he has received the documents provided with possible modifications and the approval note. If any further modifications on the electrical equipment result, the modified documents will need to be submitted again.

Filling the lettering filed on the electrical documents is included in the delivery. Lettering requirements shall be coordinated with the purchaser.

In additional to the documents requested in EN 60 204-1, control, system and process diagrams with standardized symbols, preferably of DIN A3 format, including corresponding system and process descriptions shall be supplied.

As CAD system for the electrical diagrams, the highest EPLAN version valid at the time of the preparation has been approved.
Course drawings or general drawings referring to the building layouts shall be supplied in DWG- or DGN format (disk, CD-ROM). Please refer to the specification for format deviations (e. g. dxf format can be found as well).

Basically, the sheet format for circuit diagrams and connection drawings is DIN A4 landscape format. (DIN A3 only upon inquiry). The pages of the entire circuit plans shall be numbered consecutively.

The plans must be suitable for microfilming.

In case of electronic controls, system-related data carriers (e. g. disk, CD-ROM) shall be supplied as well for data storage.

The listing shall be prepared acc. to the factory specification as contact plan, functional plan or instruction list each with footer and shall be supplemented by a cross reference list of all program elements as well as a comment list.

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In the listing, all inputs, outputs, meters, times, markers and segments shall be provided with comments.

If there is no definition given in the specification, the contact plan shall be chosen.

Descriptions are to be prepared:
- for data blocks: structure and content, for data words the meaning as well as possible limitations
- for function blocks: the effect, the parameterization as well as any borderline case considerations
- for program blocks: a description of the mode of operation

The listings and data carriers to be supplied need to contain the programs required for control and documentation comply with the current state and shall be reproducible on the programming devices available at the operator.

All documents on used operating and visualization systems are included in the delivery. Among others this includes licenses, manuals, system descriptions, installation discs, boot discs, used drivers, the description of structure/data storage as well as interfaces.

Connection plan
Signal exchange with other machines, interlinking, external equipment or superordinated systems shall be shown and described combined including the external connections.
Among others, the description must include the following:
name of the signaling or receiving unit acc. to circuit diagram (e. g. circuit breaker Q38)
function (e. g. spindle drive)
activity (e. g. released)
connection points (plug and terminal numbers)
marker and/or data block address

All terminal strips as well as the connection cables among themselves and to the switch cabinets shall be shown in an overview giving cable designation, cable number, number of wires and wire cross section.

Arrangement plan or arrangement table
Additionally, EN 61 082-4 applies. The local position and designation of switch cabinets, terminal boxes, operating stations, control, command and signal devices, drives and other devices of the electrical equipment need to be shown on an arrangement plan.

Circuit diagrams
The circuit diagram and its type of presentation must comply with the DIN EN 61 082 requirements.

Also bus structures and the hardware structure of the visualization system shall be shown in the circuit diagram.

For all intelligent assemblies (also PC), the supplied hard and firmware version as well as the hardware settings (DIL switch) shall be recorded in the circuit diagram.

For all electronic controls or assemblies, complete schematic diagrams (internal circuit diagrams, with measured value details of the measuring points, if required), oscillograms and references to the measuring devices to be used of the type available from the manufacturer shall be delivered. This also applies for the devices and assemblies shown in the circuit diagrams as "Black Box".

Grounding, shielding and interference suppression measures shall be shown in the circuit diagram, on the connection plan or in internal circuit diagrams of assemblies.

Operating instructions
The operating instructions need to contain all necessary information on how the machine can be reset or

restarted after a failure. Furthermore it shall be described how all functions existing on the operating station (releasable both via switch elements and visualization) operate and which respective locking mechanisms might need to be considered.
A graphic protected zone layout shall be delivered showing the individual protected zones and the corresponding safety-related operating elements (e. g. EMERGENCY OFF button).

Maintenance instructions
In addition, the national maintenance instructions apply.
For testing for proper function of the used safety equipment, respective information shall be supplied for preventive maintenance and/or accomplishment of prescribed tests together with the documentation enabling to have the tests done by skilled personnel. This includes among others adjusting instructions and information on testing possibilities, test programs, auxiliary means, limit values, position lags and follow-on distances.

For all parameterizable devices and control units, parameterization lists/set values, where possible, shall be delivered on data carrier. Parameters/set values deviating from the standard setting of the component supplier shall be marked in particular.

For protection and installation of operating systems, programs and data, a complete description with regard to all required auxiliary means and procedures shall be delivered.

For all devices for which adjustments are to be provided with replacement or a special procedure needs to be considered, these information shall be shown in an exchange instruction in the form of a consequential check list.

For every used device (e. g. drives, actuators, control modules), the appropriate manuals/descriptions shall be supplied.

Parts list
Wearing and spare parts purchased by the supplier as purchased item shall be listed with order data as well as name and address of the manufacturer and/or distributor. For names and addresses a separate list can be prepared as well.

Every electronic equipment part (device, functional group, assembly) must be described in data sheets and/or in the service manual. All kind of required information e. g. type designation, device and/or function description, graphic symbols, wiring diagram, parameterization, input values, output values, response characteristic, power loss must be included.

Initial operation
The initial operation is considered finished as soon as all inspection requirements are met.

Programming and service devices required for the initial operation shall be furnished by the supplier himself.

During the initial operation, the current version of the documentation of soft- and hardware (e. g. technical documents, listings, data carriers) need to be available for the operator at any time.

Technical inspection
For the inspection procedure, please refer to the general prefaces.

Deficiencies or deviations not found in the course of the inspection do not exculpate the supplier from the obligation to met the available regulations..
If deviations from the terms of delivery appear with the inspection of the machine which have not been approved in written form, the supplier will be obligated to remove the deficiencies free of charge.

