出國報告（出國類別：其他）

湖山水庫第二原水管工程
高壓閘門廠驗報告

服務機關：經濟部水利署中區水資源局
姓名職稱：林副工程司明鋒、蔡工程員嘉晉、鄭工程員竣益
派赴國家/地區：日本廣島縣吳市
出國期間：108.12.04-108.12.08
報告日期：109.02.27

摘要

本次廠驗目的為辦理 2 座高壓閘門廠驗，本案高壓閘門製作部分乃委託大將作工業股份有限公司(本案聯合承攬主包商之一)合作廠商 IHI 辦理，本次廠驗主要分為 5 個部分，包括耐壓及漏水試驗、外觀、尺寸、塗裝、操作等試驗，由 JIC 依據本局核定之檢驗程序書執行本次廠驗。

在耐壓及漏水試驗方面，依據本工程施工規範第 11280 章「閘閥室閘閥及附屬設施」辦理，以 1.25 倍設計水壓試水壓 10 分鐘（一側有水、另一側無水），所有金屬接合處不漏水、軸封等零配件不產生永久變形。水封漏水量之每一分鐘不得大於 2 公升，控制閘門試驗結果為 780ml/10min(=85ml/min)；防護閘門試驗結果為 560 ml/10min(=23ml/min)，結果皆為合格。

在單機運轉試驗方面，包含閥體升降順暢性、閘閥運轉速度、運轉數據(如電壓、電流、工作壓力…等)之紀錄，所有測試皆正常合於規範，其中防護閘門運轉速度為升起 0.134m/min;關閉 0.129 m/min；控制閘門運轉速度為升起 0.144m/min;關閉 0.133 m/min，皆符合規範值 0.1-0.15m/min。

在外觀尺寸方面，本工程以 IHI 提供經本局核定之細設圖說及檢驗程序書，說明其公差大部分均為 1-3mm，明顯較本工程規範訂定約 4-5mm 為小，廠商均以符合 JIS 標準之量測工具量測，部分隱蔽部分無法量測，各部位量測結果均符合規範，誤差均在容許誤差範圍內，且各部位外觀均無瑕疵。

在塗裝品質方面，檢測標準於浸水部分皆為 320um，無浸水外露部分則為 200um，且須有 70%以上之合格率，JIC 針對可量測非隱蔽部分進行抽查，各部位量測結果均符合規範。

最後綜整會議結論由 JIC 及本局同仍所提問相關疑義，會議結論及注意事項如下：

1. 本次廠驗均合格。
2. 在出廠船運前應再檢視是否表面有需要補漆部分，應補漆後始裝箱上船。
3. 控制閘門門框內因為安裝試驗用法藍而導致之鏽蝕應於裝箱上船前移除。
4. 依據設計圖說，廠商應準備供置換之門扉面板四個角落之塞子。
5. 於設定極限開關全開之行程時，油壓圓柱頂部須於上鎖狀態。
6. 閘門軌道潤滑油之補注時機及頻率將在操作維護手冊內說明。

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第一章　目的

1-1　概述

湖山水庫位於雲林縣斗六市東南方約 10 公里處，水庫集水面積約 6.58 平方公里，由於本身集水區有限，故於清水溪流域建置桶頭攔河堰引水以為挹注。湖山水庫設有二條施工導水隧道，其中湖南壩導水隧道已規劃為取出水工輸水管路使用，為充分利用湖山壩施工導水隧道，經濟部水利署中區水資源局評估各項方案後，將湖山壩施工導水隧道改建作為備援取出水工兼作排砂使用，除辦理臨水側之取水塔設施為「湖山水庫第二出水工-取水塔工程」於 104 年 5 月 21 日發包施工，已於 107 年 5 月完工，今再由經濟部水利署發包辦理「湖山水庫第二原水管工程」，銜接取水塔之下游端閘閥室、消能工及輸水管路工程，期使湖山水庫第二取出水工發揮整體綜效。

「湖山水庫第二原水管工程」整體工程內容主要包含閘門操作室(含 2 座高壓閘門及蝶閥等相關重要水工設備)、輸水鋼管、水管橋、下游出流閥井(含球閥、排泥閥、減壓閥等重要水工設備)等部分。

本次廠驗目的為辦理 2 座高壓閘門廠驗，本案高壓閘門製作部分乃委託大將作工業股份有限公司合作廠商 IHI 辦理，其為一家日商重工業公司，最前身為「石川島造船廠」，最早期可朔至第一次世界大戰前，至今各式基礎重工業製造皆有承接，已累積數十年基礎重工業實績，為本工程主包商大將作工業股份有限公司持股過半之合作廠商；另第三方檢測單位為 Japan Inspection Co.Ltd(日本檢察株式會社)(以下簡稱 JIC)，專門辦理各項工業檢查試驗，國內主要水工機械均委託該單位為國外製作之第三方檢測公正單位，已辦理國內多次如台電、中油等單位委託國外製作設備之第三方檢測作業。

本次廠驗主要分為 5 個部分，包括耐壓及漏水試驗、外觀、尺寸、塗裝、操作等試驗，由 JIC 依據本局核定「控制閘門(含油壓設備)工廠製造及檢驗程序書」及「防護閘門(含油壓設備)工廠製造及檢驗程序書」2 本檢驗程序書執行本次廠驗(詳附件一及附件二)，另本工程高壓閘門規範第 11280 章「閘閥室閘閥及附屬設施」如附件三。若本次廠驗均合格，待辦理裝箱上船前之最後檢查及修補，即可經由海運運抵台灣。

1-2 行程相關資料

本案主要委託第三方公正單位 JIC 辦理高壓閘門廠驗工作，本次由篠原美知夫君(Michio Shinohara)擔任檢驗官，另本局派遣三名本工程承辦人員參與並監督廠驗作業，確保第三方公正單位依據已核定之檢驗程序書辦理廠驗作業，會同本案承攬廠商大將作工業股份有限公司併同前往，IHI 合作廠商（株）仁方鉄工所(NigataIron Works)，位於日本本州廣島縣吳(呉)市，距離廣島機場約車程 2 個小時，本次參加人員如下表 1-1，本次行程表如下表 1-2，廠驗地點如下圖 1-1。

表 1-1 參加人員表

單位	職稱	姓名	備註
中水局	副工程司	林明鋒	主辦本次廠驗
	工程員	蔡嘉晉	協辦
	工程員	鄭竣益	協辦
大將作	海外業務經理	馮恩賜	
	經理	陳宏典	本工程現職品管人員
	經理	蔣惠菁	本工程前任品管人員
	業務工程師	高敏茹	
Japan Inspection Co. Ltd.	工業檢驗部	Michio Shinohara	篠原美知夫 *本次檢驗官
IHI	水門產品管控部(1級土木技術士)	Makoto Hasegawa	長谷川誠
	水門設計課長(土木工程師)	AtsuoMatano	渥野敦夫
	業務部	Atsushi Morikawa	深川德士
	水門品質管制部課長	Koji Ishiyam	石山浩司
	水門品質管制部	Koji Otani	大谷幸次
	業務部	Hiromi Nishimura	西村洋美
	銷售部	Natsuki Wada	和田奈月

表 1-2 行程表

日期	時間	詳細行程
108/12/04	預計下午出發晚上抵達	台北桃園(TPE)至日本廣島(HIJ)
108/12/05	0830-1700	1. 控制閘門檢驗(外觀、尺寸、塗裝、操作等試驗) 2. 防護閘門水壓試驗
108/12/06	0830-1700	1. 控制閘門水壓試驗 2. 防護閘門檢驗(外觀、尺寸、塗裝、操作等試驗)
108/12/07	0830-1700	整體報告總結
108/12/08	預計上午出發中午抵達	日本廣島(HIJ)至台北桃園(TPE)

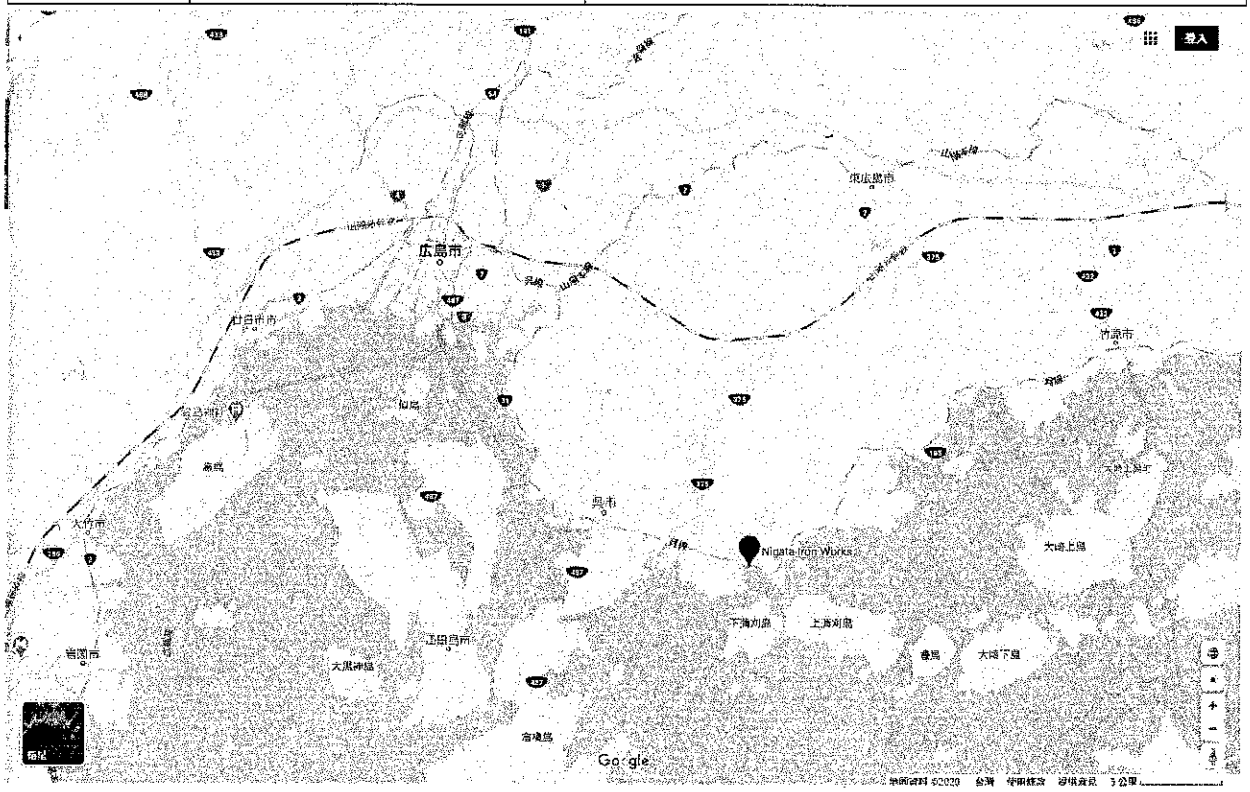


圖1-1 廠驗位置圖

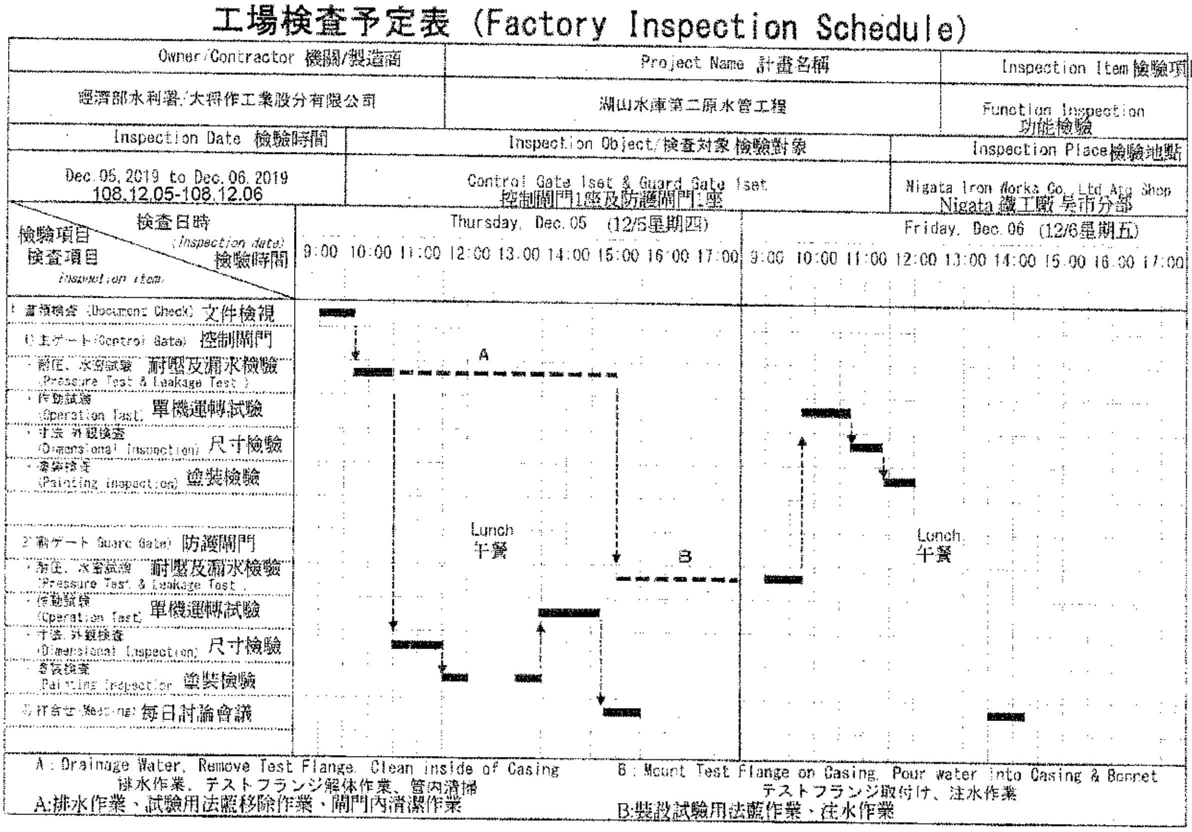
第二章　測試過程、執行情形及結果

2-1　概要

廠驗主要分為 5 個部分，包括耐壓及漏水試驗、外觀、尺寸、塗裝、操作等試驗，廠商依據已核定之第三方公正單位檢驗程序書辦理檢驗，並依據本工程施工規範第 11280 章「閘閥室閘閥及附屬設施」辦理，安排依序第一天先辦理控制閘門的耐壓及漏水試驗，再辦理防護閘門之外觀、尺寸、塗裝、操作等試驗，且在此同時，廠商同時準備第二天辦理之防護閘門之耐壓及漏水試驗，將控制閘門內的水排乾、移除試驗用法蘭及閘門內之清潔作業，待第一天試驗結束，再將試驗用法蘭裝上防護閘門，以辦理第二天之耐壓及水壓測試，第二天再辦理控制閘門之外觀、尺寸、塗裝、操作等試驗，再於第三天開會討論檢驗報告內容，其中第一天及第二天之詳細時程如下表 2-1，以下依檢驗類別分章敘述。

表 2-1 日程表

工廠檢驗時程表



2-2 耐壓及漏水試驗

依據本工程施工規範第 11280 章「閘閥室閘閥及附屬設施」辦理，以 1.25 倍設計水壓試水壓 10 分鐘（一側有水、另一側無水），所有金屬接合處不漏水、軸封等零配件不產生永久變形。水封漏水量之每一分鐘不得大於 2 公升；因本試驗屬高壓試驗，廠商須另行製作一座試驗用法蘭，分上下游面 2 個殼體套住高壓閘門上下游面，使閘門內達到水密，其上游面設有加壓裝置，下游面則設計一出水管以量測漏水量，依據本案高壓閘門檢驗程序書，本次試驗壓力為 1.016MPa，廠商以空氣壓縮機配合壓力表及計時碼表，以該壓力暫壓 10 分鐘，並於下游側排水孔放置水桶，並於碼表計時至 10 分鐘後，再將盛水倒至標準量筒，測試其漏水量不得大於每分鐘 2 公升。廠商並特別繪製示意圖如下圖 2-2-1，試驗結果如下表 2-2-1，第三方檢驗試驗報告如下圖 2-2-2、2-2-3，試驗相關照片如下表 2-2-2。

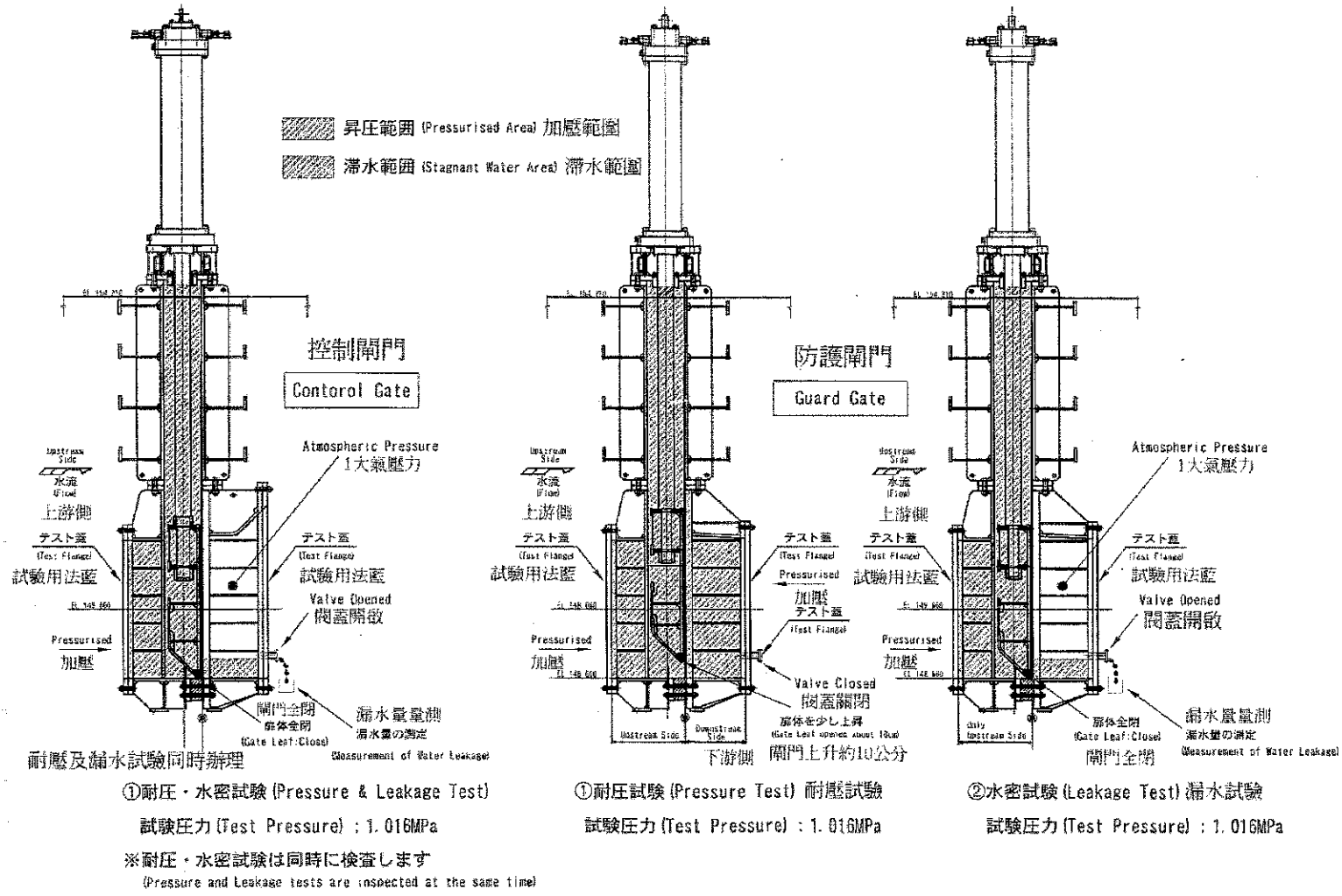


圖2-2-1　耐壓及漏水試驗示意圖

表 2-2-1　耐壓及漏水試驗結果表

試驗項目	試驗壓力	試驗標準	試驗結果
水壓試驗	1.016MPa	≦2000ml/min	控制閘門
			780ml/10min(=85ml/min)
			防護閘門
			560ml/10min(=23ml/min)

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INSPECTION ITEM	Control Gate (Gate Type: High Pressure Slide Gate)

2.Hydraulic test

検査項目 Item	試験圧力 Test pressure	判定基準 Judging standard	検査結果 Inspection result	
			社内 in-house	立会 Witness
水圧試験	1.016MPa	水密構造部以外からの漏水のないこと No leakage No deformation	good	good
pressure test		≦2000mL/min	960 ml/min	85ml/min (780ml/10min)

Reference Procedure;Document No,180098-MP-010-B

WITNESSED BY
REVIEWED BY
M.Shinohara
DEC 05 2019

Inspected by
IHI Infrastructure Systems Co.,Ltd.
Gate & Penstock Quality Control Group
Koji Otani　NOV. 28, 2019

圖2-2-2　控制閘門試驗報告內容

試驗報告(出廠證明)判定審核章
設計、規範值: 詳檢驗紀錄表(11280)
廠商初判人員簽名: 陳宏連
☑符合 ☐不符合　本件業經核對無誤並符合契約規範規定，如有偽造文書情事，均由文件上公司及簽名人員負刑事及民事所有責任
監造單位複判人員簽名:
☑合格 ☐不合格

INSPECTION ITEM	Guard Gate (Gate Type: High Pressure Slide Gate)

2.Hydraulic test

検査項目 Item	試験圧力 Test pressure	判定基準 Judging standard	検査結果 Inspection result	
			社内 In-house	立会 Witness
水圧試験	1.016MPa	水密保持部及び各部からの漏水のないこと No leakage No deformation	good	good
pressure test		≦2000ml/min	170 ml/min	23ml/min (560ml/10min)

Reference Procedure; Document No,180098-MP-020-B

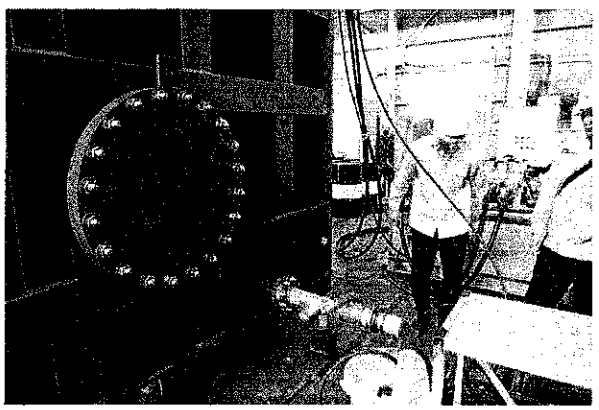
WITNESSED BY
REVIEWED BY
M.Shinohara
DEC. 05. 2019

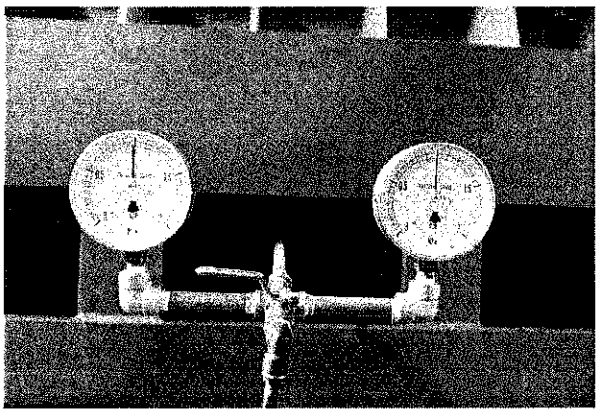
Inspected by
IHI Infrastructure Systems Co.,Ltd.
Gate & Penstock Quality Control Group
Koji Otani
NOV. 28. 2019

試驗報告(出廠證明)判定審核章
設計、規範值 詳檢驗紀錄表(11580)
廠商初判人員簽名:
☑符合 ☐不符合 本件業經核對無誤並符合契約規範規定，如有偽造文書情事，均由文件上公司及其簽名人員負刑事及民事所有責任
監造單位複判人員簽名:
☑合格 ☐不合格

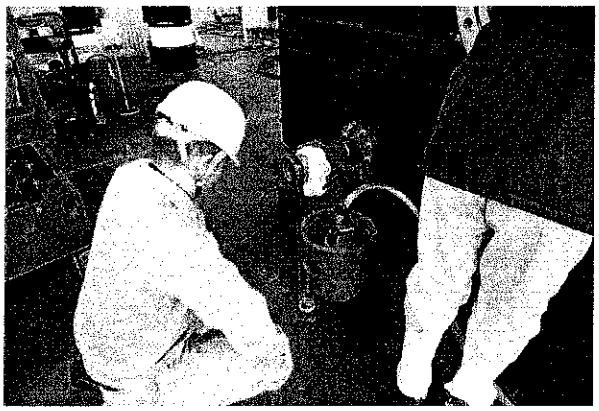
圖2-2-3 防護閘門試驗報告內容

表 2-2-2 耐壓及漏水試驗照片一覽表

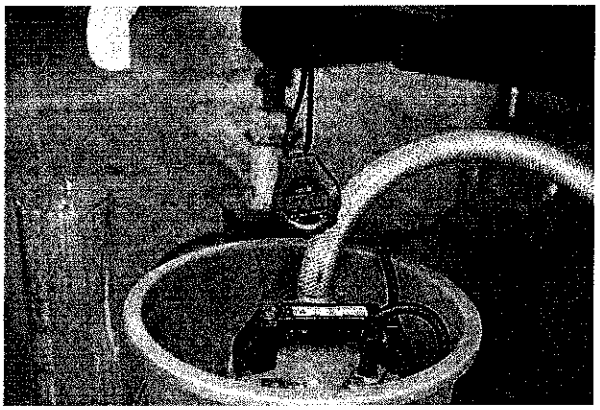




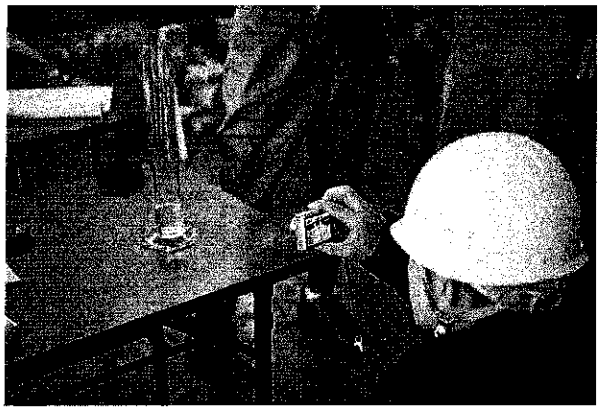
初始加壓達到達到 1.016MPa，開始漏水試驗後會慢慢洩壓



抽水馬達主要用意為備用以抽除周圍多餘積水



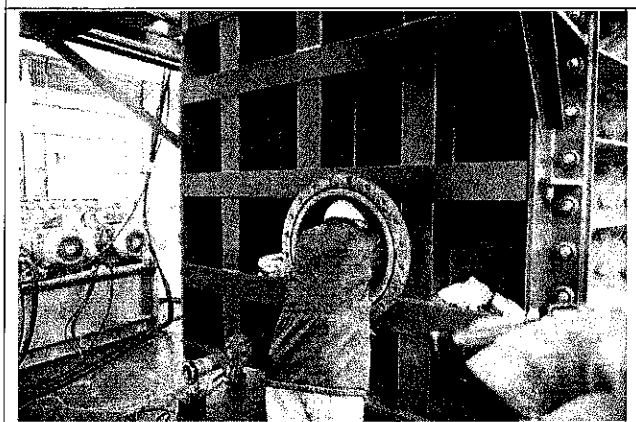
以碼表精確計時



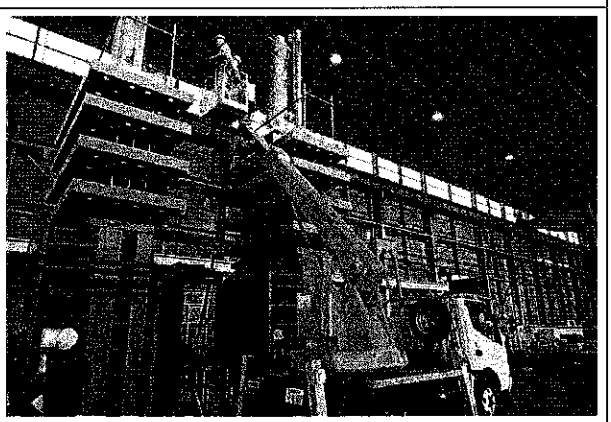
JIC 人員平視量筒拍照

JIC 人員及 IHI 檢查人員

配合白板拍照



等待計時時 JIC 人員同步檢視門框內是否有漏水情況



使用高空工作車檢視油壓系統有無漏油情形

2-3 單機運轉試驗

依據本工程施工規範第 11280 章「閘閥室閘閥及附屬設施」辦理，作業內容包含：各構件之裝配尺寸與精度、閥體升降順暢性、閘閥運轉速度、運轉數據(如電壓、電流、工作壓力…等)之紀錄。此部分即為無水單機試驗，於現場以油壓單元實際操作閘門上升及下降，並記錄電壓(設計值：220V±10%)、電流(設計值：<63A)、工作溫度(設計值：至多較氣溫高 40℃)、油壓、油溫(設計值：<55℃)、啟閉速度(設計值：0.1-0.15m/min)等數據，並檢視是否於標準誤差範圍內，另以目視檢查是否產生不正常震動、極限開關作動、開度計等是否正常，兩個閘門之試驗結果如下表 2-3-1~表 2-3-3，第三方試驗報告如下圖 2-3-1、2-3-2，試驗相關照片如下表 2-3-4。

表 2-3-1　運轉試驗結果表

防護閘門		馬達			壓力			速度		
試驗項目		電壓	電流	溫度升高	起始壓力	棒側壓力	頭側壓力	關閉時間	速度	揚程
設計值		220V±10%	≦63A	至多較氣溫高 40℃	21MPa	MPa	MPa	23min	0.1-0.15 m/min	2300mm
開	自檢	205	57.5	20-25	20.5	0.5	1.9	17.33	0.133	2301
	第三方	199	59.8	11-18	20.5	0.5	2.0	17.18	0.134	2298
閉	自檢	204	57.5	25-26	20.5	0.8	0.5	21.05	0.109	2301
	第三方	200	57.5	18-22	20.5	1.0	0.5	17.8	0.129	2298
控制閘門		馬達			壓力			速度		
試驗項目		電壓	電流	溫度升高	起始壓力	棒側壓力	頭側壓力	關閉時間	速度	揚程
設計值		220V±10%	≦63A	至多較氣溫高 40℃	21MPa	MPa	MPa	23min	0.1-0.15 m/min	2300mm
開	自檢	202	57.2	27-30	20.5	0.5	2.0	18.82	0.122	2300
	第三方	202	58.8	12-17	20.5	1.0	2.0	15.95	0.144	2298
閉	自檢	202	57.9	30-32	20.5	15	19	17.87	0.129	2300
	第三方	198	59.3	17-20	20.5	15	18.5	17.33	0.133	2298

表 2-3-2　油溫及氣溫變化表

控制閘門	運轉方向		油溫(℃)	氣溫(℃)	防護閘門	運轉方向		油溫(℃)	氣溫(℃)
	開 Open	自檢	47→37	21→19		開 Open	自檢	23→29	18→17
		廠驗	18→20	8.5→8.5			廠驗	12→18	13→13
	閉 Close	自檢	37→38	19→19		閉 Close	自檢	29→33	17→16
		廠驗	20→25	8.5→9			廠驗	18→23	13→13
基準值			55℃以下	-	基準值			55℃以下	-

表 2-3-3　目視檢查項目表

控制閘門/防護閘門	判定基準	檢查結果	
		自檢	廠驗
馬達絕緣類型	是否符合送審資料	符合	符合
震動	是否有不正常震動	無	無
極限開關動作	閘門全開時作動正常	正常	正常
	閘門全閉時作動正常	正常	正常
	其他極限開關均作動正常	正常	正常
開度計動作	開度計作動正常	正常	正常

INSPECTION ITEM	Control Gate (Gate Type: High Pressure Slide Gate)

1.Operation Inspection

区分 Division	運転方向 Direction of driving		電動機 Electric Motor			圧力 Pressure			開閉速度Speed			
			電圧 Voltage	電流 Current	温度 Temperature	元圧 Former pressure	ﾛｯﾄﾞ側圧力 Rod side pressure	ﾍｯﾄﾞ側圧力 Head side pressure	開閉時間 Hoisting time	速度 Speed	揚程 Operating stroke	流量調整弁の目盛り Flow control valve scale
			(V)	(A)	(℃)	MPa	MPa	MPa	min	m/min	mm	-
	設計値 Design value		220	63	---	21	---	---	23	0.1	2300	---
	開 Open	社内 In-house	202	57.2	27→30	20.5	0.5	2.0	18.82	0.122	2300	3.2
		立会 Witness	202	58.8	12→17	20.5	1.0	2.0	15.95	0.144	2298	3.2
	閉 Close	社内 In-house	202	57.9	30→32	20.5	15	19	17.87	0.129	2300	3.1
		立会 Witness	198	59.3	17→20	20.5	15	18.5	17.33	0.133	2298	3.1
基準値 Reference value			±10%	定格電流以下 Below ratings current	気温＋40℃ Ambient temperature ＋40℃ or less	規定値にあること a regulated value			0.1～0.15m/min		-	-

区分 Division	運転方向 Direction of driving		温度 Temperature	
			油温 Temperature of oil (℃)	気温 Temperature of room (℃)
	設計値 Design value		---	---
	開 Open	社内 In-house	47→37	21→19
		立会 Witness	18→20	8.5→8.5
	閉 Close	社内 In-house	37→38	19→19
		立会 Witness	20→25	8.5→9
基準値 Reference value			55℃以下 55℃ or less	

Reference Procedure;

Document No,180098-MP-010-B

Inspected by
IHI Infrastructure Systems Co.,Ltd.
Gate & Penstock Quality Control Group

NOV. 28、2019

Koji Otani

WITNESSED BY
REVIEWED BY
M.Shinohara
DEC. 06. 2019

検査項目 Item	判定基準 Judging Standard	検査結果 Inspection result	
		社内 In-house	立会 Witness
電動機絶縁種 Insulation type of motor	所定の絶縁種であること Accommodate to spec	good	good
振動 Vibration	有害な振動が無いこと There is no harmful vibration.	good	good
リミットスイッチの確認 Confirmation of Limit Switch	全開リミットスイッチが正常に作動すること Fully open limit Switch works normally	good	good
	全閉リミットスイッチが正常に作動すること Fully closing limit Switch works normally	good	good
	その他リミットスイッチが正常に作動すること All other limit Switch works normally	good	good
	開度計が正常に作動すること Position indicator works normally	good	good

試驗報告(出廠證明)判定資料確認
Confirmation of position indicator
設計、規範值 詳檢驗紀錄表(11280)
廠商初判人員簽名: 陳宏里
✓符合 □不符合 本件業經核對無誤並符合相關規範規定，如有偽造文書情事，均由文件上公司及其簽名人員負刑事及民事所有責任
監造單位複判人員簽名:
✓合格 □不合格

圖2-3-1 控制閘門運轉試驗報告內容

INSPECTION ITEM	Guard Gate (Gate Type: High Pressure Slide Gate)

1.Operation Inspection

区分 Division	運転方向 Direction of driving	電動機 Electric Motor			圧力 Pressure			開閉速度Speed			
		電圧 Voltage	電流 Current	温度 Temperature	元圧 Former pressure	ロット゛側圧力 Rod side pressure	ヘット゛側圧力 Head side pressure	開閉時間 Hoisting time	速度 Speed	揚程 Operating stroke	流量調整弁の目盛り Flow control valve scale
		(V)	(A)	(℃)	MPa	MPa	MPa	min	m/min	mm	-
	設計値 Design value	220	63	---	21	---	---	23	0.1	2300	---
開 Open	社内 In-house	205	57.5	20→25	20.5	0.5	1.9	17.33	0.133	2301	2.4
開 Open	立会 Witness	199	59.8	11→18	20.5	0.5	2.0	17.18	0.134	2298	2.4
閉 Close	社内 In-house	204	57.5	25→26	20.5	0.8	0.5	21.05	0.109	2301	2.5
閉 Close	立会 Witness	200	57.5	18→22	20.5	1.0	0.5	17.80	0.129	2298	2.7
基準値 Reference value		±10%	定格電流以下 Below ratings current	気温+40℃ Ambient temperature +40℃ or less	規定値にあること a regulated value				0.1～0.15m/min	-	-

区分 Division	運転方向 Direction of driving	温度 Temperature	
		油温 Temperature of oil (℃)	気温 Temperature of room (℃)
	設計値 Design value	---	---
開 Open	社内 In-house	23→29	18→17
開 Open	立会 Witness	12→18	13→13
閉 Close	社内 In-house	29→33	17→16
閉 Close	立会 Witness	18→23	13→13
基準値 Reference value		55℃以下 55℃ or less	-

Reference Procedure;

Document No,180098-MP-020-B

Inspected by
IHI Infrastructure Systems Co.,Ltd.
Gate & Penstock Quality Control Group
Nov.28.2019
Koji Otani
K. Otani

WITNESSED BY
REVIEWED BY
M.Shinohara
DEC. 05. 2019

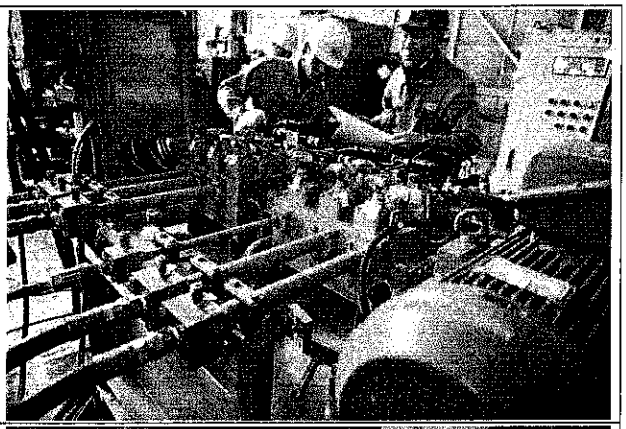
INSPECTED JAPAN INSPECTION CO.,LTD. J.I.C

検査項目 Item	判定基準 Judging Standard	検査結果 Inspection result	
		社内 In-house	立会 Witness
電動機絶縁種 Insulation type of motor	所定の絶縁種であること Accommodate to spec	good	good
振動 Vibration	有害な振動が無いこと There is no harmful vibration.	good	good
リミットスイッチの確認 Confirmation of Limit Switch	全開リミットスイッチが正常に作動すること Fully open limit Switch works normally	good	good
	全閉リミットスイッチが正常に作動すること Fully closing limit Switch works normally	good	good
	その他リミットスイッチが正常に作動すること All other limit Switch works normally	good	good
開度計の確認 Confirmation of position Indicator	開度計が正常に作動すること Position indicator works normally	good	good

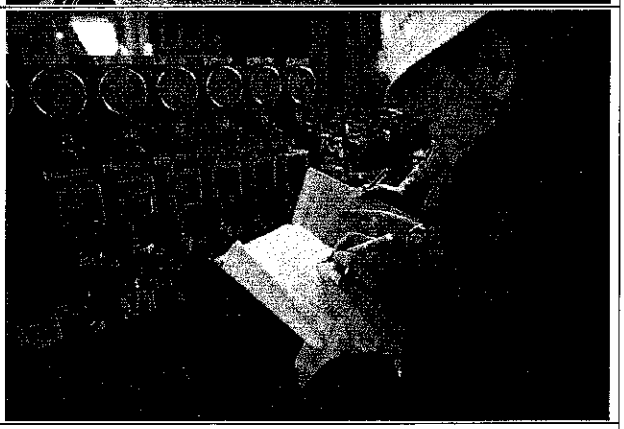
試驗報告(出廠證明)判定審核章
設計、規範值: 詳檢驗紀錄表(11>60)
廠商初判人員簽名: [signature]
☑符合 □不符合 本件業經核對無誤並符合契約規範規定，如有偽造文書情事，均由文件上公司及其簽名人員負刑事及民事所有責任
監造單位複判人員簽名: [signature]
☑合格 □不合格

圖2.3-2 防護閘門運轉試驗報告內容

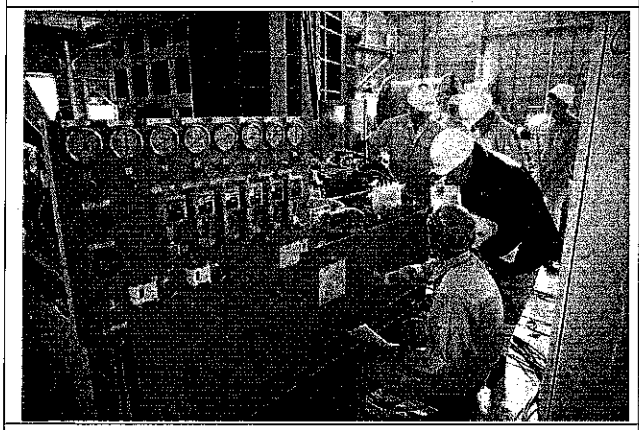
表 2-3-4　運轉試驗照片一覽表



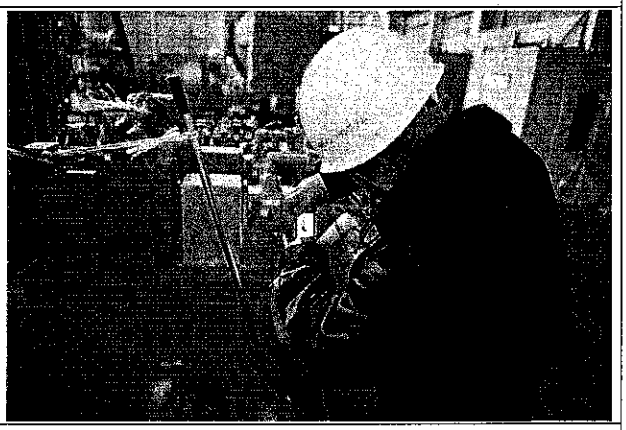
檢驗官量測二次側電流



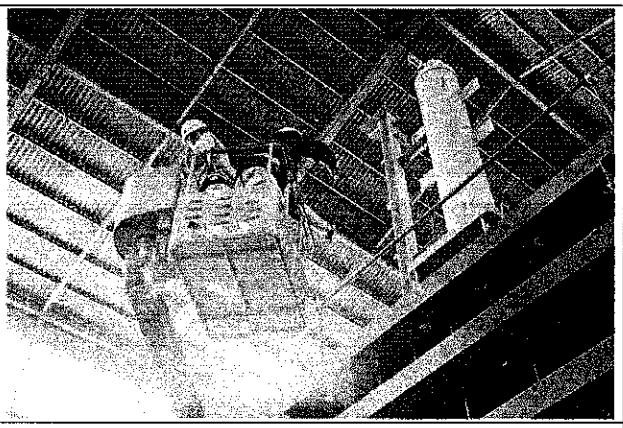
檢驗官紀錄運轉中各項數據



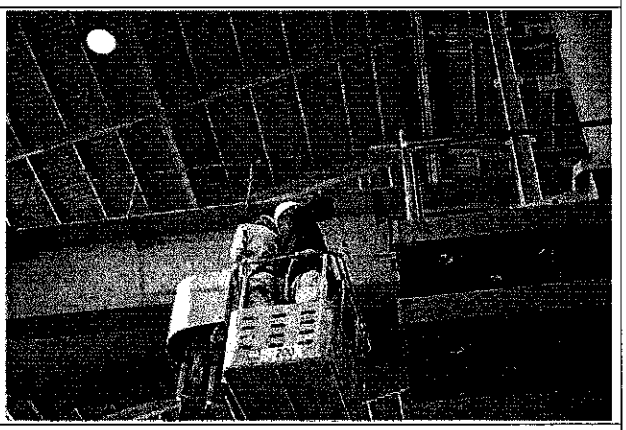
檢驗官檢驗油壓單元狀況



檢驗官檢驗油壓單元狀況



檢驗官檢查開度指示計是否與閘門開度吻合



須檢查開度指示計是否與閘門開度吻合


檢驗官檢測極限開關備品是否能正常運作

2-4 外觀及尺寸試驗

依據本案高壓閘門檢驗程序書，量測閘門尺寸及組裝品質，JIC 依據 IHI 提供經本局核定之細設圖說及檢驗程序書辦理檢驗，其容許誤差大部分均為 1-3mm，明顯較本工程規範訂定約 4-5mm 為小，廠商均以符合 JIS 標準之量測工具，配合手電筒等照明設備抽樣量測，一旁由 JIC 檢驗官抽測並監督數值及過程並拍照記錄量測值，部分隱蔽部分無法量測，兩個閘門之尺寸量測平面參考圖如下圖 2-4-1，結果全部量測部位皆合格，如下表 2-4-1~表 2-4-5，第三方試驗報告如下圖 2-4-2~2-4-7，相關照片如下表 2-4-6。

