# **STANDARD DESIGN CRITERIA (StDC) BASIC REQUIREMENTS**





# Change Index

Version	Description	Tool Owner
All	Update March 2022	Corporate CEM/PME
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Holcim Technology Ltd Corporate CEM/PME

Document Number: LHSTX-PM&E-OS09-000000-001-02

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# **HEALTH & SAFETY**



**Health and Safety is our core value.** At Holcim, we want to do more than prevent accidents. We want to create a healthy and safe environment for our employees, contractors, communities and customers based on a true safety culture.

Health and Safety is at the center of everything we do, from the daily routines in our plants to our customers' project worksites and our actions in our neighboring communities. Our aspiration is to conduct our business with zero harm to people. We believe in visible leadership and personal accountability for Health and Safety at all levels and throughout our organization.

#### To reach this aspiration, we are committed to:

- Maintain a global Health and Safety Management System designed to continuously improve our performance and actively manage risk in our business
- Drive for operational discipline by instilling a mindset of safe execution and follow-up
- · Communicate openly with all stakeholders on relevant health and safety issues

# INTRODUCTION

# **Objectives of the Standard Design Criteria (StDC)**

- Provide standard technical specifications to the Holcim community that is based on proven technologies and practical experiences from constructing, maintaining and operating plants.
- Achieve an optimized balance between high Overall Equipment Efficiency (OEE) and Mean Time Between Failures (MTBF) during the expected lifetime of the assets considering the lowest possible CAPEX.
- Ensure transparency and consistency among Supplier's offers to Holcim projects.

# **Application and General instructions**

- The Standard Design Criteria (StDC) covers all engineering projects including Cement and Geocycle.
- The StDC is a reference guideline for designing new plants in Greenfield, Brownfield replacement and revamping projects. This document is also equally applicable and relevant for quarry & plant operation and maintenance teams for achieving efficient operation & maintenance which will ultimately improve the overall plant performance.
- All statements and paragraphs marked with are design provisions for safe construction, operation and maintenance of the plant. Deviations and exceptions are not allowed.
- For non-safety related design variations, justification of the alternative must be properly recorded.
- The Basic Requirements document contains general specifications applicable for Mechanical, Electrical and Civil design.
- The Mechanical Equipment, Electrical Equipment and Systems, and Civil and Structural Works documents shall be used in conjunction with the Basic Requirements section.
- Specifications for Mechanical, Electrical and Civil components of the projects shall be reflected in the Data Sheets (where available). They are intended to standardize the way Suppliers present specifications to Holcim.
- The Standard Design Criteria lists certain codes and standards. In the event that any such specified codes and standards are inconsistent with any codes or standards enforced by law, the most stringent standard shall govern the Contractor's performance as far as not in conflict with local regulatory obligations.

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# 1. PLANT CLASSIFICATION: MECHANICAL, ELECTRICAL EQUIPMENT, CIVIL AND STRUCTURAL WORKS

Plant classification follows the specification as per Holcim Asset Coding (HAC) Manual. The Contractor shall adopt the mentioned Plant classification thus ensuring proper identification of all Equipment and the associated Cost of the Works. Also refer to paragraph 3.3.7 Identification/Marking.

# 2. EQUIPMENT STANDARDIZATION, MATERIALS AND STANDARDS

# 2.1 Equipment Standardization

The use of identical Equipment and components shall be maximized throughout the Project, where practical, thus minimizing spare parts inventory while at the same time optimizing maintenance procedures and parts interchangeability.

Equipment includes:

All Equipment or components performing similar functions at similar capacities shall be identical in make, model and size and shall include identical components and parts such as bearings, motors, seals, drives, control devices, etc.

# 2.2 Materials and Standards

a) The metric system (SI-units) applies exclusively for the design of the Plant including all Equipment, provided that it is accepted for construction, fabrication, erection, safety and environmental purposes in the country of project execution. This requirement is extended to all documents, e.g. all specifications, drawings and operation- and maintenance manuals.

The Contractor shall always include all metric equivalents on all drawings and specifications, should the metric system not apply for any portion of the Plant.

b) Hazardous Substances need to be clearly labeled, identified, declared and reported using the Globally Harmonized System (GHS) as well as any specific hazard classification system regulatory requirements applicable to the country. All cargo, carriers and containers etc. used for such substances shall meet this requirement, declared in the respective forms i.e. Safety Data Sheet (SDS) and reported at all times. An SDS must be obtained and kept at the site for all hazardous substances used to be stored there. A hazardous substances risk assessment must be completed for all intended uses of hazardous substances at the site.

