Our Ref: OM-LA/026

Alpha
Consulting Engineers Pte Ltd
2 ALEXANDRA ROAD, #03-03 DELTA HOUSE, SINGAPORE 159919
TEL: (65) 6276 2228 FAX: (65) 6276 9929 E-MAIL: ace@alpha.com.sg
WEBSITE: www.alpha.com.sg COMPANY REGN NO. 199407965N

19 September 2008

MEMORANDUM

To: All Engineering Staff

From: Loh Fook Yuen

SINGAPORE STANDARDS, REDAS & GOVERNMENT ACT

Please be informed that we have purchased the following Standards and Act and all these are in pdf which can be viewed at our office intranet.

1. SS 142 : 1976 Specification for steel pipes, fittings and special for water, gas and sewage
http://intranet.alpha.com.sg/library/Code_of_Practice/SS142.pdf

2. SS 213 : 1998 Specification for unplasticized PVC pipes and fittings for soil, waste and vent applications
http://intranet.alpha.com.sg/library/Code_of_Practice/SS213.pdf

3. SS 272 : 1983 Specification for unplasticized PVC pipes below ground for drainlines and sewers
http://intranet.alpha.com.sg/library/Code_of_Practice/SS272.pdf

4. SS 525 : 2006 Code of Practice for drainage of roofs
http://intranet.alpha.com.sg/library/Code_of_Practice/SS525.pdf

5. SS 538 : 2008 Code of Practice for maintenance of electrical equipment of electrical installations
http://intranet.alpha.com.sg/library/Code_of_Practice/SS538.pdf

6. Electricity Act (Revised Edition 2004)
http://intranet.alpha.com.sg/library/Code_of_Practice/Electricity%20Act%20(Revised%20Edition%202004).pdf

7. Gas Act (Revised Edition 2002)
http://intranet.alpha.com.sg/library/Code_of_Practice/Citygas/Gas%20Act%20(Revised%20Edition%202002).pdf

8. Government Gazette – Acts Supplement
http://intranet.alpha.com.sg/library/Code_of_Practice/Government%20Gazete%20-%20Acts%20supplement.pdf

2/...

BCA
ISO 9000
CERT. NO.: 324
SS ISO 9001 : 2000

9. Public Utilities Act (Revised Edition 2002)
http://intranet.alpha.com.sg/library/Code_of_Practice/Public%20Utilities%20Act%20(Revised%20Edition%202002).pdf

10. Info-Communications Development Authority of Singapore Act (Revised Edition 2000)
http://intranet.alpha.com.sg/library/Code_of_Practice/IDA%20of%20Singapore%20Act%20(Revised%20Edition%202000).pdf

11. REDAS Design and Building Conditions of Contract (2nd Edition)
http://intranet.alpha.com.sg/tech-info/REDAS%20Design%20&%20Build%20Conditions%20of%20Contract%20(2nd%20Edition).pdf

LOH FOOK YUEN

cc TLS/RT/LCT/CCG/GSH
cc Memo File

/kt

CONTENTS

		Page
Foreword		5
	SPECIFICATION	
1.	GENERAL	
1.1	Scope	6
1.2	Design and Application	6
1.3	Definitions	6
1.4	Designation	6
1.5	Materials	7
1.6	Information to be given by the Purchaser in the Enquiry or Order	7
1.7	Marking	7
1.8	Manufacturer's Certificate	7
1.9	Protection for Transport and Handling	7
2.	PIPES	
2.1	Sizes, Weights and Test Pressures	8
2.2	Lengths	8
3.	JOINTS	
3.1	Types of Joints	10
3.2	Butt Welded Joints	10
3.3	Sleeve Joints for Welding	11
3.4	Slip on Type Couplings	13
3.5	Fixed Flange Joints	14
3.6	Screwed and Coupled Joints	14
3.7	Other Joints	14
4.	FITTINGS AND SPECIALS	
4.1	General	15
4.2	Fabrication	15
4.3	Testing	15
4.4	Tolerances	15
4.5	Even Curvature Bends	16
4.6	Gusseted Bends	17
4.7	Tees	18
4.8	Collars	18

Page

5. PROTECTIONS

5.1 General - - - - - - - 20
5.2 Surface Preparation - - - - - - 21
5.3 Coatings - - - - - - - 21
5.4 External Protections - - - - - - 21
5.5 Internal Protections - - - - - - 22
5.6 Tests on Applied Protections - - - - - 24
5.7 Test on Concrete Used for Internal Protection - - 25
5.8 Stop Back of Protections at Ends - - - - 25
5.9 Completion of Protections at Joints - - - - 25

