



CAWANGAN
KEJURUTERAAN MEKANIKA

BORANG - AC_ACCH - SKM 2 - 2009


CHECKLIST OF ACCEPTANCE CRITERIA


SERVICES : AIR CONDITIONING & MECHANICAL VENTILATION SYSTEM


PROJECT NAME :


FILE NO. :


**ACCEPTANCE CRITERIA
FOR INSTALLATION
OF
AIR COOLED CHILLER SYSTEM**


 CAWANGAN KEJURUTERAAN MEKANIKA		BORANG - AC_ACCH - SKM 2 - 2009			
		CHECKLIST OF ACCEPTANCE CRITERIA			
		SERVICES : AIR CONDITIONING & MECHANICAL VENTILATION SYSTEM			
		PROJECT NAME :			
		FILE NO. :			
ACCEPTANCE CRITERIA FOR INSTALLATION OF AIR COOLED CHILLER (ACCH)					
NO.	ITEMS	CRITERIA	(√) / (X)	DATE/INITIAL	REMARKS
1	DRAWINGS & DOCUMENTS				
a.	Working drawings	Provided and approved before the system installation is carried out. Coordination with other disciplines at site (Coordinated drawings)			
b.	Contract document/Copy of : • Technical Specification • Design Requirement • Tech. Data of Equip. Offered	Provided for references.			
2	TECHNICAL CHECKLIST				
2.1	ACCH				
a.	ACCH no.				
b.	Type of chiller	Air Cooled Chiller			
c.	Type of compressor	Screw/Reciprocating			
d.	Physical chiller appearance	Good condition and no dented/crack.			
e.	Chiller installation	Chiller mounted on cast concrete plinths c/w manufacturer's recommended vibration isolators.			
f.	Chiller plinth	Reinforced concrete.			
g.	Chiller spring mounting	Provide neoprene or equal approved pads between spring and foundation.			
h.	Valves, fittings for pipeworks at Chiller	Valves, fittings such as pressure gauge, strainer, temperature gauge, flexible connector, etc. at the Chiller pipeline in good condition.			
i.	Thermometer & pressure gauges	Provided and placed in the piping adjacent to the chiller unit in the following locations: • Cond. water line entering condenser • Cond. water line leaving condenser • Chilled water line entering cooler. • Chilled water line leaving cooler			
j.	Flow switches	Installed in chilled water & condenser water piping of each chiller. Mounted in horizontal runs at least 5 times the pipe diameter downstream from bend or tee.			
k.	Cable trunking	Surface & concealed - G.I. conduits Cable trays - perforated hot dipped galvanised. Cable trunking - hot dipped galvanised Size - up to 100mm x 100mm (18 swg) Size - up to 150mm x 150mm (16 swg) Size - larger (not less than 14 swg)			
NOTES : √ - Comply to specification/drawings (Acceptable) X - Not Comply to specification/drawings (Not Acceptable)					