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Inspection requirements
All technical values forming the basis of the contract are met.

The machine must be at operating state temperature.

A written confirmation that the electrical equipment of the machine complies with the regulations for national safety at work.

The documentation was submitted with the delivery for each machine with the defined number.

For machines in explosive rooms, a copy of the test certificate "Report on the examination of the electrical equipment in explosive rooms" as well as the affirmation showing that the used electrical operating means comply with EN 50 014 and the following shall be enclosed.

For electrical devices used as protective equipment (e. g. overflow protection, leakage indication) in system with materials hazardous to waters or combustible liquids, a type approval certificate shall be submitted.

Costs for tests and certificates shall be borne by the supplier.

Submittal of technical documents
With the inspection, 1 set of technical documents including listings and data carriers shall be handed over to the Contracting Agency for each machine showing all modifications and thus, the current status of the technical equipment. An inspection copy serves the supplier for preparation of the final plans.

Not later than 2 months after the inspection, the supplier must make all technical documents available to the purchaser as original.
If nothing different is given in the general prefaces, this will include 3 sets on paper and 2 sets on data carrier.

In case of non-compliance with this deadline due to the supplier, the purchases, giving appropriate days of grace, reserves himself the right to have missing documents prepared at the supplier's expenses.

Until submittal of the final documents, the contractual service is considered not complete.

Training
An instruction in the machine shall be conducted for the operating and maintenance staff. The time shall be set as required. Among others, the following subjects need to be handled in detail:
- overall function of the machine
- automation concept
- hardware structure
- installation concept
- operating and signaling concept (e. g. operation and failure indication)
- software structure
- modules for aggregates (aggregate modules, linkage module)
- structure of data coupling (e. g. data exchange between machine control and superordinated control unit)
- explanation of interference possibilities for modification of parameters and texts, with presentation of practice-oriented examples
- troubleshooting and tracking by means of the documentation, e. g. with the help of a programming device

With his offer, the supplier shall make a proposal on extend and costs of an appropriate system training in hard- and software.

For performance of the instruction/system training, the records of the documentation shall be prepared accordingly and made available to the course participants.

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10.8 Further additional electrical requirements for the systems of the technical building equipment:

Switch cabinets / distributions:
Safety-related functions in the switch cabinet shall be realized by hardware solutions (conventional), e. g. the following functions:
- anti-frost protection,
- E-stop or emergency-stop,
- main alarms from FDS (Fire Detection System) or AMS (Air Monitoring System),
- overflow protection,
- position and torque switches of drives,
- thermal protection switches or PTC elements in motors.

Control voltage
The voltage shall be generated by control transformers (230VAC, 24VAC) from the three-phase power system and
shall be grounded on secondary side via line-up terminals with disconnection plug. This connection shall be arranged right next to the control transformer.

RCD
All-current-sensitive RCD for consumer circuits with expected direct current portion in the residual current shall be used.

Grounding and potential equalization:
An absolutely potential-free protective conductor must be used. Reliable conductance of the EMC potential must be guaranteed. Only star-shape cross linking is allowed.
The central grounding resistance(s) shall be measured and reduced, if necessary.

Cabling:
- inherently safe line shall be marked blue (ATEX)
- all cables and lines being installed through the test stands "Engine Dyno" and "Chassis Dyno" need to be installed in oil-resistant design.
- for interfaces see interface list
- in air handling units, the installation shall be provided in IP65, conduit in device components with high air temperatures allowed only in metallic

Installation systems:
- installation and connection of all sheet metal ducts and trays in consideration of a EMC-oriented grounding
- the following reserves in the tray assignment shall be met (currently planned final upgrading)
    1. in the test stand: 40%
    2. in the building: 20%
- trays shall be marked with max. 10 meter spacing or at the floor or wall passage (closed passages on both sides, open transitions (e. g. shafts) only one time (Formica sign font size at least 12 mm), marking with colors as coordinated with the ordering party

Repair switch:
- load current-side shut-off, switch with auxiliary contact for 20-230VAC/DC 0.5A

Indicator units:
Indicator units shall be mounted in visible height, possible also in angled or horizontal position. The position shall be coordinated with the supplier of the indicator units and the site supervision. For this, the position of the display at the sensor shall be kept in mind.

Automation system (MACS):

- automatic restart after malfunction or power failure
- WATCHDOG monitoring of all interfaces with malfunction indication

Initial operations - all disciplines:
Prior to the initial operation executed by third parties (switching on power supply), the supplier (all disciplines) of electrical system components shall assure himself of the fact that the cables and lines are connected correctly.

Then the voltage supply for these system components will be switched on and function, running direction and signal transfer will be tested. This shall be recorded in written form and shall be attached to the documentation of the respective disciplines.

Initial operation MSR (measuring and control technology) with discipline:
The initial operation shall be conducted and verified by testing each data and field device from the field level via the automation level up to presentation and operability on the management level.
Verification must be provided in written form in clear list form. The respective test shall be signed by the responsible person (person will be named). Participating persons of other disciplines will also be named and sign for participation in the test.

Furthermore, initial operation and adjustment include:
- protocollary recording of actual currents
- testing the failure indication system

Function tests:
The function test of the individual systems shall be proven by a test run.

They include:
- safety installations
- control and switching devices
- hydraulic balancing (discipline heating, cooling or cold water)
- performance tests

The test runs shall be recorded individually and need to be finished prior to the technical inspection. The records as part of the documentation shall be handed over in the course of the inspection. All measurements relevant for the system operation shall be recorded. During this phase, the contractor must deploy his own staff.

After the test run, during an at least 14-day operating phase the contractor has to prove that the systems meet the guaranteed properties (e. g. partial and full load) in the automatic mode.

If requested, the test phase can be split in winter phase / summer phase / partial load phase.