Hazardous materials (inflammables, gases, corrosives, explosives, etc.) shall be stored in suitable locations, to avoid pollution, fire and explosions.

Proper ventilation, accesses, containment, and security shall be provided according to specific requirements or local regulations.

c) **Prohibited and restricted substances** as declared by International and Local regulations and standards cannot be used.

#### 3. HEALTH AND SAFETY AND MAINTENANCE ASPECTS

#### 3.1 General

- a) The overall design shall be performed in a way to facilitate safe assembly and erection at site and method statement shall be provided. The design shall allow for maximum pre-assembly in order to minimize site fabrication and works.
- b) Overall design shall ensure ease of maintenance and repair and result in facilities with adequate provisions for safe operation, servicing and maintenance. Provisions shall be made for proper maintenance and for the easy removal and replacement of mechanical, electrical and other equipment.
- c) The sizing of rooms and the location of equipment shall ensure adequate clear space for equipment maneuvering and maintenance operations. The arrangement of valves, control equipment and similar items shall ensure easy access and shall not be in concealed areas.
- d) In the selection of materials and equipment, due consideration shall be given to the availability and cost of replacement parts and the need for special tools and instructions in performing maintenance operations.
- e) HAZID (Hazard Identification) study shall be carried out during the basic engineering of the project, and any findings or recommendation shall be incorporated into the final design.
- f) HAZOP (Hazard and Operability) study shall be carried once the P&ID, functional design specification (FDS) and other engineering specifications are ready, and any findings or recommendation shall be incorporated into the final design. The HAZOP study shall be chaired by an approved competent person who is independent of the project or the contractor.
- g) Precautions for plants and equipment operating in regions with very low ambient temperatures to be obtained from the Holcim memo for precautions for the design of mechanical equipment in cold climate conditions.

#### 3.2 Health and Safety

#### 3.2.1 General

The design must comply with Holcim Group Health and Safety standards as well as the applicable Health and Safety regulations in the Country of project execution. The more stringent Standard applies in case of conflict.

#### 3.2.2 Potentially explosive atmospheres

Areas with potentially explosive atmospheres shall be classified into corresponding Hazardous Areas as per ISO/IEC 60079-10 Part 1 and Part 2 and equipment located in those areas (Ex zones) shall be designed according to the applicable international and local standards defined for those areas (ATEX, IECEx or NEC/SEC certified). The demarcation of all Ex zones shall be clearly documented by the Contractor and the Hazardous Area Classification (HAC) drawings submitted for review by the Owner. The plant layout shall be designed such that to minimize the Ex equipment and prevent unauthorized access (e.g. switchgears, control panels, electrical equipment, junction boxes could be located away from the dusty area - none Ex).

# 3.2.3 Warning signs

Warning signs to warn personnel of workplace hazards and instruct employees on ways to avoid injuries shall be as pictograms in English and local language(s).

# 3.2.4 Start-up alert systems

Every Plant Department shall be equipped with visible and audible start-up alert systems to notify start of process equipment.

All moving machinery shall be equipped with warning devices being activated before and during any movement.

# 3.2.5 Emergency stop devices

Every Plant Department shall be equipped with local manual and automatic emergency stop devices, thus preventing injury to people or damage to Equipment.

# 3.2.6 Guards

Safety guards shall be installed in order to prevent, where necessary, any physical contact with moving machinery or moving Components.

Guards shall be easy handable, colored and removable only with the aid of a tool or in conjunction with an interlock.

Guards must be manufactured from good quality and durable materials to prevent access and/or the ejection of material or objects.

Positioning of the guard must provide adequate clearance between the hazard and the reach point of body parts being protected.

Guards must be designed to reduce manual handling risks when being removed or replaced (e.g. lifting points or handles).

All machine safety guards shall be designed in accordance with local regulations or International Standards.

# 3.2.7 Explosion Vents

The explosion vents shall be designed according to ISO/EN 14491 and be located in such a way that the explosion waves propagate away from the building into open areas that are made inaccessible to the workers during normal operation of the plant. Restricted access and platform shall be provided to maintain the explosion vent.

# 3.2.8 Isolation Valves

Lockable isolation valves for compressed air, water and fuels shall be provided at each diversion, building entrance and next to consumption points.