TABLES

1. Seamless Steel Pipes - - - - - - 8
2. Welded Steel Pipes - - - - - - 9
3. Dimensions of Even Curvature Bends - - - - 16
4. Dimensions of Gusseted Bends - - - - 17
5. Dimensions of Tees - - - - - - 19

FIGURES

1. Butt Welding Joint Preparation - - - - - 10
2. Long Sleeve Welded Joint - - - - - 12
3. Short Sleeve Welded Joint - - - - - 13
4. Slip on Type Coupling - - - - - - 13
5. Even Curvature Bend, 90° - - - - - 16
6. Even Curvature Bend, less than 90° - - - - 16
7. Gusseted Bend, Type 1, not more than 30° - - - 17
8. Gusseted Bend, Type 2, 31° to 60° - - - - 17
9. Gusseted Bend, Type 3, 61° to 90° - - - - 17
10. Plain End Tee for Slip on Type Coupling and Butt Welded Joint - - - - - - 18
11. Sleeve Joint Tee for Welding - - - - - 18
12. Tee with Flanged Branch - - - - - 18
13. Collar - - - - - - - - 18

Contents

		Page
Foreword		7

SPECIFICATION

1	Scope	8
2	Definitions	8
3	Materials	8
4	Freedom from defects	9
5	Colour	9
6	Dimensions for pipes	9
7	Dimensions for fittings	10
8	Jointing	23
9	Properties	23
10	Sampling	25
11	Marking	27

ANNEXES

A	Determination of dimensions of pipe	28
B	Softening point test	29
C	Method for determining PVC and titanium dioxide content of UPVC pipes and fittings	31
D	Tensile test	36
E	Heat reversion test for pipe	37
F	Impact test for pipe	38
G	Hydrostatic pressure test	41
H	Test for opacity	43
I	Stress relief test	44
J	Load test at 100 kgf	45

TABLES

1	Dimensions of soil, waste and vent pipes	9
2.1	Dimensions of moulded UPVC socket fittings for UPVC SWV pipe	11
2.2	Minimum socket dimension A (for 3 m length and 50°C temperature range)	12
2.3	Inspection openings minimum clear diameter	13

Page

2.4	Test openings minimum clear diameter	17
3.1	Test requirements and frequency of sampling for pipes	26
3.2	Test requirements and frequency of sampling for fittings	26
4	Total mass for impact test at 20°CTest openings minimum clear diameter	39

FIGURES

1.1	Sketch of a moulded UPVC socket fitting	11
1.2	Typical UPVC rubber ring expansion joint with groove in socket	12
2.1	Single junction	13
2.2	Single sweep junction	13
2.3	Double sweep junction	14
2.4	4-way junction (unswept)	14
2.5	M and F bend	14
2.6	Bend	15
2.7	Vented bend	15
2.8	Straight coupling	16
2.9	Slip coupling (for repair)	16
2.10	Expansion coupling with rubber seal ring	16
2.11	Socket reducer	17
2.12	Test opening	17
2.13	Boss connector	17
2.14	Pan collar	18
2.15	Off-set pan collar	18
2.16	Level invert taper	19
2.17	Vent cowl	19
2.18	Weathering apron	19
2.19	S-trap	20
2.20	P-trap	20
2.21	Grating for floor trap	21
2.22	Grating for floor waste	22
3	Schematic arrangement of vicat softening point apparatus	30
4	Cutting edges of punch	36
5	Impact testing machine	40
6	End connections for pressure test	42

CONTENTS

		Page
Foreword		4

SPECIFICATION

1.	Scope	5
2.	Definitions	5
3.	Material	5
4.	Colour	5
5.	Freedom from defect	6
6.	Dimensions	6
7.	Length of pipes	6
8.	Jointing	6
9.	Testing	15
10.	Sampling	16
11.	Marking	16

APPENDICES

A.	Determination of dimensions of pipe	18
B.	Softening point test	19
C.	Method for determining the PVC and titanium dioxide content of UPVC pipes and fittings	21
D.	Tensile test	22
E.	Heat reversion test for pipe	23
F.	Impact test for pipe	25
G.	Hydrostatic pressure test	28
H.	Stress relief test	30
J.	Test for opacity	31
K.	Angular defection test (type test)	32
L.	Hydrostatic pressure test (quality control test for factory made solvent welded assemblies)	33
M.	Diameter distortion test (type test for joint assemblies)	34
N.	Negative pressure test for elastomeric seal joints	36