If the test run does not show a satisfying result, the test run phase will need to be extended until a final positive result has been achieved.

Documentation:
All drawings and listings as well as other textual documents shall also be made available on data carrier. Data formats shall be coordinated with the ordering party. Drawings normally in drawing format (e. g. DWG or DGN).
For all system components, a colored overview scheme shall be applied sunfast under foil / glass on an appropriate location.

All relevant system components shall be provided with an identification number to be entered on the overview scheme and applied on the fixture or field device on site.

10.9 Measuring and control technology of the technical building equipment

General
For an extensively automatic and economic operation of the entire technical building equipment, a freely programmable automation system in SPS/DDC technology is planned. The system provides regulating, control and monitoring tasks for the technical building equipment listed in the system description.

The systems are shown in MSR-specific function diagrams. The basis for this is the construction design of the technical building equipment.
Each function diagram has a data point list acc. to ISO EN 16484 attached. The functions of the systems and parts are described in the system description and are converted in data points.

The system has to provide the following functions:

- controlling
- regulation
- operation/failure indications
- self-monitoring

A digital scanning regulation with electrical actuating drives shall be offered as type of regulation. It must be possible to upgrade the system and to connect it to a superordinated building control system or central control system. For this, the system must be equipped with a respective interface module.

Via the interface module, all
- indications
- switching commands
- measurants
- control units
- actuating elements

of the substation (in the other controller) must be controllable by the control system. Response times of < 10 seconds are to be met.

The switch cabinets for the systems are functionally divided in:
- manual operation and monitoring via operator panel (HMI) in the switch cabinet of the controller
- generation of control voltage
- hardware circuits containing all safety-related combinations
- power electronics assembly for switching and energy distribution to the field devices
- control voltage assemblies for conversion and combination of signals
- controller with input/output assemblies containing all regulating and control units

The contents of the scope of services described from now on in the individual titles are services of the bidder MAC and will need to be included proportionately into the unit priced, if nothing different is given in the individual items.

This includes hard- and software, manual operation level, switch cabinet, engineer processing, installation, initial operation, inspection documents, instruction of the operating staff.

Plans and documents (in national and English language)
The system diagrams, circuit diagrams and software plans shall be prepared as wiring diagrams and/or flow

charts on CAD and need to comply with the latest DIN-EN 61082. Standardized terms and symbols shall be used. As soon as the services have been completed, the data carriers shall be handed over to the Contracting Agency.

The wiring diagram of the main circuit and the control circuit shall be separated clearly.

Individual controllers and suchlike presenting a closed unit can be shown symbolically. The terminal connections and their designation need to be visible. Then, attachment of the description of the internal circuit diagram of the simplified shown part is mandatory. The devices and/or destinations to be connected shall be designated in the circuit diagrams clearly.

Identification of the devices acc. to IEC 750 and information on their types as well as adjustment need to be shown in the circuit diagrams.

For cabling of the field devices provided by others, the contractor shall hand over the locations showing the identifications from the control diagrams or circuit diagrams to the "cabling" contractor by means of cable lists with clear determination of the cable designation.

Approval of plans
The below listed documents shall be submitted to the Contracting Agency for approval (no function test!). This submittal must be provided in due time so that possible change requests can be considered without causing any delays in the schedule.

- up-dated control diagrams and data point lists
- wiring diagrams
- assembly plan of the cabinets with dimensions (front and interior views)
- overview plans with connections to all connected switch cabinets
- terminal plans with cross reference to other switch cabinets
- cable lists (see cables and lines)
- parts lists giving the makes of the devices
- assignment plan of the automation system, incl. addressing
- overview plan with entry of the locations of the operating units and information foci

The documents shall be prepared acc. to EN 61082 and ISO EN 16484.

Wiring diagrams in the switch cabinet
It shall be seen that during the installation, just one current set of wiring diagrams, if applicable with manual entries, can be found in the switch cabinet.

Cables and lines
The cables between switch cabinets of the system, field devices, peripheral devices and external disciplines will be provided by others acc. to the information from the cable list to be prepared by the contractor. For this, the destinations shall be entered on the assembly drawings (as described in "Plans and documents") and marked additionally on site with adhesive tags.

The cables and lines will be installed by others in installation system of up to approx. 30 - 50 cm in front of the respective field device. The residual installation and fastening of the cables up to the cable entry is included in the scope of services and delivery of the contractor and shall be included into the unit prices as connection work. The cables shall be fastened up to 10 cm in front of the cable entry and shall be provided with pull relief.
Max. 2-loop cable reserves (diameter = 10 cm and/or acc. to bending radius of the cable manufacturer) on field devices are allowed. Larger loops will be measures only if technical necessity for maintenance and control can be proven.

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The cable list needs to show: output, destination name, cable type, cross section, number of wires, marking of the wires up to the output and destination, (also for external disciplines).

All cables and lines shall be identified with permanent labeling (acc. to general directions) both at the beginning and the end.

Connection of cables on both sides as well as between system switch cabinets and switch cabinets of external disciplines and further cables to drives and/or actuating elements and field devices etc. are services of the contractor.
For the calculation it shall be kept in mind that the connection considered rigid, flexible, non-shielded and shielded cables and lines with all kind of connection accessories.

Cable connection includes:

- in front of cable entries: workmanlike installation, fastening, cutting in length, peeling the insulation of the cables and insulation measurement (power cable - measurement and record per line section)
- insertion, sealing the cable passage
- fastening on the cable strain-relief clamps incl. fastening material
- connection on bus bar or terminals incl. small and fastening material.
- labeling

Only the feed-in of the switch cabinet will be connected by the "ELECTRICAL" contractor.

Prior to submittal of the as-built/inspection documents, all cable and wire designations are to be updated on the terminal plans(in the system cabinets of external disciplines as well).
Each connected cable shall be documented with the opposite name. The opposite names shall be obtained by the contractor at his own responsibility.