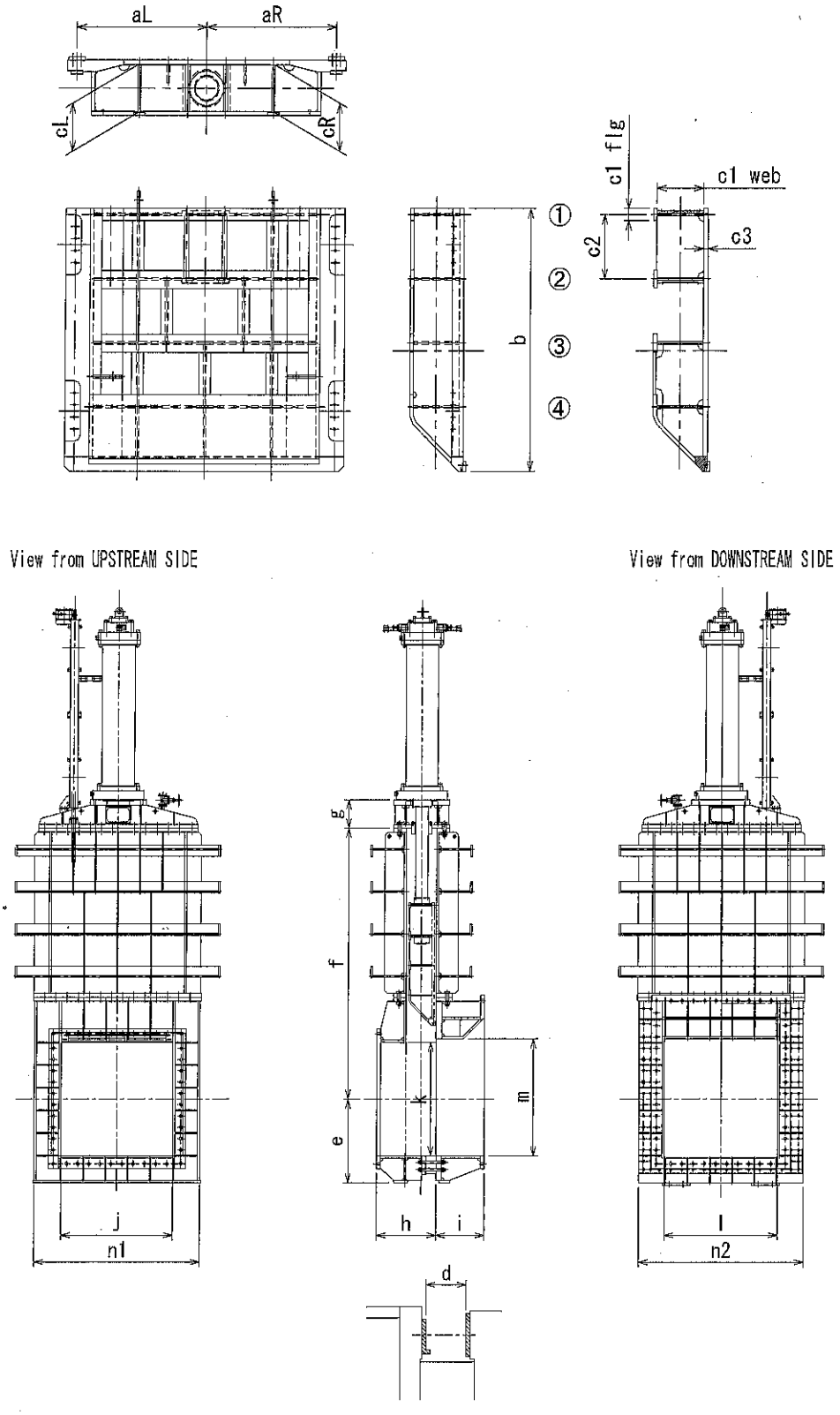


圖2-4-1　控制閘門及防護閘門尺寸量測位置參考圖

表 2-4-1　控制閘門外觀尺寸量測結果表 1

單位:mm

控制閘門量測項目-1		量測點				設計值	容許誤差	自檢		廠驗	
								量測值	誤差	量測值	誤差
a	門扉寬度	頂部			aL	1100	±1	1100	0		
					aR			1100	0		
					a	2200	±2	2200	0		
		底部			aL	1100	±1	1100	0		
					aR			1100	0		
					a	2200	±2	2200	0		
b	門扉高度	左側				2230	±1	2229	-1		
		右側						2229.5	-0.5		
c1	門扉深度	①	左側		Web	395	±2	394	-1		
					Flg	100	±2	100	0		
			右側		Web	395	±2	394	-1		
					Flg	100	±2	100	0		
		②	左側		Web	388	±2	387	-1		
					Flg	150	±2	149.5	-0.5		
			右側		Web	388	±2	387	-1		
					Flg	150	±2	149	-1		
		③	左側		Web	388	±2	387	-1		
					Flg	150	±2	150	0		
			右側		Web	388	±2	387	-1	390	+2
					Flg	150	±2	150	0	151	+1
		④	左側		Web	388	±2	387	-1		
			右側		Web	388	±2	387	-1		
c2	主要水平樑距離	① to ②				550	±5	550	0		
		② to ③				545		545	0	543	-2
		③ to ④				545		545	0		
c3	面板厚度	最小值				40	±0.8（JIS）	40.13	+0.13		

表 2-4-2　控制閘門外觀尺寸量測結果表 2

單位：mm

控制閘門量測項目-2		量測點		設計值	容許誤差	自檢		廠驗	
						量測值	誤差	量測值	誤差
d	閘門軌道寬度	左側	上方	145	±1	145	0	145	0
			下方			145	0	145	0
		右側	上方			145	0	145	0
			下方			145	0	145	0
e	自閘門中心道閘門底部之門框高度	左側		1480	±3	1480	0	1480	0
		右側				1480	0	1478	-2
f	自閘門中心道閘門頂部之門框高度	左側		4800	±2	4799	-1	4802	+2
		右側				4801	+1	4801	+1
g	油壓缸蓋高度	左側		505	±2	505	0	505	0
		右側				505	0	505	0
h	上游側門框長度	左側		1085	±2	1085	0	1086	+1
		右側				1085	0	1086	+1
i	下游側門框長度	左側		855	±2	857	+2	855	0
		右側				857	+2	857	+2
j	上游側門框內寬度	左側		2000	±3	1999	-1	2000	0
		右側				2000	0	2000	0
k	上游側門框內高度	左側		2000	±3	1999.5	-0.5	2000	0
		右側				2001	+1	2001	+1
l	下游側門框內寬度	左側		2030	±3	2028	-2	2028	-2
		右側				2030	0	2030	0
m	下游側門框內高度	左側		2070	±3	2069	-1	2069	-1
		右側				2069	-1	2070	0
n	上游側門框寬度	n1	上方	2960	±5	2963	+3	2963	+3
			下方			2961	-1	2961	+1
	下游側門框寬度	n2	上方	2950	±5	2947	-3	2952	+2
			下方			2950	0	2951	+1

表 2-4-3　防護閘門外觀尺寸量測結果表 1

單位:mm

防護閘門量測項目-1		量測點			設計值	容許誤差	自檢		廠驗	
							量測值	誤差	量測值	誤差
a	門扉寬度	頂部		aL	1100	±1	1100	0		
				aR			1100	0		
				a	2200	±2	2200	0		
		底部		aL	1100	±1	1100	0		
				aR			1100	0		
				a	2200	±2	2200	0		
b	門扉高度	左側			2230	±1	2230	0		
		右側					2229.5	-0.5		
c1	門扉深度	①	左側	Web	395	±2	394	-1		
				Flg	100	±2	101	+1		
			右側	Web	395	±2	394	-1		
				Flg	100	±2	100	0		
		②	左側	Web	388	±2	387	-1		
				Flg	150	±2	150	0		
			右側	Web	388	±2	387	-1	389	+1
				Flg	150	±2	150	0	150	0
		③	左側	Web	388	±2	387	-1		
				Flg	150	±2	150	0		
			右側	Web	388	±2	387	-1	389	+1
				Flg	150	±2	150	0	151	+1
		④	左側	Web	388	±2	387	-1		
			右側	Web	388	±2	387	-1	386	-2
c2	主要水平樑距離	① to ②			550	±5	550	0		
		② to ③			545		545	0	544.5	-0.5
		③ to ④			545		545	0		
c3	面板厚度	最小值			40	±0.8（JIS）	40.29	+0.29		

表 2-4-4　防護閘門外觀尺寸量測結果表 2

單位:mm

防護閘門量測項目-2		量測點		設計值	容許誤差	自檢		廠驗	
						量測值	誤差	量測值	誤差
d	閘門軌道寬度	左側	上方	145	±1	145	0	145	0
			下方			145	0	145	0
		右側	上方			145	0	145	0
			下方			145	0	145	0
e	自閘門中心道閘門底部之門框高度	左側		1480	±3	1481	+1	1481	+1
		右側				1478	-2	1478	-2
f	自閘門中心道閘門頂部之門框高度	左側		4800	±2	4801	+1	4801	+1
		右側				4801	+1	4802	+2
g	油壓缸蓋高度	左側		505	±2	506	+1	506	+1
		右側				506	+1	506	+1
h	上游側門框長度	左側		1085	±2	1085	0	1084	-1
		右側				1085	0	1085	0
i	下游側門框長度	左側		855	±2	857	+2	857	+2
		右側				857	+2	857	+2
j	上游側門框內寬度	左側		2000	±3	2000	0	2001	+1
		右側				2001	+1	2000	0
k	上游側門框內高度	左側		2000	±3	1997	-3	1997	-3
		右側				1997	-3	1997	-3
l	下游側門框內寬度	左側		2030	±3	2027	-3	2028	-2
		右側				2029	-1	2027	-3
m	下游側門框內高度	左側		2070	±3	2067	-3	2067	-3
		右側				2067	-3	2067	-3
n	上游側門框寬度	n1	上方	2960	±5	2963	+3	2961	+1
			下方			2962	+2	2962	+2
	下游側門框寬度	n2	上方	2950	±5	2950	0	2951	+1
			下方			2950	0	2950	0

表 2-4-5　控制閘門及防護閘門外觀組裝檢驗項目表

控制閘門/防護閘門 目視檢查項目	檢查標準	自檢	廠驗
組件密合度	組件皆於正常位置	良好	良好
水封面表面狀況	沒有多餘物體	良好	良好
不鏽鋼表面狀況	沒有鏽蝕	良好	良好
損壞狀況	外觀沒有任何損壞	良好	良好
螺栓狀況	以測試槌檢查沒有螺絲鬆脫	良好	良好
各部份設備狀況	各設備皆於正常位置	良好	良好

INSPECTION ITEM	Control Gate (Gate Type: High Pressure Slide Gate)

Dimension inspection

Measuring point

Inspection	Date	Confirmation
In-house	Oct.03,2019	
Witness	Dec.06,2019	

REVISWED BY

Unit:mm

Measuring items		Inspection points			Design data	Tolerance	In-house inspection		Witness inspection	
							Data	Difference	Data	Difference
a	Gate leaf width	Top		aL	1100	±1	1100	0		
				aR			1100	0		
				a	2200	±2	2200	0		
		Bottom		aL	1100	±1	1100	0		
				aR			1100	0		
				a	2200	±2	2200	0		
b	Gate leaf height	Left			2230	±1	2229	-1		
		Right					2229.5	-0.5		
c1	Gate leaf depth	①	Left	Web	395	±2	394	-1		
				Flg	100	±2	100	0		
			Right	Web	395	±2	394	-1		
				Flg	100	±2	100	0		
		②	Left	Web	388	±2	387	-1		
				Flg	150	±2	149.5	-0.5		
			Right	Web	388	±2	387	-1		
				Flg	150	±2	149	-1		
		③	Left	Web	388	±2	387	-1		
				Flg	150	±2	150	0		
			Right	Web	388	±2	387	-1	390	+2
				Flg	150	±2	150	0	151	+1
		④	Left	Web	388	±2	387	-1		
			Right	Web	388	±2	387	-1		
c2	Distance between main horizontal beam	① to ②			550	±5	550	0		
		② to ③			545		545	0	543	-2
		③ to ④			545		545	0		
c3	Skin plate thickness	minimum			40	±0.8 (JIS)	40.13	+0.13		

試驗報告(出廠證明)判定簽章

設計、規範值: 詳檢驗紀錄表(11280)

廠商初判人員簽名: 陳宗典

☑符合 ☐不符合 本件業經核對無誤並符合契約規範規定，如有偽造文書情事，均由文件上公司及具簽名人員負刑事及民事所有責任

監造單位複判人員簽名:

☑合格 ☐不合格

圖2-4-2 控制閘門尺寸量測試驗報告內容

INSPECTION ITEM	Control Gate (Gate Type: High Pressure Slide Gate)

Inspection	Date	Confirmation
In-house	NOV. 26 2019	
Witness	Dec. 06, 2019	

& REVIEWED BY

Unit:mm

Measuring items		Inspection points		Design data	Tolerance	In-house inspection		Witness inspection	
						Data	Difference	Data	Difference
d	Gate slot	Left	Upper	145	±1	145	0	145	0
			Lower			145	0	145	0
		Right	Upper			145	0	145	0
			Lower			145	0	145	0
e	Casing height from gate center to bottom	Left		1480	±3	1480	0	1480	0
		Right				1480	0	1478	-2
f	Casing height from gate center to top	Left		4800	±2	4799	-1	4802	+2
		Right				4801	+1	4801	+1
g	Bonnet cover height	Left		505	±2	505	0	505	0
		Right				505	0	505	0
h	Upstream side Casing length	Left		1085	±2	1085	0	1086	+1
		Right				1085	0	1086	+1
i	Downstream side Casing length	Left		855	±2	857	+2	855	0
		Right				857	+2	857	+2
j	Inside dimension of pipe width (Upstream side)	Upper		2000	±3	1999	-1	2000	0
		Lower				2000	0	2000	0
k	Inside dimension of pipe height (Upstream side)	Left		2000	±3	1999.5	-0.5	2000	0
		Right				2001	+1	2001	+1
l	Inside dimension of pipe width (Downstream side)	Upper		2030	±3	2028	-2	2028	-2
		Lower				2030	0	2030	0
m	Inside dimension of pipe height (Downstream side)	Left		2070	±3	2069	-1	2069	-1
		Right				2069	-1	2070	0
n	Casing width (Upstream side)	n1	Upper	2960	±5	2963	+3	2963	+3
			Lower			2961	+1	2961	+1
	Casing width (Downstream side)	n2	Upper	2950	±5	2947	-3	2952	+2
			Lower			2950	0	2951	+1

Reference Procedure: Document No.180098-MP-010-B

試驗報告(出廠證明)判定審核章
設計、規範值: 詳檢驗紀錄表(11280)
廠商初判人員簽名:
□符合 □不符合 本件業經核對無誤並符合契約規範規定，如有偽造文書情事，均由文件上公司及其簽名人員負刑事及民事所有責任
監造單位複判人員簽名:
□合格 □不合格

圖2-4-3 控制閘門尺寸量測試驗報告內容(續)

INSPECTION ITEM	Control Gate (Gate Type: High Pressure Slide Gate)

1. Visual Inspection for Assembly

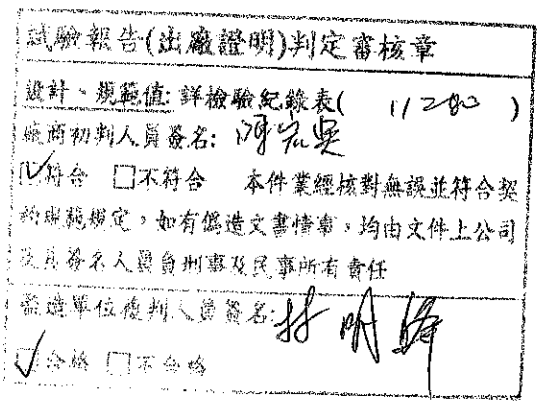
Item	Acceptance	In-house inspection	Witness inspection
Condition of component fitting	It is checked by viewing, components are fitting proper position	good	good
Condition of the surface on seal and sliding plate	It is checked by viewing, there is no foreign object	good	good
Condition of the surface on Stainless Steel	It is checked by viewing, there is no rust	good	good
Damage	It is checked by viewing, there is no damage	good	good
Condition of Bolt	It is checked by testing hammer, there is no loose bolt	good	good
Condition of equipment fitting	It is checked by viewing, equipmentsts are fitting proper position	good	good

Reference Procedure; Document No.180098-MP-010-B

WITNESSED BY
REVIEWED BY
M. Shinohara
DEC. 06. 2019

Inspected by
IHI Infrastructure Systems Co.,Ltd.
Gate & Penstock Quality Control Group
Nov. 28. 2019
Koji Otani

圖2-4-4　控制閘門外觀檢查報告內容



INSPECTION ITEM	Guard Gate (Gate Type: High Pressure Slide Gate)

Dimension inspection

Measuring point

Inspection	Date	Confirmation
In-house	Oct.03.2019	
Witness	Dec. 25, 2019	

REVIEWED BY

Unit:mm

Measuring items		Inspection points			Design data	Tolerance	In-house inspection		Witness inspection	
							Data	Difference	Data	Difference
a	Gate leaf width	Top		aL	1100	±1	1100	0		
				aR			1100	0		
				a	2200	±2	2200	0		
		Bottom		aL	1100	±1	1100	0		
				aR			1100	0		
				a	2200	±2	2200	0		
b	Gate leaf height	Left			2230	±1	2230	0		
		Right					2229.5	-0.5		
c1	Gate leaf depth	①	Left	Web	395	±2	394	-1		
				Flg	100	±2	101	+1		
			Right	Web	395	±2	394	-1		
				Flg	100	±2	100	0		
		②	Left	Web	388	±2	387	-1		
				Flg	150	±2	150	0		
			Right	Web	388	±2	387	-1	389	+1
				Flg	150	±2	150	0	150	0
		③	Left	Web	388	±2	387	-1		
				Flg	150	±2	150	0		
			Right	Web	388	±2	387	-1	389	+1
				Flg	150	±2	150	0	151	+1
		④	Left	Web	388	±2	387	-1		
			Right	Web	388	±2	387	-1	386	-2
c2	Distance between main horizontal beam	① to ②			550	±5	550	0		
		② to ③			545		545	0	544.5	-0.5
		③ to ④			545		545	0		
c3	Skin plate thickness	minimum			40	±0.8 (JIS)	40.29	+0.29		

試驗報告(出廠證明)判定審核章

設計、規範值: 詳檢驗紀錄表(11280)

廠商初判人員簽名:

☑符合 ☐不符合 本件業經核對無誤並符合契約規範規定，如有偽造文書情事，均由文件上公司及其簽名人員負刑事及民事所有責任

監造單位複判人員簽名:

☑合格 ☐不合格

圖2-4-5 防護閘門尺寸量測試驗報告內容

INSPECTION ITEM	Guard Gate (Gate Type: High Pressure Slide Gate)

Inspection	Date	Confirmation
In-house	NOV. 26 2019	K. [signature]
Witness	Dec. 05, 2019	M. Shinohara

& REVIEWED BY

Measuring items		Inspection points		Design data	Tolerance	In-house inspection Data	In-house inspection Difference	Witness inspection Data	Witness inspection Difference
d	Gate slot	Left	Upper	145	±1	145	0	145	0
			Lower			145	0	145	0
		Right	Upper			145	0	145	0
			Lower			145	0	145	0
e	Casing height from gate center to bottom	Left		1480	±3	1481	+1	1481	+1
		Right				1478	-2	1478	-2
f	Casing height from gate center to top	Left		4800	±2	4801	+1	4801	+1
		Right				4801	+1	4802	+2
g	Bonnet cover height	Left		505	±2	506	+1	506	+1
		Right				506	+1	506	+1
h	Upstream side Casing length	Left		1085	±2	1085	0	1084	-1
		Right				1085	0	1085	0
i	Downstream side Casing length	Left		855	±2	857	+2	857	+2
		Right				857	+2	857	+2
j	Inside dimension of pipe width (Upstream side)	Upper		2000	±3	2000	0	2001	+1
		Lower				2001	+1	2000	0
k	Inside dimension of pipe height (Upstream side)	Left		2000	±3	1997	-3	1997	-3
		Right				1997	-3	1997	-3
l	Inside dimension of pipe width (Downstream side)	Upper		2030	±3	2027	-3	2028	-2
		Lower				2029	-1	2027	-3
m	Inside dimension of pipe height (Downstream side)	Left		2070	±3	2067	-3	2067	-3
		Right				2067	-3	2067	-3
n	Casing width (Upstream side)	n1	Upper	2960	±5	2963	+3	2961	+1
			Lower			2962	+2	2962	+2
	Casing width (Downstream side)	n2	Upper	2950	±5	2950	0	2951	+1
			Lower			2950	0	2950	0

Reference Procedure; Document No,180098-MP-020-B

試驗報告(出廠證明)判定審核章 2-4-6
設計、規範值: 詳檢驗紀錄表(11-280)
廠商初判人員簽名: [signature]
☑符合 □不符合 本件業經核對無誤並符合契約規範規定，如有偽造文書情事，均由文件上公司及其簽名人員負刑事及民事所有責任
監造單位複判人員簽名: [signature]
✓合格 □不合格

防護閘門尺寸量測試驗報告內容(續)

INSPECTION ITEM	Guard Gate (Gate Type: High Pressure Slide Gate)

1. Visual Inspection for Assembly

Item	Acceptance	In-house inspection	Witness inspection
Condition of component fitting	It is checked by viewing, components are fitting proper position	good	good
Condition of the surface on seal and sliding plate	It is checked by viewing, there is no foreign object	good	good
Condition of the surface on Stainless Steel	It is checked by viewing, there is no rust	good	good
Damage	It is checked by viewing, there is no damage	good	good
Condition of Bolt	It is checked by testing hammer, there is no loose bolt	good	good
Condition of equipment fitting	It is checked by viewing, equipmentsts are fitting proper position	good	good

Reference Procedure; Document No,180098-MP-020-B

WITNESSED BY
REVIEWED BY
M.Shinohara
DEC. 05. 2019

Inspected by
IHI Infrastructure Systems Co.,Ltd.
Gate & Penstock Quality Control Group
NOV. 28, 2019
Koji Otani

圖2-4-7　防護閘門外觀檢查報告內容

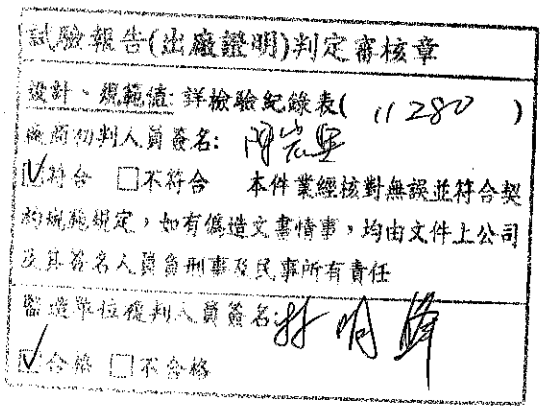
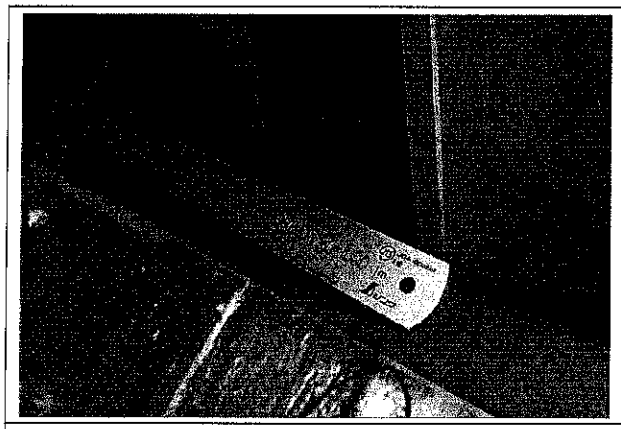
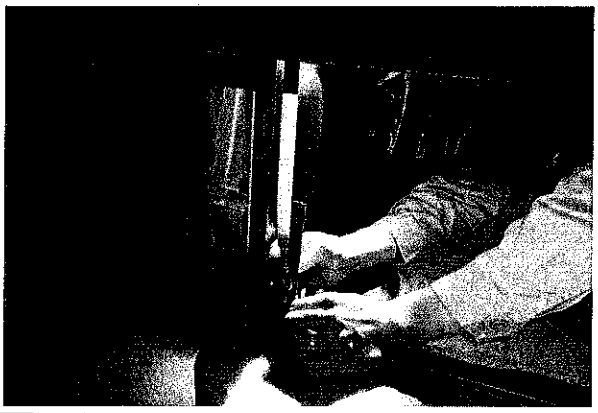

試驗報告(出廠證明)判定審核章
設計、規範值: 詳檢驗紀錄表(11280)
檢商初判人員簽名:
☑符合 ☐不符合 本件業經核對無誤並符合契約規範規定，如有偽造文書情事，均由文件上公司及其簽名人員負刑事及民事所有責任
監造單位複判人員簽名:
☑合格 ☐不合格

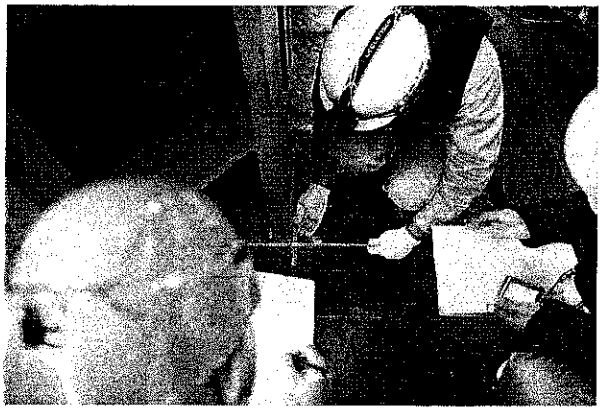
表 2-4-6　尺寸量測及外觀試驗照片一覽表

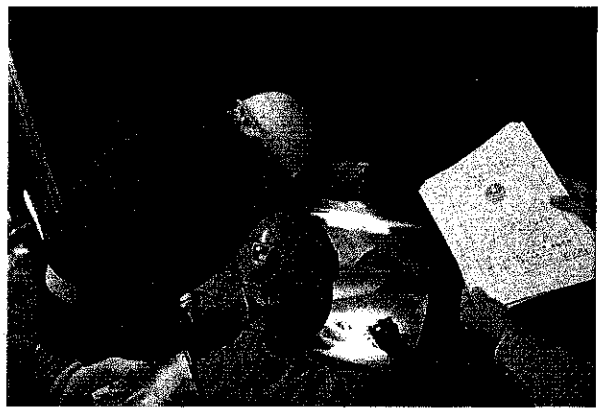


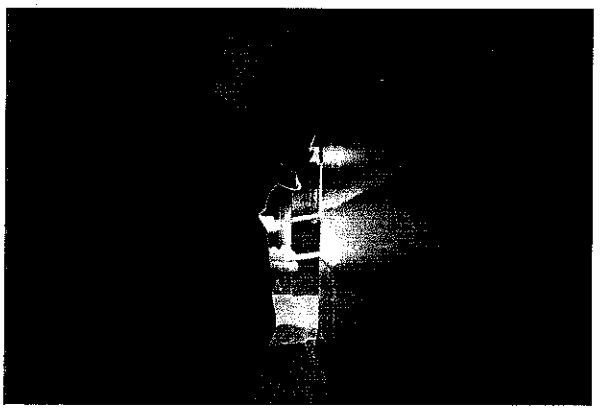
以 JIS 標準尺量測

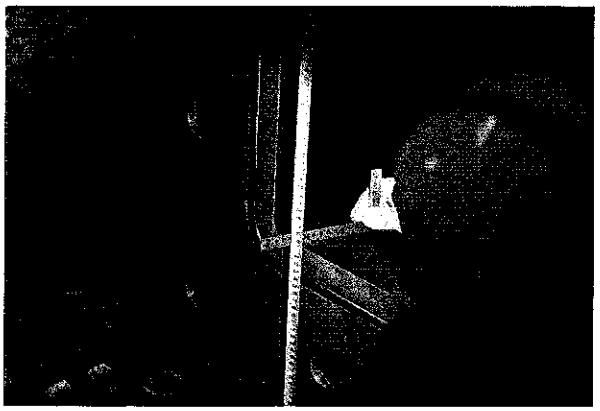


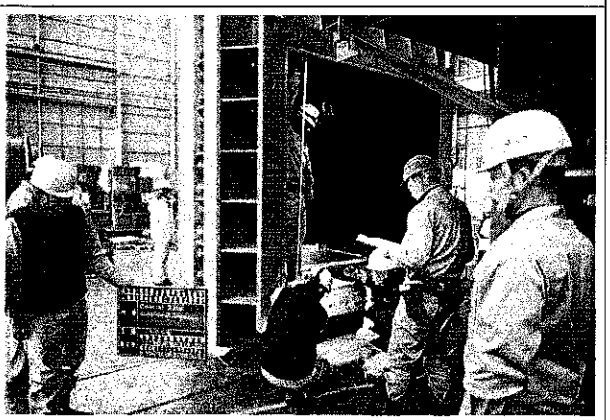
配合捲尺及頭燈

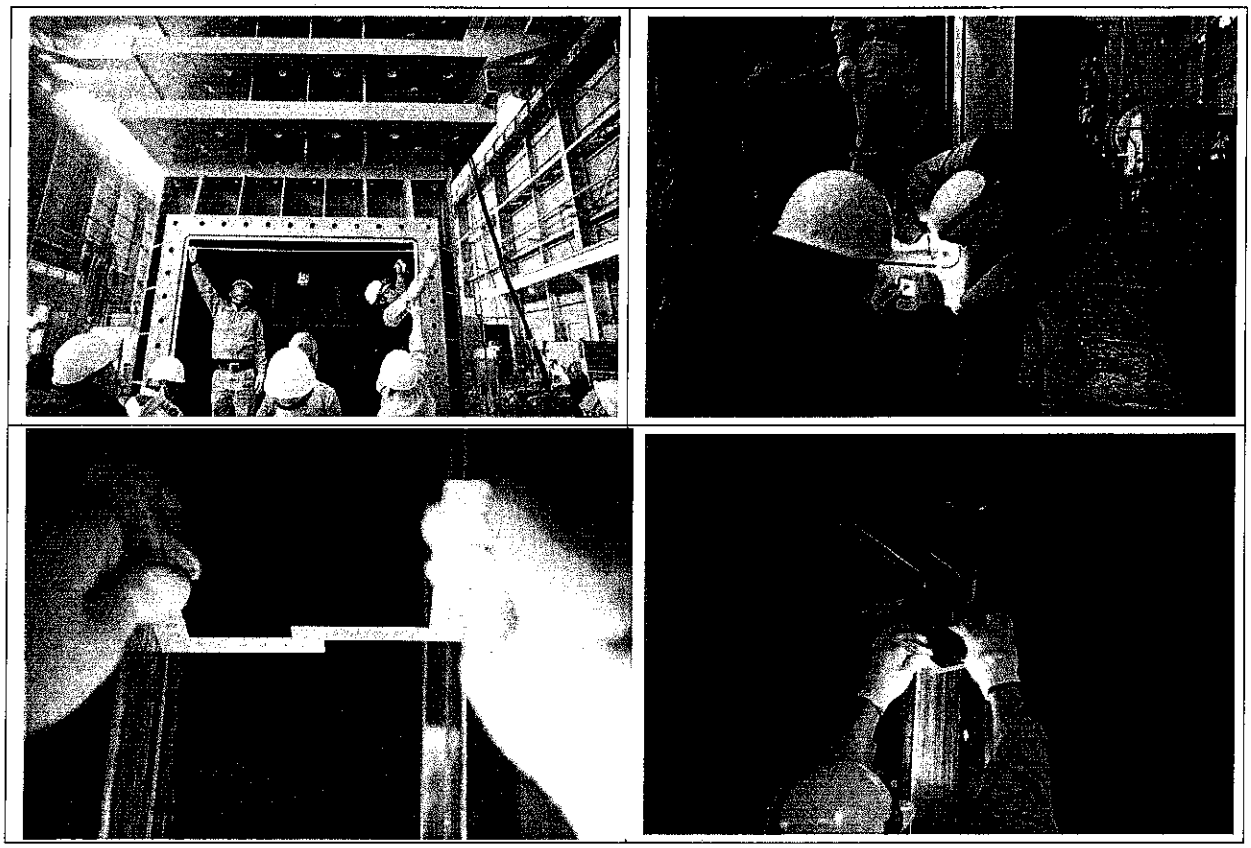












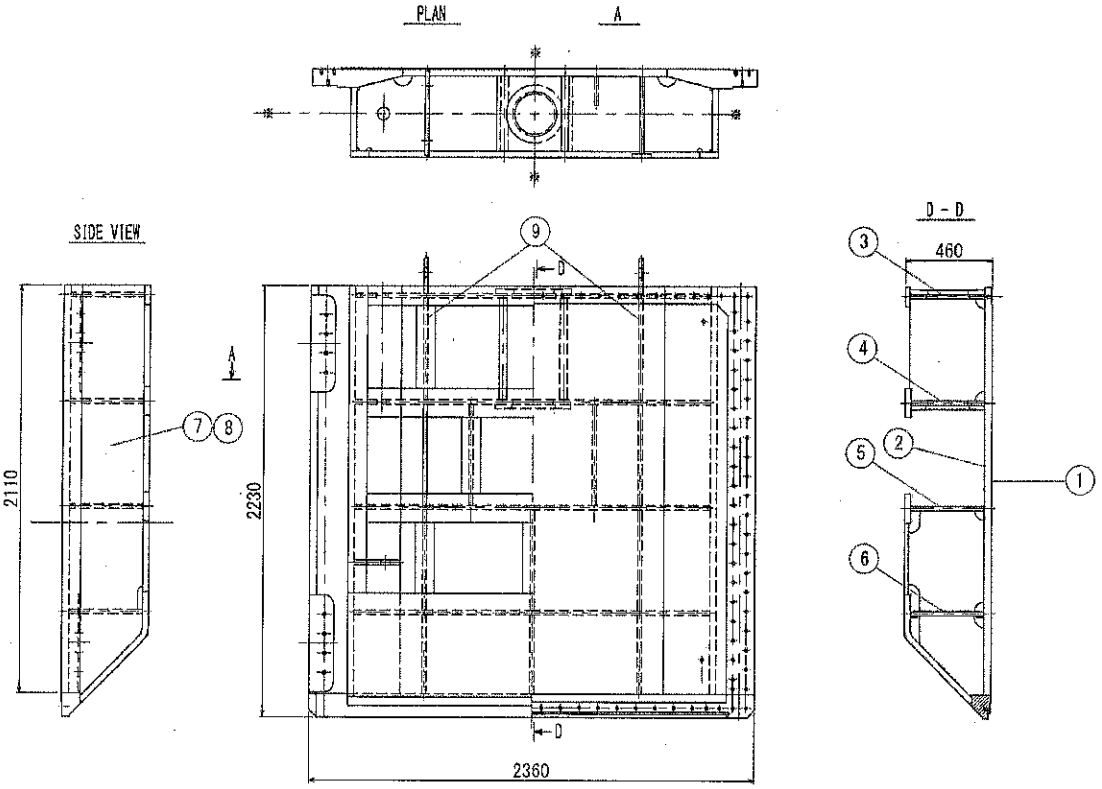
2-5 膜厚檢驗試驗

依據本案 2 高壓閘門檢驗程序書(詳附件一及附件二)，量測閘門油漆膜厚，廠商均以符合 CNS 標準之膜厚計量測工具，配合手電筒等照明設備抽樣量測，該兩個閘門檢測標準於浸水部分皆為 320um，無浸水外露部分則為 200um，且須有 70%以上之合格率，先由 IHI 於 10 月份進行全面自主檢查，12 月廠驗時第三方檢測則針對可量測非隱蔽部分進行抽查，結果全部量測部位皆合格，如下表 2-5-1~表 2-5-8，第三方試驗報告如下圖 2-5-1~2-5-10，試驗相關照片如下表 2-5-9。

表 2-5-1　控制閘門門扉膜厚量測結果表

部件	控制閘門門扉								
量測時機	最外層塗裝完成後								
量測時間	2019.10.03(自檢)、2019.12.06(廠驗)								
位置	浸水部分	設計膜厚	320 μm	最小膜厚	224 μm				
總塗裝面積	29.1 m^2	須檢測點位	60 點	總檢測點位	60 點				
檢測結果	最小膜厚	自檢	405 μm	廠驗	307 μm				
	平均值膜厚	自檢	468 μm	廠驗	445 μm				

量測位置



量測資料													單位: μm
量測位置			a (上部)		b (下部)		c (左邊)		d (右邊)		平均值		最小值	
			自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗
①	下游面面板	1	523	532	433	517	460	524	440	583	464	539	433	517
		2	411	613	430	572	449	579	440	600	433	591	411	572
		3	434	621	506	594	435	624	508	536	471	594	434	536
		4	467	563	445	565	443	586	427	537	446	563	427	537
		5	410	824	485	621	516	580	484	625	474	663	410	580
		6	457	645	439	613	475	576	457	608	457	611	439	576

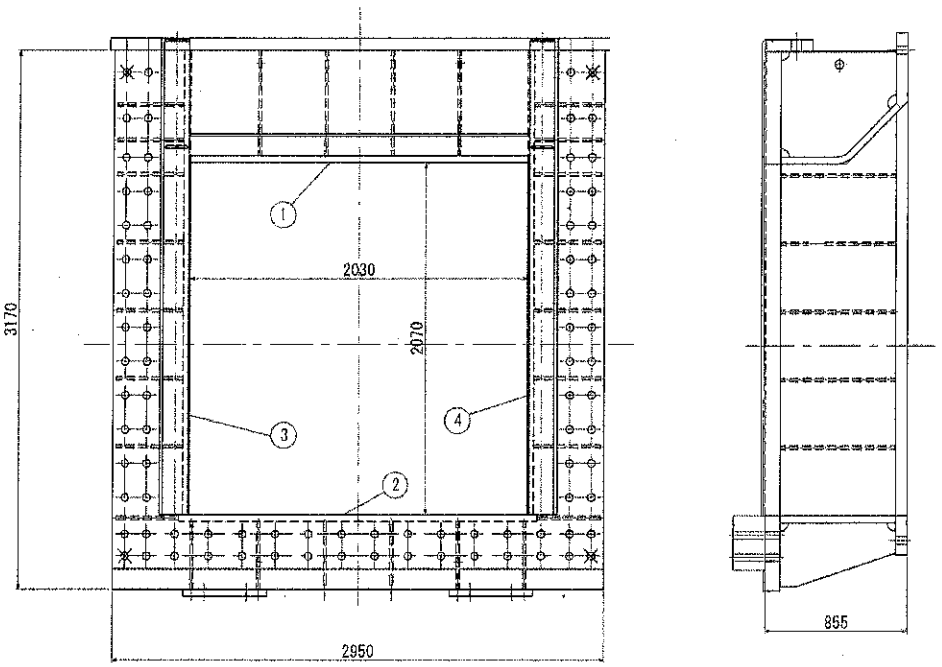
		7	448	698	448	596	465	689	460	569	455	638	448	569
		8	471	550	426	516	484	522	437	490	455	520	426	490
②	上游面面板	1	475	383	440	362	494	399	482	400	473	386	440	362
		2	483	334	465	339	440	347	408	320	449	340	408	320
		3	416	413	468	340	513	388	489	333	472	369	416	333
		4	462	342	503	337	510	345	421	425	474	362	421	337
		5	492	314	420	307	471	342	535	325	480	322	420	307
		6	442	326	524	326	439	321	412	314	454	322	412	314
③	第一支主樑	1	508		439		517		457		480		439	
		2	431		422		455		464		443		422	
		3	466		424		493		500		471		424	
		4	518		427		443		450		460		427	
		5	480		438		508		474		475		438	
		6	412		415		463		453		43		412	
④	第二支主樑	1	464	349	489	329	494	331	457	329	476	335	457	329
		2	484		428		466		482		465		428	
		3	508		511		506		473		500		473	
		4	445	377	517	371	455	395	432	354	462	374	432	354
		5	429	372	510	376	442	417	445	343	457	375	429	343
		6	513		437		471		517		485		437	
		7	498		514		487		529		507		487	
		8	494	335	485	347	489	371	493	360	490	353	485	335
⑤	第三支主樑	1	421	358	467	373	459	359	429	415	444	376	421	358
		2	520	394	474	436	515	423	440	416	487	417	440	394
		3	486	572	433	548	500	578	465	502	471	550	433	502
		4	471	474	450	432	456	435	456	444	458	446	450	432
		5	522	349	471	363	481	389	515	357	497	365	471	349
		6	468	338	497	328	448	366	429	345	461	344	429	328
		7	409		430		499		463		450		409	
		8	469		462		476		534		485		462	
⑥	第四支主樑	1	434	466	499	417	468	449	469	477	468	452	434	417
		2	474		510		481		502		492		474	
		3	462		469		472		500		476		462	
		4	468		504		405		406		446		405	
		5	450	311	478	309	475	336	456	333	465	322	450	309
		6	510		435		440		413		450		413	
		7	513		503		504		452		493		452	
		8	477	478	466	531	521	476	442	502	477	497	442	476
⑦	左側邊樑	1	486		494		454		425		465		425	
		2	439		479		447		445		453		439	

		3	424		432		511		426		448	424	
		4	511		507		492		455		491	455	
⑧	右側邊樑	1	470		472		437		508		472	437	
		2	453		422		436		434		436	422	
		3	482		438		441		504		466	438	
		4	475		456		408		493		458	408	
⑨	垂直樑	1	428		468		442		517		464	428	
		2	515		431		484		453		471	431	
		3	465		487		506		511		492	465	
		4	473		468		500		475		479	468	
		5	502		530		486		468		497	468	
		6	440		470		506		461		469	440	
		7	450		429		448		485		453	429	
		8	489		476		418		467		463	418	

表 2-5-2　控制閘門下游面門框膜厚量測結果表

部件	控制閘門下游面門框								
量測時機	最外層塗裝完成後								
量測時間	2019.10.03(自檢)、2019.12.06(廠驗)								
位置	浸水部分	設計膜厚	320 μm	最小膜厚	224 μm				
總塗裝面積	8 m^2	須檢測點位	16 點	總檢測點位	16 點				
檢測結果	最小膜厚	自檢	444 μm	廠驗	432 μm				
	平均值膜厚	自檢	587 μm	廠驗	540 μm				