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ACCEPTANCE CRITERIA FOR INSTALLATION OF CHILLED WATER PUMP (CHWP)					
NO.	ITEMS	CRITERIA	(√) / (X)	DATE/INITIAL	REMARKS
1	DRAWINGS & DOCUMENTS				
a.	Working drawings	Provided and approved before the system installation is carried out. Coordination with other disciplines at site (Coordinated drawings).			
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2	TECHNICAL CHECKLIST				
2.1	CHWP				
a.	CHWP no.				
b.	CHWP Installation	CHWP & driver installed on on a fabricated steel base plate.			
c.	CHWP insulation	CHWP including standby units insulated with not less than 50 mm injected P.U. foam. Allow for removal of the upper section of the pump on horizontally split type without destruction to the insulation.			
d.	Chilled water pipeworks to CHWP	Installed c/w steel bracket support to CHWP in good operating condition.			
e.	Valves, fittings for pipeworks at CHWP	Valves, fittings such as flexible connector, strainer, isolating valve, check valve, pressure gauge, thermometer etc at the CHWP pipeline in good operating condition.			
f.	Cable trunking	Surface & concealed - G.I. conduits Cable trays - perforated hot dipped galvanised. Cable trunking - hot dipped galvanised Size - up to 100mm x 100mm (18 swg) Size - up to 150mm x 150mm (16 swg) Size - larger (not less than 14 swg)			
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ACCEPTANCE CRITERIA FOR INSTALLATION OF AIR HANDLING UNITS (AHU)					
NO.	ITEMS	CRITERIA	(N) / (X)	DATE/INITIAL	REMARKS
1	DRAWINGS & DOCUMENTS				
a.	Working drawings	Provided and approved before the system installation is carried out. Coordination with other disciplines at site (Coordinated drawings).			
b.	Contract document/Copy of : • Technical Specification • Design Requirement • Tech. Data of Equip. Offered	Provided for references.			
2	TECHNICAL CHECKLIST				
2.1	AHU				
a.	AHU no.				
b.	Installation	AHU install on proper plinth c/w isolator.			
c.	AHU housing	In good condition, not dented.			
d.	Cooling coils & fins	In good condition, not dented.			
e.	Chilled water pipeworks to AHU	Installed c/w bracket support to AHU in good condition.			
f.	Valves fittings for pipeworks at AHU	Valves fittings such as 3 way modulating valve, butterfly valve, balancing valve, flexible joints etc. at the AHU in good condition.			
g.	Condensate drain pipe at AHU	Installed c/w trap, insulation in good condition and comply to specification.			
h.	Ductworks at AHU	Installed c/w insulation in good condition and comply to specification.			
i.	Duct flexible connections	Provided at location where ductwork joins the AHU. Consist of 2 layers of 567g vapour proof canvas or nylon fabric.			
j.	Filter section • Primary filters	Provided and can be remove/replace easily. 50mm thickness. Additional set of filter supplied for number of filter supplied.			
	• Secondary filters (Optional)	Provided and can be remove/replace easily. Air tight seal between filter holding frame & housing (approved propriety factory made). Additional set of filter supplied for number of filter supplied.			
	• Filter gauge	Manometer installed across bank of filters (primary, secondary & tertiary filters).			
k.	Temperature controller for AHU	Provided and in good condition.			
l.	Starter panel for AHU	Provided and in good condition.			
m.	Cable trunking	Surface & concealed - G.I. conduits Cable trays - perforated hot dipped galvanised. Cable trunking - hot dipped galvanised Size - up to 100mm x 100mm (18 swg) Size - up to 150mm x 150mm (16 swg) Size - larger (not less than 14 swg)			
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ACCEPTANCE CRITERIA FOR INSTALLATION OF CHILLED WATER FAN COIL UNITS (FCU)					
NO.	ITEMS	CRITERIA	(√) / (X)	DATE/INITIAL	REMARKS
1	DRAWINGS & DOCUMENTS				
a.	Working drawings	Provided and approved before the system installation is carried out. Coordination with other disciplines at site (Coordinated drawings).			
b.	Contract document/Copy of : • Technical Specification • Design Requirement • Tech. Data of Equip. Offered	Provided for references.			
2	TECHNICAL CHECKLIST				
2.1	FCU				
a.	FCU no.				
b.	FCU installation	FCU install with proper 'C' channel, rubber pad & steel bracket.			
c.	FCU housing	In good condition, not dented.			
d.	FCU cooling coils & fins	In good condition, not dented.			
e.	Chilled water pipeworks to FCU	Installed c/w steel bracket support to FCU in good condition.			
f.	Valves fittings for pipeworks at FCU	Valves fittings such as 2 or 3 way valve, balancing valve, gate valve etc at the FCU in good condition.			
g.	Drain pan for FCU	Galvanized steel and powder painted to withstand ASTM B-117 Salt Spray Test at 500 hours, and proper insulated.			
h.	Condensate drain pipe at FCU	Installed c/w trap, insulation in good condition and comply to specification.			
i.	Ductworks at FCU	Installed c/w insulation in good condition and comply to specification.			
j.	Filter section • Primary filters	Provided and can be remove/replace easily. 50mm thickness. Additional set of filter supplied for number of filter supplied.			
	• Secondary filters (Optional)	Provided and can be remove/replace easily. Air tight seal between filter holding frame & housing (approved propriety factory made). Additional set of filter supplied for number of filter supplied.			
	• Filter gauge	Manometer installed across bank of filters (primary, secondary & tertiary filters).			
k.	Temperature controller for FCU	Provided and in good condition.			
l.	Starter panel for FCU	Provided and in good condition.			
m.	FCU cable trunking	Surface & concealed - G.I. conduits Cable trays - perforated hot dipped galvanised. Cable trunking - hot dipped galvanised Size - up to 100mm x 100mm (18 swg) Size - up to 150mm x 150mm (16 swg) Size - larger (not less than 14 swg)			
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ACCEPTANCE CRITERIA FOR INSTALLATION OF CHILLED WATER EXPANSION WATER TANK					
NO.	ITEMS	CRITERIA	(√) / (X)	DATE/INITIAL	REMARKS
1	DRAWINGS & DOCUMENTS				
a.	Working drawings	Provided and approved before the system installation is carried out. Coordination with other disciplines at site (Coordinated drawings).			
b.	Contract document/Copy of : • Technical Specification • Design Requirement • Tech. Data of Equip. Offered	Provided for references.			
2	TECHNICAL CHECKLIST				
2.1	Chilled Water Exp. Tank				
a.	Tank material	Hot dipped galvanized pressed steel treated with anti-rust compound.			
b.	Expansion Water Tank Installation	Tank provided with extended mild steel brackets (I-Beams) for supporting tank on concrete plinths.			
		Tank installed complete with access cover, overflow pipe, level indicator, scour pipe, etc.			
		Internal tank surfaces painted with tar epoxy.			
		External surface of tank insulated with 19 mm thick P.U. material sheathed with 22 Gauge galvanised steel sheet with at least two layers of anti-rust painting.			
		No water leakages at any water tank joints, pipes etc.			
c.	Incoming make up water supply	Provided c/w stop valve, float valve.			
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ACCEPTANCE CRITERIA FOR INSTALLATION OF PIPEWORKS					
NO.	ITEMS	CRITERIA	(√) / (X)	DATE/INITIAL	REMARKS
1	DRAWINGS & DOCUMENTS				
a.	Working drawings	Provided and approved before the system installation is carried out. Coordination with other disciplines at site (Coordinated drawings).			
b.	Contract document/Copy of : • Technical Specification • Design Requirement • Tech. Data of Equip. Offered	Provided for references.			
2	TECHNICAL CHECKLIST				
2.1	PIPEWORKS				
A.	Chilled/Condenser Water Pipes				
a.	Pipe material	Galvanised iron heavy grade Class C pipes to BS EN 10255:2004.			
b.	Pipe installation & welding works	Carried out by competent person. Competent welder certificate provided.			
c.	Straight vertical run pipe of more than 30m length	Have dirt pockets formed from equal tee and plugs at low point of risers.			
d.	Pipeworks in all plantrooms	Installed with flanges and/or union dependant in pipe size at intervals not exceeding 6m.			To facilitate repair or dismantling.
e.	After pipelines installed	All opening capped or plugged, and left in place until removal is necessary for completion of installation. Piping flushed or blown clean and strainers or line pockets cleared from foreign materials before putting pipelines into service. Piping thoroughly cleaned and free from scale by wire brushing.			To prevent entrance of materials that would obstruct the pipe.
f.	Pipe clearance	Approximately 50mm left between outlet of pipe or insulation and the nearest wall, ceiling or equipment surface.			
g.	Pipe insulation				
i.	Chilled water pipes	Factory fabricated pre-insulated pipes. Field insulation only allowed for valves, flanges and other pipeline fittings and this shall carried out in accordance to the manufacturer's instruction. Personnel conducting field insulation must be authorized by the manufacturer. Letter of Authorization from manufacturer with personnel names must clearly spelled out before any of field insulation work is to be carried out. Combined insulation of two or more pipes shall not be approved. Pre-insulated pipes must have ends suitably prepared to accept welded joints. Samples of insulating material and workmanship submitted to the S.O. for approval before proceeding with the installation work.			