Prior to initial operation of all system, the commissary of the bidder has to assure himself of the accuracy of the property-furnished electrical installation. The bidder is liable for all own services also if damage is caused by external accessories.

Signal exchange
Voltage for the signal exchange (linkings) is defined with 24 V. The signals will be made available by a potential-free contact. The signal receiver provides the linking voltage.
Signals serving for activation or indication shall be provided via a normally open contact (operating current principle) and signals serving protective purposes or for alarm or failure indication (operator, system protection) in the quiescent current principle (ISO EN 16484).

Emergency-off chain/safety chain
The emergency-off and other safety connections do not apply for one discipline only but engage in many switch cabinets. Due to this, a circuit with the so-called "master" emergency-off was defined. The MSR switch cabinet provides the MASTER functions and distributes the signals to subordinated switch cabinets (also external disciplines) by signal duplication.

Switch cabinet
The MSR cabinets include control tasks, system monitoring, automatic regulation of the systems of the technical building equipment as well as necessary automation equipment, incl. coupling relays for signal receiving from safety-engineering systems (fire alarm system, room monitoring system) as well as all circuit breakers for switching fans, circulating pumps and other aggregates.

Supply of the MSR cabinets will be provided via a fused feed-in in consideration of the required capacity. The supply voltage for the SPS/DDC system shall be generated newly in each separately fed switch cabinet.

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Supply of the electrical actuating drives will be provided via a separate control transformer.

Cable entry: from the bottom.

The cables shall be fastened on C-profile rails by means of cable clamps and shall be sealed with cable entry bushings (with elastic clamping profile for equal cross section). In particular for the air-conditioning of the switch cabinet, sealing must be provided reliably.

On all fields, cabinet fastening shall be provided. At an appropriate position, the switch cabinet shall be sufficiently secured against tilting.

All installation parts of the basic equipment and the hardware components shall be clearly arranged and combined in the assemblies with space reserves (see general part).

Casing, switch cabinet doors and hinged frames that might be required shall be grounded with respective cross sections and flexible Cu flat cable (16 mm²) both on top and on bottom.

Attention shall be paid on EMS-oriented design of the switch cabinet: measuring cables shall be run separated from power cables, EMS cable screw connections and EMS shield buses with earthing clamps shall be used, cable shielding has to be kept up to the connection point also within the switch cabinet, etc.

All devices, components and systems need to show the CE symbol.

All live parts in the cabinet can be removed individually, shall be covered against contact, protective type at least IP 20.

If necessary, live parts shall be covered with acrylic glass. The bus bars shall be arranged in uniform positions.

All outlets, also auxiliary contacts, shall be wired. All wires of the field-sided cabling shall in the switch cabinet be connected with terminals (reserves). Loose cable ends in the wiring space are not allowed. Door connections shall be installed in cable hoses.

Field devices
The field devices shall be delivered completely with installation-related accessories and small parts, shall be mounted, connected, put into operation and adjusted. All field devices shall be identified with permanent labeling acc. to the designations in the diagrams. Labeling will each be provided by the supplier (contractor).

Pipe-sided installation
For field devices of the MSR to be mounted on pipe side (sensors etc.), furnishing for the mounting discipline (medium" will be provided only. As soon as assembled, the electrical connection will be provided by the MSR contractor again.

Duct-sided installation
For field devices of the MSR to be mounted on duct side, installation will be provided by the MSR contractor himself in coordination with the discipline "air handling systems". If inspection openings are required for installation and/or maintenance of the field devices, these will need to be furnished by the "air handling system" contractor in coordination with the site supervision.

Placing of field devices
The MSR contractor alone will be responsible for placing the field devices, their readability and correct

arrangement in the flow of the medium. The control mode will be decisively defined by the correct position of the sensors.

Software
The software shall be prepared acc. to the system description. The attached control diagrams as well as the data points serve as supporting material.

Prior to preparation of the software, the individual functions of the system shall be clarified with the Contracting Agency.

The application software is quoted as fixed price and is bound to the number of data points on a percentage basis, i. e. if the number of SPS data points increases or decreases, the price of the application software as percentage will change as well. The real and communicative data points DO/AO/DI/DIC/AI are defined as data points. The number of data points can be taken from the information list.

Preparation of the application software shall be provided in consideration of the described requirements on the management system. All linkings, indications and defined target values, switching commands, alarms, binary points etc. are included in the fixed price.

Program structure and operation are subject to the used engineering tool.

The software shall be prepared in CFC, SFC only. (included in the engineering tool only)

Preparation of the static mimics and animation with dynamic fade ins acc. to functional diagram and data point lists. One or several mimics shall be prepared for each system.

The mimics will be derived from the attached control diagrams and the "as built" system and shall be submitted to the operator for approval 8 weeks before the system's completion.

The following documentation information are part of the application software:

- function block description for system aggregates and controlling in written and graphic form, e. g. for functions as: starting-up, de-icing operation, room temperature control, return speed limitation, failure change-over, shutdown regulation etc.
- parameter sheets for control circuits giving the values for KP, TI, MIN, MAX, target values etc.
- E/A check list for alarm, analog and digital in- and outputs giving the indications on the SPS, date and signature of the performing person, both for the system (sensor level) and the management system (mimics).
- 3.5" disc / CD with label and current software status

Function description, parameter list and check list shall be submitted to the Contracting Agency IAW the directions for documentation prior to the date of the inspection.

Hardware
The MSR functions of the operational systems will be assured by autarkic working, locally arranged controllers (DDC / SPS).
Safety-relevant connections and controls will be hard-wired and provided acc. to terms of safety. They must not be realized via the software.
The system software must be that flexible that an optimum adjustment to the system requirements regarding simultaneous accomplishment of any regulating tasks, controller tasks and system monitoring is given.