# 3.2.9 Traffic Plan, Roads and Parking Areas

Access roads to Owner's customer shipping areas, service(s) building(s), and raw material & fuel storage areas shall be kept separate from access to production areas.

An alternative access to be considered in the layout as part of the rescue plan.

Pedestrian areas, roads (vehicle traffic routes) and parking areas shall be laid out and designed to provide distinct separation from each other.

The design of roads and accesses shall be done in the way to facilitate maneuverability of the equipment, minimizing the need of reversing, and by avoiding interference between different equipment and vehicles that would operate at the area.

# The extent of properly paved roadways and surfaces needs to be assessed for each project based on the environmental impact and occupational exposure to dust.

#### 3.2.10 Pedestrian Walkways

Pedestrian walkways shall be well marked with a clear separation from areas that are intended for vehicle traffic. Roadway & railway crossings shall be well marked with appropriate signage alerting operators and pedestrians of the danger. If the walkway passes under a conveyor, overhead protection shall be provided to protect pedestrians from falling objects.

# 3.2.11 Sub Surface Equipment Installation

Equipment installations below ground level shall be justified and if required properly designed (escape routes, space for maintenance, water drainage...).

# 3.2.12 Permanent life lines and anchor points

Anchor Points must be suitable for the conditions prevailing in the workplace (e.g. weather, salt water spray or other corrosives, extremes of temperature).

Anchor points must be designed, manufactured and installed to ensure a static load capacity.

Anchors must be able to support 22kN per worker attached.

Anchors must be tagged with their rating.

Anchorages for specific purposes must be tagged as such, e.g. "Work position only", or "Rope access only", etc.

Doors and manholes to vertically access confined spaces shall be provided with double anchoring point and need to be compatible for access and rescue requirements.

# 3.2.13 Dust collecting hoppers

Dust collection hoppers shall be designed for being 110% full of material.

# 3.2.14 Piping

For fixed pipe work, the pipes shall be routed as much as possible away from any vehicle traffic road (to avoid collision damage). If routed alongside a road, protection shall be provided (ex: road railing). Piping shall be marked with color and/or label.

Pipes shall be tested against leakage by pressure test or equivalent.

The route of underground pipe work shall be adequately protected from physical damage such as excessive surface loading, ground movement or ground disturbance and clearly marked (with warnings provided by standard colored plastic mesh). If mechanical joints used, they shall be installed in a closed inspection pit, which is readily accessible for inspection.

# 3.2.15 Forced ventilation

A forced ventilation system shall be provided whenever ventilation is required for regular operation activities.

# 3.2.16 Emergency Showers and Eye Wash Stations

A risk assessment must reveal where Emergency showers and eye wash stations with noncontaminated water at suitable temperature must be provided including:

- a) Each of the three lowest stages of the preheater
- b) Main burner platform
- c) Chemical storages
- d) Wet-chemistry laboratory
- e) Plant control room
- f) Other relevant areas with the risk of exposure incidents due to hazardous substances (i.e. water treatment, ammonia storage etc.)

#### 3.2.17 Water

Source of water accumulation around the site must be avoided to prevent associated health risks (e.g. in malaria areas to reduce mosquitos for vector control, prevent water sources that can be contaminated with rodent borne diseases such as leptospirosis etc.).

Reject flow to the natural environment shall be regulated.

Adequate filtration devices shall be provided to avoid the transport of oil/grease and solids (oils/sand traps) prior to any discharge to external networks and/or bodies of water.

#### 3.3 Maintenance

#### 3.3.1 Accessibility

All Equipment that require periodic inspection, lubrication, cleaning, adjustment, repair or replacement, or that are designed for manual operation or cleaning, shall be easily accessible by virtue of their location or by means of stairs, galleries, fixed ladders or platforms.

#### 3.3.2 Supporting Structures, Maintenance Platforms, Accesses

- a) The design and specifications of platforms and walkways must follow the requirements of ISO 14122 as a minimum.
- b) Anchor points shall be provided to permit the safe use of harnessed access to roofs and sides of buildings.

- c) All supporting structures, maintenance platforms and access facilities to Equipment shall be designed as required to provide the proper and safe access to the Equipment for the purpose of inspection and maintenance.
- d) Concrete silo outlet equipment shall be accessible without ladders and equipped with two sides platform made of grates.
- e) Steel silos outlet equipment might be accessible with ladders conditional to safety engineering provisions.
- f) Distance between floor or platform (fixed or movable) to equipment and instrumentation shall not exceed 1.6m, unless otherwise approved by the Owner.
- g) Platforms have to be dimensioned to provide lay-down areas for spare parts and consumables.