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h.	Pipe jacket material	Above ground - the outer casing (jacketing) shall be a spiral formed lock seamed galvanized iron type of SWG 26 gauges (0.5 mm).			
		The surface painted with an approved rust inhibitive primer and two (2) high gloss-finishing coats to approved colors and to the approval of the S.O.			
		Buried/underground - Jacket material for chilled water pipes shall be high density polyethylene (HDPE) tube conforming to approved standard.			
i.	Underground pipe characteristics	Galvanized iron to BS EN 10255:2004 Class 'C', factory wrapped externally with bituminous comply to BS 534:1990.			
		Complete with pipes pierce through floors, ceilings or walls.			
		Laid at least 900 mm below the surface and adequate provision for protection against vehicle movements and corrosion shall be taken.			
		Insulated pipe laid on a sand bed completely free of stones, back-filled with sand around and over the pipe to a minimum depth of 80 mm.			
		Next layer of backfill shall then be 300 mm deep of material free of stones. The trench shall then be filled with available material			
B.	Condensate Drain Pipes				
a.	Condensate drain pipes	PVC Class C for all sizes.			
		Insulated with 25 mm thick Armaflex or flexible expanded rubber compound.			
C.	Fill Pipes				
a.	Fill pipes	Same material with the pipe it connected.			Size of pipe shall be approved.
	Refrigerant Pipes				
a.	Refrigerant pipes material	Hard drawn seamless copper refrigerant pipes with copper fittings and silver soldered joints.			
		Properly supported and anchored to the building structure using steel hangers, anchors, brackets and supports.			
		For refrigerant piping above 80mm O.D, it may be constructed from extra heavy quality black iron steam pipes with welded joints, in lieu of hard drawn copper refrigerant pipes.			
b.	Refrigerant pipes insulation	Whole of the liquid and suction refrigerant lines including fittings, valves and strainer bodies, flanges, etc. insulated with 50 mm thick Armaflex expanded rubber compound or approved equivalent.			