The below described software and program features must be offered for each controller.

The system software must meet the following requirements:

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a) Real time operating system with clock and calendar (he system time will be synchronized between all controllers every day, the server is master)

b) The application parameters must be available for the authorized operator at any time for input, modification and cancellation. This requirement is particularly important since the system must not stand still.

c) Accessibility will be provided by limitation by means of access control. Protection shall be split in at least 3 levels. Access will be granted only by password.

1st level: monitoring
- monitoring all data points and parameters

2nd level: parameterizing
- modification of application parameters like temperature, humidity, operating periods etc.

3rd level: operating
- modification of regulating characteristics like the proportional band width etc.
- operating the system components per HAND functions

The application programming language shall serve for easy realization of any regulating tasks as well as allow for reconditioning and further processing of operating data and the accomplishment of individual logic functions and control programs.

Basically, the standardized programming method FUP (function plan) shall be used. The AWL (instruction set) shall be used only in exceptional cases. The operator must be put in the position to understand and adjust the instructions and functions.

Requested operators of the programming language:

- Arithmetic:
Processing of measured and calculated values as well of the logical 1 and 0. The final results need to be provided with defined units and it must be possible to choose them via data point addresses (virtual data point).

Addition
Subtraction
Multiplication
Division
Min/Max selection
Enthalpy (from temperature and humidity)
Calculation of the absolute humidity by means of the relative humidity
Absolute value and/or absolute difference
">" generates logical 1 or 0 as result
"<" generates logical 1 or 0 as result
Memorizing meter and elements for time delays.
Boolean logic: processing of messages as well as logical results (1 or 0). Results are 1 or 0.
Or (not exclusively)
And
Not

Commands:
As result of logical operations and/or comparisons, the following commands need to be programmable.
On (and/or second speed frequency)

Off
Slowly
Higher
Deeper
Release event program

Requested operands

In addition to measuring values, messages and events, it must be possible to process the following:

- constants in the range of +0.0001 up to +9999
- time
- weekday
- system-related operands like parameter file no. etc.

In addition to the actual regulating tasks, the DDC/SPS system must be able to provided the following additional functions via the superordinated building control system:

- software-related solution of the entire system control
  incl. locking with the regulating functions
- spontaneous indication of messages with recording
  on the printer
- central limit value control of analog values
- time-dependent switching
- event-dependent switching
- manual selection/remote control (on/off)
- presentation of mimics and status images of the control diagrams listed in the specifications in form of color graphics on the monitor. The given parameters and the actual values need to be fade in on the mimic at the subject position. As well as the status of the control and regulating equipment. As regards air handling systems, images of the same system concept can be used several times. If in case of other disciplines, there are only controls and monitoring units, these can be compiled in table form acc. to disciplines.

All messages, failures and alarms shall be shown by means of a flashing light.

Differentiation is made in:
1. maintenance messages and other information
2. failures
3. function failure (alarms)
By means of this differentiation, the effect of a failure will be evaluated.

Example:
A breakdown of a double pump is considered uncritical and will be called a failure.
However, if both pumps break down, this will ask for comprehensive measures (e. g. cut off of all PST) and will be called a function failure.

All failures and status indications which have already been repaired and/or removed will be kept until acknowledgement.

Definition, documentation and entry of programs, program modules and parameters will be provided by the contractor.

The following operation and indication functions need to be found at the switch cabinet:

- indication of all analog measuring values

- indication of all analog set values (controller output) in %
- spontaneous indication of all failure alarms and alarms
- indication of all operating conditions (status indication)
- modification of target values, time programs, limit values etc.
- manual accomplishment of switching commands
- manual actuating element positioning (hand/automatic switch)

The offered controller must have the following regulating algorithms:

P = proportional control
PI = proportional-integral control
PID = proportional-integral differential

If actuating elements are controlled in sequence, an individual analog output for each actuating element shall be considered and the sequence formation shall be provided in the controller.

The following input and output signals need to be processed

and/or offered by the system:

- analog inputs
  temperature, humidity and pressure sensors
  direct voltage: (0) 2 up to 10 V
  load-independent current: (0) 4 up to 20 mA
  passive sensors e. g. Pt/Ni 1000; Pt/Ni 100 et all.

The value range and the unit can be parameterized freely with the software.

- binary inputs
  potential-free closed and normally open contacts

- analog outputs
  for continuous controlling (0) 2 up to 10 V and/or (0) 4 up to 20 mA

- binary outputs for control tasks and/or 2-point or 3-point control of potential-free changeover contacts, switching capacity 230 V, 5 A.

It is mandatory fort he controller to have the described software and program features. The system software must be buffered on the controller for at least 48 hours.
The application parameters must be available for the authorized operator at any time for entry, modification and cancellation. This requirement is particularly important since the system must not stand still.

The application programming language shall serve for easy realization of any regulating tasks as well as allow for reconditioning and further processing of operating data and the accomplishment of individual logic functions and control programs.

For calculation of the application software, the following issues need to be considered: the software shall be prepared acc. to the attached function description. The design control diagrams serve for clarification of the function description.

The software includes preparation of the control diagrams (EN ISO 16484) on basis of the assembly design of the disciplines which need to get approved by the Contracting Agency, the conversion of the control circuits into a system-specific address catalogue in the controller.

Including importing, initial operation, adjustment and testing with modification/supplementation of the program, if required, in connection with all connected systems. Documentation of the function package inspected by the Contracting Agency.

The standard programs acc. to the system description are part of the application software. The program shall be structured in such a manner that the data can be fed by the operating personal without any programming knowledge.

A data point address of the data points shall be proposed for coordination with the Contracting Agency. The BMK (identification of operating means) of the disciplines shall preferably be used again.