量測位置



量測資料　　單位: μm

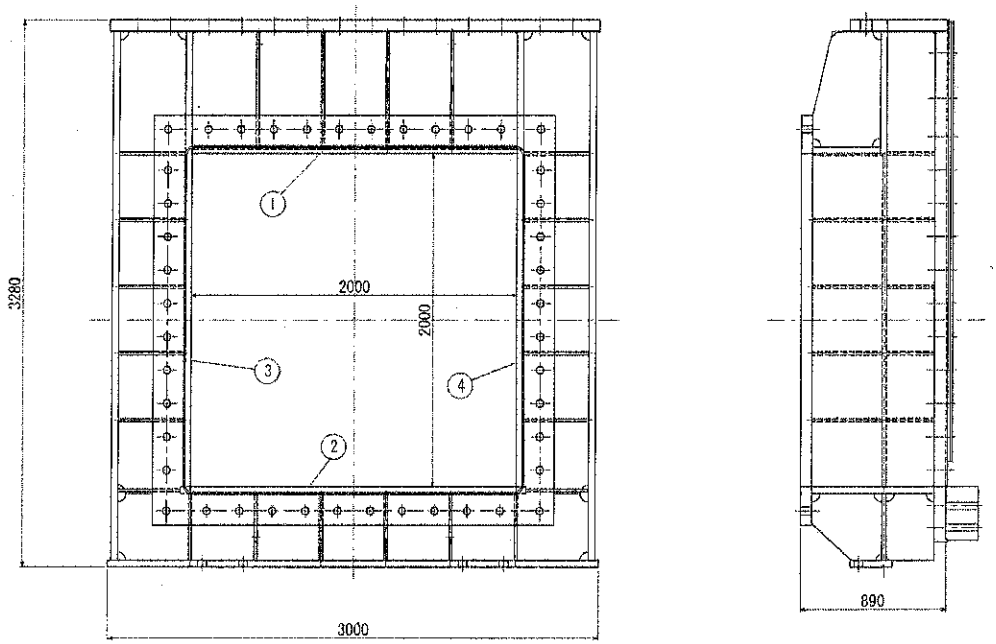
量測位置			a (上部)		b (下部)		c (左邊)		d (右邊)		平均值		最小值	
			自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗
①	浸水部分上部表面	1	500	539	444	439	491	532	549	482	496	498	444	439
		2	500		558		486		539		521		496	
		3	634		623		699		570		632		570	
		4	506	446	495	451	495	433	496	460	498	448	495	433
②	浸水部分下部表面	1	665		707		707		766		711		665	
		2	696	623	694	586	779	691	608	632	694	633	608	586
		3	620		691		728		618		664		618	
		4	636	673	533	698	567	694	618	692	589	689	533	673
③	浸水部分左邊表面	1	515	510	518	566	532	507	451	522	504	526	451	507
		2	753		755		692		712		729		692	

		3	689		655		559		639		636		559	
		4	567	479	524	513	540	432	498	486	532	478	498	432
④	浸水部分右邊表面	1	481	487	509	510	515	509	521	497	507	501	481	487
		2	609		761		619		565		639		565	
		3	560		591		521		565		559		521	
		4	467	596	473	569	475	533	485	492	475	548	467	492

表 2-5-3　控制閘門上游面門框膜厚量測結果表

部件	控制閘門上游面門框								
量測時機	最外層塗裝完成後								
量測時間	2019.10.03(自檢)、2019.12.06(廠驗)								
位置	浸水部分	設計膜厚		320 μm	最小膜厚		224 μm		
總塗裝面積	8 m^2	須檢測點位		16 點	總檢測點位		16 點		
檢測結果	最小膜厚		自檢	444	μm	廠驗	460	μm	
	平均值膜厚		自檢	596	μm	廠驗	562	μm	

量測位置



量測資料　　單位: μm

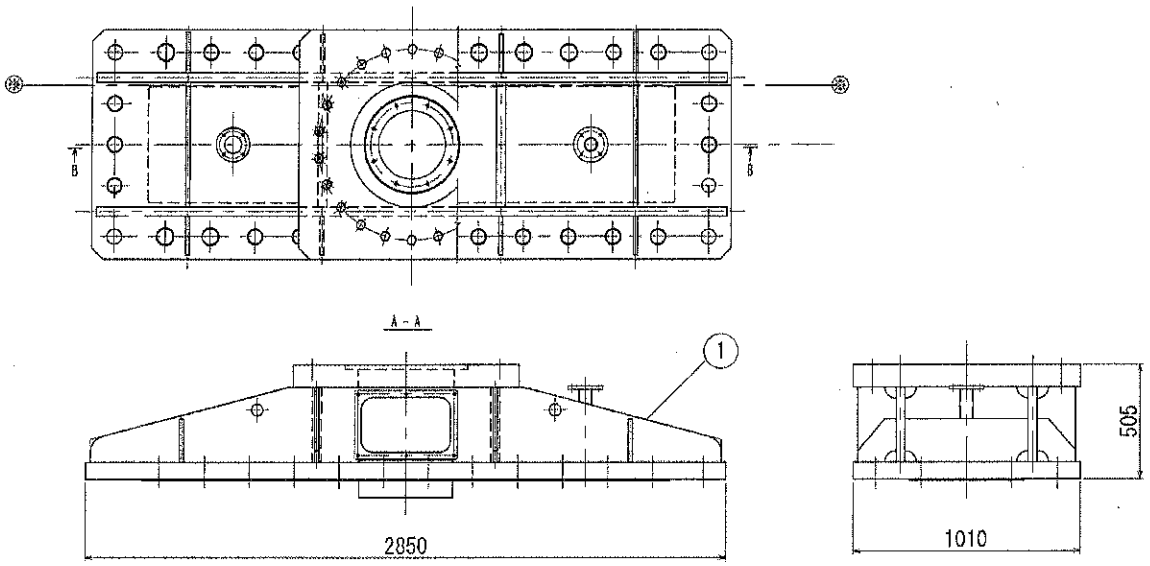
量測位置			a (上部)		b (下部)		c (左邊)		d (右邊)		平均值		最小值	
			自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗
①	浸水部分上部表面	1	485	489	463	488	507	493	472	510	482	495	463	488
		2	473	626	560	581	573	523	538	660	536	598	473	523
		3	559		558		538		524		545		524	
		4	622		519		629		558		582		519	
②	浸水部分下部表面	1	646		725		669		702		686		646	
		2	705		771		960		885		830		705	
		3	625	627	599	621	636	545	589	719	612	628	589	545
		4	598	649	596	587	544	571	525	530	566	584	525	530
③	浸水部分左邊表面	1	504	534	583	497	528	472	526	485	535	497	504	472
		2	781		713		771		744		752		713	

		3	751		735		676		710		718		676	
		4	555	499	580	460	596	478	565	463	572	475	555	460
④	浸水部分右邊表面	1	551		561		521		535		542		521	
		2	537		656		610		577		595		537	
		3	459	739	479	688	519	798	444	670	475	724	444	670
		4	520	487	470	501	491	474	521	518	501	495	470	474

表 2-5-4　控制閘門油壓閥蓋膜厚量測結果表

部件	控制閘門油壓閥蓋							
量測時機	最外層塗裝完成後							
量測時間	2019.10.03(自檢)、2019.12.06(廠驗)							
位置	外露部分	設計膜厚	200 μm	最小膜厚	140 μm			
總塗裝面積	8.7 ㎡	須檢測點位	18 點	總檢測點位	18 點			
檢測結果	最小膜厚	自檢	351	μm	廠驗	344	μm	
	平均值膜厚	自檢	441	μm	廠驗	419	μm	

量測位置



量測資料　　單位: μm

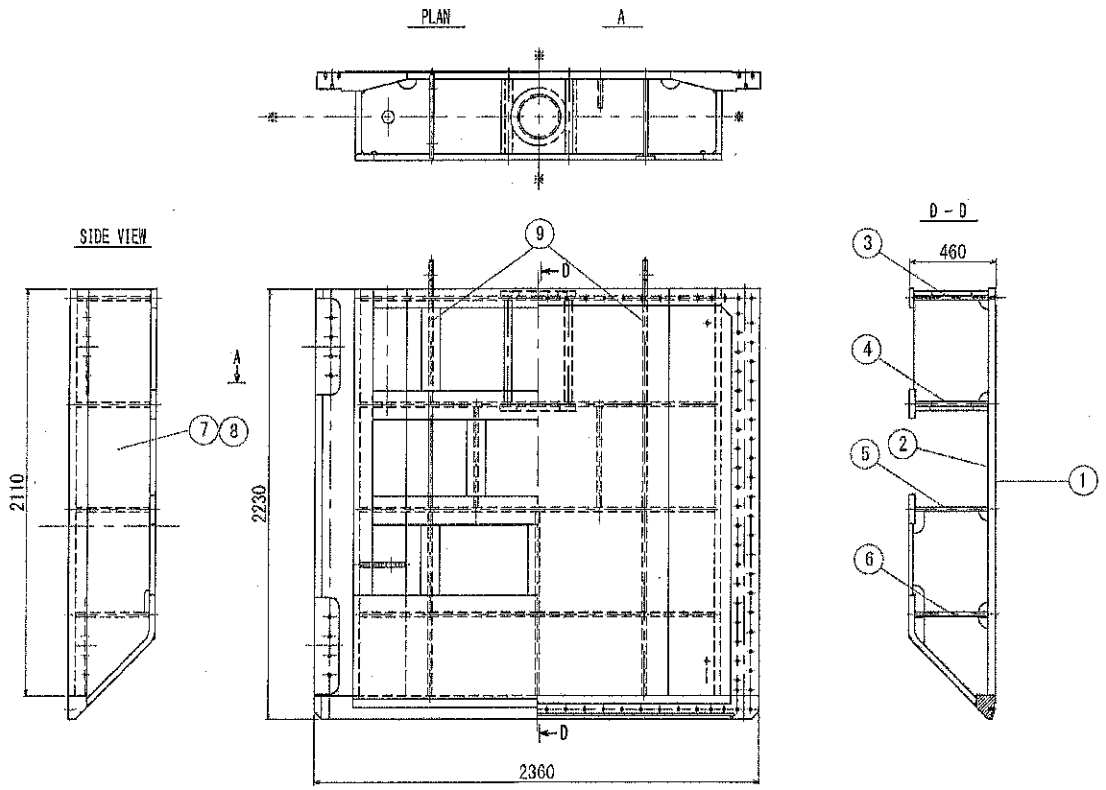
量測位置			a (上部)		b (下部)		c (左邊)		d (右邊)		平均值		最小值	
			自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗
①	外露部分	1	391		429		421		375		404		375	
		2	406		475		434		477		448		406	
		3	396		443		381		409		407		381	
		4	398		519		537		393		462		393	
		5	475	408	550	453	532	418	452	344	502	406	452	344
		6	373	421	481	433	446	404	449	470	437	432	373	404
		7	384	424	386	424	428	504	423	439	405	448	384	424
		8	415	436	405	445	410	438	423	442	413	440	405	436
		9	439		453		431		439		441		431	
		10	402		439		464		419		431		402	

		11	452		493		465		473		471		452	
		12	432		472		457		450		453		432	
		13	371		479		381		448		420		371	
		14	476		472		470		505		481		470	
		15	389	398	465	446	458	406	407	423	430	418	389	398
		16	462	375	492	366	470	374	463	358	472	368	462	358
		17	489		504		481		486		490		481	
		18	399		351		354		380		371		351	

表 2-5-5　防護閘門門扉膜厚量測結果表

部件	防護閘門門扉							
量測時機	最外層塗裝完成後							
量測時間	2019.10.03(自檢)、2019.12.05(廠驗)							
位置	浸水部分	設計膜厚	320 μm	最小膜厚	224 μm			
總塗裝面積	29.1 m^2	須檢測點位	60 點	總檢測點位	60 點			
檢測結果	最小膜厚	自檢	364 μm	廠驗	303 μm			
	平均值膜厚	自檢	495 μm	廠驗	447 μm			

量測位置



量測資料　　單位: μm

量測位置			a (上部)		b (下部)		c (左邊)		d (右邊)		平均值		最小值	
			自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗
①	下游面面板	1	539		594		507		559		550		507	
		2	888		837		850		798		843		798	
		3	490		507		500		492		497		490	
		4	524	514	523	546	529	575	488	542	519	544	488	514
		5	796	497	816	659	757	519	653	515	756	547	653	497
		6	502	548	509	562	495	520	493	566	500	549	493	520
		7	532	732	522	743	490	645	546	815	523	734	490	645

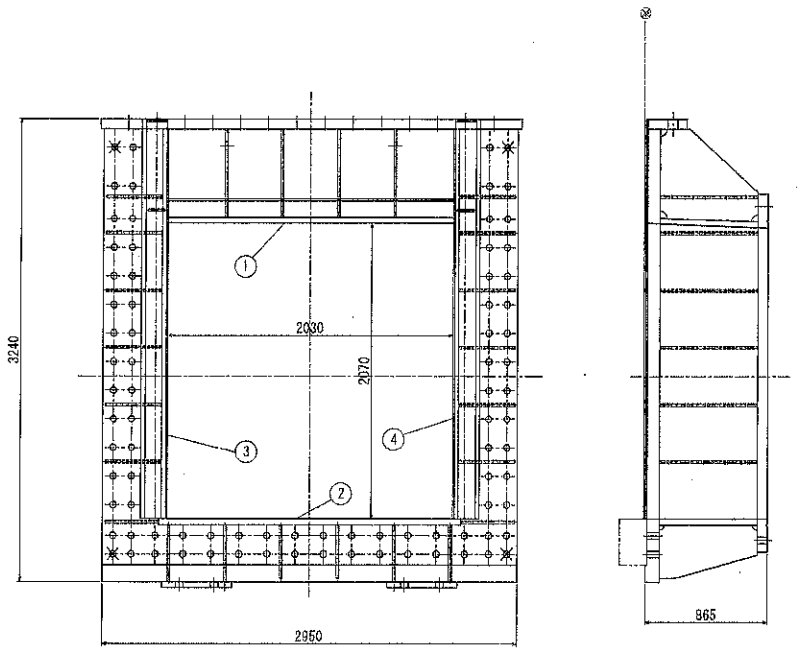
		8	583	495	617	531	606	515	592	536	600	519	583	495
②	上游面面板	1	560		586		575		582		576		560	
		2	743		745		738		754		746		738	
		3	799		807		856		740		801		740	
		4	540	343	509	329	566	353	522	403	357		329	
		5	558	326	577	480	566	464	522	356	556	407	522	326
		6	524	443	512	413	581	414	543	364	540	409	512	364
③	第一支主樑	1	392		388		391		416		397		388	
		2	519		448		393		497		464		393	
		3	393		384		411		392		395		384	
		4	455		440		426		505		457		426	
		5	471		397		480		426		444		397	
		6	376		375		378		374		376		374	
④	第二支主樑	1	569		581		532		545		557		532	
		2	482		386		495		448		453		386	
		3	396		367		402		417		396		367	
		4	435		420		375		434		416		375	
		5	379		398		391		384		388		379	
		6	368		374		396		384		381		368	
		7	388		405		405		429		407		388	
		8	441		403		408		404		414		403	
⑤	第三支主樑	1	459	349	412	377	433	366	470	303	444	349	412	303
		2	406		403		377		480		417		377	
		3	414		434		475		441		441		414	
		4	465	373	529	410	499	382	425	385	480	388	425	373
		5	424		443		458		446		443		424	
		6	389	361	481	463	387	367	486	398	436	397	387	361
		7	413		427		467		505		461		413	
		8	474		479		492		515		490		474	
⑥	第四支主樑	1	545	348	493	384	445	347	531	341	504	355	445	341
		2	382	412	419	610	384	418	412	375	399	454	382	375
		3	614		650		552		634		613		552	
		4	505	397	514	404	457	321	580	312	514	359	457	312
		5	471		575		605		503		539		471	
		6	401	331	378	371	374	310	390	327	386	335	374	310
		7	398		456		500		419		443		398	
		8	752		589		409		734		621		409	
⑦	左側邊樑	1	657		678		671		677		671		657	
		2	643		406		557		492		525		406	
		3	403		471		598		502		544		471	

		4	595		480		472		536		521		472	
⑧	右側邊樑	1	588		457		574		542		540		457	
		2	465		640		502		571		545		465	
		3	426		474		450		462		453		426	
		4	461		569		514		563		527		461	
⑨	垂直樑	1	386		374		410		373		386		373	
		2	397		386		364		395		386		364	
		3	374		485		483		392		434		374	
		4	375		391		392		408		392		375	
		5	514		491		499		393		474		393	
		6	381		405		395		420		400		381	
		7	391		416		417		396		405		391	
		8	389		377		385		397		387		377	

表 2-5-6　防護閘門下游面門框膜厚量測結果表

部件	防護閘門下游面門框							
量測時機	最外層塗裝完成後							
量測時間	2019.10.03(自檢)、2019.12.06(廠驗)							
位置	浸水部分	設計膜厚	320 μm	最小膜厚	224 μm			
總塗裝面積	8.1 m^2	須檢測點位	17 點	總檢測點位	18 點			
檢測結果	最小膜厚	自檢	438 μm	廠驗	465 μm			
	平均值膜厚	自檢	557 μm	廠驗	563 μm			

量測位置



量測資料　　單位: μm

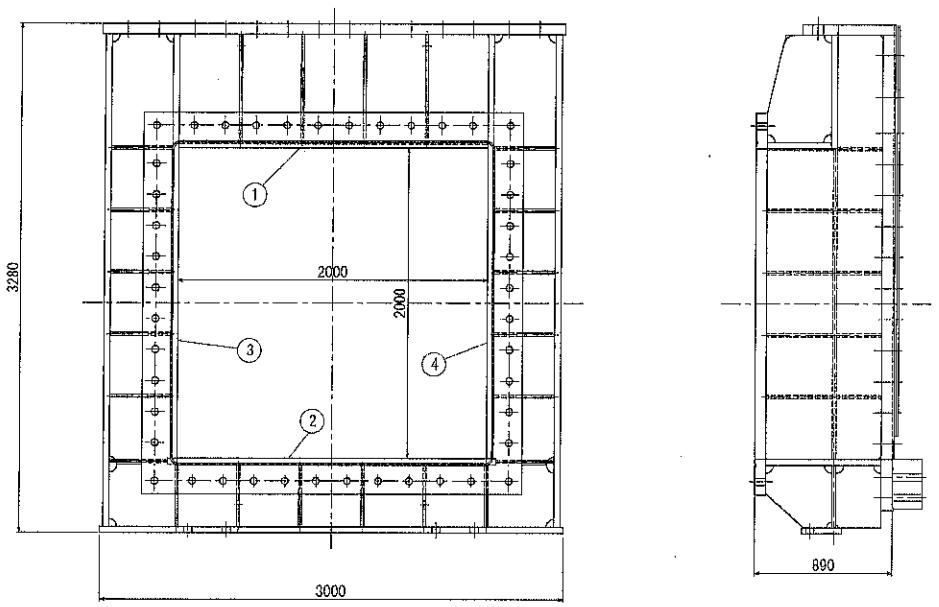
量測位置			a (上部)		b (下部)		c (左邊)		d (右邊)		平均值		最小值	
			自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗
①	浸水部分上部表面	1	560	534	581	475	560	555	561	556	566	530	560	475
		2	543	736	604	620	604	432	584	578	584	667	543	578
		3	557	759	523	647	611	679	534	536	556	655	523	536
		4	541	599	516	551	490	535	489	640	509	581	489	535
②	浸水部分下部表面	1	513	476	551	492	530	482	487	526	520	494	487	476
		2	522		523		529		502		519		502	
		3	606	494	629	487	606	516	605	552	612	512	60	487
		4	651		615		618		597		620		597	
③	浸水部分左邊表面	1	522		581		568		509		545		509	
		2	543	521	562	565	578	465	547	548	558	525	543	465

		3	600		609		568		601		595		568	
		4	553	590	592	628	563	560	570	556	570	584	553	556
		5	460		470		439		438		452		438	
④	浸水部分右邊表面	1	528	525	530	490	564	499	561	501	546	504	528	490
		2	560		609		590		630		597		560	
		3	586		565		569		594		579		565	
		4	560	543	530	691	499	564	537	535	532	583	499	535
		5	578		586		576		558		575		558	

表 2-5-7　防護閘門上游面門框膜厚量測結果表

部件	防護閘門上游面門框							
量測時機	最外層塗裝完成後							
量測時間	2019.10.03(自檢)、2019.12.06(廠驗)							
位置	浸水部分	設計膜厚	320 μm	最小膜厚	224 μm			
總塗裝面積	7.9 m^2	須檢測點位	16 點	總檢測點位	16 點			
檢測結果	最小膜厚	自檢	405	μm	廠驗	466	μm	
	平均值膜厚	自檢	567	μm	廠驗	564	μm	

量測位置



量測資料　　單位: μm

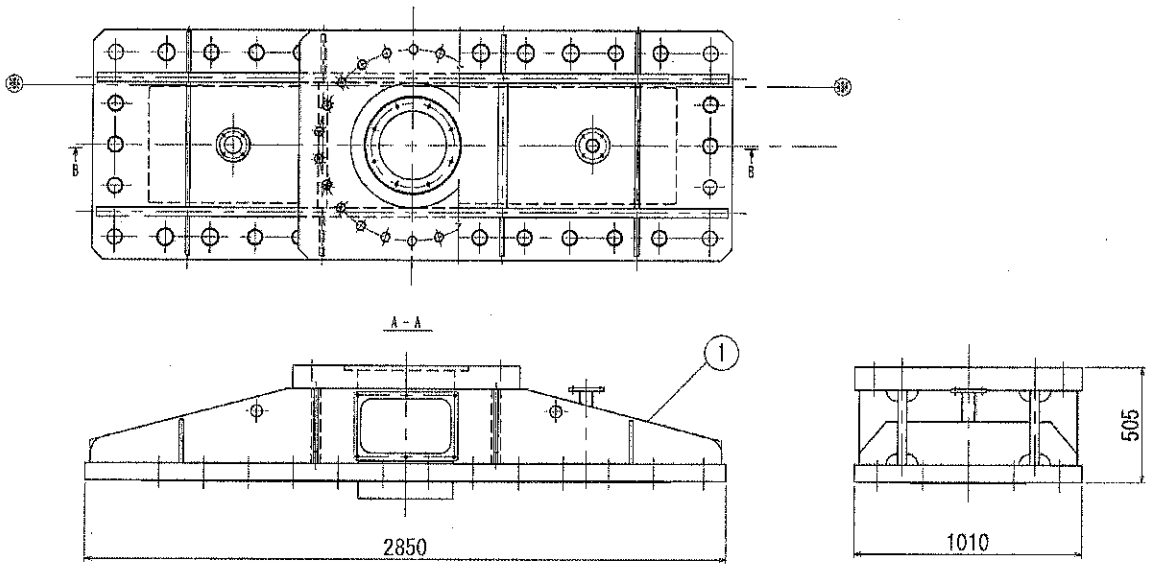
量測位置			a (上部)		b (下部)		c (左邊)		d (右邊)		平均值		最小值	
			自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗
①	浸水部分上部表面	1	564	547	532	535	582	602	508	554	547	560	508	535
		2	749		564		641		649		648		564	
		3	600		526		554		541		555		526	
		4	522	547	702	564	603	538	626	480	613	532	522	480
②	浸水部分下部表面	1	675		650		648		624		649		624	
		2	562	807	632	726	596	788	611	658	600	745	562	658
		3	612		597		593		579		595		579	
		4	484	689	479	697	504	608	464	660	463	664	464	608
③	浸水部分左邊表面	1	459	537	405	504	440	483	448	512	438	509	405	483
		2	558		646		552		521		569		521	
		3	591		646		550		699		622		550	

		4	512	539	444	515	525	560	498	515	495	532	444	515
④	浸水部分右邊表面	1	482	471	522	479	529	474	528	466	515	473	482	466
		2	723		598		563		613		624		563	
		3	623		641		576		569		602		569	
		4	532	482	498	479	511	539	536	496	519	499	498	479

表 2-5-8　防護閘門油壓閥蓋膜厚量測結果表

部件	防護閘門油壓閥蓋						
量測時機	最外層塗裝完成後						
量測時間	2019.10.03(自檢)、2019.12.06(廠驗)						
位置	外露部分	設計膜厚	200 μm	最小膜厚	140 μm		
總塗裝面積	8.7 m^2	須檢測點位	18 點	總檢測點位	18 點		
檢測結果	最小膜厚	自檢	362 μm	廠驗	352 μm		
	平均值膜厚	自檢	448 μm	廠驗	425 μm		

量測位置



量測資料　　單位: μm

量測位置			a (上部)		b (下部)		c (左邊)		d (右邊)		平均值		最小值	
			自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗	自檢	廠驗
①	外露部分	1	385	409	439	414	416	441	394	460	409	431	385	409
		2	391		445		444		470		438		391	
		3	387		386		409		415		399		386	
		4	381		485		443		412		430		381	
		5	519	419	533	435	504	435	484	411	510	425	484	411
		6	406	431	539	352	412	406	428	495	446	421	406	352
		7	396	496	451	377	409	435	453	490	427	450	396	377
		8	362	445	403	420	424	416	417	428	402	427	362	416
		9	449		464		431		466		45		431	
		10	392		431		411		418		413		392	
		11	441		576		433		452		476		433	

		12	427		474		440		439		445		427	
		13	420		505		479		406		453		406	
		14	475		504		474		498		488		474	
		15	439	377	460	438	452	401	483	421	459	409	439	377
		16	501	401	523	440	480	433	494	387	500	415	480	387
		17	469		455		504		489		479		455	
		18	410		462		437		421		433		410	

INSPECTION REPORT FOR DRY FILM THICKNESS								
Particular	Gate Leaf (Control Gate)							
Measuring time	After completion of final painting [Final Coal tar Epoxy Resin Paint] at shop							
Measuring date/month/year	03 October 2019							
Portion	Submerged	Specified thickness	320 μm	Minimum thickness	224 μm			
Total Painting Area/Length	29.1 m^2	Need to Inspection	60 point	Activity Inspection	60 point			
Result	Minimum thickness	In-house	405 μm	Witness	307 μm			
	Average of thickness	In-house	468 μm	Witness	445 μm			

Measuring Point

WITNESSED BY

REVIEWED BY

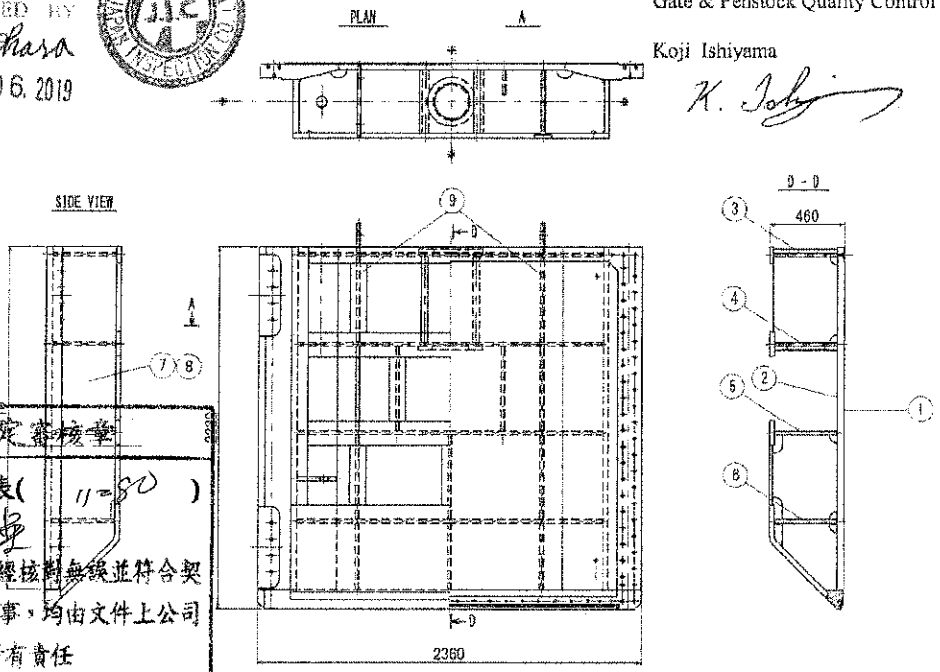
M.Shimchara

DEC. 06. 2019

Inspected by
IHI Infrastructure Systems Co.,Ltd.
Gate & Penstock Quality Control Group

Koji Ishiyama

K. Ishiyama



試驗報告(出廠證明)判定審核章

設計、規範值: 詳檢驗紀錄表(11-80)

檢商初判人員簽名:

☑符合 ☐不符合 本件業經核對無誤並符合契約規範規定，如有偽造文書情事，均由文件上公司及負責人員負刑事及民事所有責任

監造單位複判人員簽名:

☑合格 ☐不合格

Data Unit: μm

Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Skin Plate (Downstream Side)	1	523	532	433	517	460	524	440	583	464	539	433	517
		2	411	613	430	572	449	579	440	600	433	591	411	572
		3	434	621	506	594	435	624	508	536	471	594	434	536
		4	467	563	445	565	443	586	427	537	446	563	427	537
		5	410	824	485	621	516	580	484	625	474	663	410	580
		6	457	645	439	613	475	576	457	608	457	611	439	576
		7	448	698	448	596	465	689	460	569	455	638	448	569
		8	471	550	426	516	484	522	437	490	455	520	426	490
②	Skin Plate (Upstream Side)	1	475	383	440	362	494	399	482	400	473	386	440	362
		2	483	334	465	339	440	367	408	320	449	340	408	320
		3	416	413	468	340	513	388	489	333	472	369	416	333
		4	462	342	503	337	510	345	421	425	474	362	421	337
		5	492	314	420	307	471	342	535	325	480	322	420	307
		6	442	326	524	326	439	321	412	314	454	322	412	314

圖2-5-1 控制閘門門扉膜厚檢查報告內容

Data													Unit: μm	
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
③	Main Beam (Upper Beam)	1	508		439		517		457		480		439	
		2	431		422		455		464		443		422	
		3	466		424		493		500		471		424	
		4	518		427		443		450		460		427	
		5	480		438		508		474		475		438	
		6	412		415		463		453		436		412	
④	Main Beam (2'nd Beam)	1	464	349	489	329	494	331	457	329	476	335	457	329
		2	484		428		466		482		465		428	
		3	508		511		506		473		500		473	
		4	445	377	517	371	455	393	432	354	462	374	432	354
		5	429	372	510	367	442	417	445	343	457	375	429	343
		6	513		437		471		517		485		437	
		7	498		514		487		529		507		487	
		8	494	335	485	347	489	371	493	360	490	353	485	335
⑤	Main Girder (3'rd Beam)	1	421	358	467	373	459	359	429	415	444	376	421	358
		2	520	394	474	436	515	423	440	416	487	417	440	394
		3	486	572	433	548	500	578	465	502	471	550	433	502
		4	471	474	450	432	456	435	456	444	458	446	450	432
		5	522	349	471	363	481	389	515	357	497	365	471	349
		6	468	338	497	328	448	366	429	345	461	344	429	328
		7	409		430		499		463		450		409	
		8	469		462		476		534		485		462	
⑥	Main Girder (Bottom Beam)	1	434	466	499	417	468	449	469	477	468	452	434	417
		2	474		510		481		502		492		474	
		3	462		469		472		500		476		462	
		4	468		504		405		406		446		405	
		5	450	311	478	309	475	336	456	333	465	322	450	309
		6	510		435		440		413		450		413	
		7	513		503		504		452		493		452	
		8	477	478	466	531	521	476	442	502	477	497	442	476
⑦	Side Beam (Left Bank Side)	1	486		494		454		425		465		425	
		2	439		479		447		445		453		439	
		3	424		432		511		426		448		424	
		4	511		507		492		455		491		455	
⑧	Side Beam (Right Bank Side)	1	470		472		437		508		472		437	
		2	453		422		436		434		436		422	
		3	482		438		441		504		466		438	
		4	475		456		408		493		458		408	
⑨	Vertical Beam	1	428		468		442		517		464		428	
		2	515		431		484		453		471		431	
		3	465		487		506		511		492		465	
		4	473		468		500		475		479		468	
		5	502		530		486		468		497		468	
		6	440		470		506		461		469		440	
		7	450		429		448		485		453		429	
		8	489		476		418		467		463		418	

WITNESSED BY

REVIEWED BY Kinotaru

Inspected by
IHI Infrastructure Systems Co.,Ltd.
Gate & Penstock Quality Control Group

Koji Ishiyama

試驗報告(出廠證明)判定審核

設計、規範值: 詳檢驗紀錄表(11380) DEC 06 2019

廠商初判人員簽名:

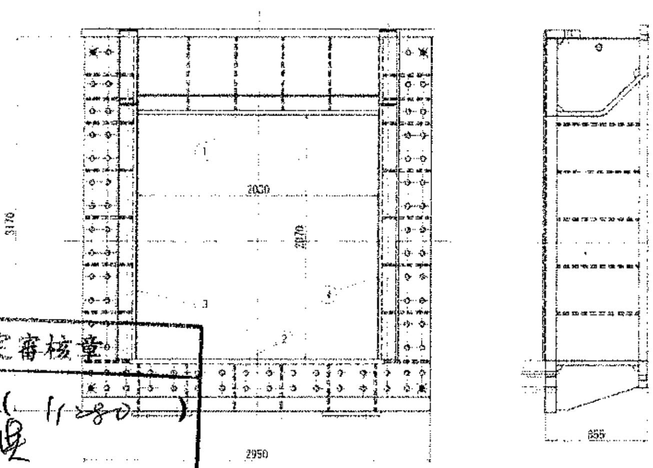
☑符合 ☐不符合 本件業經核對無誤並符合契約規範規定，如有偽造文書情事，均願負法律責任及其簽名人員負刑事及民事所有責任

監造單位複判人員簽名:

☑合格 ☐不合格

INSPECTION REPORT FOR DRY FILM THICKNESS							
Particular	Casing of Downstream Side (Control Gate)						
Measuring time	After completion of final painting〔Final Coal tar Epoxy Resin Paint〕at shop						
Measuring date/month/year	03 October 2019						
Portion	Submerged	Specified thickness	320 μm	Minimum thickness	224 μm		
Total Painting Area/Length	8 m²	Need to Inspection	16 point	Activity Inspection	16 point		
Result	Minimum thickness	In-house	444 μm	Witness	432 μm		
	Average of thickness	In-house	587 μm	Witness	540 μm		

Measuring Point



Inspected by
IHI Infrastructure Systems Co.,Ltd.
Gate & Penstock Quality Control Group

Koji Ishiyama

WITNESSED BY
REVIEWED BY
M Shinohara
DEC 06 2019

試驗報告(出廠證明)判定審核章
設計、規範值、詳檢驗紀錄表(11280)
廠商初判人員簽名:
☑符合 □不符合 本件業經核對無誤並符合契約規範規定，如有偽造文書情事，均由文件上公司及具簽名人員負刑事及民事所有責任
監造單位複判人員簽名:
☑合格 □不合格

Data — Unit: μm

Measuring Point			a (upper) In-house	a (upper) Witness	b (bottom) In-house	b (bottom) Witness	c (left side) In-house	c (left side) Witness	d (right side) In-house	d (right side) Witness	Average In-house	Average Witness	Minimum In-house	Minimum Witness
①	Surface submerged in water (Top)	1	500	539	444	439	491	532	549	482	496	498	444	439
		2	500		558		486		539		521		486	
		3	634		623		699		570		632		570	
		4	506	446	495	451	495	433	496	460	498	448	495	433
②	Surface submerged in water (Bottom)	1	665		707		707		766		711		665	
		2	696	623	694	586	779	691	608	632	694	633	608	586
		3	620		691		728		618		664		618	
		4	636	673	533	698	567	694	618	692	589	689	533	673
③	Surface submerged in water (Left)	1	515	510	518	566	532	507	451	522	504	526	451	507
		2	753		755		692		714		729		692	
		3	689		655		559		639		636		559	
		4	567	479	524	513	540	432	498	486	532	478	498	432
④	Surface submerged in water (Right)	1	481	487	509	510	515	509	521	497	507	501	481	487
		2	609		761		619		565		639		565	
		3	560		591		521		565		559		521	
		4	467	596	473	569	475	533	485	492	475	548	467	492

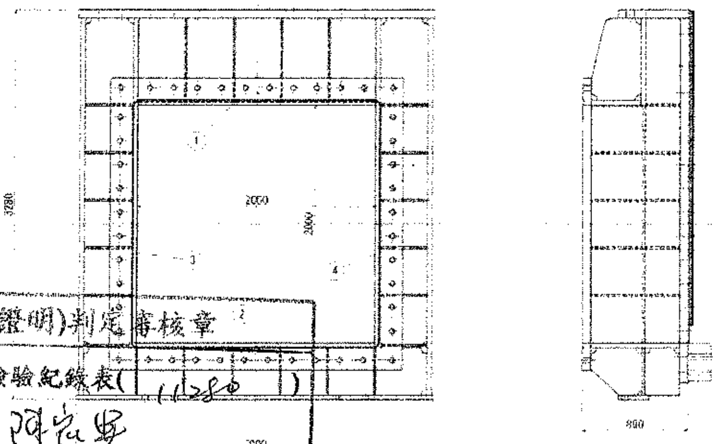
圖2-5-3　控制閘門下游面門框膜厚檢查報告內容

INSPECTION REPORT FOR DRY FILM THICKNESS								
Particular	Casing of Upstream Side (Control Gate)							
Measuring time	After completion of final painting (Final Coal tar Epoxy Resin Paint) at shop							
Measuring date/month/year	03 October 2019							
Portion	Submerged	Specified thickness	320 μm		Minimum thickness		224 μm	
Total Painting Area/Length	8 m^2	Need to Inspection	16 point		Activity Inspection		16 point	
Result	Minimum thickness		In-house	444 μm	Witness	460 μm		
	Average of thickness		In-house	596 μm	Witness	562 μm		

Measuring Point

Inspected by
IHI Infrastructure Systems Co.,Ltd.
Gate & Penstock Quality Control Group

Koji Ishiyama



WITNESSED BY
REVIEWED BY
DEC. 06. 2019

試驗報告(出廠證明)判定審核章
設計、規範值：詳檢驗紀錄表(   )
廠商初判人員簽名：
☑符合 □不符合　本件業經核對無誤並符合契約規範規定，如有偽造文書情事，均由文件上公司及其簽名人員負刑事及民事所有責任
監造單位複判人員簽名：
☑合格 □不合格

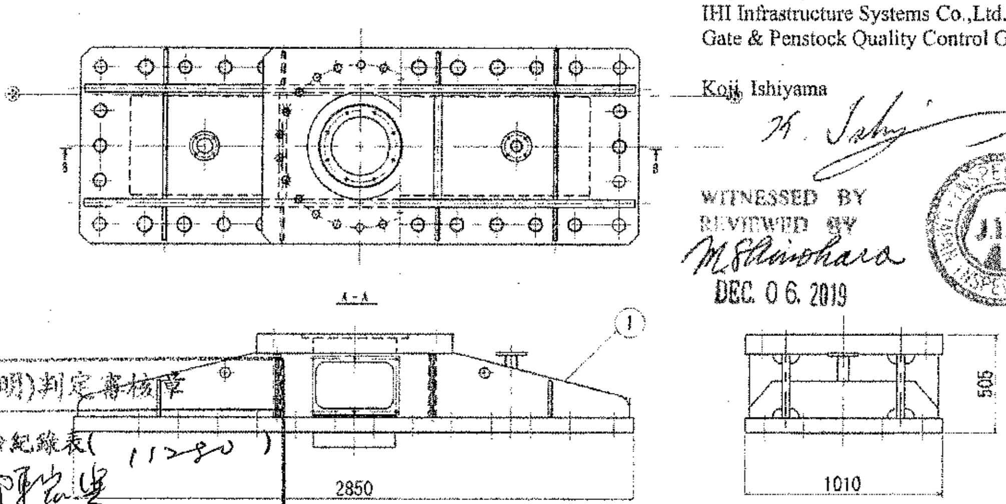
Measuring point			a (upper) In-house	a (upper) Witness	b (bottom) In-house	b (bottom) Witness	c (left side) In-house	c (left side) Witness	d (right side) In-house	d (right side) Witness	Average In-house	Average Witness	Minimum In-house	Minimum Witness
①	Surface submerged in water (Top)	1	485	489	463	488	507	493	472	510	482	495	463	488
		2	473	626	560	581	573	523	538	660	536	598	473	523
		3	559		558		538		524		545		524	
		4	622		519		629		558		582		519	
②	Surface submerged in water (Bottom)	1	646		725		669		702		686		646	
		2	705		771		960		885		830		705	
		3	625	627	599	621	636	545	589	719	612	628	589	545
		4	598	649	596	587	544	571	525	530	566	584	525	530
③	Surface submerged in water (Left)	1	504	534	583	497	528	472	526	485	535	497	504	472
		2	781		713		771		744		752		713	
		3	751		735		676		710		718		676	
		4	555	499	580	460	586	478	565	463	572	475	555	460
④	Surface submerged in water (Right)	1	551		561		521		535		542		521	
		2	537		656		610		577		595		537	
		3	459	739	479	688	519	798	444	670	475	724	444	670
		4	520	487	470	501	491	474	521	518	501	495	470	474

Data — Unit: μm

圖2-5-4　控制閘門上游面門框膜厚檢查報告內容

INSPECTION REPORT FOR DRY FILM THICKNESS							
Particular	Bonnet Cover (Control Gate)						
Measuring time	After completion of final painting〔Final Epoxy Resin Paint〕at shop						
Measuring date/month/year	03 October 2019						
Portion	Exposed	Specified thickness	200 μm	Minimum thickness	140 μm		
Total Painting Area	8.7 ㎡	Need to Inspection	18 point	Activity Inspection	18 point		
Result	Minimum thickness	In-house	351 μm	Witness	344 μm		
	Average of thickness	In-house	441 μm	Witness	419 μm		

Measuring Point



Inspected by
IHI Infrastructure Systems Co.,Ltd.
Gate & Penstock Quality Control Group

Koji Ishiyama

WITNESSED BY
REVIEWED BY
M.Shinohara
DEC. 0 6. 2019

J.I.C INSPECTED

試驗報告(出廠證明)判定審核章
設計、規範值: 詳檢驗紀錄表(11280)
廠商初判人員簽名:
☑符合 □不符合 本件業經核對無誤並符合契約規範規定，如有偽造文書情事，均由文件上公司及其簽名人員負刑事及民事所有責任
監造單位複判人員簽名:
☑合格 □不合格

Measuring point			Data										Unit: μm	
			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Exposed surface	1	391		429		421		375		404		375	
		2	406		475		434		477		448		406	
		3	396		443		381		409		407		381	
		4	398		519		537		393		462		393	
		5	475	408	550	453	532	418	452	344	502	406	452	344
		6	373	421	481	433	446	404	449	470	437	432	373	404
		7	384	424	386	424	428	504	423	439	405	448	384	424
		8	415	436	405	445	410	438	423	442	413	440	405	436
		9	439		453		431		439		441		431	
		10	402		439		464		419		431		402	
		11	452		493		465		473		471		452	
		12	432		472		457		450		453		432	
		13	371		479		381		448		420		371	
		14	476		472		470		505		481		470	
		15	389	398	465	446	458	406	407	423	430	418	389	398
		16	462	375	492	366	470	374	463	358	472	368	462	358
		17	489		504		481		486		490		481	
		18	399		351		354		380		371		351	