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2.2	PIPE FLANGES				
a.	Flanges	Provided at each piping connection of equipment, valves or strainers. Weld neck type. Mating faces for each connection must be compatible. Bolt holes in perfect alignment.			
2.3	PIPE SLEEVES				
a.	Pipe sleeves	One nominal diameter larger than the service pipe, except for sizes 100mm and above. Fitted for pipes passing through floors, walls or partitions. Galvanised pipe off-cuts for galvanised or black iron pipe. Brass or copper for copper pipe. Fitted in floors generally end 12mm above finished floor level for general areas. Fitted in floors generally end 50mm above finished floor level for plant rooms and wet floor areas, tightly caulked with suitable diameter asbestos rope. Pipe pass through fire break walls/partitions, clearance between pipes or insulation and sleeves tightly pegged with suitable diameter asbestos rope.			To form sound and fire barrier.
2.4	EXPANSION JOINTS AND ANCHORS				
a.	Expansion joints	Provided in any straight arm of chilled and condenser water piping over 60m length. Guided bellow type.			
b.	Pipe spacing and anchoring	Refer specification.			To control movement of pipes due to thermal and pressure gauges.
2.5	PIPE FITTINGS				
a.	Pipe fittings	Cast iron or cast/forged steel. Standard pieces used throughout the whole installation.			
b.	Screwed joints sealing compound	Litharge or glycerin.			
c.	Pipe jointings	Joints up to and including 65 mm (2½") diameter on black steel piping made by means of screwed or welded connections. Joints up to and including 65 mm (2½") diameter on galvanized steel piping made by means of screwed connections.			
2.6	PIPE HANGERS & SUPPORTS				
a.	Hangers & support	Rigid construction and properly isolated.			To prevent noise & vibration.
b.	Hangers & support intervals :				
	i. Up to and including 50 mm (2" diameter) bore	• 3.0 m apart (Horizontal spacing) • 3.5 m apart (Vertical spacing)			