Additionally, the software must have a reserve of 30% for addressing and control circuits.

The standard programs for preparation of all application programs shall be submitted to the Contracting Agency on data carrier after completion together with the documentation including all necessary licenses.

Management system
The system shall be constructed in forward-looking technology and shall be completely adjusted to the offered DDC or SPS controllers (automation level).
Despite of its complex technology, the system shall be controllable by the system operator and shall facilitate working accordingly.
Optimum system reliability and availability as well as a comfortable graphic user interface shall also be given.

Compatibility and upgrading as system-management system must be possible.

It is planned to connect additionally available and future DDC systems to the system. For selection it shall be considered that external makes will need to be integrated as well.

Peripheral devices can be coupled independent of location and distance via generally available ways of communication.

Basically, the system has to provide monitoring, controlling and optimizing the processes in the operational systems fully automatically.

10.10 Building site facilities

1.The building site facilities are auxiliary facilities required for accomplishment of contractual services.

2. The contractor shall submit a site facility plan considering the possible utilization of construction site, installation of supply, worksite delivery ways, prior to start of approval and coordination.

3. The expenditure for the official approvals, inspection of site facilities, preparation of possibly required structural calculations, delivery of all operation material, energy costs, costs of utilities, removal of all soiling arising in the scope of utilization of site facility, keeping free of snow, winter maintenance belong to the secondary services of respective items.

4. Obtaining of all traffic approvals for the erection and dismantling as well as the orderly operation of worksite is the contractor's business. He shall request all required approvals in time and at his expense.

5. Increased requirements regarding personal protection, dust protection and noise protection (noise reducing machines acc. to latest standard) shall be included in the unit prices.

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10.11 Crane systems - Technical regulations and implementation rules

1. Scope

The services will be accomplished in accordance with the valid regulations, current version, as well as in accordance with the supplementary text below.

For calculation of the hoisting machines, the FEM rules from the European Federation of Materials Handling and Storage Equipment are to be met.

For calculation of the crane, DIN V ENV 1993-6 (DIN 15 018) together with the current standards are to be met.

2. Accomplishment

2.1 Construction documents:
The contractor has to prepare a general drawing showing his services according to quantity measurement on site and the drawings of the site supervision.

Information needs to be given about interference with existing elements and elements yet to be provided due to this performance.

Upon approval of the individual services, detail and shop drawings showing constructions, dimensions, type of fastening, sealing material, corrosion protection etc. are to be prepared.

If any licensing requirements for accomplishment of this performance are to be met, e. g. structural proof, fire rating, welding proof etc., these documents are to be submitted to the site supervision in due time together with the drawings for approval.

The shop work may not be started prior to approval of the prepared documents.

2.2 Surface protection
If the specs do not include any additional information, all construction parts will need to be delivered derusted metallic bright and with prime and finishing coat.

Construction parts that cannot be processed any more after they have been installed shall be pretreated in such a manner that corrosion cannot appear subsequently. The construction parts are to be delivered with finishing coat; all connecting means installed on site need to be of non-rusting material.

If nothing different is demanded in the specifications, corrosion protection shall be planned for stress factor I = industrial atmosphere acc. to DIN EN ISO 12944-1.

Surface treatment shall match the type of corrosion protection acc. to DIN EN ISO 12944-4.

a) Coatings

Prime coats:
inside: declared layer thickness at least 40 micrometer, single application

outside: declared layer thickness at least 80 micrometer, double application in different colors and additional corner protection treatment

Finishing coats:
application on site after accomplished installation or factory-applied

inside: declared layer thickness at least 80 micrometer, double application

outside: declared layer thickness at least 160 micrometer, double application

In case of inaccessibility, the outside corrosion protection shall be used for all steel parts.

The single steps shall be accomplished in different colors. Installation damage shall be repaired workmanlike.

b) Hot-dip galvanization

Hot-dip galvanization of the steel parts shall be provided acc. to DIN EN ISO 1461 with a layer thickness of at least 80 micrometer and/or acc. to DIN EN ISO 10684 for connecting means with a layer thickness of at least 40 micrometer.

The processed steel has to be appropriate for hot-dip galvanization since the construction has to be planned and manufactured suitable for hot-dip galvanization.

Damage and surface defects due to subsequent processing are to be repaired by means of a zinc dust coating by fourfold application with a layer thickness of 140 micrometer after previous thorough cleaning.

c) Duplex systems

The treatment of surfaces of metal coats and the selection of materials shall be coordinated. Pre-treatment with acids and copper sulfate is not allowed.

Inside:
coating declared layer thickness at least 80 micrometer, double application

Outside:
coating declared layer thickness at least 160 micrometer, double application

2.3 Accomplishment
Transport and protective measures

The fixtures must be transported to the site duly, must be unloaded and stored intermediately, if required (period of storage should not exceed 1 week).

Protective and securing measures for the performance are to be provided.

2.4 Installation
The installation performance has to be provided in such a manner that previous performances will not be affected in their function.
For fastening of existing construction elements, the permit of the site supervision needs to be obtained. The connection shall be provided in such a manner that no kind of corrosion damage might appear.

10.12 Absorption panelling - Technical regulations and implementation rules

1. Scope

The activity have to be done according to italian law and after the following specifications.

2. Material and constructional elements

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The mounting parts have to be correctly delivered, unloaded, temporary stored on the building site.
The constructor has to care for protection and security his activity. After the transport of the mounting parts to the building site they have to be accepted by construction management. Damages on the mounting part have to be eleminated before installation.

3. Construction

Construction documents:
The constructor has to deliver a key plan of his activities based on the local measurement and the drawing of the construction management. He has to give information about the influence of existent and future elements of his activity.
After release of separate activities he has to prepare details and shop drawings in which you can see the construction, descripton of attachment, sealing material, protection against corrosion, towed loads etc.