圖2-5-5　控制閘門油壓閥蓋膜厚檢查報告內容

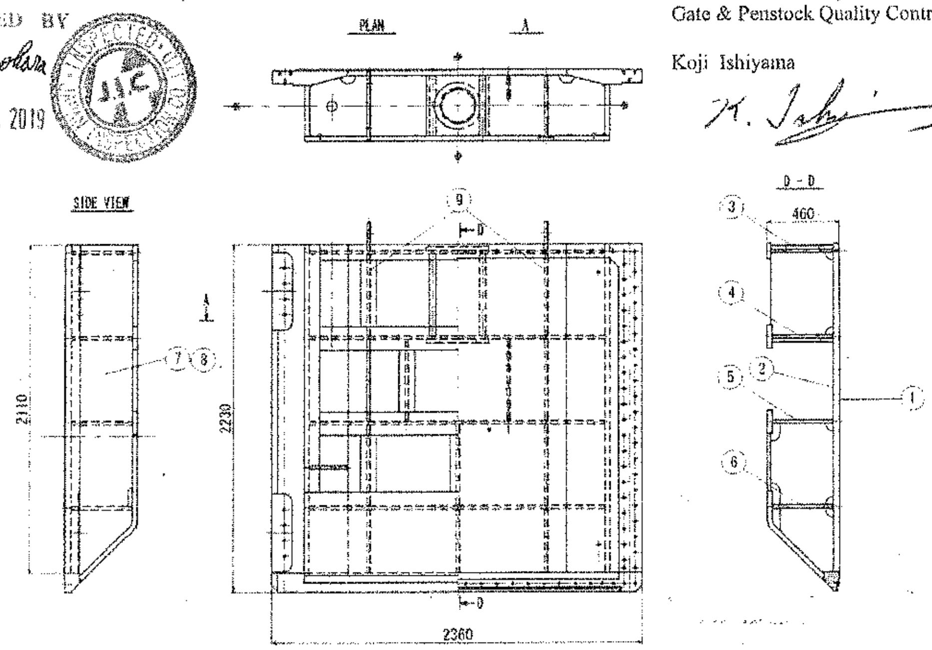
INSPECTION REPORT FOR DRY FILM THICKNESS							
Particular	Gate Leaf (Guard Gate)						
Measuring time	After completion of final painting〔Final Coal tar Epoxy Resin Paint〕at shop						
Measuring date/month/year	03 October 2019						
Portion	Submerged	Specified thickness	320 μm	Minimum thickness	224 μm		
Total Painting Area/Length	29.2 m^2	Need to Inspection	60 point	Activity Inspection	60 point		
Result	Minimum thickness	In-house	364 μm	Witness	303 μm		
	Average of thickness	In-house	495 μm	Witness	447 μm		

Measuring Point

WITNESSED BY
REVIEWED BY
DEC 05 2019

Inspected by
IHI Infrastructure Systems Co.,Ltd.
Gate & Penstock Quality Control Group

Koji Ishiyama



Data														Unit: μm
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Skin Plate (Downstream Side)	1	539		594		507		559		550		507	
		2	888		837		850		798		843		798	
		3	490		507		500		492		497		490	
		4	524	514	534	546	529	575	488	542	519	544	488	514
		5	796	497	816	659	757	516	653	515	756	547	653	497
		6	502	548	509	562	495	520	493	566	500	549	493	520
		7	532	732	522	743	490	645	546	815	523	734	490	645
		8	583	495	617	531	606	515	592	536	600	519	583	495
	Skin Plate ... Side)	1	560		586		575		582		576		560	
		2	743		748		738		754		746		738	
		3	799		807		856		740		801		740	
		4	540	343	509	329	566	353	522	403	534	357	509	329
		5	558	326	577	480	566	464	522	356	556	407	522	326
		6	524	445	512	413	581	414	543	364	540	409	512	364

試驗報告(出廠證明)判定審核章
設計、規範值：詳檢驗紀錄表(1)
廠商初判人員簽名：
☑符合 ☐不符合 本件業經核對無誤並符合契約規範規定，如有偽造文書情事，均由廠商公司及其簽名人員負刑事及民事所有責任
監造單位複判人員簽名：
☑合格 ☐不合格

圖2-15-6 防護閘門門扉膜厚檢查報告內容

Data														Unit: μm	
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
③	Main Beam (Upper Beam)	1	392		388		391		416		397		388	
		2	519		448		393		497		464		393	
		3	393		384		411		392		395		384	
		4	455		440		426		505		457		426	
		5	471		397		480		426		444		397	
		6	376		375		378		374		376		374	
④	Main Beam (2'nd Beam)	1	569		581		532		545		557		532	
		2	482		386		495		448		453		386	
		3	396		367		402		417		396		367	
		4	435		420		375		434		416		375	
		5	379		398		391		384		388		379	
		6	368		374		396		384		381		368	
		7	388		405		405		429		407		388	
		8	441		403		408		404		414		403	
⑤	Main Girder (3'rd Beam)	1	459	349	412	377	433	366	470	303	444	349	412	303
		2	406		403		377		480		417		377	
		3	414		434		475		441		441		414	
		4	465	373	529	410	499	382	425	385	480	388	425	373
		5	424		443		458		446		443		424	
		6	389	361	481	463	387	367	486	398	436	397	387	361
		7	413		457		467		505		461		413	
		8	474		479		492		515		490		474	
⑥	Main Girder (Bottom Beam)	1	545	348	493	384	445	347	531	341	504	355	445	341
		2	382	412	419	610	384	418	412	375	399	454	382	375
		3	614		650		552		634		613		552	
		4	505	397	514	404	457	321	580	312	514	359	457	312
		5	471		575		605		503		539		471	
		6	401	331	378	371	374	310	390	327	386	335	374	310
		7	398		456		500		419		443		398	
		8	752		589		409		734		621		409	
⑦	Side Beam (Left Bank Side)	1	657		678		671		677		671		657	
		2	643		406		557		492		525		406	
		3	603		471		598		502		544		471	
		4	595		480		472		536		521		472	
⑧	Side Beam (Right Bank Side)	1	588		457		574		542		540		457	
		2	465		640		502		571		545		465	
		3	426		474		450		462		453		426	
		4	461		569		514		563		527		461	
⑨	Vertical Beam	1	386		374		410		373		386		373	
		2	397		386		364		395		386		364	
		3	374		485		483		392		434		374	
		4	375		391		392		408		392		375	
		5	514		491		499		393		474		393	
		6	381		405		395		420		400		381	
		7	391		416		417		396		405		391	
		8	389		377		385		397		387		377	

WITNESSED BY
REVIEWED BY

DEC 05 2019

Inspected by
IHI Infrastructure Systems Co.,Ltd.
Gate & Penstock Quality Control Group

Koji Ishiyama

試驗報告(出廠證明)判定審核章

設計、規範值: 詳檢驗紀錄表(11280)

廠商初判人員簽名:

□符合 □不符合 本件業經核對無圖地符合契約規範規定，如有偽造文書情事，均由文件上公司及其簽名人員負刑事及民事所有責任

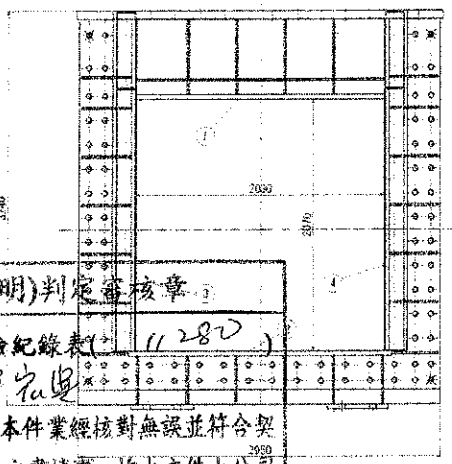
監造單位複判人員簽名:

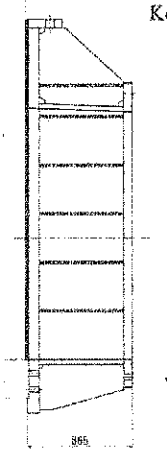
☑合格 □不合格

防護閘門門扉膜厚檢查報告內容(續)

INSPECTION REPORT FOR DRY FILM THICKNESS									
Particular	Casing of Downstream Side (Guard Gate)								
Measuring time	After completion of final painting (Final Coal tar Epoxy Resin Paint) at shop								
Measuring date/month/year	03 October 2019								
Portion	Submerged	Specified thickness	320 μm	Minimum thickness	224 μm				
Total Painting Area/Length	8.1 m^2	Need to Inspection	17 point	Activity Inspection	18 point				
Result	Minimum thickness	In-house	438 μm	Witness	465 μm				
	Average of thickness	In-house	557 μm	Witness	563 μm				

Measuring Point





Inspected by
IHI Infrastructure Systems Co.,Ltd.
Gate & Penstock Quality Control Group

Koji Ishiyama

WITNESSED BY
REVIEWED BY
M.Shinohara
DEC. 06. 2019

試驗報告(出廠證明)判定審核章

設計、規範值: 詳檢驗紀錄表(1/280)

廠商初判人員簽名:

☑符合 ☐不符合 本件業經核對無誤並符合契約規範規定，如有偽造文書情事，均由文件上公司及其簽名人員負刑事及民事所有責任

監造單位複判人員簽名:

☑合格 ☐不合格

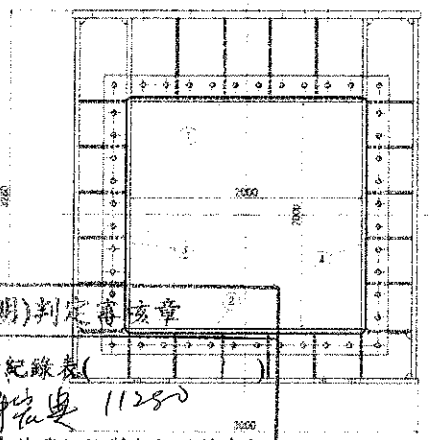
Unit: μm

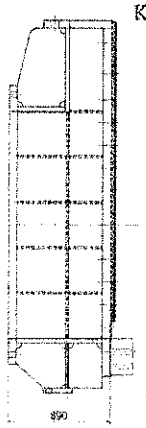
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Surface submerged in water (Top)	1	560	554	581	475	560	555	561	556	566	530	560	475
		2	543	736	604	620	604	732	584	578	584	667	543	578
		3	557	759	523	647	611	679	534	536	556	655	523	536
		4	541	599	516	531	490	535	489	640	509	581	489	535
②	Surface submerged in water (Bottom)	1	513	476	551	492	530	482	487	526	520	494	487	476
		2	522		523		529		502		519		502	
		3	606	494	629	487	606	516	605	552	612	512	605	487
		4	651		615		618		597		620		597	
③	Surface submerged in water (Left)	1	522		581		568		509		545		509	
		2	543	521	562	565	578	465	547	548	558	525	543	465
		3	600		609		568		601		595		568	
		4	553	590	592	628	563	560	570	556	570	584	553	556
		5	460		470		439		438		452		438	
④	Surface submerged in water (Right)	1	528	525	530	490	564	499	561	501	546	504	528	490
		2	560		609		590		630		597		560	
		3	586		565		569		594		579		565	
		4	560	543	530	691	499	564	537	535	532	583	499	535
		5	578		586		576		558		575		558	

圖2-5-8 防護閘門下游面門框膜厚檢查報告內容

INSPECTION REPORT FOR DRY FILM THICKNESS									
Particular	Casing of Upstream Side (Guard Gate)								
Measuring time	After completion of final painting (Final Coal tar Epoxy Resin Paint) at shop								
Measuring date/month/year	03 October 2019								
Portion	Submerged	Specified thickness	320 µm	Minimum thickness	224 µm				
Total Painting Area/Length	7.9 m^2	Need to Inspection	16 point	Activity Inspection	16 point				
Result	Minimum thickness	In-house	405 µm	Witness	466 µm				
	Average of thickness	In-house	567 µm	Witness	564 µm				

Measuring Point





Inspected by
IHI Infrastructure Systems Co.,Ltd.
Gate & Penstock Quality Control Group

Koji Ishiyama

WITNESSED BY
REVIEWED BY

DEC. 06. 2019

試驗報告(出廠證明)判定簽核章
設計、規範值: 詳檢驗紀錄表(
廠商初判人員簽名: 陳宏東 11250
□符合 □不符合 本件業經核對無誤並符合契約規範規定，如有偽造文書情事，均由文件上公司及具簽名人員負刑事及民事所有責任
監造單位複判人員簽名:
☑合格 □不合格

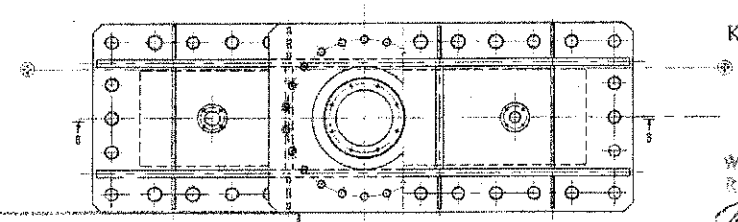
Unit: µm

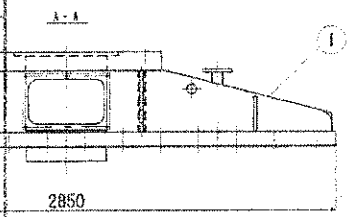
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Surface submerged in water (Top)	1	564	547	532	535	582	602	508	554	547	560	508	535
		2	749		564		631		649		648		564	
		3	600		526		554		541		555		526	
		4	522	547	702	564	603	538	626	480	613	532	522	480
②	Surface submerged in water (Bottom)	1	675		650		648		624		649		624	
		2	562	807	632	726	596	788	611	658	600	745	562	658
		3	612		597		593		579		595		579	
		4	484	689	479	697	504	608	464	660	483	664	464	608
③	Surface submerged in water (Left)	1	459	537	405	504	440	483	448	512	438	509	405	483
		2	558		646		552		521		569		521	
		3	591		646		550		699		622		550	
		4	512	539	444	515	525	560	498	515	495	532	444	515
④	Surface submerged in water (Right)	1	482	471	522	479	529	474	528	466	515	473	482	466
		2	723		598		563		613		624		563	
		3	623		641		576		569		602		569	
		4	532	482	498	479	511	539	536	496	519	499	498	479

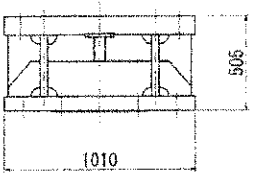
圖2-5-9　防護閘門上游面門框膜厚檢查報告內容

INSPECTION REPORT FOR DRY FILM THICKNESS									
Particular	Bonnet Cover (Guard Gate)								
Measuring time	After completion of final painting〔Final Epoxy Resin Paint〕at shop								
Measuring date/month/year	03 October 2019								
Portion	Exposed	Specified thickness		200 μm		Minimum thickness		140 μm	
Total Painting Area	8.7 ㎡	Need to Inspection		18 point		Activity Inspection		18 point	
Result	Minimum thickness		In-house	362 μm		Witness		352 μm	
	Average of thickness		In-house	448 μm		Witness		425 μm	

Measuring Point







Inspected by
IHI Infrastructure Systems Co.,Ltd.
Gate & Penstock Quality Control Group

Koji Ishiyama

K. Ishiyama

WITNESSED BY
REVIEWED BY
M. Shimokawa
DEC. 06. 2019

試驗報告(出廠證明)判定審核章

設計、規範值 詳檢驗紀錄表(11580)

檢測初判人員簽名: 陳宏典

☑符合 ☐不符合 本件業經核對無誤並符合契約規範規定，如有偽造文書情事，均由文件上公司及其簽名人員負刑事及民事所有責任

當地單位複判人員簽名: 林明輝

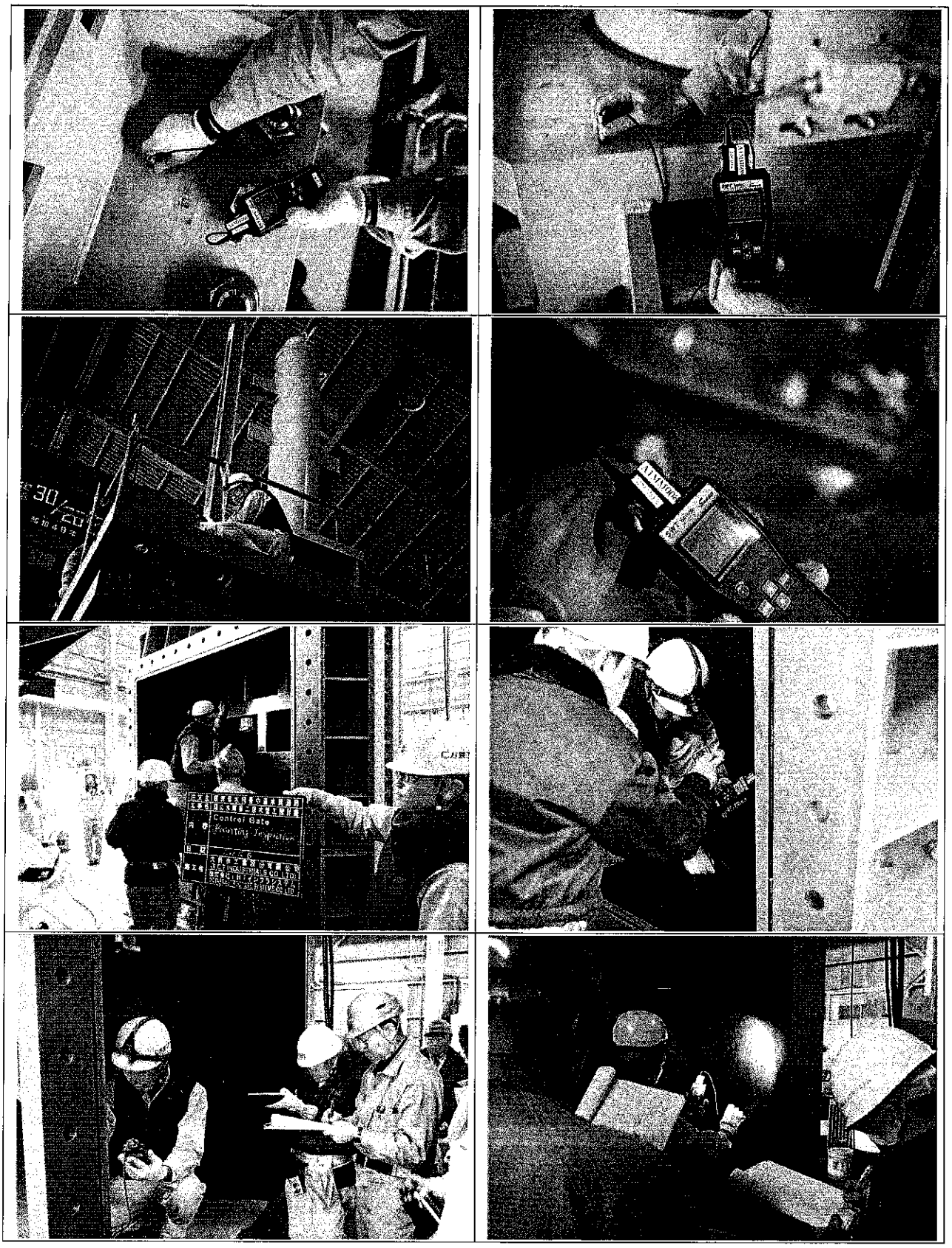
☑合格 ☐不合格

Unit: μm

Measuring point			Data												Average		Minimum	
			a (upper)		b (bottom)		c (left side)		d (right side)									
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness					In-house	Witness	In-house	Witness
①	Exposed Surface	1	385	409	439	414	416	441	394	460					409	431	385	409
		2	391		445		444		470						438		391	
		3	387		386		409		415						399		386	
		4	381		485		443		412						430		381	
		5	519	419	533	435	504	435	484	411					510	425	484	411
		6	406	431	539	352	412	406	428	495					446	421	406	352
		7	396	496	451	377	409	435	453	490					427	450	396	377
		8	362	445	403	420	424	416	417	428					402	427	362	416
		9	449		464		431		466						453		431	
		10	392		431		411		418						413		392	
		11	441		576		433		452						476		433	
		12	427		474		440		439						445		427	
		13	420		505		479		406						453		406	
		14	475		504		474		498						488		474	
		15	439	377	460	438	452	401	483	421					459	409	439	377
		16	501	401	523	440	480	433	494	387					500	415	480	387
		17	469		455		504		489						479		455	
		18	410		462		437		421						433		410	

圖2-5-10 防護閘門油壓閥蓋膜厚檢查報告內容

表 2-5-9　膜厚量測照片一覽表



2-6 廠驗綜整會議

主要討論廠驗相關內容及報告呈現方式，並歸納結論，第三方檢驗單位 JIC 說明本次廠驗合格，另相關結論及注意事項如下：

7. 在出廠船運前應再檢視是否表面有需要補漆部分，應補漆後始裝箱上船。

8. 控制閘門門框內因為安裝試驗用法藍而導致之鏽蝕應於裝箱上船前移除。

9. 依據設計圖說，廠商應準備供置換之門扉面板四個角落之塞子。

10. 於設定極限開關全開之行程時，油壓圓柱頂部須於上鎖狀態。

11. 閘門軌道潤滑油之補注時機及頻率將在操作維護手冊內說明。

下圖 2-6-1、2-6-2 則為綜整會議紀錄，圖 2-6-3、2-6-4 為當日開會狀況，並由本局代表林副工程司明鋒、大將作工業產品經理陳宏典先生、IHI 品管部門 Ishiyama 先生、JIC 第三方檢測檢驗官 Shinohara 先生等代表具名簽署。

Minutes of Meeting

Witness Inspection for Control Gate and Guard Gate of the Project for Hushan Reservoir Raw water Pipeline II Engineering Project was carried out from Dec. 5 to 6, 2019 at Nigata Iron Works Co., Ltd. Ato Shop in Japan.

Attendees;

Owner: Mr. Ming-Feng Lin, Mr. Chia-Chin Tsai, Mr. Chun-Yi Cheng
TCT: Mr. Hung-Tien Chen, Mr. Simon Feng, Ms. Hui-Ching Chiang, Ms. Min-Ru Kao
Third Party Company Inspector: Mr. Shinohara
IIS: Mr. Hasegwa, Mr. Matano, Ms. Nishimura, Mr. Ishiyama, Mr. Otani

The following items were inspected;

Control Gate;

1) Dimensional Inspection
2) Hydraulic Inspection (Pressure Test and Leakage Test)
3) Operation Inspection
4) Painting Inspection
5) Visual Inspection for Assembly

Guard Gate;

1) Dimensional Inspection
2) Hydraulic Inspection (Pressure Test and Leakage Test)
3) Operation Inspection
4) Painting Inspection
5) Visual Inspection for Assembly

Inspection Results; Acceptable

圖2-6-1　廠驗綜整會議報告內容

Comments to be taken action by IIS are as follows;

1) Touch up paint for both gates shall be done before shipment.
2) The rust due to the test flange was found inside casing for Control Gate.
   The rust shall be removed before shipment.
3) The four plugs of both gate leaves shall be changed according to the drawing.
4) The setting procedure of limit switch position shall be submitted for locking cylinder.
5) Greasing period and grease maker recommended by IIS shall be described in the Operation and Maintenance Manual.

All attendees agreed on the above results and comments signed by;

Mr. Ming-Feng Lin
Associate Engineer
The Owner

Mr. Hung-Tien Chen
Project Manager
TCT INDUSTRIALS CO. LTD.

Mr. Shinohara
Third Party Company Inspector
Japan Inspection Co., Ltd.

Mr. Ishiyama
Manager of Gate & Penstock
Quality Control Group
Quality Control Dept.
IHI Infrastructure Systems
Co., Ltd

圖2-6-2　廠驗綜整會議報告內容(續)

圖2-6-3　廠驗綜整會議狀況

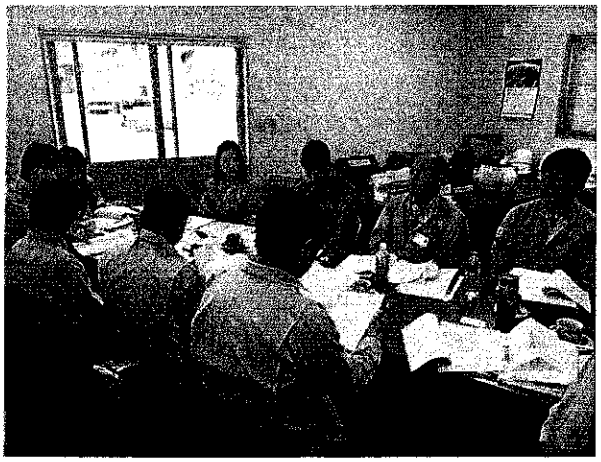


圖2-6-4　廠驗綜整會議狀況(續)

材料設備檢驗紀錄表

工　程　名　稱	湖山水庫第二原水管工程
主　辦　機　關	經濟部水利署
監　造　單　位	經濟部水利署中區水資源局湖管中心
廠　　商	大將作工業股份有限公司/義力營造股份有限公司
檢驗(查)項目	操作閘門及防護閘門尺寸、銲道、水壓及單機運轉
依　據　規　定	第 11280 章
檢驗(查)位置	日本廣島-廠驗
取樣(檢查)時間	108　年　12　月　04 日
樣　品　名　稱	高壓操作閘門及防護閘門
樣　品　數　量	操作閘門及防護閘門各一組
試　驗　單　位	第三方檢驗
試　驗　時　間	108 年 12 月 04 日 08 時
檢驗(檢查)結果	☑符　合 □不符合 處理方式： 廠商簽認：陳宏史
抽　驗　單　位	☑監造單位　□主辦機關　□上級機關
會同取樣者	機關：經濟部水利署 監造單位：經濟部水利署中區水資源局湖管中心 廠商：大將作工業股份有限公司
會　驗　者	機關：經濟部水利署 監造單位：經濟部水利署中區水資源局湖管中心 廠商：大將作工業股份有限公司
備　　註	1. 各項工程使用材料設備及施工品質之試驗應由符合 CNS 17025 (ISO/IEC 17025)規定及依標準法授權之實驗室認證機構認可之實驗室辦理，並出具試驗報告。 2. 不符合或待改善者應填寫不符和事項報告通知廠商提出矯正及預防措施，並實施追蹤管制。 3. 另各局如有需要,在不影響該表表內必要項目欄位之同時,可自訂相關表格。

填表者：林明輝　　監造單位：王維凱

第三章　心得及建議

3-1　心得

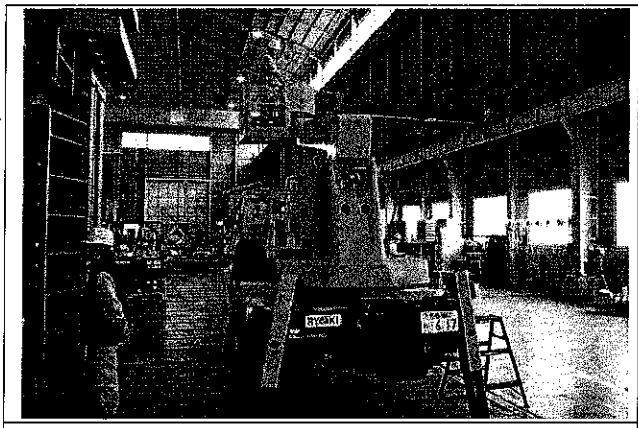
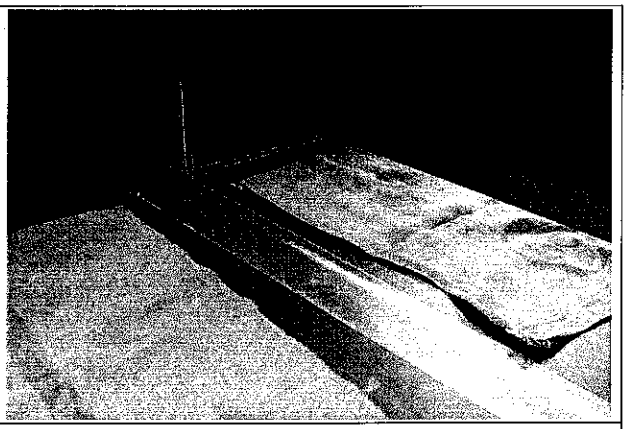
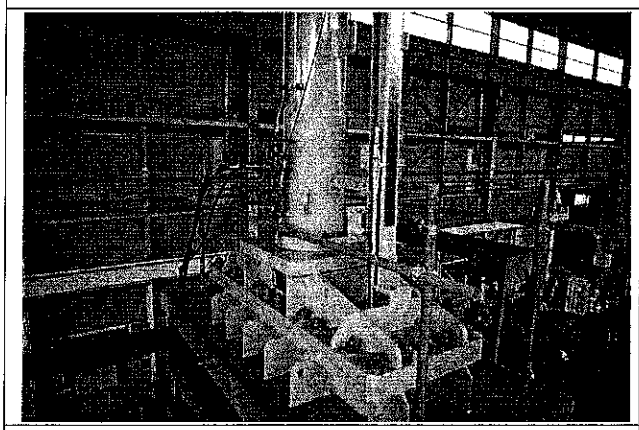
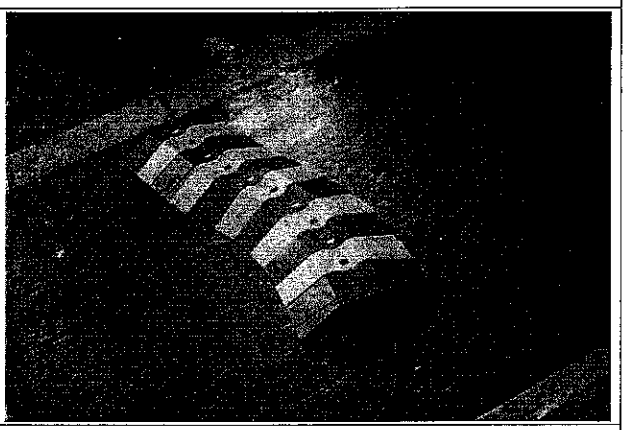
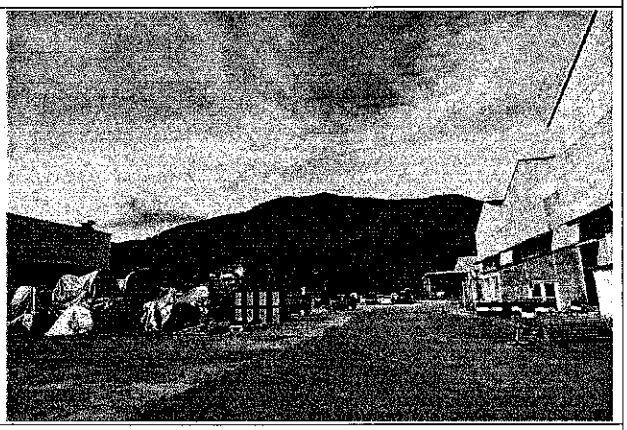
本次本局同仁實際參與本工程高壓閘門廠驗，實屬難得，以下採條列數點心得：

1. 感謝經濟部、水利署長官及本局長官支持，本工程團隊有機會實際至日本參與高壓閘門廠驗。
2. IHI 於出發前調查所需全套工作服及工作鞋尺寸，並備妥安全帽供參與人員配戴，符合本工程對於職業安全之標準。
3. IHI 及 JIC 皆依 2 座高壓閘門檢驗程序書(詳附件一及附件二)內所需檢查項目逐項執行，安排行程並備妥相關文件供本團隊參考，準備開會場所，場所內整潔明亮，工廠旁廁所亦非常乾淨，且亦備有免治馬桶，文件及物品皆排放整齊，並於預定時程內完成各項試驗，效率極高。
4. 廠區外環境整潔不凌亂，堆置材料亦有帆布覆蓋，其餘空地或鋪面均平坦無垃圾，廠內動線優良，設備均置於規劃範圍內，且均有將物件以棧板墊高，廠區內採光明亮，各設備無明顯鏽蝕，員工亦均全時佩戴安全帽，非常有制度，以上數項優點可供國內鋼鐵廠商參考，如下表 3-1-1。
5. 本局同仁會後所提問有關試驗用法蘭，其上下游面互鎖之框架結構，主要為模擬門框及閘門於固結混凝土內之狀況，且直覺水壓應於閘門下半部較大，下半部應較上半部有更強之三角支撐構件，然現場所見閘門門框上半部之三角框架結構較下半部有更多支撐構件，經由本局同仁詢問 IHI 設計課長 Matano 先生解釋，高壓閘門之左右側及頂水封均以青銅材料(CAC403)製作，設計原意除於閘門啟閉時較為順暢外，可允許少許漏水(如 2-2 節所述)，然底水封原設計即以天然橡膠(NBR)材料製作，其止水能力遠大於左右側及頂水封，加上 Matano 先生說明該構件(閘門門框加上試驗用法蘭)底部結構較強，為故為符合閘門現場安裝實際狀況(完整包覆於 280kgf/cm2 混凝土中)，設計更多構件加強閘門上半部門框及試驗用法藍間之密合度，以達到最高之止水效果，始符合實際，照片參照下表 3-1-1。
6. 本局同仁於 JIC 進行尺寸量測時，隨機詢問閘門滑動面板是否依圖說所示，距離門框僅為 2mm 空間(通常此部分即為閘門製作之精密度及水密程度所在)，IHI 人

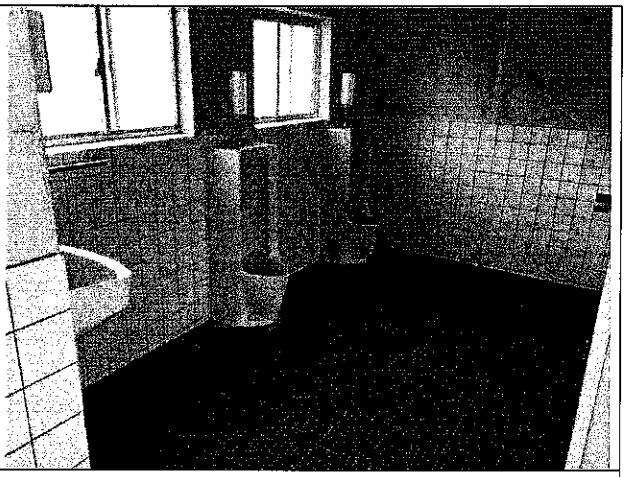
員除現場量測外，並能於稍後提供廠內自檢相關照片供本局同仁參考，表示其製造過程之自主檢查有確實執行，尤其該部分為整個閘門最重要也最小的間距，其圖說如下表 3-1-1。

7. 本次廠驗之工廠僅位於小海港之一小型鋼鐵廠，然仍有高規格表現，除表示 IHI 自身管理能力外，顯見日本國內製造業之水準。

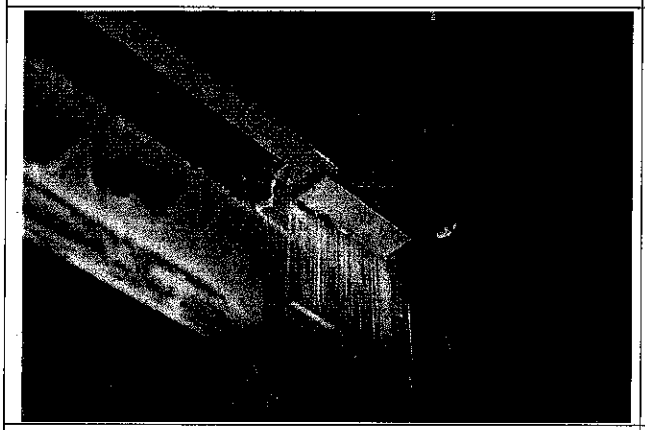
表 3-1-1　心得照片一覽表

	
廠內備有高空工作車	為防止人員於閘門內滑倒且保護油漆
	
於高處架設欄杆	人行動線上之管線盒
	
產品均以棧板墊高	環境整潔，物料集中以帆布覆蓋

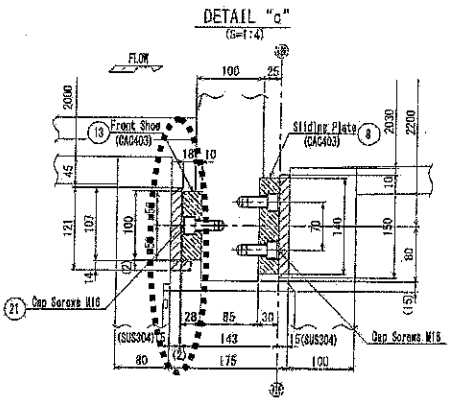
動線明朗，廠房整潔



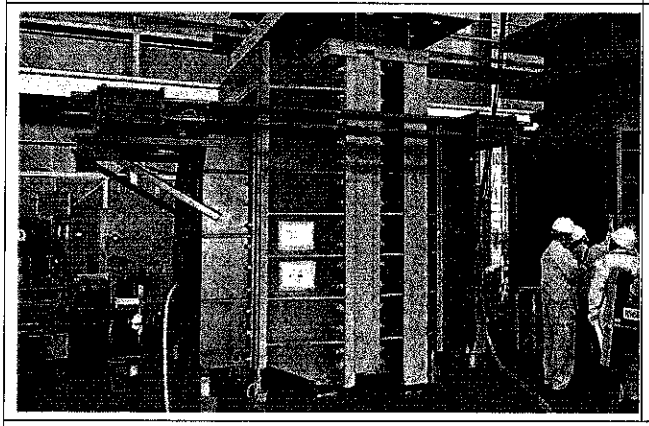
廁所整潔且無臭味

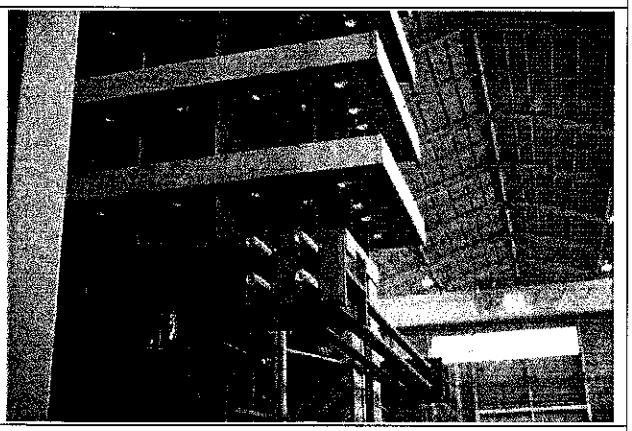


青銅水封及橡膠水封；滑動面板距離門框 2mm



圖說：滑動面板距離門框 2mm

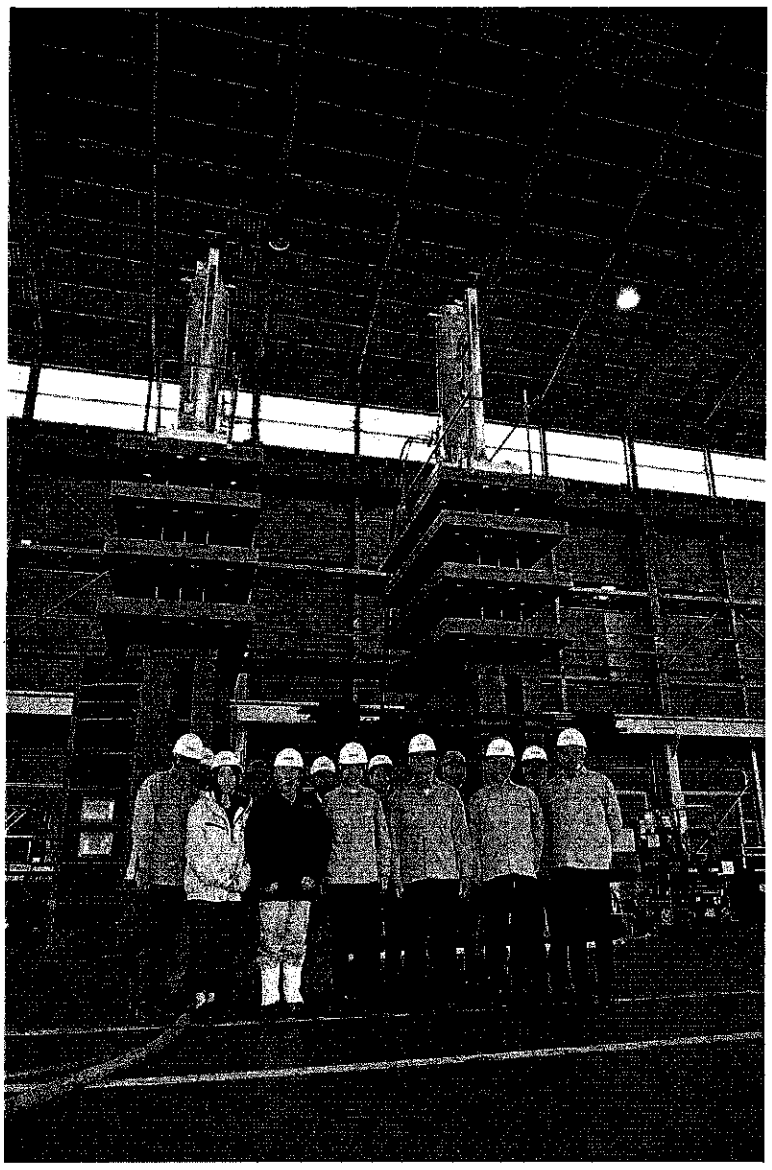




試驗用法蘭(紅色)上方以多組結構架及連桿鎖固門框上半部

3-2 建議

1. 因國內無高壓閘門市場，故一般均委由國外廠商施作，其相關浸水主要組件之精密度均小於本工程規範(依據附件三本工程施工規範，各組件公差均約 4-5mm，然依據 IHI 提出之相關圖說，約僅 1-3mm)，建議若爾後仍有相關案件，建議派遣相關同仁實際參與國外之廠驗，應有助於提升國內機械製造之品質。



附件一

控制閘門(含油壓設備)工廠製造及檢驗程序書

檔　　號：
保存年限：

經濟部水利署中區水資源局　函

機關地址：41351臺中市霧峰區吉峰里峰堤路195號
聯 絡 人：蔡嘉晉
聯絡電話：05-5261977　#200
電子信箱：chiachin@wracb.gov.tw
傳　　真：05-5267386

受文者：如行文單位

發文日期：中華民國108年06月21日
發文字號：水中湖字第10833030000號
速別：普通件
密等及解密條件或保密期限：
附件：如說明二

主旨：有關貴公司檢送「湖山水庫第二原水管工程」控制閘門(含油壓設備)工廠製造及檢驗程序書及防護閘門(含油壓設備)工廠製造及檢驗程序書修正B版，本局同意核定，請依工廠製造及檢驗程序書及相關規範辦理，請查照。

說明：

一、復貴公司108年5月31日將字第108050035函。

二、隨文檢附控制閘門(含油壓設備)工廠製造及檢驗程序書及防護閘門(含油壓設備)工廠製造及檢驗程序書修正B版各1份。

正本：大將作工業股份有限公司
副本：義力營造有限公司、本局湖管中心

A13-031

經 濟 部 水 利 署

湖山水庫第二原水管工程

核定日期：108.6.20

核定文號：10833036000

修正	日期	說明	修正者	校對	核准
B	108.5.31	依水中湖字第10833023000號函修正	E.OYA	R.NAKASO	K.ISHIYAMA
A	108.4.1	依水中湖字第10833011650號函修正	E.OYA	R.NAKASO	K.ISHIYAMA

控制閘門(含油壓設備)工廠製造及檢驗程序書

Test and Inspection Procedure at Shop for Control Gate Dimensional, Welding, Painting and Assembly Inspection

IHI Infrastructure Systems Co., Ltd.