As amende Feb 199

Contents

		Page
Foreword		10

CLAUSES

Section One – General

1	Scope	11
2	References	11
3	Definitions	12

Section Two – Materials and components

4	Materials and components for rainwater goods	12
4.1	General	12
4.2	Gutter components	12
4.2.1	Aluminium	12
4.2.2	Titanium zinc	12
4.2.3	Stainless steel SS316-2B finish	12
4.2.4	Zinc/aluminium alloy coated steel	12
4.2.5	Copper-natural mill finish & pre-weathered copper	13
4.2.6	GRP (Glass Reinforced Plastics)	13
4.3	Downpipes	13
4.3.1	Cast Iron	13
4.3.2	Unplasticised PVC	13
4.3.3	Titanium zinc	13
4.3.4	Stainless steel SS316–2B finish	13
4.3.5	Zinc/aluminium alloy coated steel	13
4.3.6	Polyethylene (PE)	13
4.4	New materials	13

Section Three – Design

5	Meteorological aspects of design	13
5.1	General	13
5.2	Design rates of rainfall	14
5.3	Wind	15
5.4	Thermal movement	15
5.4.1	Gutters	15
5.4.2	Rainwater pipes	15
6	Run-off	16
6.1	Effective catchment area	16

Page

6.1.1 General 16
6.1.2 Flat roofs 16
6.1.3 Sloping and curved roofs 16
6.1.4 Vertical surfaces 16
6.2 Rate Of run-off 17
7 Hydraulic design of roof drainage 17
7.1 General principles 17
7.2 Standard method of design 17
7.3 Gutters 17
7.3.1 Gutter provision 17
7.3.2 Leaf cover for gutters 18
7.3.3 Minimum gradient 18
7.3.4 Type of gutters 18
7.3.5 Profile of gutters 18
7.3.6 Dimensions of gutters 18
7.4 Roof drainage design flowchart 19

Section Four – Work on site

8 Types and spacing of fixings 35
8.1 Gutters – general considerations 35
8.1.1 Gutter support 35
8.1.2 Deep gutters 35
8.1.3 Eaves gutters 35
8.1.4 Moulded gutters 36
8.1.5 Industrial eaves gutters 36
8.1.6 Valley, skylight, parapet, boundary wall and large box gutters 36
8.2 Rainwater pipes 36
8.2.1 Pipes which require painting 36
8.2.2 Pipe fixing 36
8.2.3 Materials for pipe fixing 36
9 Jointing 36
9.1 Jointing gutters 36
9.1.1 General 36
9.1.2 Cast iron and steel gutters 37
9.1.3 Aluminium gutters 37
9.2 Jointing rainwater pipes 37
9.2.1 General 37
9.2.2 Horizontal runs of pipes 37

Page

9.2.3 Flat roofs 37
9.2.4 Metal pipes 37
9.2.5 uPVC pipes 38
10 Access to pipes 38
11 Encased pipes 38
12 Termination of rainwater pipes 38
13 Internal rainwater pipes 38

Section Five – Testing, commissioning and maintenance procedures for gravity and siphonic roof drainage systems

14 Testing and commissioning 38
14.1 General 38
14.2 Gutters and flat roofs 39
14.2.1 Test for leakage 39
14.2.2 Visual inspection 39
14.2.3 Inspection for ponding 39
14.3 Rainwater pipeworks 39
14.3.1 Test for leakage 39
14.3.2 Visual inspection 39
14.3.3 Test for blockage 39
15 Maintenance 39
15.1 Periodic inspection and cleaning 39

Section Six – Prevention of mosquito breeding in roof drainage system

16 General 40
17 Roof drainage 40
17.1 Roof gutters 40
17.2 Leaf covers for roof gutters 40
17.3 Rainwater downpipes for roof drainage 40

ANNEXES

A Symbols 68
B Bibliography 70

Page

TABLES

1	Flow capacity of standard eaves gutters (level)	60
2	Reduction factors for capacities of long half-round eaves gutters	60
3	Reduction factors for capacities of standard eaves gutters containing angles	60
4	Capacity of outlet weirs for flat roofs	61
5	Capacity of overflow weirs (sharp-edged weir)	61
6	Capacity of overflow spout pipes	62
7(a)	Capacity of grated circular outlets	63
7(b)	Capacity of grated circular outlets (90 % opening)	64
7(c)	Capacity of grated circular outlets (80 % opening)	64
7(d)	Capacity of grated circular outlets (70 % opening)	65
7(e)	Capacity of grated circular outlets (60 % opening)	65
8	Capacity of vertical rainwater pipes	66
9	Capacity of horizontal rainwater pipes	67