# 3.3.3 Modularity of Equipment

Components of Equipment shall be modular in design thus facilitating easy and fast maintenance, exchange or repair with minimal interference with other components. Quick connectors, plug & socket systems, etc. shall be used to ease maintenance, replacement and repair.

# 3.3.4 Hoists

- a) Hoists, monorail trolleys and hooks shall be included to enable safe maintenance and repair service.
- b) Unless maintenance with a mobile crane has been considered in the layout, all hoists, monorail trolleys and hooks shall be designed for the safe lifting and transfer of the heaviest and the biggest component of the Equipment.
- c) The appropriate installation of support beams shall be included for Equipment which is moved once a year or less.
- d) Permanently installed hoists shall be included or design shall enable usage of mobile cranes for more frequently moved Equipment.
- e) Safe access and/or platform shall be provided for the maintenance or operation of hoists.

# 3.3.5 Lifting lugs

Equipment to be dismantled for regular maintenance shall be equipped with lifting lugs (or equivalent) and lifting procedure shall be clearly described in the equipment user manual.

# 3.3.6 Condition Based Maintenance

The drives of raw mills, kilns, cement- and coal mills and main process fans shall be equipped for state-of-the art online and/or offline data collection for condition monitoring. Refer to StDC part *Mechanical Equipment*.

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# 3.3.7 Identification/Marking

All Equipment, sub-assemblies, components, units, instruments, pipes and electric cables shall have unmistakable Holcim Asset Coding (HAC) identification. HAC codes shall be appropriately extended where necessary. All markings shall be both in Contract Language as well as in the Project Owner's preferred language. Markings shall correspond with the data, symbols and instructions used in the Operating- and Maintenance Manuals.

Signs shall be provided to indicate the risks on:

- a) Personal protective equipment (PPE) requirement in each area.
- b) On equipment and installations, i.e. accessible equipment with surfaces temperature above 60°C.

# 3.3.8 Access, inspection and clean-out doors on equipment

All equipment shall incorporate access, inspection and clean-out doors as required to assist in daily maintenance of equipment, locating potential problems, verifying the proper operation of the equipment and related instrumentation and control devices.

Access manholes, Inspection and clean-out doors shall:

- a) Be provided with suitable platforms and accesses
- b) Be located where the worker will not be exposed to danger (e.g. projections)
- c) Require a tool for opening
- d) Be of hinged design
- e) If potential to swing open, a measure shall be provided to limit the opening or swinging
- f) Access manholes shall be designed to allow passage, minimum dimensions shall be as per the applicable regulations, but not smaller than 610 mm diameter
- g) Be insulated when installed on insulated equipment

# 4. QUALITY AND OPERATIONAL ASPECTS

#### 4.1 Site Assembly

Equipment shipped to the Site shall be pre-assembled to the considering restrictions for shipping and handling. All Equipment shall be properly prepared for the Site assembly with appropriate alignment holes, match markings and all required temporary bracings. Special devices, parts and tools necessary for proper Site assembly shall be identified and provided with the Equipment.

# 4.2 Welding

All welding materials required for on-site assembly shall be supplied in the required quality and in sufficient quantity including spares. It shall be properly packed and marked according to its intended use. Welding instructions shall be included. The Equipment shall be properly prepared for welding.

# 4.3 Corrosion protection, Painting, Galvanization

a) All steel and cast surfaces of equipment and its supporting steel structures shall have surface preparation and corrosion protection (painting or galvanizing) treatment according to the corrosive categories C1 to C5 of ISO 12944-2.

The required category for the project is defined in the respective Contract document.

- b) The quality of surface treatment systems for equipment shall be equal or superior to the criteria in Paragraph 4.3.1 (Examples of surface treatment).
- c) The color-coding shall meet the requirements of the table in Paragraph 4.3.2 (Color Code for Finish Painting).
- d) Original equipment manufacturer (OEM) standard color is acceptable.
- e) The Contractor shall design its surface treatment systems according to duration class "Medium" (5 to 15 years) or superior as specified in ISO 12944-5, § 5.5.
- f) If there is no seaworthy packing provided, the painting shall give a protection against corrosion during sea transport.
- g) The paint required for touch-up painting work during and after erection of the equipment shall not deviate from the initial paint as per specification.
- h) The following procedures shall be strictly followed for all site-painting work:
  - Touch-up painting work shall recover all damages on the painted surface of the Equipment caused during sea and land transportation, erection and commissioning).
  - Surface treatment shall be satisfactorily carried out prior to commencement of painting. In particular welding spatters and slag shall be removed prior to painting.
  - The addition of any other dilution (thinners) than requested by paint Supplier is not allowed.