設計/繪圖	E.OYA	108.2.15	複　核	R.NAKASO	108.2.15
初　核	E.OYA	108.2.15	核　准	K.ISHIYAMA	108.2.15

義力營造股份有限公司

大將作工業股份有限公司

共同承攬

初版日期	編號
108.2.15	H07A－MP－010－B

控制閘門（含油壓設備）工廠製造及檢驗程序書

送審核簽署表

工程名稱：湖山水庫第二原水管工程

契約編號：107 經水工中 01 號

承攬廠商	提報版次：B 版	簽署欄(含日期)
	提報日期：108 年 5 月 7 日	工地主任：
	廠商名稱：大將作工業股份有限公司	
	用印：	品管人員：
監造單位	審查結果： □退回修正 □修正後認可 ☑認可 □其它	審查人員：
執行機關	審查結果： □退回修正 □修正後核定 ☑核定 □其它	審查人員：

「湖山水庫第二原水管工程」閘閥設備審查會議紀錄

（108.05.10 水中湖字第 10833023000 號）

審查意見回覆表

序號	章節	審查意見	辦理情形	頁碼
林副工程司士元				
1		鋼管設計計算書銲接效率：0.95，工地銲接效率為 0.9，其對應銲道 RT 檢測率標準為何。	銲接效率與銲道 RT 檢測率，無相對應標準，銲道 RT 檢測率係由設計單位於施工規範第 11282 章 3.2(1)節上予以規定。	
鄭正工程司國華				
1		電氣設備型錄第 23-2 應改用 LED-150W 不再使用納氣燈(以公文停用)。	將於收到正式變更公文後遵辦。	
2		明冠 2200mm 電動蝶閥應加強自主檢驗鑄件無砂孔，無何檢驗應補件提出。	有關蝶閥鑄件砂孔，所有外露部分於製造過程中均已修補，至於內部無法確定部分，廠驗時已以 20kg/cm^2 壓力進行閥體檢測(蝶閥最大工作壓力 8.2537kg/cm^2)，故強度已足夠，應無需再另作檢驗。	
3		1.下游連接管路 1K+153.366~1K+221.364 施工圖製造圖未提送安裝圖請補送如何安裝?基座安裝圖。 2.圖號 H07A-DP-7005 請補充：1. φ36、φ48 基礎螺栓預埋時應與鋼筋銲接堅固，調整完成後再灌二次混凝土。2.單孔減壓閥、3.電動球閥基座，如何與地板鋼筋結合都未提出未畫出未畫圖最基本應附註說明。	1.安裝圖詳圖號 H07A-DP-7000、7005。 2.閥室之基礎座已補基礎螺栓(含錨板)與鋼筋連結固定要求；另基礎座亦已補配筋圖。 減壓閥井：詳圖號 H07A-DP-1005、1010。 出流閥井：詳圖號 H07A-DP-7005。	
4		閘閥室鋼管施工製造圖： 1.圖號：H07A-DP-7005：應補充基礎螺栓如何固定與鋼筋部分未畫出，也應註明基礎台語基礎螺栓在與地板鋼筋結合請補充(基礎台未見鋼筋，要補充)。 2.閘閥室鋼管施工製造應列入重點廠商自主檢驗表，不論廠內製造及現場安裝應列入重點檢驗(如鋼板厚度、銲道尺寸及開槽尺寸等等)。	1.本閘閥室地板(EL148.66)以下為巨積混凝土，未鋪設鋼筋，為穩固高壓閘門基礎座，將於閘閥室混凝土高程約 147.00 時，先行埋設基礎座錨板(面板高程 147.41)，並於混凝土高程達 147.41m 時進行閘門固定座之安裝，固定座安裝完成後，即接續進行閘門框及其他接合件之安裝，詳圖號 H07A-OH-1005。 2.閘閥室鋼管工廠製造及現場安裝均會依規定辦理自主檢查後，再通知甲方檢驗，主要銲接管#67、#68、#70 及#71 等管，其板厚、銲道尺寸及開槽尺寸於施工製造圖均有規定，	

			詳圖號 H07A-OH-5020、5025、5030、5040。	
5		開閉室控制閘門與防護閘門應補送安裝圖如何與基礎台鋼筋銲接固定請補充。	1.開閉室控制閘門與防護閘門安裝圖，詳設計圖 H07A-OH-1000、2160。 2.高壓開閉基礎台無鋼筋，控制閘門與防護閘門將置放於本公司專設之固定座上，詳圖號 H07A-OH-1000、2160。	
6		開閉室屋頂高度往後可吊出油壓缸嗎?請補充說明。室內有吊車嗎?如何維修有考慮嗎?	1.經量測油壓缸頂部至樑下緣距離為 4740mm，油壓缸取出需要空間為 2578mm，尚餘 2162mm，有足夠空間吊出油壓缸。 2.本開閉室未配置室內吊車，但屋頂上有配設吊鈎，詳圖號 H07A-OH-6000。 3.日後油壓缸若需拆下維修，可利用屋頂上之吊鉤搭配其他臨時吊具予以拆下及裝設。	
7		請黎明公司函文來本局將鈉氣燈應改用 LED 較符合規定。開閉室照明高度 9 公尺應修正為 6m 以內。	1.鈉氣燈改用 LED 案，將於正式收到公文後遵辦。 2.開閉室照明高度 9 公尺，依審查意見改為 6m 以內。	
黃工程員振聲				
1		H07A-OH-5000、5010 電動蝶閥處增設旁通閥與工作平台。	1.增設之旁通閥，詳圖號 H07A-OH-5000、5025、5035、5070、5075。 2.增設之工作平台，詳圖號 H07A-OH-5000、5080、5085。	
2		H07A-OH-5025 Detail" b" 、" c" 斜角開口要銲接。	H07A-OH-5025 Detail"b"、"c"斜角開口處，已補銲接符號。	
3		H07A-OH-2150 typcial section 追加水壓錶	已加設水壓表，詳圖號 H07A-OH-2150、2153。	
林工程員鈺凱：				
1		鋼管所用法蘭之 O 型環及其溝槽未進行相關計算，無法確認是否符合需求。	本案 ϕ2200mm 鋼管 O 型環直徑為 10mm，溝槽深為 7.00~7.05mm，壓擠率介於 30.0~30.5%；且 O 型環外緣採緊貼溝槽外壁設置，符合內壓設計規定，應已符合需求。	
2		開閉室鋼管#70#71#72#73 底部為方形，且有環樑設計，請考量現場施打混凝土時，是否有無法填滿空隙之可能。	開閉室鋼管#70、#71、#72、#73 等管均有裝置環樑，為減少環樑對混凝土澆灌影響，均於環樑腹板與上翼板交接處適當距離內增設半徑 5cm 之流通孔，以增加混凝土流動性，另將於混凝土灌漿澆置時，加強震動搗實。詳圖號 H07A-OH-5040、5050、5055、5060	
詹副工程師燿鴻				

1		黎明圖說 WS-M002，油壓單元設計要點6.其他規定另詳規範第 11280 章第 3.3 節，查無此章。	施工規範第 11280 章為「閘閥室閘閥及附屬設備」，3.3 節為「閘閥設計製造要點」，3.4 節為「吊門機設計要點」，應是 3.4 節誤植為 3.3 節。	
2		圖 C-6 電動機耐熱溫度 155°F，規範 16221-5 至少 E 級(120°C)以上知絕緣未標示，請說明。	本工程閘閥室油壓設備用馬達馬力數為 18.5kw，絕緣等級為 F 級(最高允許溫度 155° C)。詳控制(防護)閘門工廠製造及檢驗程序書 H07A-MP-010(020)5.4 節 P13，	
林工程員信嘉				
1		油壓系統 1.圖說內有尺寸標註為 O，請問 O 為何? 2.圖說各編號，某部分尚未說明，建議編號增加列表說明。 3.圖號：K18-0339-1，圖內氣油壓零件符號，建議另外製作符號目錄，俾供參考。	1.O 表示直徑。 2.已補說明，詳圖號 H07A-OH-3115、3125。 3.圖內油壓零件已補附中文名稱，詳設計圖 H07A-OH-3115、3125、3135、3145、3165、3175	
2		H07A-MP-010-A控制閘門(含油壓設備)工廠製造及檢驗程序書 P8、P9 頁，執照及證明書模糊。	已將所附執照及證明書更新，詳控制(防護)閘門工廠製造及檢驗程序書 H07A-MP-010(020)4.2.4 節 P8~9。	
蔡工程員嘉晉				
1		圖說部分 1.閘閥室鋼管、閘閥安裝圖、通氣管及旁通管圖等建議放同一份資料(彼此有關聯)。 2.控制及防護閘門油壓缸規格請確定(與計算書不一致)。	1.遵照辦理，詳閘閥室設備施工製造圖。 2.控制閘門油壓缸規格為 500/225x2300(全行程 2370)。 防護閘門油壓缸規格為 400/225x2300(全行程 2370)。 修正部分，詳圖號 H07A-OH-2100、控制(防護)閘門油壓設備計算書 H07A-OH-120(220) P11~12。	
2		油壓系統 1.油壓系統表格格式建議與其他閘件一樣。 2.兩組油壓泵交互運轉供油，並設有一組手動油壓泵(圖上手動圖示?)，請說明控制流程	1.遵照辦理，詳圖號 H07A-OH-3110、3115、3120、3125、3130、3135、3140、3145、3150、3160、3165、3170、3175。 2.1 本油壓系統設有 A、B 兩組油壓泵，並分由 A、B 兩組馬達各別帶動，泵浦選擇開關分「A 油壓泵」、「交互運轉」、「B 油壓泵」三種模式，當選擇「交互運轉」時，若第一次起動為 A 油壓泵，第二次起動則為 B 油泵。	

			a. 運轉模式選擇單動時: 當選擇開關選擇 A 油壓泵運轉時，若運轉中 A 油壓泵故障無法繼續運轉，需將選擇開關轉至 B 油壓泵，並按泵浦啟動後，方能繼續運轉。 b. 運轉模式選擇連動時: 當系統由 A 油壓泵運轉時，若運轉中 A 油壓泵故障無法繼續運轉，系統將自動切換至 B 油壓泵，由 B 油壓泵繼續供壓運轉。 2. 2 手動油壓泵係電動油壓泵無法運轉時才會操作，與電動油壓泵無流程關係。	
		3. 油壓鋼計算書附件 3-1~3-2，設備圖數字部分建請增述設備說明 4. 油壓系統配置圖請標示圖例及缺安裝圖，油壓槽請劃出安裝圖面及預埋固定方式。	3. 已補設備名稱說明，詳圖號 H07A-OH-3115、3125。 4. 油壓零件已補附中文名稱，詳圖號 H07A-OH-3115、3125、3135、3145、3165、3175。 油壓單元件配置圖，詳圖號 H07A-OH-5000、其固定方式將按照原廠預留之 ϕ19mm 螺栓孔，以 M16 化學螺栓固定之，共 6 支。	
3		計算書 1. 防護開門計算書 P11 應該是防護開門資訊，衝程應為 2300mm 請確定，控制開門活塞面積為 500mm 衝程 2370mm，防護開門為 400mm 衝程 2300mm?並與圖說一致。 2. 相關設備圖，如涉及後續維運資料(如油壓配置圖面等)需翻譯成中文。 3. 不同計算書表示同一東西，符號確不一樣，如開關向上拉力有時是 Wu 有時 Fu 建議符號一致。 4. 混凝土強度計算只有水壓計算是否足夠，沒考慮閘體荷重?計算式 f 為 P*sealing wide/2/bearing wide 請確定公式?	1. 控制開門油壓缸規格為 500/225x2300(行程)，2370mm=全行程(Full Stroke)。 防護開門油壓缸規格為 400/225x2300(行程)，2370mm=全行程(Full Stroke)。 詳控制(防護)開門油壓設備計算書 H07A-OH-120(220)P11~12。 2. 已附油壓單元設備名稱中英對照，詳設計圖 H07A-OH-3115、3125、3135、3145、3165、3175。 3. 已將不一致名稱修為一致，詳控制(防護)開門油壓設備計算書 H07A-OH-120(220)P3。 4. 已修正混凝土強度計算，詳控制(防護)開門計算書 H07A-OH-110(210)P81、P82。	
4		工廠製造及檢驗程序書: 1. 檢驗表格請補附相關人員簽認位置。 2. 請增加極限開關、防止超運轉測試及	1. 檢驗表格已附相關人員簽認欄位，詳控制(防護)開門工廠製造及檢驗程序書 H07A-MP-010(020) P16、P17。 2-1. 本高壓閘門因需配合鎖定裝置動作需要，	

		測試時間、運轉油壓缸運轉速度、流量及壓力、開度測試(4-20mA)測試百分比等欄位，以完善測試紀錄。	上限之極限開關分為「全開開關」、「上限開關」兩種；至於下限之極限開關為「全開開關」(另設有開門全開時泵浦自動停止裝置)，將於設備現場安裝完成後，依契約進行測試。 2-2. 設備工廠測試時間，預定於108年12月，詳控制(防護)閘門工廠製造及檢驗程序書H07A-MP-010(020) P2。 設備現場測試時間:設備安裝完成後辦理，確切時間屆時再通知。 2-3. 油壓缸運轉速度:依施工規範11280章3.4.3節規定為0.1~0.15m/min。 2-4. 流量:依施工規範11280章3.4.6節規定，油壓泵額定流量應不少於設計流量之115%，依計算，油壓缸於速度0.15m/min，需油量最大=29.45 ℓ/min，則油壓泵需要流量=29.45x1.15=33.87 ℓ/min，本工程油壓泵額定流量36.8 ℓ/min > 33.87 ℓ/min。詳設計圖H07A-OH-6000，控制(防護)閘門油壓設備計算書H07A-OH-120(220)P7、P10。 2-5. 壓力:本油壓系統最大壓力設定於210 kg/cm^2，符合施工規範11280章3.4.14節油壓系統壓力不大於210 kg/cm^{2}規定、詳設計圖H07A-OH-6000、控制(防護)閘門油設備計算書H07A-OH-120(220)P1。 2-6 開度:將按開度行程0~2700mm，依比例等分輸出信號4-20mA。	
5		其他:資料尚缺安裝說明書。	有關高壓閘閥安裝部分，日後將提出工地安裝程序書。	
綜合結論				
1		為配合政府節約能源政策，請黎明公司據以辦理，將本案照明全面改採led，並俟本局函請水利署同意後辦理。	將於收到正式變更公文後遵辦。	
2		有關電動蝶閥處增設旁通閥與工作平台，請大將作公司確認所需空間及預算，提供本局作變更依據。	蝶閥增設旁通閥與工作平台設計圖如下。 1. 旁通閥設計圖，詳H07A-OH-5070、5075。 2. 工作平台設計圖，詳H07A-OH-5080、5085。 預算部分將另案提送	
3		本次檢送閘閥相關資料，請依意見修正後原則同意辦理。	資料已依審查意見修正完妥。	

4		本次會議請於108年5月31日前修改完成後送局憑辦。	所提意見已修正完成，並於108/5/31陳送。	

CONTENTS

1. GENERAL

This procedure is applied to the shop inspection for Control Gate of the project for Hushan Reservoir Raw Water Pipeline II Engineering Project "湖山水庫第二原水管工程 ".

1.1 Standards and/or codes

The shop inspection is performed in accordance with the following standards and/or codes.

1) The technical specification for this project	
2) CNS	Chinese National Standards (Taiwan)
3) AISC	American Institute of Steel Construction
4) ASTM	American Society of Testing and Materials
5) ANSI	American National Standards Institute
6) ASME	American Society of Mechanical Engineers
7) AWS	American Welding Society
8) EN	European Standards
9) BS	British Standards
10) DIN	Deutsche Industrial Norman
11) JIS	Japanese Industrial Standards
12) Technical Standards for Gate and Penstock	Electric Power Civil Engineering Association, Japan
13) JSSC	Japanese Society of Steel Construction
17) Dam and Weir Technical Standards	Japan Association of Dam & Weir Equipment Engineering
18) Dam and Weir Inspection Essentials	Japan Association of Dam & Weir Equipment Engineering

1.2 Reports for submission

Reports for submission are as follows;

1) Material test report (Material lists and mill certificates for principal members)
2) Welding test report (Non Destructive Test report)
3) Shop assembly inspection report (Including operation test reports)
4) Painting inspection reports (Dry film thickness reports)
5) Certificates and/or test reports for purchased products

2. SCOPE OF TEST AND INSPECTION

2.1 Scope of Test and Inspection

Test and inspection are performed in accordance with the item and category as indicated in the following Table 2-1.

Table 2-1 Scope of test and inspection

Description		Material inspection	Welding inspection		Shop assembly			Painting inspection
			Visual check	Non destructive test	Dimension inspection	Water Pressure test Leakage test	Operation test	Dry film thickness inspection
Control Gate	1 set	□	○	□	□	◎	※◎	◎

Remarks: 1) Mark [◎] is witnessed by the inspector.

2) Mark [○] is carried out by ourselves and test reports are submitted.

3) Mark [□] is carried out by ourselves and/or witnessed by the inspector.

4) ※Operation test is performed at manufacture's factory.

5) The Inspector means The Employer or third party inspector

Third party: JAPAN INSPECTION CO., LTD

2.2 Schedule of Test and Inspection

The plan of Test and inspection schedule is shown in the following Table 2-2.

Table 2-2 Test and Inspection Schedule

Test and Inspection	PLAN	Object
Material Inspection	Mar.2019	Main Material Steel Plate
Equipment Inspection and Test	Jul.2019	Hydraulic Cylinder
Equipment Inspection and Test	Nov.2019	Hydraulic Unit
Shop Assembly Inspection and test	Dec.2019	Control Gate
Welding Inspection	ditto	Control Gate
Painting Inspection	ditto	Control Gate

2.3 Time Schedule for Oversea Inspection

Draft Time Schedule for Oversea Inspection of shop assembly is shown in the following Table 2-3.

In shop inspection, the following two gates are inspected simultaneously.

1. Control Gate
2. Guard Gate

Table 2-3 Time Schedule

1st day

time	item	note
10:00 ~ 11:00	Introduction	Include the confirmation of previous inspection
11:00 ~ 12:00	Non destructive test	
12:00 ~ 13:00	Lunch time	
13:00 ~ 15:00	Dimension Inspection	
15:00 ~ 16:00	Painting Inspection	
16:00 ~ 17:00	Meeting	

2nd day

Test	item	note
9:00 ~ 9:30	Introduction	
9:30 ~ 10:30	Water Pressure Test	Water will be filled in the Gate during the night
10:30 ~ 12:00	Preparation and Cleaning	
12:00 ~ 13:00	Lunch time	
13:00 ~ 15:00	Operation Test	
15:00 ~ 16:00	Meeting	

Details are to be submitted later.

3. MATERIAL INSPECTION

3.1 Certificated mill test reports

All materials used in this project are in conformity with JIS or equivalent standards.
Their conformance with the specification is checked on certificated mill test reports.
Main components and equipment is shown in table 3-1

Table 3-1 Main Component and Equipment

Equipment	Component	Material	JIS or other Standards
Casing	Connecting Flange	SM400C,SM490C	JIS G 3106
	Beam	SM490B, SM490A	JIS G 3106
	Casing Body	SM400B, SM400A	JIS G 3106
		SF440A	JIS G 3201
		SUS304	JIS G 4304
	Sliding Plate	SUS304	JIS G 4304
Bonnet	Connecting Flange	SM490C	JIS G 3106
	Body	SM490B	JIS G 3106
		SUS304	JIS G 4304
	Beam	SM400A	JIS G 3106
	Sliding Plate	SUS304	JIS G 4304
Bonnet Cover	Connecting Flange	SM490C	JIS G 3106
	Rib	SM490B, SM400A	JIS G 3106
	Boss	SUS304	JIS G 4303
	Bush	CAC403	JIS H 5120
Gate Leaf	Skin Plate	SM400C, SM490B	JIS G 3106
	Beam	SM490B,SM490A, SM400A	JIS G 3106
	Seal Plate	CAC403	JIS H 5120
	Rubber Seal	NR	JIS K 6251 / ASTM D 412 JIS K 6253 / ASTM D 2240 JIS K 6258 / ASTM D 471 JIS K 6262 / ASTM D 395 JIS K 6257 / ASTM D 573
Hoist	Cylinder Tube	EN S355J2H	EN 10210
	Rod	EN1.4462	EN 10088

3.2 Chemical Composition

The chemical composition of raw materials is checked on the mill sheet (Mill Certificate).

3.3 Mechanical Properties

The mechanical properties of raw materials are checked on the mill sheets (Mill Certificate).

4. WELDING INSPECTION

All welds are inspected in accordance with the following methods. The specified welds are inspected by Non Destructive Test.

4.1 Visual inspection

All welds are visually inspected in accordance with Technical Standards for Gate and Penstock.
Welds are acceptable to the following visual inspection using the gauge.
Visual inspection acceptance of weld profiles is shown in Table 4-1.

Table 4-1 Acceptance of weld profiles

Item		Acceptance
1	Undercut	Undercut acceptance is shown in Table 4-2.
2	Piping porosity	Piping porosity acceptance is shown in Table 4-3.
3	Crater	All craters shall be filled to the full cross section of the weld, except for the end of intermittent weld outside of their effective length
4	Crack	Welds shall have no cracks.
5	Reinforcement	Reinforcement acceptance is shown in Table 4-4.
6	Over lap	Over lap is not acceptable.
7	Arc strike	Arc strike is not acceptable.
8	Underrun	A filet weld in any single continuous weld shall be permitted to underrun the nominal fillet size, provided that the undersize portion (-1mm) of the weld does not exceed 10% of the length of the weld except 50mm at the both ends of the weld.

Table 4-2 Acceptable value on undercut

Thickness mm	Control limit*	Permissible limit**
T≦6	≦0.3 mm	≦0.6 mm
T>6	≦0.5 mm	≦0.8 mm

*: Undercut which depth is under the control limit is permitted in case of its hole length is within 90% of butt welded joint length in any stress members, or within 80% of all other welded joint length.
**: Undercut which depth is under the permissible limit is not permitted.

Table 4-3 Acceptable value on piping porosity

Joint type	Number of piping porosity
Butt joint, T joint or corner joint of the principal member	Not permitted
All other groove	≦3:the number of piping porosity in each joint or in any 1000mm length of weld, provide that if the diameter of piping porosity is ≦1mm Φ, 3 piping porosities is regarded as 1 piping porosity.

Table 4-4 Acceptable value on reinforcement of weld

Thickness	Main structure of gate	Discharge pipe under pressure	Other main structure under pressure
t≦12 mm	3 mm	2mm	3 mm
12mm< t≦25 mm	4 mm	2.5mm	3.5 mm
t> 25 mm	6 mm	3mm	4 mm

4.2 Non Destructive Test

4.2.1 General

Radiographic test (RT) is performed on full penetration butt weld joints.

Ultrasonic test (UT) is also performed on full penetration butt weld joints.

Liquid Penetrant test (PT) is performed on all welds on Gate leaf, Seal Seats of Casing and Side Guide including Sliding Plate of Bonnet.

Non Destructive test is conducted by the engineer who has the qualification of the level 2 or 3.

Radiographic test is in accordance with JIS Z 3104.

Ultrasonic test is in accordance with JIS Z 3060.

Liquid Penetrant test is in accordance with JIS Z2343.

All defects observed are removed and repaired. The replacement weld and contiguous parts to the original weld are retested.

4.2.2 Examination ratio

(1) Examination ratio of RT and UT

The examination ratios are shown in Table 4-5.

Table4-5 Examination ratios of RT and UT

Items	Full Penetration Butt weld	
	RT	UT
Control Gate	above 20%	100%

Remarks:

1) RT is applicable to the plate thickness less than 50mm basically.

2) UT is applicable to the plate thickness more than 50mm basically or the portion where RT is impossible.

3) RT has priority over UT.

RT is relatively easy to apply. Most of defects such as cracks, blowhole, incomplete fusion, slag inclusion, and incomplete penetration may easily be detected. This RT is basically employed in this project.

(2) Examination ratio of PT

The examination ratio of PT is shown in Table 4-6.

	All welds on Gate leaf, Seal Seat of Casing and Side Guide incl. Sliding Plate of Bonnet
Control Gate	100%

4.2.3 Object for NDT

(1) Object for RT and UT

Full Penetration butt welds on Gate leaf, Bonnet and Upstream side Casing

(2) Object for PT

① All welds on Gate leaf
② All welds on Seal Seats of Casing (Gate frame)
③ All welds on Side Guide and Sliding Plate of Bonnet (Gate frame)

4.2.4 Execution engineer's qualification

Engineer's qualification is below.

氏名 小山 典幸 生年月日 1969年02月26日
NAME NORIYUKI KOYAMA DATE of BIRTH Year Month Date
署名 小山典幸
SIGNATURE
個人コード P00520473
ID. Code
JIS Z 2305 による認証制度に基づいて実施した審査の結果、表記に記すNDT方法・レベルについて適格であると認め、認証したことを証明します。
This certificate proves that the holder is certified as NDT personnel of the NDT method and level described on the front side of the card as a result of the qualification based on the certification system in accordance with JIS Z 2305 (ISO 9712 modified).

注意
*認証運営委員会委員長印及び写真へのゴールドシールの無いものは無効となります。 *倫理に関する規定に違反した場合失効となります。 *本証明書は技術者の資格を証明するものでありNDT作業の許可を与えるものではありません。
Caution
*In case of no seal of Chairman in the front side of the card and no gold seal on the photograph above, the certificate is invalid. (Chairman: Chairman of Certification Steering Committee) *When the code of ethics is violated, this certificate will be invalid. *This certificate attests that the holder has the qualification of NDT personnel, but it does not give the personnel any operating authorization.

JIS Z 2305
非破壊試験技術者資格証明書
NON-DESTRUCTIVE TESTING PERSONNEL CERTIFICATE

認証番号 CERTIFICATE No. N10254572
氏名 NAME 小山 典幸 NORIYUKI KOYAMA 生年月日 DATE of BIRTH 1969年02月26日 Year Month Date
NDT方法・レベル NDT METHOD・LEVEL 放射線透過試験・レベル2 Radiographic Testing LEVEL2
発効年月日 (DATE of CERTIFICATION) 2015年04月01日
更新年月日 (DATE of RENEWAL) ****年**月**日
有効期限 (DATE of EXPIRATION) 2020年03月31日
工業分野 INDUSTRIAL SECTOR マルチセクター（材料、溶接、構造物） MULTI-SECTOR(MATERIALS,WELDS AND STRUCTURES)
一般社団法人 日本非破壊検査協会 認証事業本部
THE JAPANESE SOCIETY for NON-DESTRUCTIVE INSPECTION PERSONNEL CERTIFICATION DIVISION
JSNDI 認証運営委員会委員長 CHAIRMAN OF CERTIFICATION STEERING COMMITTEE 井上 裕嗣 HIROTSUGU INOUE

JSNDI

交付番号：2016041102010028
Number of Issue

JIS Z 2305:2001 非破壊試験技術者 資格情報証明書

Attestation of Information on a Certificate of JIS Z 2305:2001 Non-destructive Testing Personnel

個人コード ID Code	P00520473
氏　名 Name	小山　典幸 NORIYUKI KOYAMA
生年月日 Date of Birth	1969年02月26日 February 26,1969

認証番号 Certificate No.	N10254572
NDT方法（略称） NDT method (Abbreviation)	放射線透過試験（RT） Radiographic Testing (RT)
レベル Level	2
工業分野 Industrial Sector	マルチセクター（材料、溶接、構造物） Multi-Sector (Materials,Welds and Structures)
発効年月日 Date of Certification	2015年04月01日 April 01,2015
更新年月日 Date of Renewal	****年**月**日 **** ** ****
有効期限 Date of Expiration	2020年03月31日 March 31,2020

この資格情報証明書は下記発行日現在の資格情報であることを証明する。
This Attestation of Information on a Certificate attests the information on a certificate as of the date of issue below.

管理情報コード
a management information code

発行日：2016年04月11日
Date of Issue : April 11,2016

東京都江東区亀戸2-25-14 立花アネックスビル10階
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一般社団法人 日本非破壊検査協会
認証事業本部 認証運営委員会 委員長　井上　裕嗣

HIROTSUGU INOUE
Chairman of Certification Steering Committee
Personnel Certification Division
The Japanese Society for Non-Destructive Inspection

公印は黒色の電子印です
This Society's official seal above is a black colour electronic seal.

＊「資格情報証明書について」は当協会ホームページをご覧ください（http://www.jsndi.jp/）
Please see "About Attestation of Information on a Certificate" written in Japanese in the JSNDI website (http://www.jsndi.jp/).

4.2.5 Radiographic examination

(1) Photographing method

The arrangement of identification marks on radiograph films is shown in Figure 4-1.

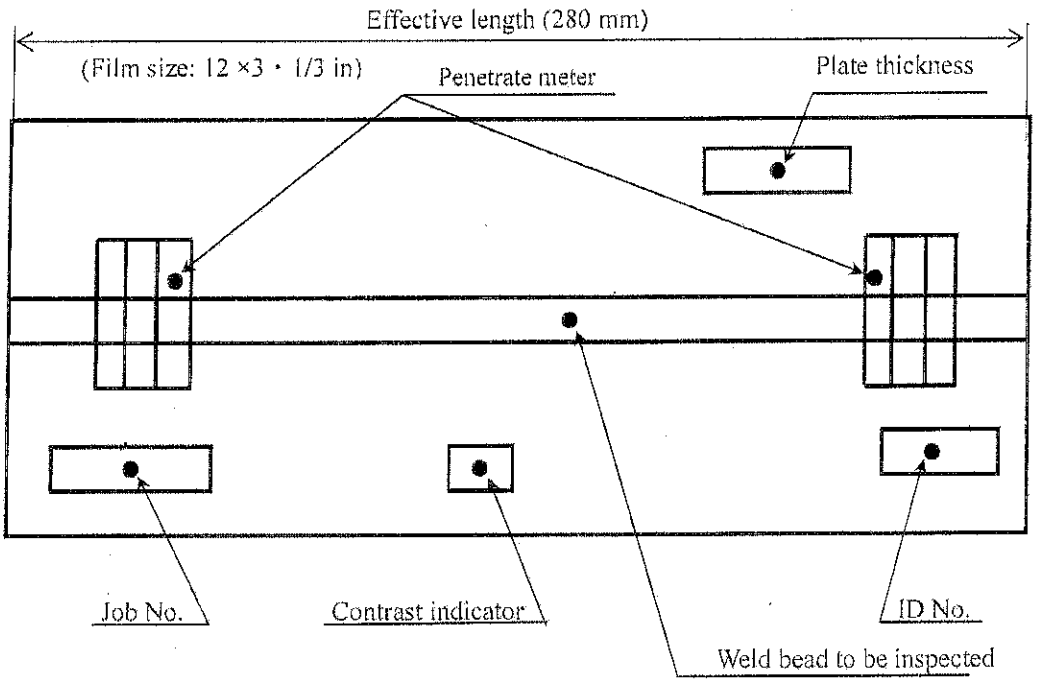


Figure 4-1 Arrangement of identification marks

(2) Acceptance Criteria

Radiographic classification is in accordance with JIS Z 3104 [Methods of radiographic examination for welded joints in steel]. Then acceptance is shown in Table 4-6.

Table 4-6 Acceptance in the radiographic examination

Kind of flaw	Acceptance
Flaw of class 1	Grade 2
Flaw of class 2	Grade 2
Flaw of class 3	Unacceptable
Combined flaws of class 1 with class 2	Grade 2

4.2.6 Ultrasonic Test

Ultrasonic Test is in accordance with JIS Z 3060 [Method for ultrasonic examination for welds of ferritic steel].

The acceptance is equal to or better than Class 2 when using L-disregard level.

Table 4-7 Classification of discontinuities according to region of echo height and indication length

Unit: mm

Region		When using M-disregard level: III When using L-disregard level: II and III			IV		
Plate thickness		18 or under	Over 18 up to and incl. 60	Over 60	18 or under	Over 18 up to and incl. 60	Over 60
Classification	Class 1	6 max.	t/3 max.	20 max.	4 max.	t/4 max.	15 max.
	Class 2	9 max.	t/2 max.	30 max.	6 max.	t/3 max.	20 max.
	Class 3	18 max.	t max.	60 max.	9 max.	t/2 max.	30 max.
	Class 4	Discontinuities exceeding the level of Class 3					
NOTE : The symbol t is plate thickness of the parent material of the groove side. In the case of a butt joint weld that joins two parent materials with different thicknesses, t is the smaller thickness of the two.							

4.2.7 Penetrant Test

The liquid penetrant test method shall conform to the requirement of JIS Z 2343 "Non-destructive testing – Penetrant testing—".

The acceptance is shown as follows;

- Cracks are not allowed on and around weld bead.
- Liner indications (independent or continuous) are not allowed on and around weld bead
- Circular indication, which major axis over 2mm is not allowed on and around weld bead.
- Scattered indications is not allowed on and around weld bead.

5. SHOP ASSEMBLY INSPECTION

The gate equipments are assembled in the shop, and dimensional inspections and visual check on welds (see 4.1) are performed at manufacture's factories.

5.1 Shop assembly position

The gate is temporarily assembled in the installation position.

5.2 Dimensional tolerances at shop assembly

Dimensional inspection is carried out for all equipments, and tolerances are shown in Table 5-1. Detailed tolerances are shown in each check sheets.

Table 5-1 Dimensional tolerances

Gate	Symbol	Point to be measured	Tolerance (mm)
High Pressure Slide Gate	aL	Gate leaf width (Left side)	±1
	aR	Gate leaf width (Right side)	±1
	b	Gate leaf height	±1
	c1	Gate leaf depth	±2
	c2	Distance between horizontal main beam *1	±5
	c3	Skin plate thickness*2	±0.8
	d	Gate slot	±1
	e	Casing height from gate center to bottom	±3
	f	Casing height from gate center to top	±2
	g	Bonnet cover height	±2
	h	Upstream side casing length	±2
	i	Downstream side casing length	±2
	j	Inside dimension of pipe width (upstream side)	±3
	k	Inside dimension of pipe height (upstream side)	±3
	ℓ	Inside dimension of pipe width (downstream side)	±3
	m	Inside dimension of pipe height (downstream side)	±3
	n	Casing width	±5

Note: *1; There is no tolerance on the reference standard. This tolerance is in house tolerance.
*2; This tolerance based on JIS G 3193

5.3 Hydraulic Test

(1) Test condition

The high pressure slide gate is tested under the following condition (See Table 5-2).

In this case, the gate is confirmed that there is no leakage from metal joints and no permanent damage.

Table5-2 Test pressure & holding time

	Design pressure	Test pressure	Holding time
Hydraulic Test	0.813 MPa	1.016 MPa	10 min

Where; Design pressure;82.862m×9.807/1000=0.813 MPa

Test pressure; 0.813×1.25=1.016MPa

(2) Leakage volume
Acceptable leakage volume of water seals is 2 liters per minute.

5.4 Operation Test

The operation test is performed at manufacture's factories.
The operational performance of the gate is checked by the operation test.
Check items and criterion are shown in Table 5-3

Table5-3 Check items and criterion on operation test (Control Gate)

Check items	Criterion
Rated capacity	2245 kN
Hoisting speed	0.1～0.15m/min
Voltage of electric motor	220V ±10%
Electric current of electric motor	63A≦ the rated current
Insulation value of motor	JIS type F
Temperature rise of bearing, motor and reducer	≦ Ambient temperature + 40℃
Vibration	Abnormal vibration is not permitted
Operation of limit switches	Normal
Operation of gate position indicator	Normal

6. PAINTING INSPECTION AT SHOP

The dry film thickness and appearance are inspected in accordance with Painting Specification.

(1) Water seal seat, guide ledge, main wheel track seat, pressure seat, and other Gate Frame
The painted surface is inspected on four detection units per meter of length, and four test units still be inspected for less than one meter of member.

Object:
Side Guide of Bonnet

(2) Gate leaf and other related members
The painted surface is inspected for two inspection units per square meter of coating area, and the deficiency still be tested on four inspection units.

Object:
Gate leaf
Surface submerged in water of Casing
Surface submerged in water of Bonnet except Side Guide
Surface submerged in water of Bonnet Cover

The painted surface is inspected for two inspection units per square meter of coating area, but at least three inspection units or more inspected per member or per side.

Object:
Hoist
Surface exposed to the air of Bonnet
Surface exposed to the air of Bonnet Cover
Indicator

Details are shown in each check sheets.

Table6-1 Specified Thickness

Painting portion	Specified Thickness
For the surface submerged in water	320 μ m
For the surface exposed to the air, including Hoist and etc.	200 μ m

7. TEST FOR PURCHASED PRODUCTS

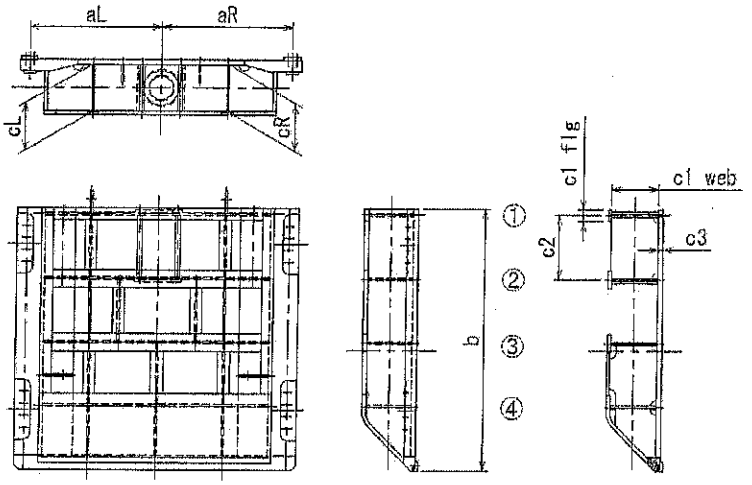
The purchased products which are hydraulic cylinder, hydraulic unit and position indicator are checked and confirmed to be good enough for use. Certificates and/or the test reports including motor of hydraulic unit are submitted.