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NO.	ITEMS	CRITERIA	(√) / (X)	DATE/INITIAL	REMARKS
	i. 65mm bore up to and p to and including 50 mm (2" diameter) bore	• 4.0 m apart (Horizontal spacing) • 4.0 m apart (Verticle spacing) Installed at not more than 10 diameters from each change in direction of			
b.	Hangers for copper pipelines	Not more than half of intervals of steel pipe.			
c.	Fixing pipe hangers or bracket to building structure	Approved metal expansion plugs/raw plugs.			
d.	Insulated chilled water, refrigerant lines	Protected by metal bearing plate curved to match the insulation. Where supports are fastened around insulation, heavy density insulation or approved type saddles shall be placed			
e.	150mm diameter pipe or below	Hung on hangers from the ceiling slab			
f.	Cradles for pipes 150mm diameter or larger and clamps for	Support pipe independent from any lagging.			
g.	Horizontal runs of pipe hangers	Allow for expansion of pipelines. Provision made for adjusting gradients and alignments. Split ring & adjustable type or other approved design hung on around steel			
h.	Vertical runs of pipe hangers	Supported by clamps or collars Support provided at each alternate floor			
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ACCEPTANCE CRITERIA FOR INSTALLATION OF DUCTWORKS					
NO.	ITEMS	CRITERIA	(√) / (X)	DATE/INITIAL	REMARKS
1	DRAWINGS & DOCUMENTS				
a.	Working drawings	Provided and approved before the system installation is carried out. Coordination with other disciplines at site (Coordinated drawings).			
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2	TECHNICAL CHECKLIST				
A.	DUCTWORK (RIGID)				
a.	Ductwork (Rigid duct)	Galvanised steel sheets No patched or make up pieced ductwork is allowed.			
	Gauge of sheet metal	Refer Technical Specification.			
	Flexible connections for rigid duct	Provided where the ductwork joins the air handling unit or fan housing. Consist of two layers of 567g (20 oz) vapour proof canvas or nylon fabric			
b.	External insulation of ducts				
	i. Fibreglass Insulation	Generally, supply and return air ductwork insulated externally with 50 mm fibreglass. Ductwork in ceiling space immediately below the roof and in the vertical duct shaft insulated with 50 mm thick fibreglass insulation.			
	ii. Polyurethane (P.U) Insulation	All ducts exposed to unconditioned space and in the plantroom shall be insulated with 50 mm thick fire-retardant type P.U.			
	iii. Polyethelyne (P.E) Insulation	Generally, supply and return air ducts insulated with 7.0 mm thick PE foam. Ductworks below the roof or in any vertical shaft have 10.0mm thick PE foam. Ductworks within the plant room and conditioned air ducts exposed to weather insulated with PE foam reinforced with galvanised wire mesh and finished with hybrid plaster.			
c.	Internal insulation of ducts				
	i. Fibreglass Insulation	Main supply air duct immediately after the centrifugal fan shall be internally insulated with 50 mm thick fibreglass, faced over with 1 mm thick perforated galvanised steel sheet.			
	ii. Polyethelyne (P.E) Insulation	Main supply air duct immediately after the centrifugal fan shall be internally insulated with 12 mm thick PE.			
	iii. Polyurethane (P.U) Insulation	Main supply air duct immediately after the centrifugal fan shall be internally insulated with 25 mm thick PU.			