#### 4.3.2 Examples of surface treatment

- a) For each relevant ISO 12944 class examples of surface treatment systems of two different corrosion protection and paint specialists are listed in the table below.
- b) The table also lists examples of surface treatment systems which are not covered by ISO 12944 for Equipment operated above 120°C.
- c) Qualities equal or superior to the examples listed in the table below are requested.

				WORKSHOP		ERECTION AT SITE					
ISO 12944 CLASS		EQUIPMENT	OPERATING TEMPERATURE Range	PRE- TREATMENT	PRIME COAT EXAMPLES	DFT	TOUCH-UP & REPAIR	CLEANING	FINISH COAT EXAMPLES	DFT	
C2	In- & Outdoor		Ambient up to 120 C		Surface Tolerant High Solid Epoxy AMERLOCK 400C	100 micron			Aliphatic Polyurethane AMERCOAT 450-Series	50 micron	
					Surface Tolerant High Solid Epoxy NEOPLAST SF 30	80 micron			Polyurethane SF 11/SF 12	50 micron	
СЗ	In- & Outdoor		Ambient up to 120 C	Ambient up to 120 C	p to	Surface Tolerant High Solid Epoxy AMERLOCK 400C	150 micron			Aliphatic Polyurethane AMERCOAT 450-Series	50 micron
		Steel			Surface Tolerant High Solid Epoxy NEOPLAST SF 30	100 micron			Polyurethane SF 11/SF 12	80 micron	
C4	In- & Outdoor	Structures, Sheet Metal, General Equipment	Ambient up to 120 C		Zinc Rich Epoxy AMERCOAT 68- SERIES	75 micron		Remove rust to at least St 2. Touch-up any trans- port or the coating and feather surrounding edges.	High Solid Aliphatic Polyurethane AMERSHIELD	100 micron	
				Cleaning according to ISO 8501-1 SIS 05 59 00 DIN 12944 p.4 Blasting according to: Sa 2.5 (40 - 60 micron anchor profile)	High Solid Epoxy NEOPLAST SG 31	160 micron	Remove rust to at least St 2.		Polyurethane SF 11/ SF 12	80 micron	
C5-I & M	In- & Outdoor		Ambient up to 120 C		Zinc Rich Epoxy AMERCOAT 68- SERIES	75 micron	Touch-up any trans- port or erection damages on		High Solid Aliphatic Polyurethane AMERSHIELD	125 micron	
					High Solid Epoxy NEOPLAST SG 31	160 micron	the coating and feather surrounding edges.		Polyurethane SF 11/SF 12	80 micron	
Not Applicable	Outdoor (visible surface)	Hot going equipment with or w/o refractories, e.g. cyclones, ducts	< 200 C		anchor profile)	Inorganic Zinc DIMETCOTE 9	65 micron			Inorganic Silica Amercoat 741 or Silicon Acryl Amercoat 891 3)	125 micron 2* 25 micron max.
		Hot going equipment with or w/o refractories, e.g. cyclones, ducts	200 up to 400 C		Inorganic Zinc DIMETCOTE 9	65 micron			Inorganic Silica Amercoat 741 or Silicone 1) Amercoat 878	125 micron 2* 25 micron max.	
Not Applicable	Outdoor (non-visible surface)	Parts at cold end e.g. Filters & ducts Insulated from outside	< 200 C		Modified Epoxy	150 micron			not required	-	
		Parts applied <u>before</u> waste heat utilization, e.g. cyclones, ducts Insulated from outside	200 up to 400 C		Inorganic Zinc DIMETCOTE 9	65 micron			not required 2) see footnote	-	
Not Applicable	Not Applicable	Machined surfaces which cannot be coated due to operation		Blank surface	Tectyl 846 or equivalent	-		Cleaning	not required	-	

Table 1: Surface Treatment Examples

DFT: Dry film thickness, Sa2.5: Sand blasting according to ISO 8501-1, St.2: Rust removal according to ISO 8501-1.