INSPECTION ITEM	Control Gate (Gate Type: High Pressure Slide Gate)

Dimension inspection

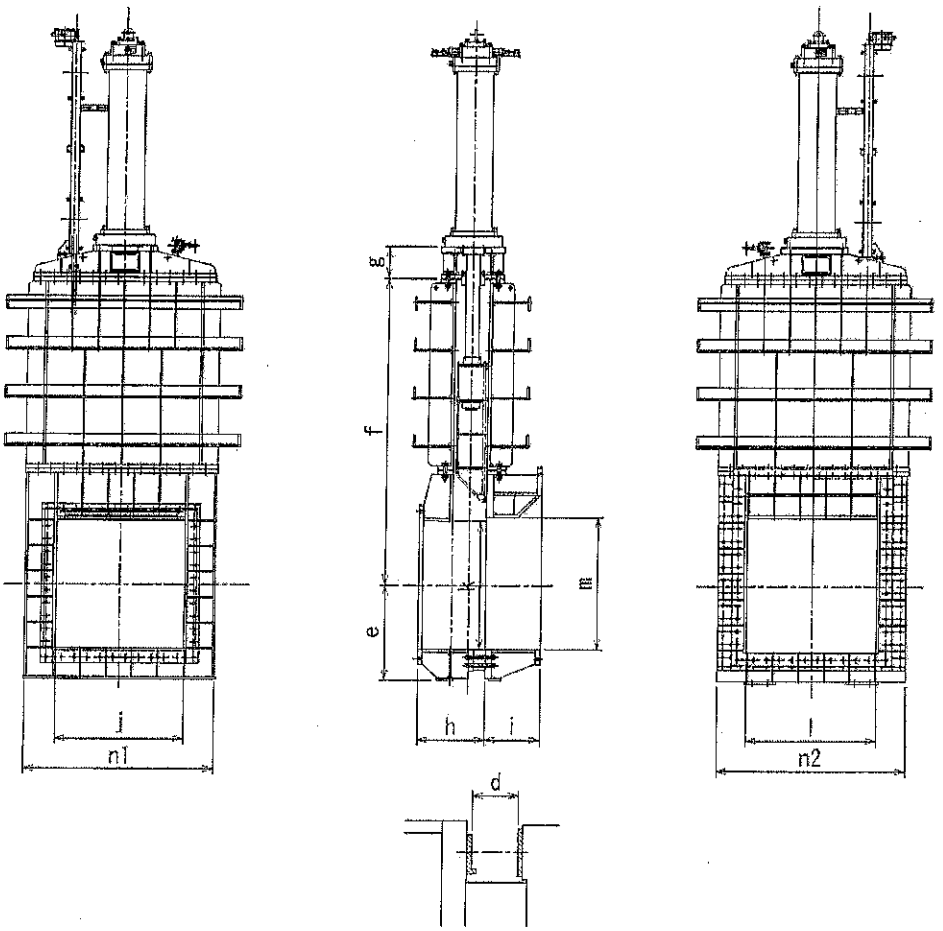
Measuring point

Gate leaf



View from UPSTREAM SIDE

View from DOWNSTREAM SIDE



INSPECTION ITEM	Control Gate (Gate Type: High Pressure Slide Gate)

Dimension inspection

Measuring point

	date	confirmation
In-house		
Witness		

Unit:mm

Measuring items		Inspection points			Design data	Tolerance	In-house inspection		Witness inspection	
							Data	Difference	Data	Difference
a	Gate leaf width	Top	aL		1100	±1				
			aR							
			a		2200	±2				
		Bottom	aL		1100	±1				
			aR							
			a		2200	±2				
b	Gate leaf height	Left			2230	±1				
		Right								
c1	Gate leaf depth	①	Left	Web	395	±2				
				Flg	100	±2				
			Right	Web	395	±2				
				Flg	100	±2				
		②	Left	Web	388	±2				
				Flg	150	±2				
			Right	Web	388	±2				
				Flg	150	±2				
		③	Left	Web	388	±2				
				Flg	150	±2				
			Right	Web	388	±2				
				Flg	150	±2				
		④	Left	Web	388	±2				
			Right	Web	388	±2				
c2	Distance between main horizontal beam	① to ②			550	±5				
		② to ③			545					
		③ to ④			545					
c3	Skin plate thickness	minimum			40	±0.8 (JIS)				

INSPECTION ITEM	Control Gate (Gate Type: High Pressure Slide Gate)

	date	confirmation
In-house		
Witness		

Unit:mm

Measuring items		Inspection points		Design data	Tolerance	In-house inspection		Witness inspection	
						Data	Difference	Data	Difference
d	Gate slot	Left	Upper	145	±1				
			Lower						
		Right	Upper						
			Lower						
e	Casing height from gate center to bottom	Left		1480	±3				
		Right							
f	Casing height from gate center to top	Left		4800	±2				
		Right							
g	Bonnet cover height	Left		505	±2				
		Right							
h	Upstream side Casing length	Left		1085	±2				
		Right							
i	Downstream side Casing length	Left		855	±2				
		Right							
j	Inside dimension of pipe width (Upstream side)	Upper		2000	±3				
		Lower							
k	Inside dimension of pipe height (Upstream side)	Left		2000	±3				
		Right							
l	Inside dimension of pipe width (Downstream side)	Upper		2030	±3				
		Lower							
m	Inside dimension of pipe height (Downstream side)	Left		2070	±3				
		Right							
n	Casing width (Upstream side)	n1	Upper	2960	±5				
			Lower						
	Casing width (Downstream side)	n2	Upper	2950	±5				
			Lower						

INSPECTION ITEM	Control Gate (Gate Type: High Pressure Slide Gate)

1. Visual Inspection for Assembly

Item	Acceptance	In-house inspection	Witness inspection
Condition of component fitting	It is checked by viewing, components are fitting proper position		
Condition of the surface on seal and sliding plate	It is checked by viewing, there is no foreign object		
Condition of the surface on Stainless Steel	It is checked by viewing, there is no rust		
Damage	It is checked by viewing, there is no damage		
Condition of Bolt	It is checked by testing hammer, there is no loose bolt		
Condition of equipment fitting	It is checked by viewing, equipmentsts are fitting proper position		

INSPECTION ITEM	Control Gate (Gate Type: High Pressure Slide Gate)

1.Operation Inspection

区分 Division	運転方向 Direction of driving		電動機 Electric Motor			圧力 Pressure			開閉速度Speed			
			電圧 Voltage	電流 Current	温度 Temperature	元圧 Former pressure	ﾛｯﾄﾞ側圧力 Rod side pressure	ﾍｯﾄﾞ側圧力 Head side pressure	開閉時間 Hoisting time	速度 Speed	揚程 Operating stroke	流量調整弁の目盛り Flow control valve scale
			(V)	(A)	(℃)	MPa	MPa	MPa	min	m/min	mm	-
	設計値 Design value		220	63	---	21	---	---	23	0.1	2300	---
	開 Open	社内 In-house			→							
		立会 Witness			→							
	閉 Close	社内 In-house			→							
		立会 Witness			→							
基準値 Reference value			±10%	定格電流以下 Below ratings current	気温＋40℃ Ambient temperature ＋40℃ or less	規定値にあること a regulated value			0.1～0.15m/min			-

区分 Division	運転方向 Direction of driving		温度 Temperature	
			油温 Temperature of oil (℃)	気温 Temperature of room (℃)
	設計値 Design value		---	---
	開 Open	社内 In-house	→	→
		立会 Witness	→	→
	閉 Close	社内 In-house	→	→
		立会 Witness	→	→
基準値 Reference value			55℃以下 55℃ or less	-

検査項目 Item	判定基準 Judging Standard	検査結果 Inspection result	
		社内 In-house	立会 Witness
電動機絶縁種 Insulation type of motor	所定の絶縁種であること Accommodate to spec		
振動 Vibration	有害な振動が無いこと There is no harmful vibration.		
リミットスイッチの確認 Confirmation of Limit Switch	全開リミットスイッチが正常に作動すること Fully open limit Switch works normally		
	全閉リミットスイッチが正常に作動すること Fully closing limit Switch works normally		
	その他リミットスイッチが正常に作動すること All other limit Switch works normally		
開度計の確認 Confirmation of position Indicator	開度計が正常に作動すること Position Indicator works normally		

INSPECTION ITEM	Control Gate (Gate Type: High Pressure Slide Gate)

2.Hydraulic test

検査項目 Item	試験圧力 Test pressure	判定基準 Judging standard	検査結果 Inspection result	
			社内 In-house	立会 Witness
水圧試験 pressure test	1.016MPa	水密構造部以外からの漏水のないこと No leakage No deformation		
		≦2000mL／min		

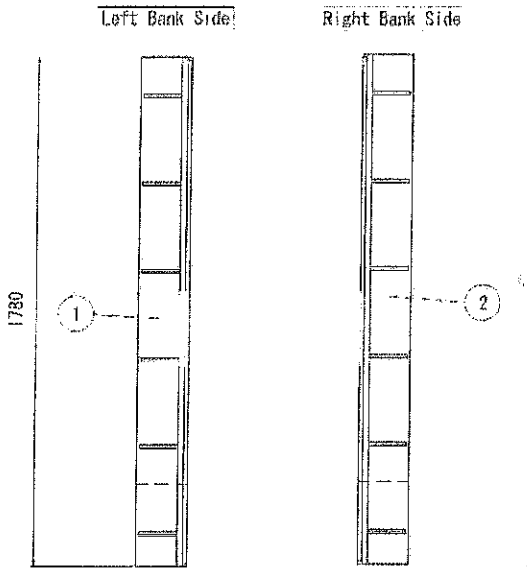
INSPECTION ITEM	Control Gate (Gate Type: High Pressure Slide Gate)

1. Visual Inspection for Welding

Item	Acceptance	In-house inspection	Witness inspection
Undercut	Undercut acceptance is shown in Table 1-1 Table1-1 Thickness mm / Control limit* / Permissible limit** T≦6 / ≦0.3 mm / ≦0.6 mm T>6 / ≦0.5 mm / ≦0.8 mm *: Under cut which depth is under the control limit is permitted in case of its hole length is within 90% of butt welded joint length in any stress members, or within 80% of all other welded joint length. **: Under cut which depth is under the permissible limit is not permitted.		
Piping porosity	Piping porosity acceptance is shown in Table 1-2. Table1-2 Joint type / Number of piping porosity Butt joint, T joint or corner joint of the principal member / Not permitted All other groove / ≦3:the number of piping porosity in each joint or in any 1000mm length of weld, provide that if the diameter of piping porosity is ≦1mmΦ, 3 piping porosities is regarded as 1 piping porosity.		
Crater	All craters shall be filled to the full cross section of the weld, except for the end of intermittent weld outside of their effective length		
Crack	Welds shall have no cracks.		
Reinforcement	Reinforcement acceptance is shown in Table 1-3 Table1-3 Thickness / Main structure of gate / Discharge pipe under pressure / Other main structure under pressure t≦12 mm / 3 mm / 2mm / 3 mm 12mm< t≦25 mm / 4 mm / 2.5mm / 3.5 mm t> 25 mm / 6 mm / 3mm / 4 mm		
Over lap	Over lap is not acceptable.		
Arc strike	Arc strike is not acceptable.		
Under run	A fillet weld in any single continuous weld shall be permitted to underrun the nominal fillet size, provided that the undersize portion (-1mm) of the weld does not exceed 10% of the length of the weld except 50mm at the both ends of the weld.		

INSPECTION REPORT FOR DRY FILM THICKNESS									
Particular	Side Guide of Bonnet (Control Gate)								
Measuring time	After completion of final painting (Final Coal tar Epoxy Resin Paint) at shop								
Measuring date/month/year									
Portion	Submerged	Specified thickness		320 µm	Minimum thickness		224 µm		
Total Painting Area/Length	1.78 m	Need to Inspection		8 point	Activity Inspection		8 point		
Result	Minimum thickness		In-house	µm		Witness	µm		
	Average of thickness		In-house	µm		Witness	µm		

Measuring Point

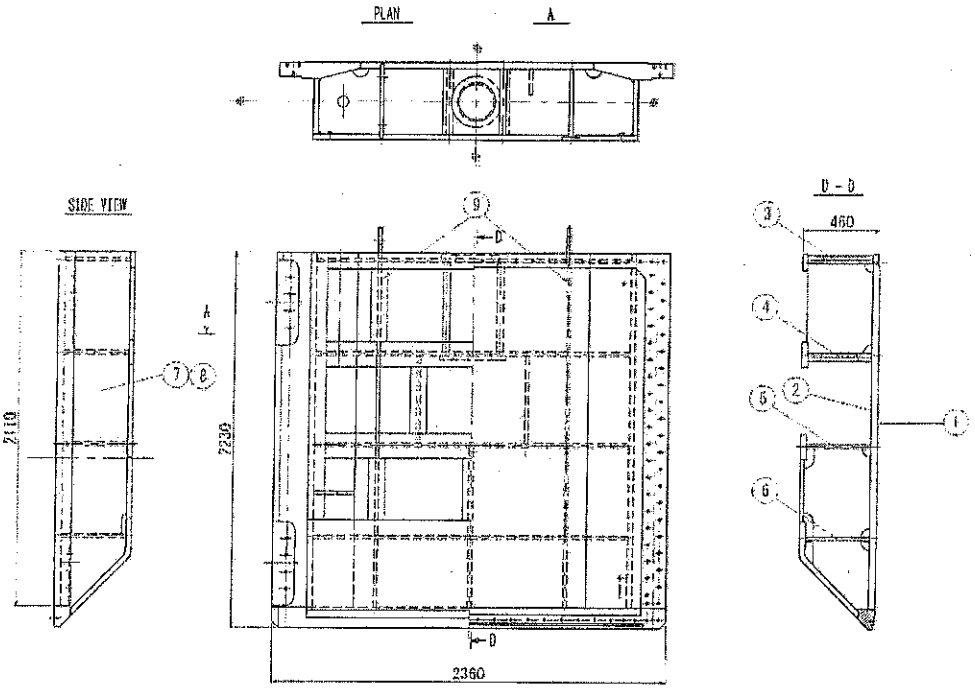


Data — Unit: µm

Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Side Guide of Bonnet (Left Bank Side)	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
②	Side Guide of Bonnet (Right Bank Side)	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												

INSPECTION REPORT FOR DRY FILM THICKNESS									
Particular	Gate Leaf (Control Gate)								
Measuring time	After completion of final painting (Final Coal tar Epoxy Resin Paint) at shop								
Measuring date/month/year									
Portion	Submerged	Specified thickness		320 μm		Minimum thickness		224 μm	
Total Painting Area/Length	29.1 m^2	Need to Inspection		60 point		Activity Inspection		60 point	
Result	Minimum thickness		In-house		μm	Witness		μm	
	Average of thickness		In-house		μm	Witness		μm	

Measuring Point



Data

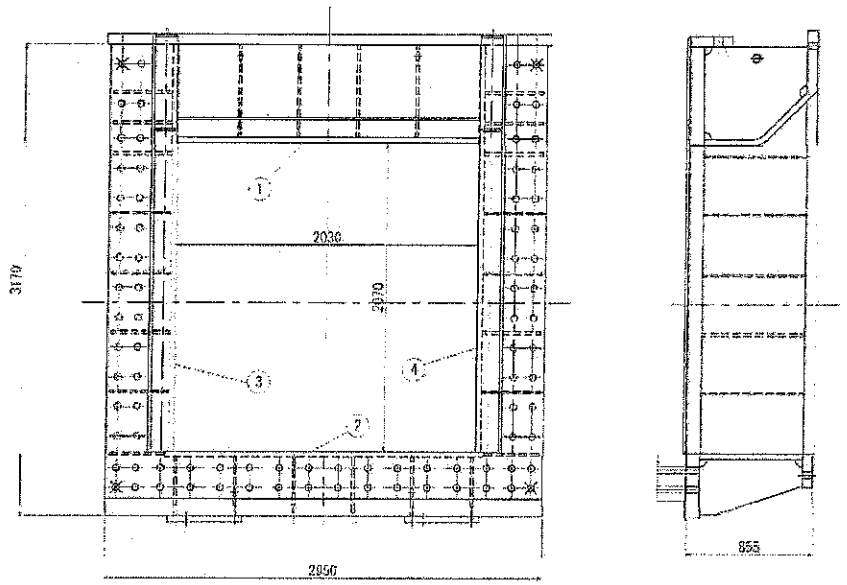
Unit: μm

Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Skin Plate (Downstream Side)	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
②	Skin Plate (Upstream Side)	1												
		2												
		3												
		4												
		5												
		6												

Data													Unit: μm
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
③	Main Beam (Upper Beam)	1												
		2												
		3												
		4												
		5												
		6												
④	Main Beam (2'nd Beam)	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
⑤	Main Girder (3'rd Beam)	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
⑥	Main Girder (Bottom Beam)	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
⑦	Side Beam (Left Bank Side)	1												
		2												
		3												
		4												
⑧	Side Beam (Right Bank Side)	1												
		2												
		3												
		4												
⑨	Vertical Beam	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												

INSPECTION REPORT FOR DRY FILM THICKNESS						
Particular	Casing of Downstream Side (Control Gate)					
Measuring time	After completion of final painting (Final Coal tar Epoxy Resin Paint) at shop					
Measuring date/month/year						
Portion	Submerged	Specified thickness	320 μm	Minimum thickness	224 μm	
Total Painting Area/Length	8 m^2	Need to Inspection	16 point	Activity Inspection	16 point	
Result	Minimum thickness	In-house	μm	Witness	μm	
	Average of thickness	In-house	μm	Witness	μm	

Measuring Point



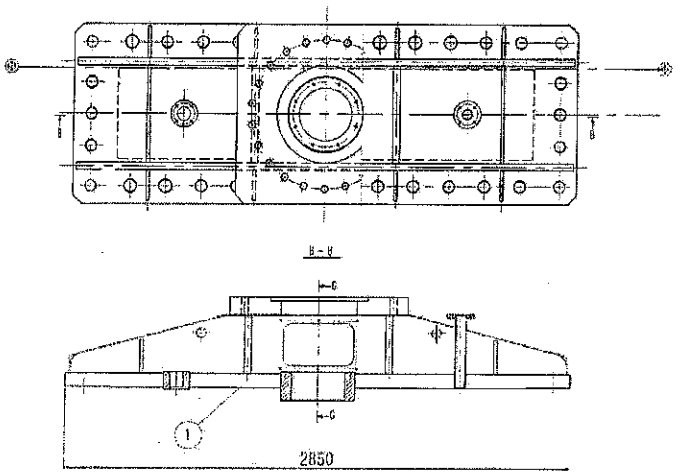
Data — Unit: μm

Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Surface submerged in water (Top)	1												
		2												
		3												
		4												
②	Surface submerged in water (Bottom)	1												
		2												
		3												
		4												
③	Surface submerged in water (Left)	1												
		2												
		3												
		4												
④	Surface submerged in water (Right)	1												
		2												
		3												
		4												

Data														Unit: μm
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
②	Surface submerged in water (Downstream Side)	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
		9												
		10												
		11												
		12												
		13												
④	Surface submerged in water (Left)	1												
		2												
		3												
		4												
④	Surface submerged in water (Right)	1												
		2												
		3												
		4												

INSPECTION REPORT FOR DRY FILM THICKNESS								
Particular	Bonnet Cover (Control Gate)							
Measuring time	After completion of final painting (Final Coal tar Epoxy Resin Paint) at shop							
Measuring date/month/year								
Portion	Submerged	Specified thickness	320 μm	Minimum thickness	224 μm			
Total Painting Area/Length	2.8 m^2	Need to Inspection	6 point	Activity Inspection	6 point			
Result	Minimum thickness	In-house	μm	Witness	μm			
	Average of thickness	In-house	μm	Witness	μm			

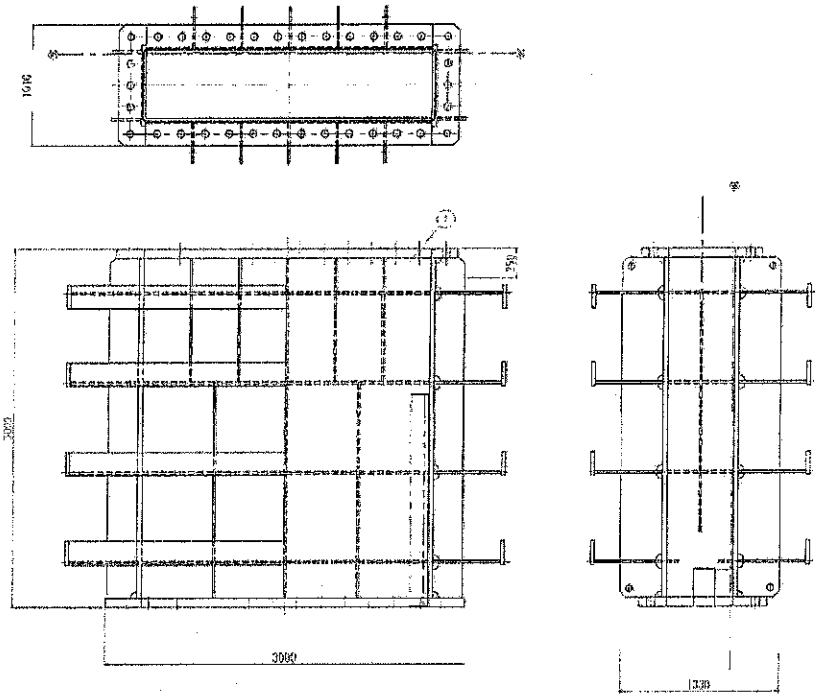
Measuring Point



Data												Unit: μm
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Surface submerged in water	1												
		2												
		3												
		4												
		5												
		6												

INSPECTION REPORT FOR DRY FILM THICKNESS						
Particular	Bonnet (Control Gate)					
Measuring time	After completion of final painting (Final Epoxy Resin Paint) at shop					
Measuring date/month/year						
Portion	Exposed	Specified thickness	200 µm	Minimum thickness	140 µm	
Total Painting Area	4.8 m²	Need to Inspection	10 point	Activity Inspection	10 point	
Result	Minimum thickness	In-house	µm	Witness	µm	
	Average of thickness	In-house	µm	Witness	µm	

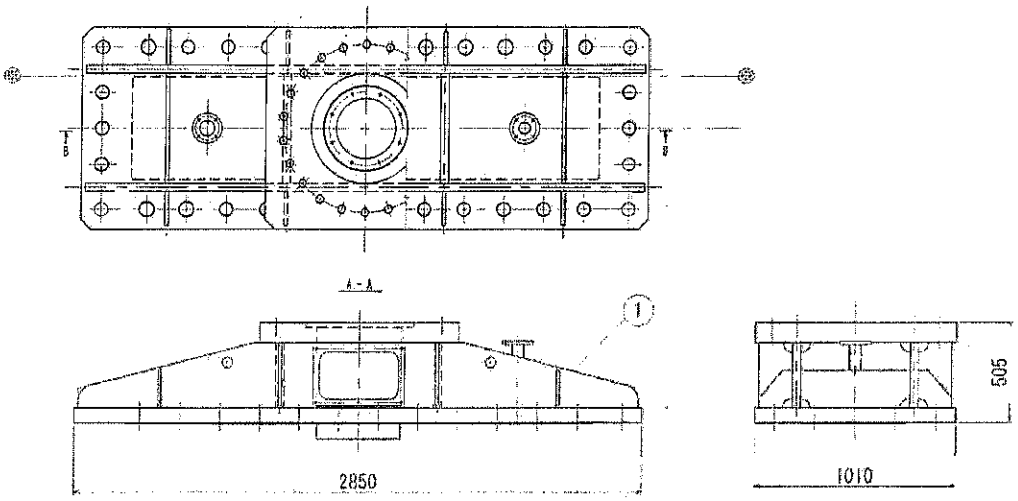
Measuring Point



Data											Unit: µm	
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Exposed surface	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
		9												
		10												

INSPECTION REPORT FOR DRY FILM THICKNESS						
Particular	Bonnet Cover (Control Gate)					
Measuring time	After completion of final painting (Final Epoxy Resin Paint) at shop					
Measuring date/month/year						
Portion	Exposed	Specified thickness	200 µm	Minimum thickness	140 µm	
Total Painting Area	8.7 m²	Need to Inspection	18 point	Activity Inspection	18 point	
Result	Minimum thickness	In-house	µm	Witness	µm	
	Average of thickness	In-house	µm	Witness	µm	

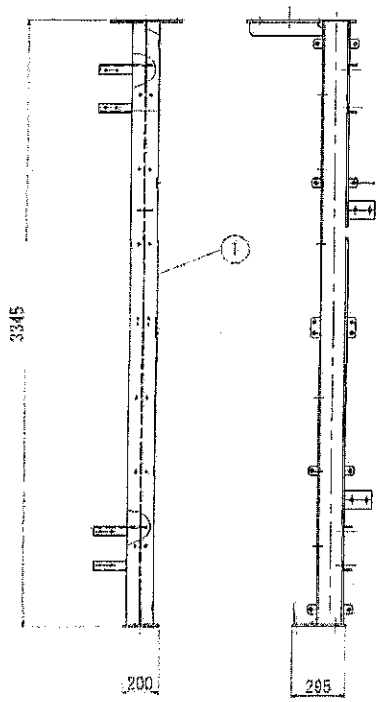
Measuring Point



Data												Unit: µm	
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Exposed surface	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
		9												
		10												
		11												
		12												
		13												
		14												
		15												
		16												
		17												
		18												

INSPECTION REPORT FOR DRY FILM THICKNESS									
Particular	Indicator (Control Gate)								
Measuring time	After completion of final painting (Final Epoxy Resin Paint) at shop								
Measuring date/month/year									
Portion	Exposed	Specified thickness		200 μm		Minimum thickness		140 μm	
Total Painting Area	4.4 m^2	Need to Inspection		10 point		Activity Inspection		10 point	
Result	Minimum thickness		In-house		μm	Witness		μm	
	Average of thickness		In-house		μm	Witness		μm	

Measuring Point



Data												Unit: μm	
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Exposed surface	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
		9												
		10												

Test and Inspection procedure of Hydraulic Cylinder at shop for Control Gate

CONTENTS

1. GENERAL

This procedure is applied to the shop inspections and tests for Hydraulic Cylinder of Control Gate, for Hushan Reservoir Raw Water Pipeline II Engineering Project "湖山水庫第二原水管工程 ".

1.1 Standards and/or codes

The shop inspections and tests are performed in accordance with the following standards and/or codes.

The shop inspection is performed in accordance with the following standards and/or codes.

1) The technical specification for this project	
2) CNS	Chinese National Standards (Taiwan)
3) AISC	American Institute of Steel Construction
4) ASTM	American Society of Testing and Materials
5) ANSI	American National Standards Institute
6) ASME	American Society of Mechanical Engineers
7) AWS	American Welding Society
8) EN	European Standards
9) BS	British Standards
10)DIN	Deutsche Industrial Norman
11)JIS	Japanese Industrial Standards
12) Technical Standards for Gate and Penstock	Electric Power Civil Engineering Association, Japan
13)JSSC	Japanese Society of Steel Construction
17)Dam and Weir Technical Standards	Japan Association of Dam & Weir Equipment Engineering
18)Dam and Weir Inspection Essentials	Japan Association of Dam & Weir Equipment Engineering

The methods and criteria of the shop inspections and tests conform to the above and/or equivalent Standards approved by the Owner in advance.

1.2 Reports for submission

Reports for submission are as follows.

1) Material test and inspection report (Material lists and mill certificates for principal members)
2) Welding test and inspection report (Non Destructive Test report)
3) Shop assembly inspection report and functional test report
4) Painting inspection reports (Dry film thickness reports)
5) Certificates and/or test reports for purchased products

2. MATERIAL TEST AND INSPECTION for HYDRAULIC CYLINDER

2.1 Confirmation of Material

All materials used for this project conform to JIS or equivalent Standards approved by the Owner in advance.

Their conformance with the specification is checked on certificated mill test report (Material Certificate).

2.2 Chemical Composition

The chemical composition of raw materials is checked on the Material Certificate.

2.3 Mechanical Properties

The mechanical properties of raw materials are checked on the Material Certificate.

2.4 Material Certificate

The following material certificates of principal component are to be prepared and submitted;

Table 2-1 Object component of material

Item	Principal component
Hydraulic Cylinder	Hydraulic cylinder tube , piston rod, piston, lock nuts, tube flange and head and cap cover

2.5 Non Destructive Test

Material for cylinder rod is to be carried out NDT (UT) if the material is forgings.

3. WELDING TEST AND INSPECTION

3.1 Visual Inspection

-Excess weld metal, leg length and throat thickness
-Undercut
-Pit on bead surface
-Overlap
-Boxing and build-up welding
-Crack

Acceptance Criteria of Welding is shown in Table 3-1.

Table 3-1 Acceptance Criteria of Welding

Item	Criteria
Excess weld metal, leg length and throat thickness	Conform to Table 3-2
Undercut	Conform to Table 3-3
Pit on bead surface	a) Pit on butt welds, T-joint consisting a cross section, or corner joint is not allowed for principal member. b) Except above Clause a), (3-pits or less / each joint) and (3-pits or less / m of joint length) are allowed. When the size of the pit is 1.0 mm or smaller, 3-pits are considered as 1-pit for these criteria.
Overlap	Overlap is not allowed.
Boxing and build-up welding	a) Boxing shall be done for the ends of fillet joints. For the portion where boxing is not possible, return welding shall be applied. b) Defect like lack of build-up welding is not allowed on the end of butt joints.
Crack	Crack is not allowed on and around bead. Any suspicious portion shall be checked with non-destructive test.

Table 3-2 Tolerance of Excess Weld Metal, Leg Length and Throat Thickness

Item	Condition	Tolerance
Height of excess metal of butt weld	For plate thickness(mm) $t \leq 12$ $12 < t \leq 25$ $25 < t$	 3.0 mm (max) 4.0 mm (max) 6.0 mm (max)
Leg length and throat thickness of fillet weld	In relation to 10% of the length except for 50 mm from both edges of a weld line	Within -1.0mm

Table 3-3 Tolerance of Undercut

Plate thickness (mm)	Standard allowance	Maximum allowance
$t \leq 6$ $t > 6$	0.3mm 0.5mm	0.6mm 0.8mm
Note	Acceptable for butt joint of principle component members when 90% of the weld line is within the above ranges, and for other joint 80%.	Undercut deeper than the above shall be repaired.

2. 准予驗收合格。

3.2 Non Destructive Test (Radiographic Test : RT)

The full penetration butt-welding joint on the cylinder tube shall be inspected by Radiographic Test.

1) General

Radiographic test (RT) is performed to the butt welds. Radiographic test is in accordance with JIS Z 3104.

All defects exceed the criteria are removed and repaired. The replacement weld and contiguous parts to the original weld are retested.

2) Radiographic Test Lengths

Radiographic Test Lengths are 100% of the full penetration butt-welding length.

3) Radiographic test Photographing method

The arrangement of identification marks on radiograph films is shown on Figure 5-1.

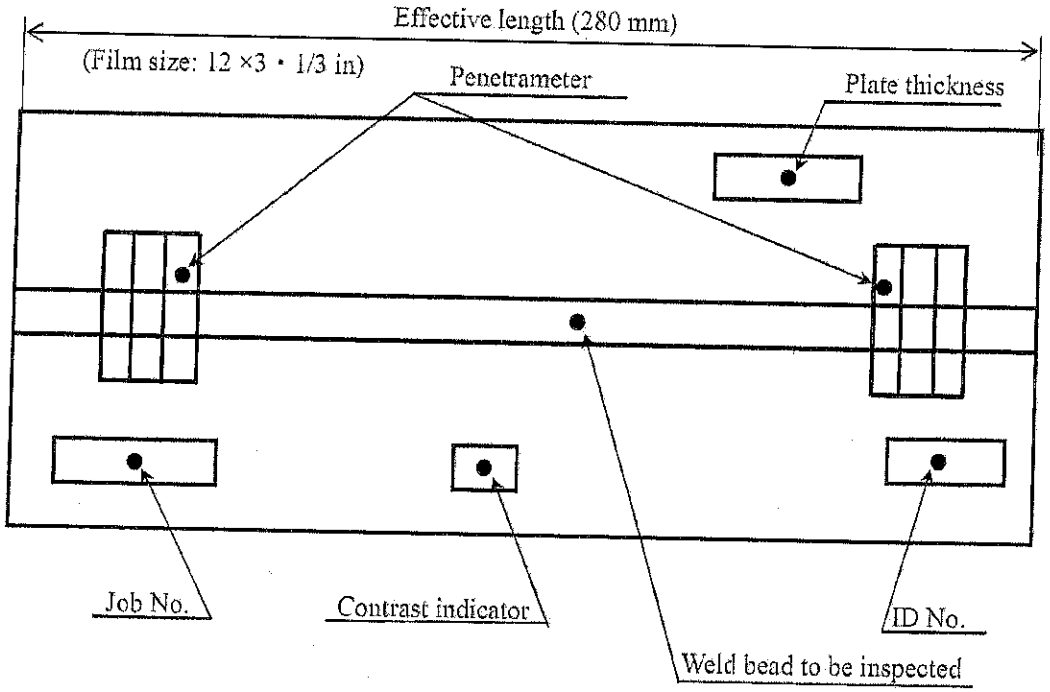


Figure 3-1 Arrangement of identification marks

4) Radiographic test Acceptance Criteria

Radiographic test classification is in accordance with JIS Z 3104 "Methods of Radiographic Test and Classification of Radiographs for Steel Welds"

Acceptance criteria for radiographic test are shown in Table 3-4.

Table 3-4 Acceptance Criteria for Radiographic Test

Type of flaw	Thickness of base metal $t \leq 50$mm	$50 < t$
Non-Flaw	Acceptable	Acceptable
Type-1	Class-2 or more	Class-1
Type-2	Class-2 or more	Class-1
Existing Type-1 and 2	Class-2 or more	Class-2 or more
Type-3 and 4	Reject	Reject

4. TEST AND INSPECTION OF HYDRAULIC CYLINDER

The quality, dimension and specified function of the hydraulic Cylinder is checked and confirmed.
Test and Inspection Method and Acceptance Criteria are shown in Table 4-1.

Table 4-1 Test and Inspection Method and Acceptance Criteria

No.	Part	Item	Method and Criteria
1	Hydraulic cylinder	Material	- Material Certificate
		Visual	- As shown in drawing
		Dimension and tolerance	- As shown in drawing - Tolerance of Cylinder length ±3.0 mm - Tolerance of Cylinder length from Cap end to cylinder rod at most contraction ±3.0 mm - Stroke ±3.0 mm - Cylinder rod diameter See Table 4-2 - Cylinder tube outside diameter ±0.8 mm - Cylinder tube inside diameter See Table 4-3
		Pressure proof test	- Not permit any outer leakage (testing condition: 1.5 × design pres. /2 min.) Not permit any deformation during pressure proof test
		Inner Leakage test	- Testing condition: 1.0× design pres. /10 min. Acceptance criteria to be informed after detail design of cylinders
		Operation test (No loading condition)	- Not permit any vibration and noise during operation. - Not permit any outer leakage during operation - Measurement of lowest operating pressure See Table 4-4
		Coating of Piston Rod	-Hard chromium plating Required plating thickness 50 μ m×2 layer
		Function Test of Dogging Device	-Confirmation of Dogging Device Function
2	Paint Material for cylinders	Material	- Check of inspection certificate by manufacturer

Table 4-2 Diameter of Piston Rod

Unit: mm

Rod Diameter	tolerance of finish dimensions	Circularity & Cylindricality
63, 80	−0.030, −0.076	0.046
100, 120	−0.036, −0.090	0.054
140, 160, 180	−0.043, −0.106	0.063
more than 180, not less than 250	−0.050, −0.122	0.072
more than 250, not less than 315	−0.056, −0.137	0.081

Table 4-3 Inside Diameter of Cylinder Tube

Unit: mm

Inside Diameter of Cylinder Tube	Case of using seal other than piston ring	
	tolerance of finish dimensions	Circularity & Cylindricality
180	+0.100, 0	0.100
more than 200, not more than 250	+0.115, 0	0.115
more than 250, not more than 300	+0.130, 0	0.130
more than 300, not more than 400	+0.140, 0	0.140
more than 400, not more than 500	+0.155, 0	0.155
more than 500, not more than 600	+0.175, 0	0.175

Table 4-4 Lowest operation pressure

[Unit :MPa]

Shape of Piston packing	Nominal pressure	In case that rod packing is not V-packing		In case that rod packing is V-packing	
		The pressure is supplied from the cap side.	The pressure is supplied from the head side.	The pressure is supplied from the cap side.	The pressure is supplied from the head side.
V	7	0.5	0.98	0.74	1.5
	14	Rated Pressure ×6%	Rated Pressure ×12%	Rated Pressure ×9%	Rated Pressure ×18%
	21				
U, O	7	0.29	0.59	0.44	0.9
	14	Rated Pressure ×4%	Rated Pressure ×8%	Rated Pressure ×6%	Rated Pressure ×12%
	21				

5. PAINTING INSPECTION

5.1 Surface Preparation Inspection

Blast cleaned surface is checked in accordance with SSPC-SP10 (ISO 8501-1, Sa 2 1/2), before shop primer painting at the steel mill shop or manufacture shop.

5.2. Visual Inspection

The criteria of visual inspection for painting are as follows:

1) Painted surface shall be smooth and free from unevenness (For instance, no remarkable run nor blister).
2) Prime or preceding painted layer shall not be seen through.
3) Hue and gloss shall be identical to the designated color.

5.3 Dry Film Thickness Inspection

After surface preparation, following paints are applied;

① Epoxy Zinc Rich Primer after surface preparation within 4 hours (Dry film thickness 50 μ m)
② Epoxy Resin Paint (Dry film thickness 45 μ m × 2 layer)
③ Epoxy Resin Paint (Dry film thickness 30 μ m × 2 layer)

Total dry film thickness: 200 μ m

The painted surface of cylinder is inspected for two inspection units per square meter of coating area, but at least three inspection units or more.

中英對照表

封面

Test and Inspection Procedure at Shop for Control Gate Dimensional, Welding, Painting and Assembly Inspection	閘閥室控制閘門之尺寸、電銲、塗裝及組配之工廠測試及檢驗程序書

目錄

P.1

GENERAL	概述
This procedure is applied to the shop inspection for Control Gate of the project for Hushan Reservoir Raw Water	本程序書適用於湖山水庫第二原水管工程之閘閥室控制閘門之工廠測試及檢驗

Pipeline II Engineering Project "湖山水庫第二原水管工程 ".	
Standards and/or codes	標準 和/或 代碼
The shop inspection is performed in accordance with the following standards and/or codes.	工廠測試及檢驗按照以下標準和/或代碼進行。
The technical specification of this project	本計畫之技術規範
CNS Chinese National Standards (Taiwan)	中國國家標準
AISC American Institute of Steel Construction	美國鋼結構學會
ASTM American Society of Testing and Materials	美國材料試驗協會
ANSI American National Standards Institute	美國國家標準學會
ASME American Society of Mechanical Engineers	美國機械工程師協會
AWS American Welding Society	美國焊接協會
EN European Standards	歐洲規範
BS British Standards	英國國家標準
DIN Deutsche Industrial Norman	德國標準協會
JIS Japanese Industrial Standards	JIS： 日本工業標準
Technical Standards for Gate and Penstock Electric Power Civil Engineering Association, Japan	社團法人電力土木技術協會(原日本水門鐵管協會)－ 水門鐵管技術基準
JSSC Japanese Society of Steel Construction	日本鋼構造協會
Dam and Weir Technical Standards Japan Association of Dam & Weir	堰壩技術標準－日本堰壩施設工程協會

Equipment Engineering	
Dam and Weir Inspection Essentials Japan Association of Dam & Weir Equipment Engineering	堰壩檢查要領－日本堰壩施設工程協會
Reports for submission	提交報告
Reports for submission are as follows:	提交報告如下
1) Material test report (Material lists and mill certificates for principal members)	材料測試報告（材料清單和主要構件之材質證明）
2) Welding test report (Non Destructive Test report)	電銲測試報告(非破壞檢驗報告)
3) Shop assembly inspection report (Including operation test reports)	工廠組立檢驗報告(包括功能測試報告)
4) Painting inspection reports (Dry film thickness reports)	油漆檢驗報告(乾膜厚度檢驗報告)
5) Certificates and/or test reports for purchased products	市購品之證明書及測試報告

P.2

SCOPE OF TEST AND INSPECTION	測試及檢驗範圍
Scope of Test and Inspection	測試及檢驗範圍
Test and inspection are performed in accordance with the item and category as indicated in the following Table 2-1.	本工廠檢驗程序書依據下列類別及項目表實施
Table 2-1 Scope of test and inspection	測試及檢驗範圍
Description	說明
Material inspection	材料檢驗
Welding inspection	電銲檢驗
Visual check	目視檢查
Non destructive test	非破壞檢驗
Shop assembly	工廠預組
Dimension inspection	尺寸檢驗
Water Pressure test	水壓試驗
Leakage test	滲漏試驗
Operation test	操作測試
Painting inspection	油漆檢驗
Dry film thickness inspection	乾膜厚度檢驗

Control Gate	控制閘門
Mark [◎] is witnessed by the inspector.	標示[◎]者須經檢驗人員見證。
Mark [○] is carried out by ourselves and test reports are submitted.	標示[○]者於此報告送審後，由我方執行。
Mark [ ] is carried out by ourselves and/or witnessed by the inspector.	標示[ ]者須經檢驗人員見證後，由我方執行。
※Operation test is performed at manufacture's factory.	操作測試於製造工廠實施。
The Inspector means The Employer or third party inspector	檢驗人員意指業主或第三機構檢查人員
Third party: JAPAN INSPECTION CO., LTD	第三機構：日本檢查株式會社
Schedule of Test and Inspection	測試及檢驗日程
The plan of Test and inspection schedule is shown in the following Table 2-2.	測試及檢驗日程如下表 2-2 所列。
Table 2-2 Test and Inspection Schedule	測試及檢驗日程
Test and Inspection	測試及檢驗
Material Inspection	材料檢驗
Equipment Inspection and Test	設備檢驗及測試
Shop Assembly Inspection and test	工廠預組檢測
Welding Inspection	電焊檢驗
Painting Inspection	油漆檢驗
PLAN	日程
Mar.2019	2019 年 3 月
Jul.2019	2019 年 7 月
Nov.2019	2019 年 11 月
Dec.2019	2019 年 12 月
ditto	同上
Object	標的物
Main Material Steel Plate	主構件鋼板
Hydraulic Cylinder	油壓缸
Hydraulic Unit	
Control Gate	控制閘門

P.3

Time Schedule for Oversea Inspection	海外檢驗預定時程表
Draft Time Schedule for Oversea	海外檢驗預定時程表如下列表 2-3 所

Inspection of shop assembly is shown in the following Table	示。
In shop inspection, the following two gates are inspected simultaneously.	工廠檢驗：下列 2 門須同步檢驗
Control Gate	控制閘門
Guard Gate	防護閘門
Time Schedule	時程
time	時間
item	項目
Introduction	簡介
Non destructive test	非破壞檢驗
Lunch time	午餐時間
Dimension Inspection	尺寸檢查
Painting Inspection	油漆檢查
Meeting	會議
note	附註
Include the confirmation of previous inspection	包含前所檢驗之確認
Test	測試
item	項目
Introduction	簡介
Water Pressure Test	水壓測試
Preparation and Cleaning	預備及清理
Lunch time	午餐時間
Operation Test	操作測試
Meeting	會議
note	附註
Water will be filled in the Gate during the night	水於夜間注入閘門
Details are to be submitted later.	細節將在稍後提交。

P.4

MATERIAL INSPECTION	材料檢驗
Certificated mill test reports	材料證明及測試報告
All materials used in this project are in conformity with JIS or equivalent standards.	本計畫所採用材料須符合 JIS 標準或同等標準。

Their conformance with the specification is checked on certificated mill test reports.	依據材料證明及檢驗報告檢查是否符合規範。
Main components and equipment is shown in table 3-1	主要構件及設備如表 3-1 所示。
Table 3-1 Main Component and Equipment	主要構件及設備
Equipment	設備
Component	組件
Material	材料
JIS or other Standards	JIS 標準或其他標準
Casing	門框
Connecting Flange	連結法蘭
Beam	橫樑
Casing Body	門框本體
Sliding Plate	滑動鈑
Bonnet	閘箱
Connecting Flange	連結法蘭
Body	本體
Beam	橫樑
Sliding Plate	滑動鈑
Bonnet Cover	閘箱帽蓋
Connecting Flange	連結法蘭
Rib	肋條
Boss	凸面；輪鼓
Bush	軸襯
Gate Leaf	閘門門扉
Skin Plate	面鈑
Beam	橫樑
Seal Plate	水封鈑
Rubber Seal	橡膠水封
Hoist	吊門機
Cylinder Tube	油壓缸管
Rod	昇桿
Chemical Composition	化學成分
The chemical composition of raw materials is checked on the mill sheet	原材料之化學成份須依據材料表(材料證明)檢查。

(Mill Certificate).	
Mechanical Properties	機械性能
The mechanical properties of raw materials are checked on the mill sheets (Mill Certificate).	原材料之機械性質須依據材料表(材料證明)檢查。

P.5

WELDING INSPECTION	電焊檢驗
All welds are inspected in accordance with the following methods. The specified welds are inspected by Non Destructive Test.	所有焊道須依據下列方式檢驗.所規定之焊道須以"非破壞檢驗"方式檢驗。
Visual inspection	目視檢查
All welds are visually inspected in accordance with Technical Standards for Gate and Penstock. Welds are acceptable to the following visual inspection using the gauge.	所有焊道須依據水門鐵管技術基準檢驗；利用儀錶目視檢查下列各項研判焊道是否合格。
Visual inspection acceptance of weld profiles is shown in Table 4-1.	目視檢查焊道是否合格，其描述如下表 4-1 所示。
Acceptance of weld profiles	焊道合格之描述
Item	項目
Undercut	凹陷
Piping porosity	管狀氣孔
Crater	坑洞
Crack	裂痕
Reinforcement	補強電焊
Over lap	重搭
Arc strike	弧擊
Underrun	通過標準
Acceptance	合格標準
Undercut acceptance is shown in Table 4-2.	焊道凹陷合格標準如表 4-2
Piping porosity acceptance is shown in Table 4-3.	氣孔合格標準如表 4-3
All craters shall be filled to the full cross section of the weld, except for the end of	除外部跳焊末端有效長度外，所有坑洞須填滿至焊道橫斷面所示。

intermittent weld outside of their effective length	
Welds shall have no cracks.	焊道不得有裂痕
Reinforcement acceptance is shown in Table 4-4.	補強電焊合格標準如表 4-4
Over lap is not acceptable.	焊道不得重搭
Arc strike is not acceptable.	焊道不得弧擊
A filet weld in any single continuous weld shall be permitted to underrun the nominal fillet size, provided that the undersize portion (-1mm) of the weld does not exceed 10% of the length of the weld except 50mm at the both ends of the weld.	任何單一連續焊接之填角焊須符合公稱尺寸之通過標準，所提供焊道不足部位(少於 1mm)不得超過 10%之焊道長度，其兩端 50mm 範圍除外。
Acceptable value on undercut	焊道凹陷合格標準
Thickness	厚度
Control limit	控制極限
Permissible limit	容許極限
Undercut which depth is under the control limit is permitted in case of its hole length is within 90% of butt welded joint length in any stress members, or within 80% of all other welded joint length.	任何承受應力桿件若其孔長在對焊焊道長度 90%以內或焊道全長之 80%，凹陷深度在控制極限以下是被允許的。
Undercut which depth is under the permissible limit is not permitted.	凹陷其深度在容許極限以下是不被允許的。
Acceptable value on piping porosity	管狀氣孔之合格標準
Joint type	焊道型式
Butt joint, T joint or corner joint of the principal member	主構件之對焊、T 形焊道或角隅焊道
All other groove	其他型式開槽
Number of piping porosity	管狀氣孔數量
Not permitted	不允許
≦3:the number of piping porosity in each joint or in any 1000mm length of weld, provide that if the diameter of piping porosity is ≦1mmΦ, 3 piping porosities is regarded as 1 piping	少於 3 個：每一焊道或任何 1000mm 長焊道其管狀氣孔直徑≦1mmΦ 者，3 個管狀氣孔被視為 1 個管狀氣孔

porosity.	