Construction elements:
The thickness of the sheet plate or the steel plates have to be braced, that there will be no deformation neither through treatment nor load after the installation.

Changing of length because of variation in temperature, load, treatment etc. must be possible so that there is no lose of functional capacity.

Form and dimension of necessary folded sheet plates have to be worked out according to material type, thickness and function and load.
Joint connection which are not welded have to deliver the same performance.

Connecting devices
Welding works have to be done acc. to DIN EN 29692. The components which will be connected have to be welded constantly after the prescribed preparation.

The welding seams must be ground smooth if demanded by the construction management.

Bolted connection have to be done acc. to DIN EN ISO 1478.
The screws must not be stripped because of vibration. Galvanized or not corrode construction have to be connected with hot-dip galvanized or not corrode screws.

Attachement on the building
The installation of the performance has to be done without damage of performance in his function that already was done.

To connect the absorption panelling on actual construction units the permission of the construction management is needed. The connection has to be made, that there will be no corrosion damages.

Surface protection
If there are no additional statements in the specification, all construction parts have to be delivered white-metal blast unrusted, and shop-applied priming coat.
Type and material of the priming coat have to be coordinated with the construction management.
Constructed parts which can't be treated after installation, have to be prepared that there will be no corrosion later. If the construction parts should be delivered hot-galvanized or which finished coating, the installed connection devices on the site have to be out of rust-resistant material.

Galvanising
Galvanising has to be performed according to DIN EN ISO 1461 with a layer-strengthens of min 80 m. The layer-strengthens for connection devices has to be performed min 40 m acc. to DIN EN ISO 10684.
Bind-galvanized steel plates get a zinc layer of min. 275 g/m2 on both sides.

The processed steel must be suitable for hot-dip galvanizing, the construction has to be hot-dip galvanize-fairly constructed and manufactured.

Damages and defects because of later treatment have to be repaired with a zinc coating layed on in four times with a layer-strengthens of 140 m. The positions have to be thoroughly cleaned before.
If the galvanization of the repaired construction past remains visible, the hole construction past has to be provided with an aluminium covering coating.

4. Additional services

The following points have to be taken into account:
Flow diagrams, operating diagrams, time schedules, layouts and other drawings which are needed additionaly to existing drawings and to fulfill the demanded achievement.

Building site erection plant with accommodation, stores, offices and garages when needed for operation of the building site and demanded by the employer.

10.13 Sound insulating doors, gates and windows - Technical regulations and implementation rules

Scope of service
The service includes a complete door, gate and window system ready to operate with delivery and installation.

Size information and tolerances
The indicated gate dimensions refer to the frame opening size between gate soffits as width size and/or top edge finished floor and door lintel. The size information shall be reviewed prior to door ordering. The permissible frame opening size tolerances shall be considered.

Delivery
Material and make directions are to be considered as quality standard.
At delivery of equal products, the proof acc. to approvals, test certificates etc. shall be provided free of charge by the bidder.

Installation
The installation shall be accomplished true to line acc. to entered meter lines.

The grouting of frames shall be accomplished with fine concrete grain 0/7 mm unless not described otherwise in item text.

The permaplastic pointing with silicone-free material between frame and exposed concrete and/or exposed masonry is included in the unit prices, this means, a complete service at the door frame formation shall be delivered in the area of exposed concrete or exposed masonry.

Material
Tension-free directed fine plates acc. to DIN EN 10326 shall be used for door leaves.

The sound and thermally insulating filling shall be made of incombustible mineral wool mats acc. to DIN EN 13162 construction material class A 1 incombustible, acc. to
DIN EN 13 501-1.

All hardware parts shall be provided in concealed accomplishment. The handles shall be provided in closed shape (end bent towards door leaf) with long and short escutcheons.

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Mortise locks for fire and smoke stop doors, prepared for the installation of a profile cylinder of locking system and locking plate.

Surface protection
A prime coating acc. to DIN EN ISO 12944-1 shall be applied as corrosion protection.

The material selection and pre-treatment for prime coating shall be adjusted to each other.

Accomplishment and function
Sound protection doors as multilayered sheet steel doors with test certificates concerning the achievable, evaluated sound insulation values R'w related to the total construction considering the structural bypasses.

The observance of requested sound insulation values will be tested at the site after installation acc. to DIN EN 20140.

The door system shall be coordinated to each other and represented as complete element with frame, door leaf, hardware, sealing, threshold formation, pointing, surrounding wall. The arrangement of threshold rebate is not allowed.

Secondary services
The following listed items shall be included in the unit prices.

Process, function, time, occupation plans and other drawings required as supplementation to existing plans and for fulfilment of requested services.

Worksite mobilization with billets, storage and office rooms, workshops as far as required for operation of worksite and requested by Contracting Agency.

Chiseling work, spot plastering work, grouting of frames, pointing, electrical connection and cabling of individual components among each other.

10.14 Raise floor work - Technical regulations and implementation rules

Standards
DIN EN 12825 Raised floors incl. regulations for application

General
The raised floor has to be provided as even and unshiftable surface supported by an existing unfinished concrete surface.

When walking on the slab covering, it must not noticeably move or deform.

The floor slabs have to be adapted and accurately fit in such a way that interchangeability of the slabs is ensured even after long-term use.

Renewed and repeated installation of slabs has to be easily feasible without having to perform subsequent work such as additional alignment, etc.

The floor slabs have to be insensitive to air humidity and cleaning moisture as well as to oil and fuels.

Provision of openings in the floor slabs for cable insertion and ducts, etc. has to be possible. Such openings must not reduce the load-bearing capacity of the floor slabs. Otherwise measures have to be taken to achieve the original load-bearing capacity. It should be possible to provide openings at any point. Abrasion and rust must be avoided at the cut surfaces.