#### Footnotes

- 1) Curing temperature of Silicone is above 200°C.
- 2) To be prevented: rain water or condensation of water vapor, otherwise finish coat to be applied on visible surfaces
- 3) Amercoat 891 and 741 of Comp. Ameron (NL) are not suitable with Amercoat 90S, hence Dimetcote 9 required

# 4.3.3 Color Code for Finishing Painting

Object to be coated	Color	RAL No.
Steel structures, conveyor bridge	Squirrel grey	7000
Machinery platforms, landings	Squirrel grey	7000
Portal frames of buildings, doors, window frames	Squirrel grey	7000
Stairs, ladders, walk ways, platforms	Squirrel grey	7000
Piping supports, cable rack supports	Squirrel grey	7000
Duct supports	Squirrel grey	7000
Tunnel-and manhole-lid, trenches	Squirrel grey	7000
Hoist rails, maintenance beams	Squirrel grey	7000
Silos, feed bins, hoppers, chutes	Squirrel grey	7000
Pneumatic transport pipelines	Squirrel grey	7000
Hoists, cranes	Pastel yellow	1034
Maintenance devices	Pastel yellow	1034
Nuisance filters, fans, ducts	Squirrel grey/light ivory	7000/1015
Firefighting Equipment	Tomato red	3013
Handrails, guards, buffer	Pastel yellow	1034
Belt conveyors, apron conveyors, weigh bridges, apron feeders, drag chains, elevators	Squirrel grey	7000
Motors, geared motors, gears	Squirrel grey	7000

Object to be coated	Color	RAL No.
Process filters w/o insulation	Squirrel grey	7000
Main process fans w/o insulation	Squirrel grey	7000
Kiln burners	Squirrel grey/brilliant blue	7000/5007
Process filters, dedusting cyclones, fans, w/o insulation	Squirrel grey/white aluminum	7000/9006
Waste gas ducts, stacks	White aluminum	9006
Preheater, precalciner	Squirrel grey/white aluminum	7000/9006
Fresh water pipelines	Light green	6027
Treated water pipelines	Emerald green	6001
Industrial water tank	White aluminum	9006
Pumps, piping, armatures	Grass green	6010
Waste water: piping, armatures	Bottle green	6007
Sewage treatment plant water	Gray blue with black bands	5008 + black bands
Compressor, receivers and piping for pressurized air	Brilliant blue	5007
Control air pipelines	Pastel blue	5024
Fuel oil (diesel) tank	White aluminum	9006
Pumps, piping, armature (ocher brown)	Brown	8001
SNCR ammonia piping	Canary yellow with dark violet bands	1016 + violet bands
Danger zones (striped)	Black/yellow	9005/1003

Table 2: Color Code for Finish Painting

# 4.4 Name Plates

All name plates shall be made of corrosion resistant metal or Resopal®-type materials (min. 1.6 mm thickness). It shall be securely fitted to Equipment and it shall be clearly visible and easily readable. The following name plates are required:

- a) Instruction plates, to the extent necessary for safe operation, shall be in English Language and the preferred language(s) of the Project Owner
- b) Manufacturer's labels with typical technical data
- c) Plate containing machine code (HAC) engraved according to the Plant Classification (refer to Paragraph 3.3.7 (Identification/Marking))

# 4.5 Special Tools

- a) Special tools are uncommon tools and devices that cannot be purchased by the Project Owner as "normal" tools. Such tools are tailor-made- and supplied by the Contractor for special tasks required on- or operation and maintenance of any piece of Equipment.
- b) Special tools are considered part of Equipment and hence shall be supplied with Equipment. A list shall be provided with the Equipment and identified to the Project Owner in writing. Such tools may be used during the erection of the Equipment, provided that these tools are handed over to the Project Owner undamaged after erection. Damaged tools shall be replaced immediately and free of charge to the Owner.

# 4.6 Bolts, Holding-Down Bolts and Base Plates

All bolts, nuts, washers and securing devices shall be made of galvanized steel. Such items along with base plates, frames, anchoring-, fastening- and shimming materials as required for proper assembly and installation of Equipment shall be included and part of the relevant Equipment. This also refers to all foundation bolts and fastening devices required for the attachment of Equipment to steel structures or concrete foundations.

# 4.7 Consumable Materials

- a) First fill consumables (i.e. lubricants, hydraulic fluids) for flushing or for initial filling shall be included with the equipment supply.
- b) The Project Owner will specify or approve in writing, the brands and types of consumable materials.