P.6

Acceptable value on reinforcement of weld	補強電焊之合格標準
Thickness	厚度
Main structure of gate	閘門主結構
Discharge pipe under pressure	壓力下之排水管
Other main structure under pressure	壓力下其他閘門主結構
Non Destructive Test	非破壞檢驗
General	總則
Radiographic test (RT) is performed on full penetration butt weld joints.	放射線檢驗(RT)在全滲透對接焊縫上執行
Ultrasonic test (UT) is also performed on full penetration butt weld joints.	超音波檢驗(UT)在全滲透對接焊縫上執行
Liquid Penetrant test (PT) is performed on all welds on Gate leaf, Seal Seats of Casing and Side Guide including Siding Plate of Bonnet.	對門扉及門框之所有銲接縫均需辦理滲透液探傷檢驗法（PT）檢驗。
Non Destructive test is conducted by the engineer who has the qualification of the level 2 or 3.	非破壞檢驗執行工程師須具有第 2 級或第 3 級水準之資格。
Radiographic test is in accordance with JIS Z 3104.	放射線檢驗須依據 JIS Z 3104 規範實施。
Ultrasonic test is in accordance with JIS Z 3060.	超音波檢驗須依據 JIS Z 3060 規範實施。
Liquid Penetrant test is in accordance with JIS Z2343.	
All defects observed are removed and repaired. The replacement weld and contiguous parts to the original weld are retested.	所有被查獲之瑕疵須消除及修繕。原焊道從新電焊及鄰近部位須再檢驗。
Examination ratio	檢驗率
Examination ratio of RT and UT	
The examination ratios are shown in Table 4-5.	檢驗率如下表 4-5 所示：，
Table4-5 Examination ratios of RT and UT	表 4-5 RT 和 UT 的檢驗比率

Items	項目
Full Penetration Butt weld	全滲透對接焊縫
RT	放射線檢驗
UT	超音波檢驗
Control Gate	控制閘門
above 20%	20%以上
Remarks	附註
RT is applicable to the plate thickness less than 50mm basically.	基本上 RT 放射線檢驗適用於鈑厚小於 50mm 者
UT is applicable to the plate thickness more than 50mm basically or the portion where RT is impossible.	基本上 UT 超音波檢驗適用於鈑厚大於 50mm 者或 RT 放射線檢驗無法執行部位。
RT has priority over UT.	RT 優先於 UT。
RT is relatively easy to apply. Most of defects such as cracks, blowhole, incomplete fusion, slag inclusion, and incomplete penetration may easily be detected. This RT is basically employed in this project.	RT 相對容易應用。 可以容易地檢測到大多數缺陷，例如裂縫，氣孔，不完全熔合，夾渣和不完全滲透。 該 RT 基本上用於該項目。

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Examination ratio of PT	PT 的檢查比率
The examination ratio of PT is shown in Table 4-6.	PT 的檢查比率如表 4-6 所示。
All welds on Gate leaf, Seal Seat of Casing and Side Guide incl. Siding Plate of Bonnet	門扉上的所有焊縫，套管密封座和側導板包括。 帽子側板
Control Gate	控制閘門
Object for NDT	非破壞檢驗之標的
Full Penetration butt welds on Gate leaf, Bonnet and Upstream side Casing	在門扉，閥蓋和上游側套管上的全滲透對接焊縫
Object for PT	施作 PT 的構件
All welds on Gate leaf	門扉上的所有焊縫
All welds on Seal Seats of Casing (Gate frame)	密封座（門框）上的所有焊縫
All welds on Side Guide and Siding Plate of Bonnet (Gate frame)	閥蓋側導板和側板上的所有焊縫（門框）

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Execution engineer's qualification	執行檢驗工程師之資格
Engineer's qualification is below,	工程師之資格如下所列：

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Radiographic examination	放射線檢驗
Photographing method	放射線檢驗方法
The arrangement of identification marks on radiograph films is shown in Figure 4-1.	攝影膠片上識別碼之安排如示意圖 Figure 4-1.
Effective length	有效長度
Film size:	膠片規格
Penetrate meter	滲透儀
Plate thickness	鈑厚
Job No.	工作編號
Contrast indicator	對比指示器
Weld bead to be inspected	需檢驗之焊道
ID No.	識別號碼
Figure 4-1 Arrangement of identification marks	圖 4-1 識別標記的排列
Acceptance Criteria	接受準則
Radiographic classification is in accordance with JIS Z 3104 [Methods of radiographic examination for welded joints in steel]. Then acceptance is shown in Table 4-6.	放射線檢驗依據 JIS Z 3104[鋼材焊道放射線檢驗方法]分類，接受標準如 4-6 表所示。
Acceptance in the radiographic examination	放射線檢驗標準
Kind of flaw	缺陷種類
Flaw of class 1	缺陷分類
Combined flaws of class 1 with class 2	第 1 級及第 2 級缺陷之組合
Acceptance	接受
Grade 2	第 2 級
Unacceptable	不接受

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Ultrasonic Test	超音波檢驗
Ultrasonic Test is in accordance with JIS Z 3060 [Method for ultrasonic examination for welds of ferritic steel].	超音波檢驗依據 JIS Z 3060[含鐵鋼材焊道超音波檢驗方法]實施
The acceptance is equal to or better than Class 2 when using L-disregard level.	當使用 L 無視等級時，接受等於或優於等級 2。
Classification of discontinuities according to region of echo height and indication length	根據回波高度和指示長度的區域對不連續性進行分類
Penetrant Test	滲透液檢驗
The liquid penetrant test method shall conform to the requirement of JIS Z 2343 "Non-destructive testing – Penetrant testing—".	液體滲透試驗方法應符合 JIS Z 2343"無損檢測 - 滲透液檢驗 -"的要求。
The acceptance is shown as follows;	驗收如下所示
Cracks are not allowed on and around weld bead.	焊縫上和周圍不允許出現裂縫。
Liner indications (independent or continuous) are not allowed on and around weld bead	焊縫上和周圍不允許有襯墊指示（獨立或連續）
Circular indication, which major axis over 2mm is not allowed on and around weld bead.	焊縫上和周圍不允許有長軸超過 2mm 的圓形指示。
Scattered indications is not allowed on and around weld bead.	焊縫上和周圍不允許有分散的跡象。

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SHOP ASSEMBLY INSPECTION	工廠組立檢驗
The gate equipments are assembled in the shop, and dimensional inspections and visual check on welds (see 4.1) are performed at manufacture's factories.	閘門設備於工廠預組，焊道之尺寸檢驗及目視檢查(見4.1節)在製造者工廠實施。
Shop assembly position	工廠組合部位
The gate is temporarily assembled in the installation position.	閘門於安裝位置預組。
Dimensional tolerances at shop assembly	工廠組合尺寸公差
Dimensional inspection is carried out for	所有設備必須執行尺寸檢查，其公差

all equipments, and tolerances are shown in Table 5-1. Detailed tolerances are shown in each check sheets.	如表5-1所示。詳細公差於各別檢查表標示。
Dimensional tolerances	尺寸公差
Gate	閘門
Symbol	符號
Point to be measured	量測點
Tolerance	公差
High Pressure Slide Gate	高壓滑動閘門
Gate leaf width (Left side)	閘門寬度(左側)
Gate leaf width (Right side)	閘門寬度(右側)
Gate leaf height	閘門高度
Gate leaf depth	閘門厚度
Distance between horizontal main beam	主橫梁之間
Skin plate thickness	面鈑厚度
Gate slot	閘門開槽
Casing height from gate center to bottom	閘門中心至門底之閘框高度
Casing height from gate center to top	閘門中心至門頂閘框高度
Bonnet cover height	閘箱帽蓋高度
Upstream side casing length	上游側閘框長度
Downstream side casing length	下游側閘框長度
Inside dimension of pipe width (upstream side)	管寬之內面尺寸(上游側)
Inside dimension of pipe height (upstream side)	管寬之內面尺寸(上游側)
Inside dimension of pipe width (downstream side)	管寬之內面尺寸(上游側)
Inside dimension of pipe height (downstream side)	管寬之內面尺寸(上游側)
Casing width	閘箱寬度
There is no tolerance on the reference standard. This tolerance is in house tolerance.	此公差並無參考標準，此公差為公司內部公差。
This tolerance based on JIS G 3193	此公差依據 JIS G 4304。
Hydraulic Test	水壓試驗
Test condition	試驗條件

The high pressure slide gate is tested under the following condition (See Table 5-2). In this case, the gate is confirmed that there is no leakage from metal joints and no permanent damage.	高壓滑動門門之測試條件如表5-2所示。在此條件下，確認閘門無滲漏且無永久的損壞。
Test pressure & holding time	水壓測試及持續時間
Design pressure	設計壓力
Test pressure	測試壓力
Holding time	持續時間
Hydraulic Test	水壓試驗
Design pressure	設計壓力
Test pressure	測試壓力

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Leakage volume	滲漏量
Acceptable leakage volume of water seals is 2 liters per minute.	容許滲漏量為 2 公升/分鐘。
Operation Test	操作測試
The operation test is performed at manufacture's factories.	操作測試於製造者工廠實施。
The operational performance of the gate is checked by the operation test.	閘門操作功能以操作測試來檢查。
Check items and criterion are shown in Table 5-3	檢查項目及準則如表 5-3 所示。
Check items and criterion on operation test（Gate）	閘門操作測試檢查項目及準則
Check items	檢查項目
Rated capacity	額定容量
Hoisting speed	吊門機啟閉速度
Voltage of electric motor	馬達電壓
Electric current of electric motor	馬達電流
Insulation value of motor	馬達絕緣值
Temperature rise of bearing, motor and reducer	馬達及減速機溫度昇高容忍度
Vibration	振動
Operation of limit switches	極限開關動作
Operation of gate position indicator	開度指示器運轉

Criterion	準則
Ambient temperature	周遭環境溫度
Abnormal vibration is not permitted	不得有異常振動
Normal	正常
Electric current and Insulation value of motor are to be added later.	稍後將添加電動機的電流和絕緣值。
PAINTING INSPECTION AT SHOP	工廠油漆檢查
The dry film thickness and appearance are inspected in accordance with Painting Specification.	根據塗漆規範檢查乾膜厚度和外觀。
Water seal seat, guide ledge, main wheel track seat, pressure seat, and other Gate Frame	水封座，導軌，主輪軌道座，壓力座和門框
The painted surface is inspected on four detection units per meter of length, and four test units still be inspected for less than one meter of member.	在構件塗漆表面每米長度需檢測四個點，不到一米的構件仍然需檢測四個點。
Object	物體
Side Guide of Bonnet	閥蓋側導架
Gate leaf and other related members	門扉和其他相關構件
The painted surface is inspected for two inspection units per square meter of coating area, and the deficiency still be tested on four inspection units.	塗漆表面每平方米檢查兩個點，不足部分仍需檢驗 4 個點。
Object	物體
Gate leaf	門扉
Surface submerged in water of Casing	浸沒在水中的構件(Casing)表面
Surface submerged in water of Bonnet except Side Guide	除了側導板外，浸沒在水中的構件(Bonnet)表面
Surface submerged in water of Bonnet Cover	浸沒在水中的構件(Bonnet Cover)表面

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Hoist and other members exposed to the air	暴露在空氣中的吊門機和其他構件
The painted surface is inspected for two inspection units per square meter of coating area, but at least three inspection	每平方米塗層區域檢查塗漆表面兩個檢查單元，但每個構件或每側至少檢查三個或更多檢查單元。

units or more inspected per member or per side.	
Object:	構件
Hoist	吊門機
Surface exposed to the air of Bonnet	暴露在空氣中的 Bonnet 表面
Surface exposed to the air of Bonnet Cover	暴露在空氣中的 Bonnet Cover 表面
Indicator	開度指示器
Details are shown in each check sheets.	詳細信息顯示在每張檢查表中。
Specified Thickness	規範漆膜厚度
Painting portion	油漆部位
For the surface submerged in water	浸於水中之表面
For the surface exposed to the air, including Hoist and etc.	對於暴露在空氣中的構件表面，包括吊門機等。
Specified Thickness	規範漆膜厚度
TEST FOR PURCHASED PRODUCTS	市購品測試
The purchased products which are hydraulic cylinder, hydraulic unit and position indicator are checked and confirmed to be good enough for use. Certificates and/or the test reports are submitted.	市購品如油壓缸、油壓單元及開度指示器須檢查確認其使用良好，證明書及測試報告已送審。

Test and Inspection procedure of Hydraulic Cylinder at shop for Control Gate

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Test and Inspection procedure of Hydraulic Cylinder at shop for Control Gate	閘閥室控制閘門油壓缸之工廠測試及檢驗程序書

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GENERAL	總則
Standards and/or codes	標準 和/或 代碼
Reports for submission	提交報告
MATERIAL TEST AND INSPECTION	材料試驗和檢驗
Confirmation of Material	材料核准
Chemical Composition	化學成分
Mechanical Properties	機械性能
Components to be tested	測試構件
Non Destructive Test	非破壞性檢驗
WELDING TEST AND INSPECTION	焊接試驗和檢驗
Visual inspection	目視檢驗
Non Destructive Test(RT)	非破壞性檢驗 (射線檢驗 ：RT)
TEST AND INSPECTION OF HYDRAULIC CYLINDER	油壓缸的試驗和檢驗
PAINTING INSPECTION	塗裝檢驗
Surface Preparation Inspection	表面處理檢驗
Visual Inspection	目視檢驗
Painting Film Thickness Inspection	塗裝厚度檢驗

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GENERAL	總則
This procedure is applied to the shop inspections and tests for Hydraulic Cylinder of Control Gate, for Hushan Reservoir Raw Water Pipeline II Engineering Project "湖山水庫第二原水管工程"	本程序書適用於"湖山水庫第二原水管工程"閘閥室控制閘門油壓缸之工廠檢驗。
Standards and/or codes	標準 和/或 代碼
The shop inspections and tests are performed in accordance with the	工廠測試及檢驗按照以下標準和/或代碼進行。

following standards and/or codes.	
The technical specification for this project	此工程之技術規範
Chinese National Standards (Taiwan)	中國國家標準
American Institute of Steel Construction	美國鋼結構學會
American Society of Testing and Materials	美國材料試驗協會
American National Standards Institute	美國國家標準學會
American Society of Mechanical Engineers	美國機械工程師協會
American Welding Society	美國焊接協會
European Standards	歐洲規範
British Standards	英國國家標準
Deutsche Industrial Norman	德國標準協會
Japanese Industrial Standards	日本工業標準
Technical Standards for Gate and Penstock Electric Power Civil Engineering Association, Japan	社團法人電力土木技術協會(原日本水門鐵管協會)－水門鐵管技術基準
Japanese Society of Steel Construction	日本鋼構造協會
Dam and Weir Technical Standards Japan Association of Dam & Weir Equipment Engineering	壩堰技術基準－日本壩堰設施技術協會
Dam and Weir Inspection Essentials Japan Association of Dam & Weir Equipment Engineering	壩堰技術基準－日本壩堰設施技術協會
The methods and criteria of the shop inspections and tests conform to the above and/or equivalent Standards approved by the Owner in advance.	工廠測試及檢驗之方法和標準符合業主事先批准的上述和/或同等標準。
Reports for submission	送審報告
Reports for submission are as follows.	送審報告如下
Material test and inspection report (Material lists and mill certificates for principal members)	材料試驗和檢驗報告（材料清單和主要構件之材質證明）
Welding test and inspection report (Non Destructive Test report)	焊接試驗和檢驗報告（非破壞檢驗報告）
Shop assembly inspection report and	工廠組立檢驗報告和功能測試報告

functional test report	
Painting inspection reports (Dry film thickness reports)	塗裝檢驗報告（乾膜厚度報告）
Certificates and/or test reports for purchased products	購買產品的證書和/或測試報告

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MATERIAL TEST AND INSPECTION for HYDRAULIC CYLINDER	油壓缸的材料試驗和檢驗
Confirmation of Material	確認材料
All materials used for this project conform to JIS or equivalent Standards approved by the Owner in advance.	本工程使用的材料均符合 JIS 或業主事先批准之同等標準。
Their conformance with the specification is checked on certificated mill test report (Material Certificate).	確認材料試驗報告（材質證明）符合規範的要求。
Chemical Composition	化學成分
The chemical composition of raw materials is checked on the Material Certificate.	確認材料（材質證明）的化學成分
Mechanical Properties	機械性能
The mechanical properties of raw materials are checked on the Material Certificate.	材質證明上檢查原材料的機械性能。
Material Certificate	材料證書
The following material certificates of principal component are to be prepared and submitted	應準備和提交主要構件材質證明
Object component of material	分項構件的材料
Item	項目
Principal component	主要組成部分
Hydraulic Cylinder	油壓缸
Hydraulic cylinder tube , piston rod, piston, lock nuts, tube flange and head and cap cover	油壓缸管，活塞桿，活塞，鎖緊螺帽，管法蘭和帽蓋
Non Destructive Test	非破壞檢驗
Material for cylinder rod is to be carried out NDT (UT) if the material is	如果材料是鍛件，則用於活塞桿的材料應進行 NDT（UT）。

forgings.	

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WELDING TEST AND INSPECTION	焊接試驗和檢驗
Visual Inspection	目視檢驗
Excess weld metal, leg length and throat thickness	過度焊接金屬、腳長及喉深
Undercut	焊蝕
Pit on bead surface	焊道凹坑
Overlap	焊瘤
Boxing and build-up welding	環焊和堆焊
Crack	裂縫
Acceptance Criteria of Welding is shown in Table 3-1	焊接驗收標準如表 3-1 所示
Table 3-1 Acceptance Criteria of Welding	表 3-1 焊接驗收標準
Item	項目
Criteria	標準
Excess weld metal, leg length and throat thickness	過度焊接金屬、腳長及喉深
Conform to Table 3-2	符合表 3-2
Undercut	焊蝕
Conform to Table 3-3	符合表 3-3
Pit on bead surface	焊道凹坑
a) Pit on butt welds, T-joint consisting a cross section, or corner joint is not allowed for principal member. b) Except above Clause a), (3-pits or less / each joint) and (3-pits or less / m of joint length) are allowed. When the size of the pit is 1.0 mm or smaller, 3-pits are considered as 1-pit for these criteria.	a) 主要構件不允許對接焊縫，T 形接頭包括橫截面或角接頭。 b) 除上述條款 a）外，（3 個或更少/每個接頭）和（3 個或更少/ m 的接頭長度）是允許的。當凹坑的尺寸為 1.0mm 或更小時，對於這些標準，3 坑被認為是 1 坑。
Overlap	焊瘤
Overlap is not allowed.	不允許焊瘤
Boxing and build-up welding	環焊和堆焊
a) Boxing shall be done for the ends of fillet joints. For the portion where boxing is not possible, return welding shall be applied. b) Defect like lack of build-up welding is not allowed on the end of butt	a) 環焊應在圓角接頭的末端進行。對於無法環焊的部分，應採用回焊。 b) 對接接頭末端不允許缺少堆焊。

joints.	
Crack	裂縫
Crack is not allowed on and around bead. Any suspicious portion shall be checked with non-destructive test.	焊道周圍不允許出現裂縫。 任何可疑部分都應進行非破壞檢測。
Table 3-2 Tolerance of Excess Weld Metal, Leg Length and Throat Thickness	表 3-2 過量焊接金屬、腳長及喉深之公差
Item	項目
Condition	條件
Tolerance	公差
Height of excess metal of butt weld	對接焊縫多餘金屬的高度
For plate thickness(mm)	適用板厚（mm）
max	最大值
Leg length and throat thickness of fillet weld	填角焊的腳長及喉深
In relation to 10% of the length except for 50 mm from both edges of a weld line	相對於焊接線兩邊 50 mm 的長度的 10%
Within -1.0mm	在-1.0mm 內
Table 3-3 Tolerance of Undercut	表 3-3 焊蝕公差
Plate thickness	板厚
Standard allowance	標準容許值
Maximum allowance	最大容許值
Note	備註
Acceptable for butt joint of principle component members when 90% of the weld line is within the above ranges, and for other joint 80%.	當 90%的焊縫在上述範圍內時，可接受主要構件的對接，對於其他接頭，可接受 80%。
Undercut deeper than the above shall be repaired.	比上述更深的焊蝕應予以修復。

P.40 (HC-4)

Non Destructive Test (Radiographic Test : RT)	非破壞檢驗（放射線檢驗：RT)
The full penetration butt-welding joint on the cylinder tube shall be inspected by a radiographic test.	應通過放射線照相檢驗檢查圓筒管上的全滲透對接焊縫。
General	總則
Radiographic test (RT) is performed to the butt welds. Radiographic test is in accordance with JIS Z 3104.	對接焊縫進行放射線照相測試（RT）。放射線照相試驗符合 JIS Z 3104。

All defects exceed the criteria are removed and repaired. The replacement weld and contiguous parts to the original weld are retested.	超出標準的所有缺陷都要被移除和修復。 更新焊縫和原始焊縫的連續部件將重新測試。
Radiographic Test Lengths	放射線檢驗長度
Radiographic Test Lengths are 100% of the full penetration butt-welding length.	射線照相測試長度是全滲透對接焊長度的 100%。
Radiographic test Photographing method	放射線檢驗拍攝方法
The arrangement of identification marks on radiograph films is shown on Figure 5-1.	射線照相底片上識別標記的排列如圖 5-1 所示。
Effective length (280 mm)	有效長度(280 mm)
Film size	底片大小
Penetrameter	穿透計
Plate thickness	板厚
Job No.	工作號碼
Contrast indicator	對比指示器
Weld bead to be inspected	應檢查之焊道
ID No.	識別號
Figure 3-1 Arrangement of identification marks	圖 3-1 識別標記的排列
Radiographic test Acceptance Criteria	放射線檢驗驗收標準
Radiographic test classification is in accordance with JIS Z 3104 "Methods of Radiographic Test and Classification of Radiographs for Steel Welds"	放射線檢驗分類符合 JIS Z 3104"放射線檢驗方法和鋼焊縫射線照相分類"
Acceptance criteria for radiographic test are shown in Table 3-4.	放射線檢驗驗收標準如表 3-4 所示。
Table 3-4 Acceptance Criteria for Radiographic Test	表 3-4 放射線檢驗驗收標準
Type of flaw	缺陷類型
Thickness of base metal t ≤ 50mm	基本金屬厚度 t ≤ 50mm
Non-Flaw	無缺陷
Acceptable	可接受
Type-1	類型 1
Class-2 or more	2 級或更多
Class-1	1 級
Type-2	類型 2
Existing Type-1 and 2	現有類型 1 及類型 2

Type-3 and 4	類型 3 及類型 4
Reject	拒絕

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TEST AND INSPECTION OF HYDRAULIC CYLINDER	油壓缸的試驗和檢驗
The quality, dimension and specified function of the hydraulic Cylinder is checked and confirmed.	檢查並確認油壓缸的質量，尺寸和指定功能。
Test and Inspection Method and Acceptance Criteria are shown in Table 4-1.	測試和檢驗方法和驗收標準見表 4-1。
Table 4-1 Test and Inspection Method and Acceptance Criteria	表 4-1 測試和檢驗方法和驗收標準
No.	編號
Part	部分
Item	項目
Method and Criteria	方法和標準
Hydraulic cylinder	油壓缸
Material	材料
Visual	目視
Dimension and tolerance	尺寸和公差
Pressure proof test	耐壓試驗
Inner Leakage test	內滲漏測試
Operation test	操作測試
(no loading condition)	（無負載條件）
Material Certificate	材料證書
As shown in drawing	如圖所示
Tolerance of Cylinder length	氣缸長度公差
Tolerance of Cylinder length from Cap end to cylinder rod at most contraction	氣缸長度從頂端到氣缸桿的公差最大收縮
Stroke	行程
Cylinder rod diameter	氣缸桿直徑
See Table 4-2	見表 4-2
Cylinder tube outside diameter	氣缸管外徑
Cylinder tube inside diameter	氣缸管內徑
See Table 4-3	見表 4-3
Not permit any outer leakage (testing condition: 1.5 × design pres. /2 min.)	不允許任何外部滲漏(測試條件: 1.5 × 設計壓力/2 分鐘)
Not permit any deformation during pressure proof test	在耐壓試驗期間不允許任何變形

Testing condition: 1.0× design pres. /10 min.	測試條件: 1.0×設計壓力/10 分鐘
Acceptance criteria to be informed after detail design of cylinders	氣缸詳細設計後要通知的驗收標準
Not permit any vibration and noise during operation.	操作期間不允許任何振動和噪音。
Not permit any outer leakage during operation	操作期間不允許任何外部滲漏
Measurement of lowest operating pressure	測量最低操作壓力
See Table 4-4	見表 4-4
Coating of Piston Rod	活塞桿塗層
Hard chromium plating	硬鉻電鍍
Required plating thickness	所需的電鍍厚度
Function Test of Dogging Device	閉鎖裝置的功能測試
Confirmation of dogging Device Function	確認閉鎖裝置的功能
Paint Material for cylinders	缸面油漆材料
Material	材料
Check of inspection certificate by manufacturer	製造商檢查檢驗證書
Table 4-2 Diameter of Piston Rod	表 4-2　活塞桿直徑
Unit	單元
Rod Diameter	桿直徑
tolerance of finish dimensions	最終尺寸公差
Circularity & Cylindricality	圓度和圓柱度
more than 180, not less than 250	多於 180, 不低於 250
more than 250, not less than 315	多於 250, 不低於 315
Table 4-3 Inside Diameter of Cylinder Tube	表 4-3　氣缸管內徑
Unit	單元
Inside Diameter of Cylinder Tube	氣缸管內徑
Case of using seal other than piston ring	使用活塞環以外的密封件的情況
tolerance of finish dimensions	最終尺寸公差
Circularity & Cylindricality	圓度和圓柱度
more than 200, not more than 250	多於 200, 不多於 250
more than 250, not more than 300	多於 250, 不多於 300
more than 300, not more than 400	多於 300, 不多於 400
more than 400, not more than 500	多於 400, 不多於 500
more than 500, not more than 600	多於 500, 不多於 600

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Table 4-4 Lowest operation pressure	表 4-4 最低操作壓力
Shape of Piston packing	活塞襯墊的形狀
Nominal pressure	標準壓力
In case that rod packing is not V-packing	如果活塞襯墊不是 V 型襯墊
In case that rod packing is V-packing	如果活塞襯墊是 V 型襯墊
The pressure is supplied from the cap side	壓力從帽蓋側供應
The pressure is supplied from the head side	壓力從頭側供應
Rated Pressure	額定壓力
PAINTING INSPECTION	塗裝檢驗
Surface Preparation Inspection	表面處理檢驗
Blast cleaned surface is checked in accordance with ISO 8501-1, Sa 2 1/2, before shop primer painting at the steel mill shop or manufacture shop.	根據 ISO 8501-1、Sa 2 1/2，檢查噴砂清理過的表面，在鋼鐵工廠或製造廠進行工廠底漆塗裝之前。
Visual Inspection	目視檢驗
The criteria of visual inspection for painting are as follows:	塗裝的目視檢驗標準如下：
Painted surface shall be smooth and free from unevenness	塗漆表面應光滑，無不均勻
(For instance, no remarkable run nor blister).	（例如，沒有明顯的垂流或起泡）
Prime or preceding painted layer shall not be seen through.	不得透視底漆或在塗漆層前。
Hue and gloss shall be identical to the designated color.	色調和光澤應與指定的顏色相同
Dry Film Thickness Inspection	乾膜厚度檢測
After surface preparation, following paints are applied;	表面處理後，塗上以下塗料
Epoxy Zinc Rich Primer after surface preparation within 4 hours(Dry film thickness 50μm)	表面處理後 4 小時內施塗環氧樹酯鋅粉底漆（乾膜厚度 50μm）
Coal Tar Epoxy Resin Paint(Dry film thickness 45μm×2 layer)	環氧樹脂漆柏油漆（乾膜厚 45μm×2 層）
Total dry film thickness:140μm	總乾膜厚度：140μm
The painted surface of cylinder is inspected for two inspection units per square meter of coating area, but at least three inspection units or more	對每平方米塗層區域的兩個檢查單元檢查圓筒的塗漆表面，但至少檢查三個或更多檢查單元

附件二

防護閘門(含油壓設備)工廠製造及檢驗程序書

檔　　號：
保存年限：

經濟部水利署中區水資源局　函

機關地址：41351臺中市霧峰區吉峰里峰堤路195號
聯 絡 人：蔡嘉晉
聯絡電話：05-5261977　#200
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傳　　真：05-5267386

受文者：如行文單位

發文日期：中華民國108年06月21日
發文字號：水中湖字第10833030000號
速別：普通件
密等及解密條件或保密期限：
附件：如說明二

主旨：有關貴公司檢送「湖山水庫第二原水管工程」控制閘門(含油壓設備)工廠製造及檢驗程序書及防護閘門(含油壓設備)工廠製造及檢驗程序書修正B版，本局同意核定，請依工廠製造及檢驗程序書及相關規範辦理，請查照。

說明：

一、復貴公司108年5月31日將字第108050035函。

二、隨文檢附控制閘門(含油壓設備)工廠製造及檢驗程序書及防護閘門(含油壓設備)工廠製造及檢驗程序書修正B版各1份。

正本：大將作工業股份有限公司
副本：義力營造有限公司、本局湖管中心

經 濟 部 水 利 署
湖山水庫第二原水管工程

核定日期：108、6、20

核定文號：10833033000

修正	日期	說明	修正者	校對	核准
B	108.5.31	依水中湖字第10833023000號函修正	E.OYA	R.NAKASO	K.ISHIYAMA
A	108.4.1	依水中湖字第10833011650號函修正	E.OYA	R.NAKASO	K.ISHIYAMA

防護閘門(含油壓設備)工廠製造及檢驗程序書
Test and Inspection Procedure at Shop for Guard Gate Dimensional, Welding, Painting and Assembly Inspection

IHI Infrastructure Systems Co., Ltd.

設計/繪圖	E.OYA	108.2.15	複　核	R.NAKASO	108.2.15
初　核	E.OYA	108.2.15	核　准	K.ISHIYAMA	108.2.15

義力營造股份有限公司
大將作工業股份有限公司
共同承攬

初版日期	編號
108.2.15	H07A—MP—020—B

防護閘門（含油壓設備）工廠製造及檢驗程序書

送審核簽署表

工程名稱：湖山水庫第二原水管工程

契約編號：107 經水工中 01 號

承攬廠商	提報版次：B 版	簽署欄(含日期)
	提報日期：108 年 5 月 31 日	工地主任：
	廠商名稱：大將作工業股份有限公司	
	用印：	品管人員：
監造單位	審查結果： □退回修正 □修正後認可 ☑認可 □其它	審查人員：
執行機關	審查結果： □退回修正 □修正後核定 ☑核定 □其它	審查人員： 經濟部水利署 湖山水庫管理中心 中區水資源分署

「湖山水庫第二原水管工程」閘閥設備審查會議紀錄

（108.05.10 水中湖字第 10833023000 號）

審查意見回覆表

序號	章節	審查意見	辦理情形	頁碼
林副工程司士元				
1		鋼管設計計算書銲接效率：0.95、工地銲接效率為 0.9，其對應銲道 RT 檢測率標準為何。	銲接效率與銲道 RT 檢測率，無相對應標準，銲道 RT 檢測率係由設計單位於施工規範第 11282 章 3.2(1)節上予以規定。	
鄭正工程司國華				
1		電氣設備型錄第 23-2 應改用 LED-150W 不再使用納氣燈(以公文停用)。	將於收到正式變更公文後遵辦。	
2		明冠 2200mm 電動蝶閥應加強自主檢驗鑄件無砂孔，無何檢驗應補件提出。	有關蝶閥鑄件砂孔，所有外露部分於製造過程中均已修補，至於內部無法確定部分，廠驗時已以 20kg/cm^{2}壓力進行閥體檢測(蝶閥最大工作壓力 8.2537kg/cm^2)，故強度已足夠，應無需再另作檢驗。	
3		1. 下游連接管路 1K+153.366~1K+221.364 施工圖製造圖未提送安裝圖請補送如何安裝?基座安裝圖。 2. 圖號 H07A-DP-7005 請補充：1. φ36、φ48 基礎螺栓預埋時應與鋼筋銲接堅固，調整完成後再灌二次混凝土。2. 單孔減壓閥、3. 電動球閥基座，如何與地板鋼筋結合都未提出未畫出未畫圖最基本應附註說明。	1. 安裝圖詳圖號 H07A-DP-7000、7005。 2. 閥室之基礎座已補基礎螺栓(含錨板)與鋼筋連結固定要求；另基礎座亦已補配筋圖。 減壓閥井：詳圖號 H07A-DP-1005、1010。 出流閥井：詳圖號 H07A-DP-7005。	
4		閘閥室鋼管施工製造圖： 1. 圖號：H07A-DP-7005：應補充基礎螺栓如何固定與鋼筋部分未畫出，也應註明基礎台語基礎螺栓在與地板鋼筋結合請補充(基礎台未見鋼筋，要補充)。 2. 閘閥室鋼管施工製造應列入重點廠商自主檢驗表，不論廠內製造及現場安裝應列入重點檢驗(如鋼板厚度、銲道尺寸及開槽尺寸等等)。	1. 本閘閥室地板(EL148.66)以下為巨積混凝土，未鋪設鋼筋，為穩固高壓閘門基礎座，將於閘閥室混凝土高程約 147.00 時，先行埋設基礎座錨板(面板高程 147.41)，並於混凝土高程達 147.41m 時進行閘門固定座之安裝，固定座安裝完成後，即接續進行閘門框及其他接合件之安裝，詳圖號 H07A-OH-1005。 2. 閘閥室鋼管工廠製造及現場安裝均會依規定辦理自主檢查後，再通知甲方檢驗。主要銲接管#67、#68、#70 及#71 等管，其板厚、銲道尺寸及開槽尺寸於施工製造圖均有規定，	

			詳圖號 H07A-OH-5020、5025、5030、5040。	
5		閘閥室控制閘門與防護閘門應補送安裝圖如何與基礎台鋼筋銲接固定請補充。	1.閘閥室控制閘門與防護閘門安裝圖，詳設計圖 H07A-OH-1000、2160。 2.高壓閘閥基礎台無鋼筋，控制閘門與防護閘門將置放於本公司專設之固定座上，詳圖號 H07A-OH-1000、2160。	
6		閘閥室屋頂高度往後可吊出油壓缸嗎?請補充說明。室內有吊車嗎?如何維修有考慮嗎?	1.經量測油壓缸頂部至樑下緣距離為 4740mm，油壓缸取出需要空間為 2578mm，尚餘 2162mm，有足夠空間吊出油壓缸。 2.本閘閥室未配置室內吊車，但屋頂上有配設吊鉤，詳圖號 H07A-OH-6000。 3.日後油壓缸若需拆下維修，可利用屋頂上之吊鉤搭配其他臨時吊具予以拆下及裝設。	
7		請黎明公司函文來本局將鈉氣燈應改用 LED 較符合規定。閘閥室照明高度 9 公尺應修正為 6m 以內。	1.鈉氣燈改用 LED 案，將於正式收到公文後遵辦。 2.閘閥室照明高度 9 公尺，依審查意見改為 6m 以內。	
黃工程員振聲				
1		H07A-OH-5000、5010 電動蝶閥處增設旁通閥與工作平台。	1.增設之旁通閥，詳圖號 H07A-OH-5000、5025、5035、5070、5075。 2.增設之工作平台，詳圖號 H07A-OH-5000、5080、5085。	
2		H07A-OH-5025 Detail" b" 、" c" 斜角開口要銲接。	H07A-OH-5025 Detail"b"、"c"斜角開口處，已補銲接符號。	
3		H07A-OH-2150 typcial section 追加水壓錶	已加設水壓表，詳圖號 H07A-OH-2150、2153。	
林工程員鈺凱：				
1		鋼管所用法蘭之 O 型環及其溝槽未進行相關計算，無法確認是否符合需求。	本案 ϕ2200mm 鋼管 O 型環直徑為 10mm，溝槽深為 7.00~7.05mm，壓擠率介於 30.0~30.5%；且 O 型環外緣採緊貼溝槽外壁設置，符合內壓設計規定，應已符合需求。	
2		閘閥室鋼管#70#71#72#73 底部為方形，且有環樑設計，請考量現場施打混凝土時，是否有無法填滿空隙之可能。	閘閥室鋼管#70、#71、#72、#73 等管均有裝置環樑，為減少環樑對混凝土澆灌影響，均於環樑腹板與上翼板交接處適當距離內增設半徑 5cm 之流通孔，以增加混凝土流動性，另將於混凝土灌漿澆置時，加強震動搗實。詳圖號 H07A-OH-5040、5050、5055、5060	
詹副工程師耀鴻				

1		黎明圖說 WS-M002，油壓單元設計要點/b.其他規定另詳規範第 11280 章第 3.3 節，查無此章。	施工規範第 11280 章為「閘閥室閘閥及附屬設備」，3.3 節為「閘閥設計製造要點」，3.4 節為「吊門機設計要點」，應是 3.4 節誤植為 3.3 節。	
2		圖 C-6 電動機耐熱溫度 155°F，規範 16221-5 至少 E 級(120℃)以上知絕緣未標示，請說明。	本工程閘閥室油壓設備用馬達馬力數為 18.5kw，絕緣等級為 F 級(最高允許溫度 155° C)。詳控制(防護)閘門工廠製造及檢驗程序書 H07A-MP-010(020)5.4 節 P13，	
林工程員信嘉				
1		油壓系統 1. 圖說內有尺寸標註為 0，請問 0 為何? 2. 圖說各編號，某部分尚未說明，建議編號增加列表說明。 3. 圖號：K18-0339-1，圖內氣油壓零件符號，建議另外製作符號目錄，俾供參考。	1. 0 表示直徑。 2. 已補說明，詳圖號 H07A-OH-3115、3125。 3. 圖內油壓零件已補附中文名稱，詳設計圖 H07A-OH-3115、3125、3135、3145、3165、3175	
2		H07A-MP-010-A 控制閘門(含油壓設備)工廠製造及檢驗程序書 P8、P9 頁，執照及證明書模糊。	已將所附執照及證明書更新，詳控制(防護)閘門工廠製造及檢驗程序書 H07A-MP-010(020)4.2.4 節 P8~9。	
蔡工程員嘉晉				
1		圖說部分 1. 閘閥室鋼管、閘閥安裝圖、通氣管及旁通管圖等建議放同一份資料(彼此有關聯)。 2. 控制及防護閘門油壓缸規格請確定(與計算書不一致)。	1. 遵照辦理，詳閘閥室設備施工製造圖。 2. 控制閘門油壓缸規格為 500/225x2300(全行程 2370)。 防護閘門油壓缸規格為 400/225x2300(全行程 2370)。 修正部分，詳圖號 H07A-OH-2100、控制(防護)閘門油壓設備計算書 H07A-OH-120(220) P11~12。	
2		油壓系統 1. 油壓系統表格格式建議與其他閘件一樣。 2. 兩組油壓泵交互運轉供油，並設有一組手動油壓泵(圖上手動圖示?)，請說明控制流程	1. 遵照辦理，詳圖號 H07A-OH-3110、3115、3120、3125、3130、3135、3140、3145、3150、3160、3165、3170、3175。 2.1 本油壓系統設有 A、B 兩組油壓泵，並分由 A、B 兩組馬達各別帶動，泵浦選擇開關分「A 油壓泵」、「交互運轉」、「B 油壓泵」三種模式，當選擇「交互運轉」時，若第一次起動為 A 油壓泵，第二次起動則為 B 油泵。	

			a.運轉模式選擇單動時: 當選擇開關選擇A油壓泵運轉時，若運轉中A油壓泵故障無法繼續運轉，需將選擇開關轉至B油壓泵，並按泵浦啟動後，方能繼續運轉。 b.運轉模式選擇連動時: 當系統由A油壓泵運轉時，若運轉中A油壓泵故障無法繼續運轉，系統將自動切換至B油壓泵，由B油壓泵繼續供壓運轉。 2.2手動油壓泵係電動油壓泵無法運轉時才會操作，與電動油壓泵無流程關係。	
		3.油壓鋼計算書附件3-1~3-2，設備圖數字部分建請增述設備說明	3.已補設備名稱說明，詳圖號H07A-OH-3115、3125。	
		4.油壓系統配置圖請標示圖例及缺安裝圖，油壓槽請劃出安裝圖面及預埋固定方式。	4.油壓零件已補附中文名稱，詳圖號H07A-OH-3115、3125、3135、3145、3165、3175。 油壓單元件配置圖，詳圖號H07A-OH-5000、其固定方式將按照原廠預留之ϕ19mm螺栓孔，以M16化學螺栓固定之，共6支。	
3		計算書 1.防護開門計算書P11應該是防護開門資訊，衝程應為2300mm請確定，控制開門活塞面積為500mm衝程2370mm，防護開門為400mm衝程2300mm?並與圖說一致。	1.控制開門油壓缸規格為500/225x2300(行程)，2370mm=全行程(Full Stroke)。 防護開門油壓缸規格為400/225x2300(行程)，2370mm=全行程(Full Stroke)。 詳控制(防護)開門油壓設備計算書H07A-OH-120(220)P11~12。	
		2.相關設備圖，如涉及後續維運資料(如油壓配置圖面等)需翻譯成中文。	2.已附油壓單元設備名稱中英對照，詳設計圖H07A-OH-3115、3125、3135、3145、3165、3175。	
		3.不同計算書表示同一東西，符號確不一樣，如開閥向上拉力有時是Wu有時Fu建議符號一致。	3.已將不一致名稱修為一致，詳控制(防護)開門油壓設備計算書H07A-OH-120(220)P3。	
		4.混凝土強度計算只有水壓計算是否足夠，沒考慮閥體荷重?計算式f為P*sealing wide/2/bearing wide請確定公式?	4.已修正混凝土強度計算，詳控制(防護)開門計算書H07A-OH-110(210)P81、P82。	
4		工廠製造及檢驗程序書: 1.檢驗表格請補附相關人員簽認位置。	1.檢驗表格已附相關人員簽認欄位，詳控制(防護)開門工廠製造及檢驗程序書H07A-MP-010(020) P16、P17。	
		2.請增加極限開關、防止超運轉測試及	2-1.本高壓開門因需配合鎖定裝置動作需要，	

		測試時間、運轉油壓缸運轉速度、流量及壓力、開度測試(4-20mA)測試百分比等關位，以完善測試紀錄。	上限之極限開關分為「全關開關」、「上限開關」兩種；至於下限之極限開關為「全閉開關」(另設有閘門全閉時泵浦自動停止裝置)，將於設備現場安裝完成後，依契約進行測試。 2-2.設備工廠測試時間，預定於108年12月，詳控制(防護)閘門工廠製造及檢驗程序書H07A-MP-010(020) P2。 設備現場測試時間:設備安裝完成後辦理，確切時間屆時再通知。 2-3.油壓缸運轉速度:依施工規範11280章3.4.3節規定為0.1~0.15m/min。 2-4.流量:依施工規範11280章3.4.6節規定，油壓泵額定流量應不少於設計流量之115%，依計算，油壓缸於速度0.15m/min，需油量最大=29.45 ℓ/min，則油壓泵需要流量=29.45x1.15=33.87 ℓ/min，本工程油壓泵額定流量36.8 ℓ/min > 33.87 ℓ/min。詳設計圖H07A-OH-6000，控制(防護)閘門油壓設備計算書H07A-OH-120(220)P7、P10。 2-5.壓力:本油壓系統最大壓力設定於210 kg/cm^2，符合施工規範11280章3.4.14節油壓系統壓力不大於210 kg/cm^{2}規定，詳設計圖H07A-OH-6000、控制(防護)閘門油設備計算書H07A-OH-120(220)P1。 2-6 開度:將按開度行程0~2700mm，依比例等分輸出信號4-20mA。	
5		其他:資料尚缺安裝說明書。	有關高壓閘閥安裝部分，日後將提出工地安裝程序書。	
綜合結論				
1		為配合政府節約能源政策，請黎明公司據以辦理，將本案照明全面改採led，並俟本局函請水利署同意後辦理。	將於收到正式變更公文後遵辦。	
2		有關電動蝶閥處增設旁通閥與工作平台，請大將作公司確認所需空間及預算，提供本局作變更依據。	蝶閥增設旁通閥與工作平台設計圖如下。 1.旁通閥設計圖，詳H07A-OH-5070、5075。 2.工作平台設計圖，詳H07A-OH-5080、5085。 預算部分將另案提送	
3		本次檢送閘閥相關資料，請依意見修正後原則同意辦理。	資料已依審查意見修正完妥。	

4		本次會議請於108年5月31日前修改完成後送局憑辦。	所提意見已修正完成，並於108/5/31陳送。	

CONTENTS

1. GENERAL

This procedure is applied to the shop inspection for Guard Gate of the project for Hushan Reservoir Raw Water Pipeline II Engineering Project "湖山水庫第二原水管工程 ".