FIGURES

1	Design intensity of 5-minute storm in Singapore	41
2	Calculation of effective catchment area A_e for roofs	42
3	Calculation of effective catchment area A_e for roof with vertical surfaces	43
4	Definition of eaves gutters	44
5	Definition of valley, parapet and boundary wall gutters	45
6	Description of flat roof drainage	46
7	Profile of gutters	46
8	Dimensions of gutters	47
9	Dimensions of eaves gutter (half-round and nominally half-round)	48
10	Dimensions of eaves gutter (other profiles)	49
11	Dimensions of valley, parapet and boundary wall gutters	50
12	Dimensions of gutters with restricted discharge	51
13	Flow capacities of freely-discharging half-round gutters	52
14	Design chart for freely-discharging trapezoidal gutters	53
15	Capacity of freely-discharging gutters	54
16	Capacity of circular outlets (without grating)	55
17	Effect of resistance in level gutters	56
18	Design chart for trapezoidal gutters with restricted discharge	57
19	Roof eaves design (without gutters)	58
20	Leaf cover details	59

Page

FLOWCHARTS

1	Selection of design rainfall intensity (mm/hr)	20
2	Calculation of run-off	22
3a	Eaves gutters: half-round and nominally half-round (freely discharged gutter)	23
3b	Eaves gutters: other profiles (freely discharged gutter)	25
3c	Valley, parapet and boundary wall gutters (freely discharged gutter)	27
3d	Gutter with restricted discharge	30
3e	Flat roof drainage	32
4	Vertical and horizontal pipe (gravity system)	33
5	Siphonic roof drainage system	34

Contents

Page

Foreword 8

CLAUSES

Section One – Scope and general

1.0 Introduction 10
1.1 Scope 10
1.2 Normative references 11
1.3 Definitions 11
1.4 Fundamental notes on switchroom 15
1.5 Safety 18
1.6 Maintenance 20

Section Two – Maintenance of electrical switchgear for voltages above 1 kV and up to and including 22 kV

2.1 Fundamental notes on switchroom 24
2.2 Safety 24
2.3 Maintenance 24
2.4 Recommended maintenance programmes for air-insulated switchgear 33
2.5 Recommended maintenance programme for gas insulated switchgear (GIS) with fixed circuit breaker in vacuum or SF_6 enclosure 33

Section Three – Maintenance of power and distribution transformers

3.0 Introduction 40
3.1 Types of transformers 40
3.2 Liquid-filled transformers 40
3.3 Dry-type transformers 45

Section Four – Maintenance of high-voltage power cables

4.1 Introduction 47
4.2 Preventive maintenance of high-voltage power cables 47
4.3 Predictive maintenance of high-voltage power cables and testing methods 48

Section Five – Low-voltage switchboard Page

5.1 General 49
5.2 Enclosures 49
5.3 Interlocks 50
5.4 Maintenance of circuit breakers 50
5.5 Busbars, busbar chambers and terminal connections 52
5.6 Switches 53
5.7 Maintenance of protective apparatus 53
5.8 Cable boxes and terminations 55
5.9 Fuses 55
5.10 Contactors 56

Section Six – Maintenance programme for composite units of air-break switchgear and fuses for voltages up to and including 1000 V

6.1 General 56
6.2 Recommended maintenance programme 56

Section Seven – Low-voltage power cables and cable tray/trunking system

7.1 Power cables 57
7.2 Cable tray, cable ladder and trunking systems 58

Section Eight – Testing of low-voltage electrical installation

8.1 General 60
8.2 Acceptance and maintenance tests 60
8.3 Frequency of routine maintenance tests 60
8.4 Special precautions and safety 61
8.5 Test operator 61
8.6 Test equipment 61
8.7 Maintenance records and test results 61
8.8 Insulation-resistance testing 61
8.9 Protective device testing 61
8.10 Contact resistance testing 64
8.11 Equipment earth impedance testing 64
8.12 Earthed conductor (neutral) impedance testing 64
8.13 Infrared inspection 65
8.14 Three-phase 4-wire neutral current testing 65

Page

ANNEXES

A	Caution notice	66
B	Danger notice	67
C	Notice against any interference with live apparatus	68
D	Permit-To-Work on high-voltage cables and equipment in customer's electrical installation	69
E	Statement of disconnection and reconnection of source of electricity for electrical installation taking high voltage supply from another electrical installation	70

TABLES

1.1	Maintenance frequency matrix	21
2.1	Test voltages for switchgear	26
2.2	Recommended maintenance programmes for air insulated switchgear	34
2.3	Recommended maintenance programme for gas insulated switchgear (GIS) with fixed circuit breaker in vacuum or SF_6 enclosure	39
3.1	Standard insulation classes	45
6.1	Recommended maintenance programme	57