# 4.8 Insulation and Cladding

- a) The design of fixing, overlapping and sealing is subject to the Project Owner's written approval.
- b) The type and layer thickness of insulating material for Equipment and ductwork depend on the application (refer to StDC part Mechanical Equipment).
- c) Cladding of insulating layers shall be made of aluminum or galvanized steel sheets of minimum thickness of respectively 0.75 mm or 0.63 mm. Profiled sheets may be used on large process filters and large ductwork.
- d) The use of asbestos containing materials is not permitted e.g. roofing, paneling, insulation or asbestos cement.

# 4.9 Wear Parts and Wear Protection

- a) All Equipment exposed to wear shall be protected by high wear resistant materials of bolted replaceable design. Bolt heads to be protected.
- b) Chutes handling abrasive material can be made of direct wear resistance material or base material with wear resistant liners as described in paragraph a).
- c) Special attention is needed for access to- and handling of replaceable liners. The maximum weight and size for manual handling, as governed in the country of project execution, strictly applies, however, it shall not exceed 25 kg per piece.

# 4.10 Vibration Prevention and Confinement

- a) Machine vibrations are to be limited to acceptable levels by means of decoupling of foundations (where necessary) and adequate design of building structures with due consideration of frequency/excitation aspects.
- b) Drive trains of main machinery (i.e. kiln, mills, process fans and blowers) shall be analyzed to ensure that operational speed does not coincide with natural frequency.
- c) Vibration sensors shall be provided critical equipment such as gearboxes for vertical mills and process fans etc.

# 4.11 Instrumentation tabs and mounting flange

Instrumentation tabs and mounting flanges as well as associated check and calibration tabs for process control Equipment shall be installed latest during erection in order to avoid damage to insulation and cladding after erection of the Plant.

# 5. WORKPLACE AND EXTERNAL ENVIRONMENTAL ASPECTS

# 5.1 Particulate Emissions and Controls

#### 5.1.1 Nuisance Dust Collection

- a) Dust collectors or dust suppression Equipment shall be provided wherever needed so that the Plant is visibly dust-free during operation in order to ensure limitation of dust exposure of workers of max. 1 mg/m3 respirable (8h time weighted average) according to Holcim Hazardous Substances Standard. Related ductwork and chutes shall be skillfully designed and executed, with provisions for adjustment and fine-tuning. Particular attention shall be paid to the dedusting of:
  - Transfer points of conveying Equipment
  - Hoppers, bins, silos
  - Dust producing machinery
- b) The dust collector and suppression Equipment shall be designed to a clean air dust load of less than 30 mg/Nm3 dry or according to Permits and local regulations, whichever is more stringent. Venting ducts shall always be routed to the outside of buildings.
- c) More detailed requirements are outlined in the Mechanical Standard Design Criteria.

# 5.1.2 Process Dust Collection

The process dust collectors shall include the dust collectors for the kiln, the partial kiln gas extraction (bypass), the clinker cooler and all mills, and shall be designed to have a clean gas dust load less than 30 mg/Nm<sup>3</sup> dry or according to Permits and local regulations, whichever is more stringent.

# 5.1.3 Particulate Emission Monitoring

In accordance with the Permits, the stacks of process dust collectors shall have continuous monitoring. Such stacks are equipped with correctly located and dimensioned platforms.

Particulate Emission	Design Value [mg/Nm3, dry gas at 10% O2]	Comments
Dust	10* and Permit	Bag filters exclusively for kiln/raw mill/kiln bypass gas dedusting Stacks of process dust collectors shall include continuous monitoring

\* 97% of the daily average values shall be within the Design Value

Table 3: Particulate Emission Monitoring

# 5.2 Gaseous Emissions and Control

The proposed kiln system shall be designed to be in compliance with the design values in the following table, or as imposed by the Permits or local regulations, whichever is more stringent.

SO2, NOx and VOC emissions from the main stack are continuously measured and recorded. The stack is equipped with a correctly located and dimensioned platform. Values apply also to the weighted average of both stacks in case of a separate bypass stack.