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The grid pattern of the substructure has to be adjusted to the fixtures and the switch cabinet arrangement. In addition, an assembly drawing has to be prepared. The substructure must not be produced until the submitted plan documentation has been approved by the local supervision.

A reviewable structural calculation shall be provided free of charge.

A free sample with all details shall be submitted if requested.

The surroundings of the switch cabinet and control desks has to be kept accessible.

The whole raised floor construction in connection with the unfinished floor shall be protected against impact and airborne sound transmission acc. to DIN 4109.

The floor has to be aligned true to level and uneven spots in the unfinished floor need to be leveled. For this reason, the substructure has to be adjustable to any height.

The finished raised floor must be a non-drumming and non-creaking floor.

Substructure

Unshiftable, vertically and horizontally stationary substructure consisting of galvanized steel profiles with exposed height adjustment in large-format support grid with the following requirements:

- height adjustability of all supports
- no mechanical anchoring of the support bases in the floor (dowel fastening as surcharge)
- the bearing grate has to be horizontally supported by the surrounding walls and fastened with dowels

The supports have to be fastened on the unfinished floor in order to eliminate ambient noise (clattering, etc.). (Dowel fastening will be specified as surcharge.)

The construction shall make it possible to install single panels or bigger rows of panels by keeping the stability.

Slab covering

Electrostatic discharge has to be guaranteed without additional elements. The leakage resistance shall be measured acc. to NFPA 56, Art. 2522 and verified by means of test reports by a licensed testing institute.

Recesses for the switch cabinet areas have to be provided in the covering, however, height equalizing profiles have to be installed to place the switch cabinet flush with the floor. Cantilever slabs resulting from floor openings have to be protected against tilting by screwing the slabs to the substructure.

Technical requirements steel raised floor test benches:

Distributed load:	30 kN/m2
Concentrated load:	10 kN
Slab grid:	60 x 60 cm
Overall height: approx.	145 cm

Technical requirements wooden raised floor control room:

Nominal concentrated load

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acc. to DIN EN 12825: 4 kN

Slab grid: 60 x 60 cm
Overall height: approx. 145 cm

The load values have to be observed even in case of cutouts and bridgings.

Materials:

a) raised floor slabs
Mineral floor slabs, cell fiber reinforced calciumsulphate slab, reinforced with galvanized sheet steel on the bottom.
Edge protection on all sides, glued over the whole slab thickness, for mechanical protection and against penetration of moisture. Slab covering of rolled checkered aluminum plate.

Floor slabs consisting of welded profile frames, covering plate provided as walk-on surface made of checker plate. Profile frame and checker plate firmly welded with each other. Whole floor slab galvanized.

Wooden sandwich panels
Floor slabs as sandwich panels, core material circumferentially protected against fire and moisture absorption. Slab bottom provided with galvanized, 0.5 mm thick steel coat and circumferential edge protection. Floor slabs free from formaldehyde. The whole slab is resistant to lubricating oil, hydraulic oil, benzene.

b) Substructure consisting of galvanized steel supports adjustable to any height.

c) Appropriate cutting and adjusting work on supports, doors, recesses etc. are paid off with the items of this specification, incl. required bearings, supports and other special constructions. In addition, adjusting work of the raised floor to the walls of the single rooms is also included in the specs items. It cannot be assumed that the room dimensions are within the grid (60 cm). (This applies to the complete structure incl. covering).

d) We would like to point out once again that the contractor has to check and ensure if the materials are compatible with each other (e.g. dust-bonding paint and adhesive of the support bases).

Performance / Installation

a) Protective covering, stabilization

If it is necessary to protect the floor surface by covering or to remove already installed surfaces for installations, these services will be reimbursed separately. Even special measures such as tie rods for floor stabilization in case of use before completion will be reimbursed separately.

b) Assembly drawings

The contractor will prepare the assembly drawings (grid plans) on the scale of 1:50 or 1:20 acc. to own measurements and has to submit these drawings to the supervision in triplicate for approval. The grid plans submitted by the designer have to be mandatorily observed.

c) Grid markings

The contractor shall mark the support grid of the raised floor by means of stone cutter's marks made of aluminum or plastic immediately after the installation drawings have been approved. Prior to installation of the

raised floor supports, the technical installations will cause interruptions of work. These services are paid off with the unit prices of the raised

10.15 Coating work - Technical regulations and implementation rules

Required additional work and/or deficiencies, which will be realized during the construction progress and could hardly be realized or not realized at all at the time of object inspection, shall be reported to the ordering party in writing. Samples and/or sample surfaces shall be provided under the local conditions and recorded in a protocol. The optical impression, consumption quantities and layer thicknesses may be thereby determined.

The protective function of a surface protection system significantly depends on the thickness of the protective layers. The information always refers to the dry layer thickness of the layer or layers mainly acting as protective function.

Only materials of one coating manufacturer may be used. The compatibility of the layers following one another has to be proven. The processing of all materials has to be performed meeting the provisions of the manufacturer.

During processing of two-component epoxy resins, the information in the technical guidelines as minimum temperatures, relative air humidity, moisture content of the base and reworking periods has to be met.

Aftertreatment and protective measures against weather influences by means of foil, water-retaining covering for aftertreatment of concrete.
Aftertreatment for coating materials by provision of each favorable drying and hardening conditions until reaching the characteristics for use.

Impurities from AIR-WATER-SOIL shall be avoided during repair and coating work. The empty packages arising during coating work shall be disposed acc. to the currently applicable environmental protection guidelines.

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11. Specifiaction

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12. List of unit prices
separate list

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13. Bill of quantity
separate list

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14. Analysis of unit prices
separate list