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B.	FLEXIBLE DUCTS				
a.	Flexible ducts	<p>Allowed for connection with branch duct to diffuser/grille.</p> <p>Maximum length shall be not more than 2.0 meters from branch duct.</p> <p>Constructed of double thickness aluminium foil fitted and glued around a core of helically wound zinc-coated high carbon spring steel wire.</p> <p>Alternatively, manufactured from roll strip aluminium constructed with lock seam to form a continuous flexible spiral duct.</p>			
b.	Flexible ductwork insulation	<p>Insulation shall be of 50mm thick fibreglass.</p> <p>Density = 32 kg/m3.</p> <p>Faced outside with approved vapour barrier and fitted around the flexible duct.</p> <p>All flexible ductwork to diffusers shall be insulated.</p>			
c.	Flexible ductwork connection	<p>Each spigot on rigid ducts for connection to flexible ducts leading to single air outlets shall be standard circular or equivalent oval shape with butterfly type volume control dampers fitted.</p> <p>Flexible duct connections and connections to spigots made using factory fitted male metal end collars and quick acting clamp locks, and each joint shall be made airtight.</p> <p>Ducts installed without restriction to airflow and supported where suspended above the ceiling by 38mm wide straps at not more than 1 meter spacing.</p>			
C.	FIRE RATED DUCTWORK				
a.	Fire Rated Ductwork	<p>Minimum of 2 hours fire rating.</p> <p>Encased with a framework of formed metal support channels and furring channels of sizes and at spacings recommended by the supplier of the fire rated construction.</p>			
	Fire Rated Ductwork construction	<p>50 mm (2") layer of ceramic type spray applied over the walls of the duct or plenum.</p> <p>An expanded metal lath shall be attached to the furring channels.</p> <p>A second coat of ceramic type spray shall be applied to give a minimum overall thickness of 75 mm (3") spray.</p> <p>The exposed sides of the duct or plenum shall then be sheathed with 0.8 mm galvanised steel fixed as specified for externally insulated duct sheathing.</p>			

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D.	SUPPORT & HANGERS (RIGID DUCT)				
a.	Supports and Hangers (Rigid duct)	Rigid ductwork supported at centers not greater than 2 meters apart and anchored to the building structure. Duct supports consist of 38 mm (1 1/2") mild steel angle bearers with 9.5 mm (3/8") diameter mild steel rods or 25 mm x 3 mm (1" x 1/8") mild steel strips as hangers. Direct fastening of duct to support with screws is not allowed. Duct hangers fixed to the concrete with anchor bolt. Wooden and plastic plugs are not allowed.			
e.	Elbows and Turning Vanes	All elbows have a minimum inside radius equal to the width of the duct where possible. Where space does not permit such radius, sharper or right angle bends may be used together with double thickness aerofoil shape turning vanes. Turning vanes must be securely fitted to the elbows.			
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2	TECHNICAL CHECKLIST				
2.1	Air Cooled Chiller	Acceptable/Not Acceptable			
2.2	Chilled Water Pipes	Acceptable/Not Acceptable			
2.3	Chilled Water Pumps	Acceptable/Not Acceptable			
2.4	Expansion Water Tank	Acceptable/Not Acceptable			
2.5	AHU	Acceptable/Not Acceptable			
2.6	FCU	Acceptable/Not Acceptable			
2.7	Fixed Ductwork	Acceptable/Not Acceptable			
2.8	Flexible Ducts	Acceptable/Not Acceptable			
2.9	Fire Rated Ducts	Acceptable/Not Acceptable			
2.10	Diffusers, Registers, Grilles &	Acceptable/Not Acceptable			
NOTES : √ - Comply to specification/drawings (Acceptable) X - Not Comply to specification/drawings (Not Acceptable)					
REMARKS/COMMENTS :					
Inspected by : Name : Designation : Date:			Verified by : Name : Designation : Date:		