Gaseous Emission	Design Value [mg/Nm³ dry gas at 10% O2]	Comments
SO <sub>2</sub>	<200* and <permit< td=""><td><ul> <li>Primary measures target &lt; 200 mg/Nm<sup>3</sup></li> <li>(Primary measures - raw material selection)</li> <li>Hydrated lime injection</li> <li>Wet sulfur scrubbing</li> <li>Other methods</li> <li>In difficult cases exceptional &lt;400</li> </ul></td></permit<>	<ul> <li>Primary measures target &lt; 200 mg/Nm<sup>3</sup></li> <li>(Primary measures - raw material selection)</li> <li>Hydrated lime injection</li> <li>Wet sulfur scrubbing</li> <li>Other methods</li> <li>In difficult cases exceptional &lt;400</li> </ul>

Gaseous Emission	Design Value [mg/Nm³ dry gas at 10% O2]	Comments
NOx (as NO <sub>2</sub> )	<450* and <permit< td=""><td><ul> <li>Target &lt; 450 mg/Nm<sup>3</sup> (&lt; 200 mg/Nm<sup>3</sup> as future target and for EU installations):</li> <li>Primary NOx reduction measures, and</li> <li>SNCR or SCR</li> <li>Other</li> <li>Preheater/precalciner design shall allow future target &lt; 200 mg/Nm<sup>3</sup> in all cases</li> </ul></td></permit<>	<ul> <li>Target &lt; 450 mg/Nm<sup>3</sup> (&lt; 200 mg/Nm<sup>3</sup> as future target and for EU installations):</li> <li>Primary NOx reduction measures, and</li> <li>SNCR or SCR</li> <li>Other</li> <li>Preheater/precalciner design shall allow future target &lt; 200 mg/Nm<sup>3</sup> in all cases</li> </ul>
VOC (as organic C)	<30* and <permit< td=""><td>Primary measures target 30 mg/Nm<sup>3</sup> (Primary measures - raw material selection) In difficult cases exceptional 50 mg/Nm<sup>3</sup></td></permit<>	Primary measures target 30 mg/Nm <sup>3</sup> (Primary measures - raw material selection) In difficult cases exceptional 50 mg/Nm <sup>3</sup>
со	<1000* and <permit< td=""><td></td></permit<>	
Benzene	<5 and <permit< td=""><td>Primary measures target &lt;&lt; 5 mg/Nm³ (Primary measures - raw material selection)</td></permit<>	Primary measures target << 5 mg/Nm³ (Primary measures - raw material selection)
HCI	<10 and <permit< td=""><td></td></permit<>	
NH3	<30 and <permit< td=""><td>Primary measures target &lt; 30 mg/Nm<sup>3</sup> Primary measures - raw material selection Avoid excessive SNCR-NH3 slip Avoid detached plumes</td></permit<>	Primary measures target < 30 mg/Nm <sup>3</sup> Primary measures - raw material selection Avoid excessive SNCR-NH3 slip Avoid detached plumes
Hg	<0.025 and < Permit	Target < 0.025 mg Hg/Nm <sup>3</sup> Primary measures (raw mat./fuel selection) Secondary measures Low exhaust gas temperatures and dust-to cement mill during direct operation Activated carbon injection
TI, Cd	<0.03 (each) and <permit< td=""><td></td></permit<>	

Gaseous Emission	Design Value [mg/Nm³ dry gas at 10% O2]	Comments
Other 9 HM of European IED	<0.5 (sum) and <permit< td=""><td>"Other nine" include: As, Co, Cr, Cu, Mn, Ni, Pb, Sb, V</td></permit<>	"Other nine" include: As, Co, Cr, Cu, Mn, Ni, Pb, Sb, V
PCDD/DF	<0.1 (ng TEQ/Nm³) and <permit< td=""><td></td></permit<>	

\* for the daily average

Table 4: Gaseous Emission Monitoring

#### 5.3 Noise Emission

Noise emissions are to be kept to a minimum. Local and international limits shall not be exceeded. The following applies:

The maximum noise level shall be 85 dB(A) at one meter from the emitting machine.

- a) Operating noise level for workers shall not exceed 80 dB(A) in 8 h time weighted average (TWA).
- b) Unless differently specified in the permit, at the closest point of the nearest living area outside the Plant the maximum level is 40 dB(A) at night and 55 dB(A) during the day (06:00 22:00h).
- c) Where possible, noise emission levels shall be in accordance with ISO standards 3744, 3746, 4871, 11201.

# 5.4 Liquid Effluents

The amount of liquid effluents shall be minimized by recycling and reusing waste water as much as possible. Unavoidable liquid effluents shall be treated in order to comply with local and international regulations, e.g. "Clear Water ACt" of USA-EPA or similar.

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