1.1 Standards and/or codes

The shop inspection is performed in accordance with the following standards and/or codes.

1) The technical specification for this project	
2) CNS	Chinese National Standards (Taiwan)
3) AISC	American Institute of Steel Construction
4) ASTM	American Society of Testing and Materials
5) ANSI	American National Standards Institute
6) ASME	American Society of Mechanical Engineers
7) AWS	American Welding Society
8) EN	European Standards
9) BS	British Standards
10)DIN	Deutsche Industrial Norman
11)JIS	Japanese Industrial Standards
12) Technical Standards for Gate and Penstock	Electric Power Civil Engineering Association, Japan
13)JSSC	Japanese Society of Steel Construction
17)Dam and Weir Technical Standards	Japan Association of Dam & Weir Equipment Engineering
18)Dam and Weir Inspection Essentials	Japan Association of Dam & Weir Equipment Engineering

1.2 Reports for submission

Reports for submission are as follows;

1) Material test report (Material lists and mill certificates for principal members)
2) Welding test report (Non Destructive Test report)
3) Shop assembly inspection report (Including operation test reports)
4) Painting inspection reports (Dry film thickness reports)
5) Certificates and/or test reports for purchased products

2. SCOPE OF TEST AND INSPECTION

2.1 Scope of Test and Inspection

Test and inspection are performed in accordance with the item and category as indicated in the following Table 2-1.

Table 2-1 Scope of test and inspection

Description		Material inspection	Welding inspection		Shop assembly			Painting inspection
			Visual check	Non destructive test	Dimension inspection	Water Pressure test Leakage test	Operation test	Dry film thickness inspection
Control Gate	1 set	□	○	□	□	◎	※◎	◎

Remarks: 1) Mark [◎] is witnessed by the inspector.
2) Mark [○] is carried out by ourselves and test reports are submitted.
3) Mark [□] is carried out by ourselves and/or witnessed by the inspector.
4) ※Operation test is performed at manufacture's factory.
5) The Inspector means The Employer or third party inspector
Third party: JAPAN INSPECTION CO., LTD

2.2 Schedule of Test and Inspection

The plan of Test and inspection schedule is shown in the following Table 2-2.

Table 2-2 Test and Inspection Schedule

Test and Inspection	PLAN	Object
Material Inspection	Mar.2019	Main Material Steel Plate
Equipment Inspection and Test	Jul.2019	Hydraulic Cylinder
Equipment Inspection and Test	Nov.2019	Hydraulic Unit
Shop Assembly Inspection and test	Dec.2019	Control Gate
Welding Inspection	ditto	Control Gate
Painting Inspection	ditto	Control Gate

2.3 Time Schedule for Oversea Inspection

Draft Time Schedule for Oversea Inspection of shop assembly is shown in the following Table 2-3.

In shop inspection, the following two gates are inspected simultaneously.

1. Control Gate
2. Guard Gate

Table 2-3 Time Schedule

1st day

time	item	note
10:00 ~ 11:00	Introduction	Include the confirmation of previous inspection
11:00 ~ 12:00	Non destructive test	
12:00 ~ 13:00	Lunch time	
13:00 ~ 15:00	Dimension Inspection	
15:00 ~ 16:00	Painting Inspection	
16:00 ~ 17:00	Meeting	

2nd day

Test	item	note
9:00 ~ 9:30	Introduction	
9:30 ~ 10:30	Water Pressure Test	Water will be filled in the Gate during the night
10:30 ~ 12:00	Preparation and Cleaning	
12:00 ~ 13:00	Lunch time	
13:00 ~ 15:00	Operation Test	
15:00 ~ 16:00	Meeting	

Details are to be submitted later.

3. MATERIAL INSPECTION

3.1 Certificated mill test reports

All materials used in this project are in conformity with JIS or equivalent standards.
Their conformance with the specification is checked on certificated mill test reports.
Main components and equipment is shown in table 3-1

Table 3-1 Main Component and Equipment

Equipment	Component	Material	JIS
Casing	Connecting Flange	SM400C,SM490C	JIS G 3106
	Beam	SM490B, SM490A	JIS G 3106
	Casing Body	SM400B, SM400A	JIS G 3106
		SF440A	JIS G 3201
		SUS304	JIS G 4304
	Sliding Plate	SUS304	JIS G 4304
Bonnet	Connecting Flange	SM490C	JIS G 3106
	Body	SM490B	JIS G 3106
		SUS304	JIS G 4304
	Beam	SM400A	JIS G 3106
	Sliding Plate	SUS304	JIS G 4304
Bonnet Cover	Connecting Flange	SM490C	JIS G 3106
	Rib	SM490B, SM400A	JIS G 3106
	Boss	SUS304	JIS G 4303
	Bush	CAC403	JIS H 5120
Gate Leaf	Skin Plate	SM400C, SM490B	JIS G 3106
	Beam	SM490B,SM490A, SM400A	JIS G 3106
	Seal Plate	CAC403	JIS H 5120
	Rubber Seal	NR	JIS K 6251 / ASTM D 412 JIS K 6253 / ASTM D 2240 JIS K 6258 / ASTM D 471 JIS K 6262 / ASTM D 395 JIS K 6257 / ASTM D 573
Hoist	Cylinder Tube	EN S355J2H	EN 10210
	Rod	EN1.4462	EN 10088

3.2 Chemical Composition

The chemical composition of raw materials is checked on the mill sheet (Mill Certificate).

3.3 Mechanical Properties

The mechanical properties of raw materials are checked on the mill sheets (Mill Certificate).

4. WELDING INSPECTION

All welds are inspected in accordance with the following methods. The specified welds are inspected by Non Destructive Test.

4.1 Visual inspection

All welds are visually inspected in accordance with Technical Standards for Gate and Penstock. Welds are acceptable to the following visual inspection using the gauge.

Visual inspection acceptance of weld profiles is shown in Table 4-1.

Table 4-1 Acceptance of weld profiles

Item		Acceptance
1	Undercut	Undercut acceptance is shown in Table 4-2.
2	Piping porosity	Piping porosity acceptance is shown in Table 4-3.
3	Crater	All craters shall be filled to the full cross section of the weld, except for the end of intermittent weld outside of their effective length
4	Crack	Welds shall have no cracks.
5	Reinforcement	Reinforcement acceptance is shown in Table 4-4.
6	Over lap	Over lap is not acceptable.
7	Arc strike	Arc strike is not acceptable.
8	Underrun	A filet weld in any single continuous weld shall be permitted to underrun the nominal fillet size, provided that the undersize portion (-1mm) of the weld does not exceed 10% of the length of the weld except 50mm at the both ends of the weld.

Table 4-2 Acceptable value on undercut

Thickness mm	Control limit*	Permissible limit**
T≦6	≦0.3 mm	≦0.6 mm
T>6	≦0.5 mm	≦0.8 mm

*: Undercut which depth is under the control limit is permitted in case of its hole length is within 90% of butt welded joint length in any stress members, or within 80% of all other welded joint length.

**: Undercut which depth is under the permissible limit is not permitted.

Table 4-3 Acceptable value on piping porosity

Joint type	Number of piping porosity
Butt joint, T joint or corner joint of the principal member	Not permitted
All other groove	≦3:the number of piping porosity in each joint or in any 1000mm length of weld, provide that if the diameter of piping porosity is ≦ 1mm Φ, 3 piping porosities is regarded as 1 piping porosity.

Table 4-4 Acceptable value on reinforcement of weld

Thickness	Main structure of gate	Discharge pipe under pressure	Other main structure under pressure
t≦12 mm	3 mm	2mm	3 mm
12mm< t≦25 mm	4 mm	2.5mm	3.5 mm
t> 25 mm	6 mm	3mm	4 mm

4.2 Non Destructive Test

4.2.1 General

Radiographic test (RT) is performed on full penetration butt weld joints.

Ultrasonic test (UT) is also performed on full penetration butt weld joints.

Liquid Penetrant test (PT) is performed on all welds on Gate leaf, Seal Seats of Casing and Side Guide including Sliding Plate of Bonnet.

Non Destructive test is conducted by the engineer who has the qualification of the level 2 or 3.

Radiographic test is in accordance with JIS Z 3104.

Ultrasonic test is in accordance with JIS Z 3060.

Liquid Penetrant test is in accordance with JIS Z2343.

All defects observed are removed and repaired. The replacement weld and contiguous parts to the original weld are retested.

4.2.2 Examination ratio

(1) Examination ratio of RT and UT

The examination ratios are shown in Table 4-5.

Table4-5 Examination ratios of RT and UT

Items	Full Penetration Butt weld	
	RT	UT
Control Gate	above 20%	100%

Remarks:

1) RT is applicable to the plate thickness less than 50mm basically.
2) UT is applicable to the plate thickness more than 50mm basically or the portion where RT is impossible.
3) RT has priority over UT.
   RT is relatively easy to apply. Most of defects such as cracks, blowhole, incomplete fusion, slag inclusion, and incomplete penetration may easily be detected. This RT is basically employed in this project.

(2) Examination ratio of PT

The examination ratio of PT is shown in Table 4-6.

	All welds on Gate leaf, Seal Seat of Casing and Side Guide incl. Sliding Plate of Bonnet
Control Gate	100%

4.2.3 Object for NDT

(1) Object for RT and UT

Full Penetration butt welds on Gate leaf, Bonnet and Upstream side Casing

(2) Object for PT

① All welds on Gate leaf
② All welds on Seal Seats of Casing (Gate frame)
③ All welds on Side Guide and Sliding Plate of Bonnet (Gate frame)

4.2.4 Execution engineer's qualification

Engineer's qualification is below.

氏名 小山 典幸　　生年月日 1969年02月26日
NAME NORIYUKI KOYAMA　　DATE of BIRTH Year Month Date

署名 小山典幸
SIGNATURE

個人コード P00520473
ID. Code

JIS Z 2305 による認証制度に基づいて実施した非破壊の結果、裏面に記すNDT方法・レベルについて適格であること認め、認証したことを証明します。

This certificate proves that the holder is certified as NDT personnel of the NDT method and level described on the front side of the card as a result of the qualification based on the certification system in accordance with JIS Z 2305 (ISO 9712 modified).

注意

*認証運営委員会委員長印及び写真へのコールドシールの無いものは無効となります。 *資格に関する規定に違反した場合失効となります。 *本証明書は技術者の資格を証明するものでありNDT作業の許可を与えるものではありません。

Caution

*In case of no seal of Chairman in the front side of the card and no cold seal on the photograph above, the certificate is invalid. (Chairman: Chairman of Certification Steering Committee) *When the code of ethics is violated, this certificate will be invalid. *This certificate attests that the holder has the qualification of NDT personnel, but it does not give the personal any operating authorization.

JIS Z 2305

非破壊試験技術者資格証明書

NON-DESTRUCTIVE TESTING PERSONNEL CERTIFICATE

認証番号 N10254572
CERTIFICATE No.

氏名 小山 典幸　　生年月日 1969年02月26日
NAME NORIYUKI KOYAMA　　DATE of BIRTH Year Month Date

NDT方法・レベル 放射線透過試験・レベル2
NDT METHOD & LEVEL Radiographic Testing LEVEL2

発効年月日 (DATE of CERTIFICATION) 2015年04月01日
更新年月日 (DATE of RENEWAL) ****年**月**日
有効期限 (DATE of EXPIRATION) 2020年03月31日
工業分野 マルチセクター（材料、溶接、構造物）
INDUSTRIAL SECTOR MULTI-SECTOR(MATERIALS,WELDS AND STRUCTURES)

一般社団法人 日本非破壊検査協会 認証事業本部
THE JAPANESE SOCIETY for NON-DESTRUCTIVE INSPECTION PERSONNEL CERTIFICATION DIVISION

JSNDI 認証運営委員会委員長 井上 裕嗣
CHAIRMAN OF CERTIFICATION STEERING COMMITTEE HIROTSUGU INOUE

B

JSNDI

交付番号：20160411020100028
Number of Issue

JIS Z 2305:2001 非破壊試験技術者 資格情報証明書

Attestation of Information on a Certificate of JIS Z 2305:2001 Non-destructive Testing Personnel

個人コード ID Code	P00520473
氏　名 Name	小山　典幸 NORIYUKI KOYAMA
生年月日 Date of Birth	1969年02月26日 February 26,1969

認証番号 Certificate No.	N102545?2
NDT方法（略称） NDT method (Abbreviation)	放射線透過試験（RT） Radiographic Testing (RT)
レベル Level	2
工業分野 Industrial Sector	マルチセクター（材料、溶接、構造物） Multi-Sector (Materials,Welds and Structures)
発効年月日 Date of Certification	2015年04月01日 April 01,2015
更新年月日 Date of Renewal	****年**月**日 **** ** ****
有効期限 Date of Expiration	2020年03月31日 March 31,2020

この資格情報証明書は下記発行日現在の資格情報であることを証明する。
This Attestation of Information on a Certificate attests the information on a Certificate as of the date of issue below.

管理情報コード
Management Information code

発行日：2016年04月11日
Date of Issue : April 11, 2016

東京都江東区亀戸2-25-14 立花アネックス #10階
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Tokyo 136-0071, Japan
Phone : +81 3 5609 4014 Fax : +81 3 5609 4062

一般社団法人 日本非破壊検査協会
認証事業本部 認証運営委員会 委員長　井上　裕嗣

HIROTSUGU INOUE
Chairman of Certification Steering Committee
Personnel Certification Division
The Japanese Society for Non-Destructive Inspection

公印は黒色の電子印です
This Society's official seal above is a black colour electronic seal.

＊「資格情報証明書について」は当協会ホームページをご覧ください（http://www.jsndi.jp/）
Please see"About Attestation of Information on a Certificate"written in Japanese in the JSNDI website (http://www.jsndi.jp/)

B

4.2.5 Radiographic examination

(1) Photographing method

The arrangement of identification marks on radiograph films is shown in Figure 4-1.

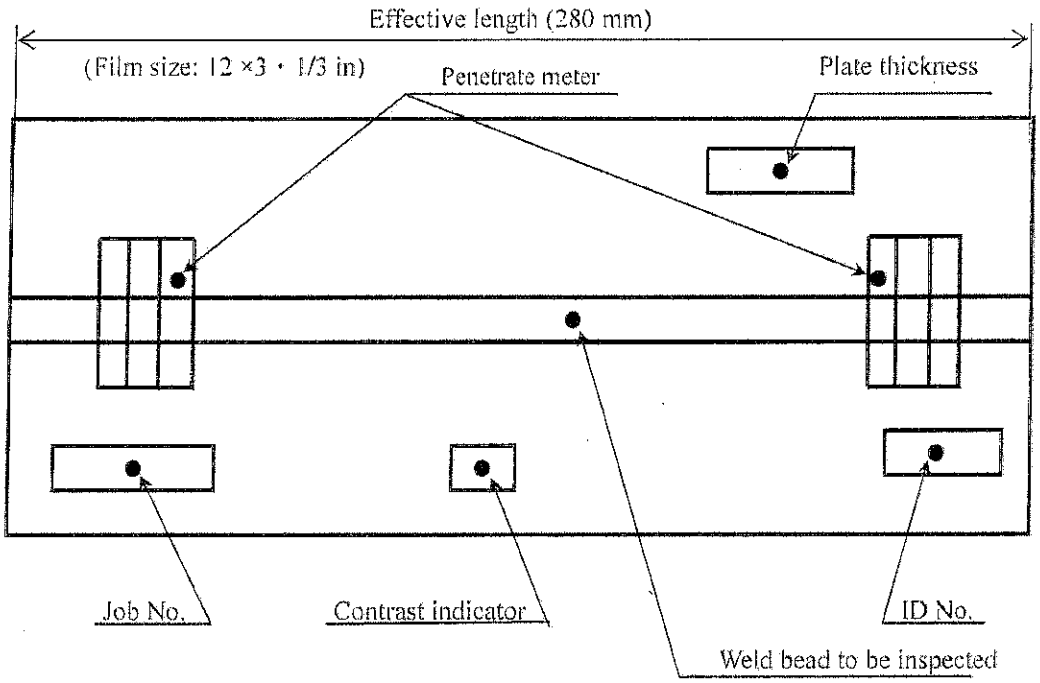


Figure 4-1 Arrangement of identification marks

(2) Acceptance Criteria

Radiographic classification is in accordance with JIS Z 3104 [Methods of radiographic examination for welded joints in steel]. Then acceptance is shown in Table 4-6.

Table 4-6 Acceptance in the radiographic examination

Kind of flaw	Acceptance
Flaw of class 1	Grade 2
Flaw of class 2	Grade 2
Flaw of class 3	Unacceptable
Combined flaws of class 1 with class 2	Grade 2

4.2.6 Ultrasonic Test

Ultrasonic Test is in accordance with JIS Z 3060 [Method for ultrasonic examination for welds of ferritic steel].

The acceptance is equal to or better than Class 2 when using L-disregard level.

Table 4-7 Classification of discontinuities according to region of echo height and indication length

Unit: mm

Region		When using M-disregard level: III When using L-disregard level: II and III			IV		
Plate thickness		18 or under	Over 18 up to and incl. 60	Over 60	18 or under	Over 18 up to and incl. 60	Over 60
Classification	Class 1	6 max.	$t/3$ max.	20 max.	4 max.	$t/4$ max.	15 max.
	Class 2	9 max.	$t/2$ max.	30 max.	6 max.	$t/3$ max.	20 max.
	Class 3	18 max.	t max.	60 max.	9 max.	$t/2$ max.	30 max.
	Class 4	Discontinuities exceeding the level of Class 3					
NOTE : The symbol t is plate thickness of the parent material of the groove side. In the case of a butt joint weld that joins two parent materials with different thicknesses, t is the smaller thickness of the two.							

4.2.7 Penetrant Test

The liquid penetrant test method shall conform to the requirement of JIS Z 2343 "Non-destructive testing – Penetrant testing—".

The acceptance is shown as follows;

- Cracks are not allowed on and around weld bead.
- Liner indications (independent or continuous) are not allowed on and around weld bead
- Circular indication, which major axis over 2mm is not allowed on and around weld bead.
- Scattered indications is not allowed on and around weld bead.

5. SHOP ASSEMBLY INSPECTION

The gate equipments are assembled in the shop, and dimensional inspections and visual check on welds (see 4.1) are performed at manufacture's factories.

5.1 Shop assembly position

The gate is temporarily assembled in the installation position.

5.2 Dimensional tolerances at shop assembly

Dimensional inspection is carried out for all equipments, and tolerances are shown in Table 5-1. Detailed tolerances are shown in each check sheets.

Table 5-1 Dimensional tolerances

Gate	Symbol	Point to be measured	Tolerance (mm)
High Pressure Slide Gate	aL	Gate leaf width (Left side)	±1
	aR	Gate leaf width (Right side)	±1
	b	Gate leaf height	±1
	c1	Gate leaf depth	±2
	c2	Distance between horizontal main beam *1	±5
	c3	Skin plate thickness*2	±0.8
	d	Gate slot	±1
	e	Casing height from gate center to bottom	±3
	f	Casing height from gate center to top	±2
	g	Bonnet cover height	±2
	h	Upstream side casing length	±2
	i	Downstream side casing length	±2
	j	Inside dimension of pipe width (upstream side)	±3
	k	Inside dimension of pipe height (upstream side)	±3
	ℓ	Inside dimension of pipe width (downstream side)	±3
	m	Inside dimension of pipe height (downstream side)	±3
	n	Casing width	±5

Note: *1; There is no tolerance on the reference standard. This tolerance is in house tolerance.
*2; This tolerance based on JIS G 3193

5.3 Hydraulic Test

(1) Test condition

The high pressure slide gate is tested under the following condition (See Table 5-2).
In this case, the gate is confirmed that there is no leakage from metal joints and no permanent damage.

Table5-2 Test pressure & holding time

	Design pressure	Test pressure	Holding time
Hydraulic Test	0.813 MPa	1.016 MPa	10 min

Where; Design pressure; 82.862m×9.807/1000=0.813 MPa

Test pressure; 0.813×1.25=1.016MPa

(2) Leakage volume
Acceptable leakage volume of water seals is 2 liters per minute.

5.4 Operation Test

The operation test is performed at manufacture's factories.
The operational performance of the gate is checked by the operation test.
Check items and criterion are shown in Table 5-3

Table5-3 Check items and criterion on operation test (Guard Gate)

Check items	Criterion
Rated capacity	1834 kN
Hoisting speed	0.1～0.15m/min
Voltage of electric motor	220V ±10%
Electric current of electric motor	63A≦ the rated current
Insulation value of motor	JIS type F
Temperature rise of bearing, motor and reducer	≦ Ambient temperature + 40℃
Vibration	Abnormal vibration is not permitted
Operation of limit switches	Normal
Operation of gate position indicator	Normal

6. PAINTING INSPECTION AT SHOP

The dry film thickness and appearance are inspected in accordance with Painting Specification.

(1) Water seal seat, guide ledge, main wheel track seat, pressure seat, and other Gate Frame
The painted surface is inspected on four detection units per meter of length, and four test units still be inspected for less than one meter of member.

Object:
Side Guide of Bonnet

(2) Gate leaf and other related members
The painted surface is inspected for two inspection units per square meter of coating area, and the deficiency still be tested on four inspection units.

Object:
Gate leaf
Surface submerged in water of Casing
Surface submerged in water of Bonnet except Side Guide
Surface submerged in water of Bonnet Cover

(3) Hoist and other members exposed to the air

The painted surface is inspected for two inspection units per square meter of coating area, but at least three inspection units or more inspected per member or per side.

Object:
Hoist
Surface exposed to the air of Bonnet
Surface exposed to the air of Bonnet Cover
Indicator

Details are shown in each check sheets.

Table6-1 Specified Thickness

Painting portion	Specified Thickness
For the surface submerged in water	320 μ m
For the surface exposed to the air, including Hoist and etc.	200 μ m

7. TEST FOR PURCHASED PRODUCTS

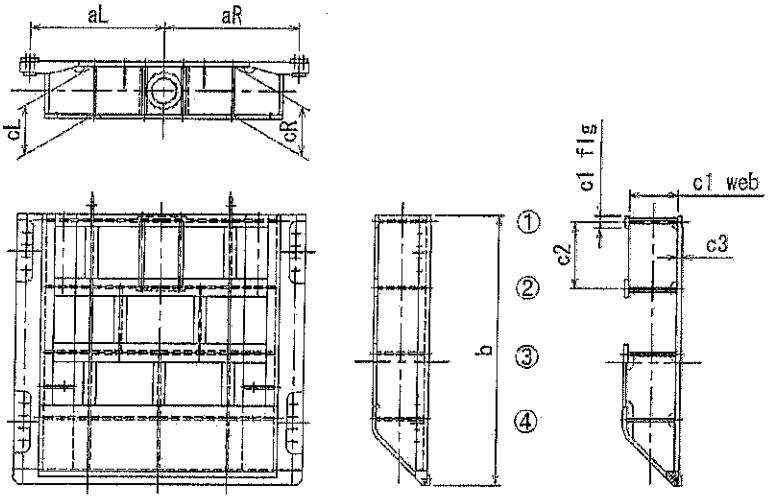
The purchased products which are hydraulic cylinder, hydraulic unit and position indicator are checked and confirmed to be good enough for use. Certificates and/or the test reports including motor of hydraulic unit are submitted.

INSPECTION ITEM	Guard Gate (Gate Type: High Pressure Slide Gate)

Dimension inspection

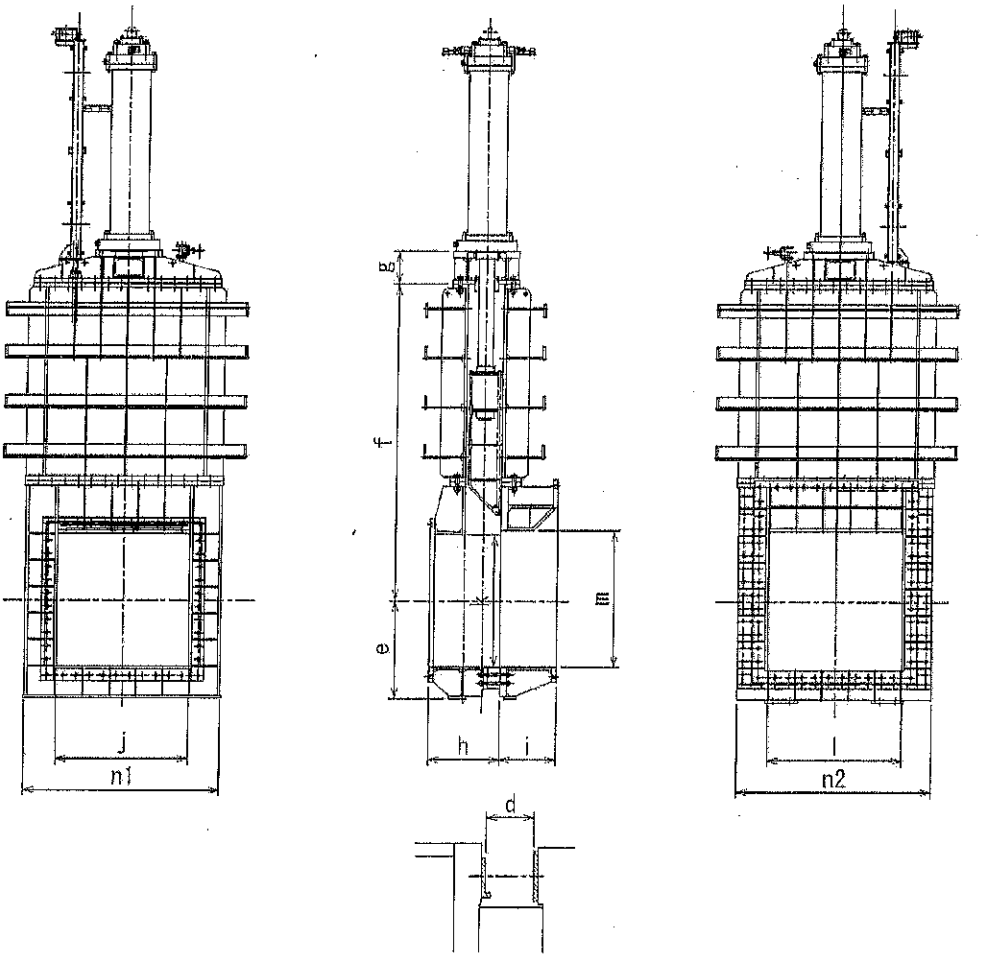
Measuring point

Gate leaf



View from UPSTREAM SIDE

View from DOWNSTREAM SIDE



INSPECTION ITEM	Guard Gate (Gate Type: High Pressure Slide Gate)

Dimension inspection

Measuring point

	date	confirmation
In-house		
Witness		

Unit:mm

Measuring items		Inspection points			Design data	Tolerance	In-house inspection		Witness inspection	
							Data	Difference	Data	Difference
a	Gate leaf width	Top	aL		1100	±1				
			aR							
			a		2200	±2				
		Bottom	aL		1100	±1				
			aR							
			a		2200	±2				
b	Gate leaf height	Left			2180	±1				
		Right								
c1	Gate leaf depth	①	Left	Web	395	±2				
				Flg	100	±2				
			Right	Web	395	±2				
				Flg	100	±2				
		②	Left	Web	388	±2				
				Flg	150	±2				
			Right	Web	388	±2				
				Flg	150	±2				
		③	Left	Web	388	±2				
				Flg	150	±2				
			Right	Web	388	±2				
				Flg	150	±2				
		④	Left	Web	388	±2				
			Right	Web	388	±2				
c2	Distance between main horizontal beam	① to ②			550	±5				
		② to ③			545					
		③ to ④			545					
c3	Skin plate thickness	minimum			40	±0.8 (JIS)				

INSPECTION ITEM	Guard Gate (Gate Type: High Pressure Slide Gate)

Dimension inspection

Measuring point

	date	confirmation
In-house		
Witness		

Measuring items		Inspection points		Design data	Tolerance	In-house inspection		Witness inspection	
						Data	Difference	Data	Difference
d	Gate slot	Left	Upper	145	±1				
			Lower						
		Right	Upper						
			Lower						
e	Casing height from gate center to bottom	Left		1480	±3				
		Right							
f	Casing height from gate center to top	Left		4800	±2				
		Right							
g	Bonnet cover height	Left		505	±2				
		Right							
h	Upstream side Casing length	Left		1085	±2				
		Right							
i	Downstream side Casing length	Left		855	±2				
		Right							
j	Inside dimension of pipe width (Upstream side)	Upper		2000	±3				
		Lower							
k	Inside dimension of pipe height (Upstream side)	Left		2000	±3				
		Right							
l	Inside dimension of pipe width (Downstream side)	Upper		2000	±3				
		Lower							
m	Inside dimension of pipe height (Downstream side)	Left		2070	±3				
		Right							
n	Casing width (Upstream side)	n1	Upper	2960	±5				
			Lower						
	Casing width (Downstream side)	n2	Upper	2950	±5				
			Lower						

INSPECTION ITEM	Guard Gate (Gate Type: High Pressure Slide Gate)

1. Visual Inspection for Assembly

Item	Acceptance	In-house inspection	Witness inspection
Condition of component fitting	It is checked by viewing, components are fitting proper position		
Condition of the surface on seal and sliding plate	It is checked by viewing, there is no foreign object		
Condition of the surface on Stainless Steel	It is checked by viewing, there is no rust		
Damage	It is checked by viewing, there is no damage		
Condition of Bolt	It is checked by testing hammer, there is no loose bolt		
Condition of equipment fitting	It is checked by viewing, equipment's are fitting proper position		

INSPECTION ITEM	Guard Gate (Gate Type: High Pressure Slide Gate)

1.Operation Inspection

区分 Division	運転方向 Direction of driving		電動機 Electric Motor			圧力 Pressure			開閉速度Speed			
			電圧 Voltage	電流 Current	温度 Temperature	元圧 Former pressure	ロッド側圧力 Rod side pressure	ヘッド側圧力 Head side pressure	開閉時間 Hoisting time	速度 Speed	揚程 Operating stroke	流量調整弁の目盛り Flow control valve scale
			(V)	(A)	(℃)	MPa	MPa	MPa	min	m/min	mm	-
	設計値 Design value		220	63	---	21	---	---	23	0.1	2300	---
	開 Open	社内 In-house			→							
		立会 Witness			→							
	閉 Close	社内 In-house			→							
		立会 Witness			→							
基準値 Reference value			±10%	定格電流以下 Below ratings current	気温＋40℃ Ambient temperature ＋40℃ or less	規定値にあること a regulated value			0.1～0.15m/min			-

区分 Division	運転方向 Direction of driving		温度 Temperature	
			油温 Temperature of oil (℃)	気温 Temperature of room (℃)
	設計値 Design value		---	---
	開 Open	社内 In-house	→	→
		立会 Witness	→	→
	閉 Close	社内 In-house	→	→
		立会 Witness	→	→
基準値 Reference value			55℃以下 55℃ or less	-

検査項目 Item	判定基準 Judging Standard	検査結果 Inspection result	
		社内 In-house	立会 Witness
電動機絶縁種 Insulation type of motor	所定の絶縁種であること Accommodate to spec		
振動 Vibration	有害な振動が無いこと There is no harmful vibration.		
リミットスイッチの確認 Confirmation of Limit Switch	全開リミットスイッチが正常に作動すること Fully open limit Switch works normally		
	全閉リミットスイッチが正常に作動すること Fully closing limit Switch works normally		
	その他リミットスイッチが正常に作動すること All other limit Switch works normally		
開度計の確認 Confirmation of position Indicator	開度計が正常に作動すること Position indicator works normally		

INSPECTION ITEM	Guard Gate (Gate Type: High Pressure Slide Gate)

2.Hydraulic test

検査項目 Item	試験圧力 Test pressure	判定基準 Judging standard	検査結果 Inspection result	
			社内 In-house	立会 Witness
水圧試験 pressure test	1.016MPa	水密構造部以外からの漏水のないこと No leakage No deformation		
		≦2000ml／min		

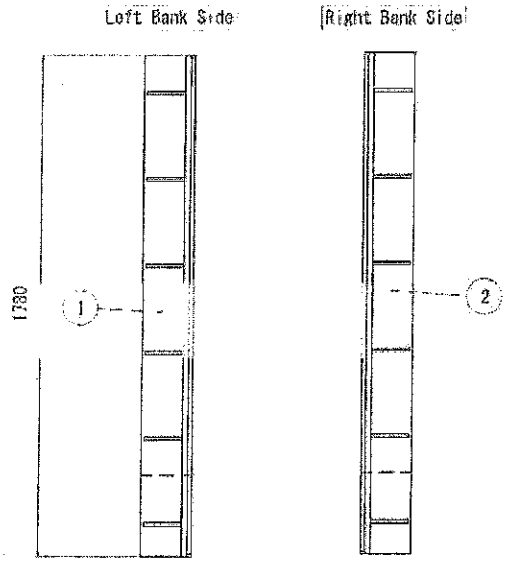
INSPECTION ITEM	Guard Gate (Gate Type: High Pressure Slide Gate)

1. Visual Inspection for Welding

<table>
<tr><th>Item</th><th>Acceptance</th><th>In-house inspection</th><th>Witness inspection</th></tr>
<tr><td>Undercut</td><td>Undercut acceptance is shown in Table 1-1
Table1-1
<table>
<tr><th>Thickness mm</th><th>Control limit*</th><th>Permissible limit**</th></tr>
<tr><td>T≦6</td><td>≦0.3 mm</td><td>≦0.6 mm</td></tr>
<tr><td>T>6</td><td>≦0.5 mm</td><td>≦0.8 mm</td></tr>
</table>
*: Under cut which depth is under the control limit is permitted in case of its hole length is within 90% of butt welded joint length in any stress members, or within 80% of all other welded joint length.
**: Under cut which depth is under the permissible limit is not permitted.</td><td></td><td></td></tr>
<tr><td>Piping porosity</td><td>Piping porosity acceptance is shown in Table 1-2.
Table1-2
<table>
<tr><th>Joint type</th><th>Number of piping porosity</th></tr>
<tr><td>Butt joint, T joint or corner joint of the principal member</td><td>Not permitted</td></tr>
<tr><td>All other groove</td><td>≦3:the number of piping porosity in each joint or in any 1000mm length of weld, provide that if the diameter of piping porosity is ≦ 1mm Φ, 3 piping porosities is regarded as 1 piping porosity.</td></tr>
</table></td><td></td><td></td></tr>
<tr><td>Crater</td><td>All craters shall be filled to the full cross section of the weld, except for the end of intermittent weld outside of their effective length</td><td></td><td></td></tr>
<tr><td>Crack</td><td>Welds shall have no cracks.</td><td></td><td></td></tr>
<tr><td>Reinforcement</td><td>Reinforcement acceptance is shown in Table 1-3
Table1-3
<table>
<tr><th>Thickness</th><th>Main structure of gate</th><th>Discharge pipe under pressure</th><th>Other main structure under pressure</th></tr>
<tr><td>t≦12 mm</td><td>3 mm</td><td>2mm</td><td>3 mm</td></tr>
<tr><td>12mm< t≦25 mm</td><td>4 mm</td><td>2.5mm</td><td>3.5 mm</td></tr>
<tr><td>t> 25 mm</td><td>6 mm</td><td>3mm</td><td>4 mm</td></tr>
</table></td><td></td><td></td></tr>
<tr><td>Over lap</td><td>Over lap is not acceptable.</td><td></td><td></td></tr>
<tr><td>Arc strike</td><td>Arc strike is not acceptable.</td><td></td><td></td></tr>
<tr><td>Under run</td><td>A filet weld in any single continuous weld shall be permitted to underrun the nominal fillet size, provided that the undersize portion (-1mm) of the weld does not exceed 10% of the length of the weld except 50mm at the both ends of the weld.</td><td></td><td></td></tr>
</table>

INSPECTION REPORT FOR DRY FILM THICKNESS									
Particular	Side Guide of Bonnet (Guard Gate)								
Measuring time	After completion of final painting (Final Coal tar Epoxy Resin Paint) at shop								
Measuring date/month/year									
Portion	Submerged	Specified thickness	320 µm	Minimum thickness	224 µm				
Total Painting Area/Length	1.78 m	Need to Inspection	8 point	Activity Inspection	8 point				
Result	Minimum thickness	In-house	µm	Witness	µm				
	Average of thickness	In-house	µm	Witness	µm				

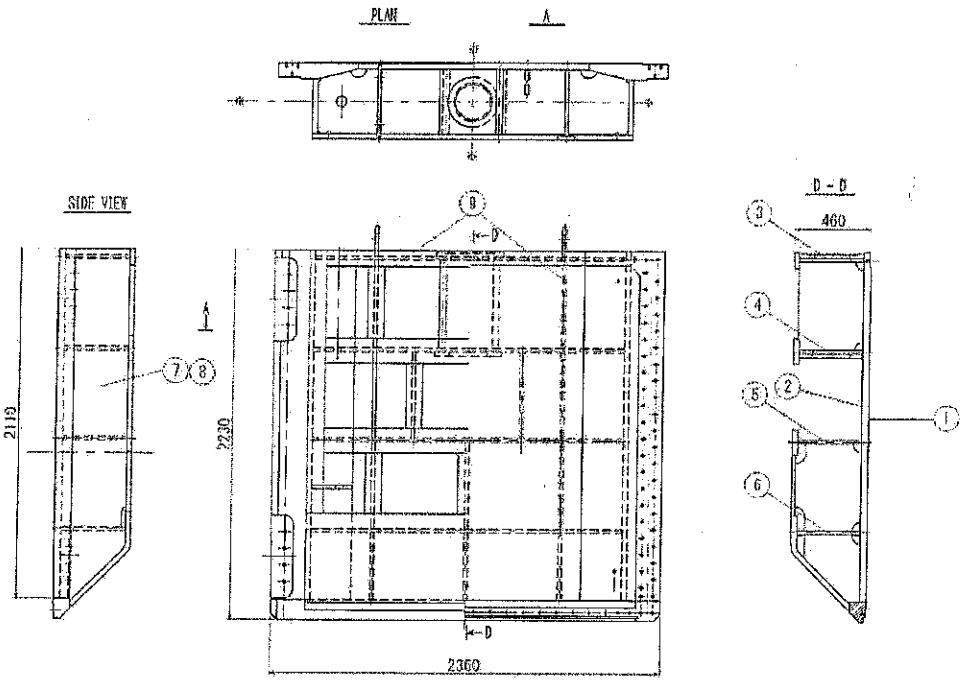
Measuring Point



Data													Unit: µm	
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Side Guide of Bonnet (Left Bank Side)	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
②	Side Guide of Bonnet (Right Bank Side)	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												

INSPECTION REPORT FOR DRY FILM THICKNESS									
Particular	Gate Leaf (Guard Gate)								
Measuring time	After completion of final painting [Final Coal tar Epoxy Resin Paint] at shop								
Measuring date/month/year									
Portion	Submerged	Specified thickness		320 μm		Minimum thickness		224 μm	
Total Painting Area/Length	29.2 m^2	Need to Inspection		60 point		Activity Inspection		60 point	
Result	Minimum thickness		In-house		μm	Witness		μm	
	Average of thickness		In-house		μm	Witness		μm	

Measuring Point



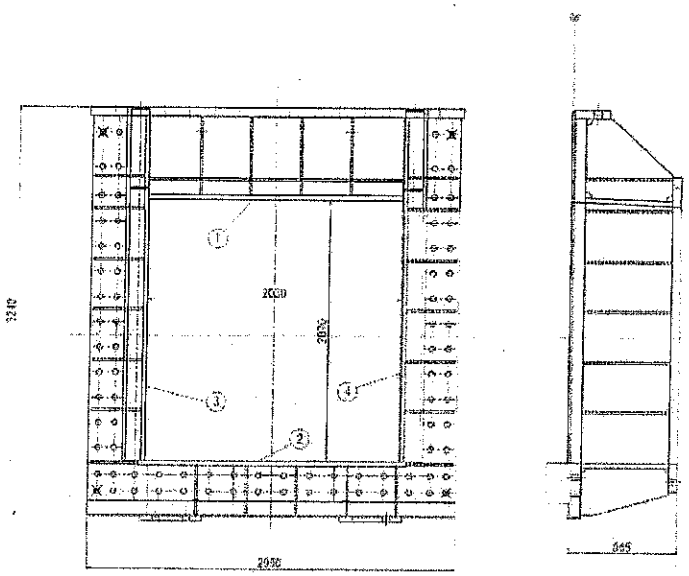
Data														Unit: μm	
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Skin Plate (Downstream Side)	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
②	Skin Plate (Upstream Side)	1												
		2												
		3												
		4												
		5												
		6												

Data														Unit: μm	
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
③	Main Beam (Upper Beam)	1												
		2												
		3												
		4												
		5												
		6												
④	Main Beam (2'nd Beam)	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
⑤	Main Girder (3'rd Beam)	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
⑥	Main Girder (Bottom Beam)	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
⑦	Side Beam (Left Bank Side)	1												
		2												
		3												
		4												
⑧	Side Beam (Right Bank Side)	1												
		2												
		3												
		4												
⑨	Vertical Beam	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												

INSPECTION REPORT FOR DRY FILM THICKNESS						
Particular	Casing of Downstream Side (Guard Gate)					
Measuring time	After completion of final painting [Final Coal tar Epoxy Resin Paint] at shop					
Measuring date/month/year						
Portion	Submerged	Specified thickness	320 µm	Minimum thickness	224 µm	
Total Painting Area/Length	8.1 m^2	Need to Inspection	17 point	Activity Inspection	18 point	

Result					
Minimum thickness	In-house	µm	Witness	µm	
Average of thickness	In-house	µm	Witness	µm	

Measuring Point

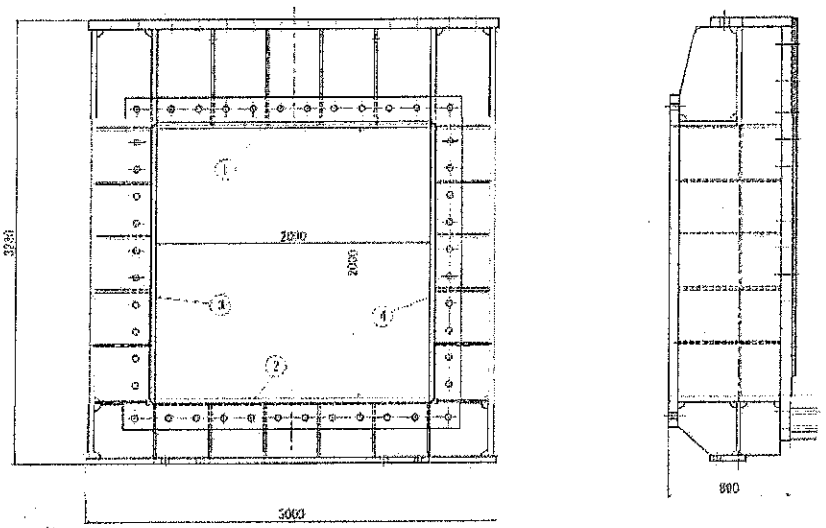


Unit: µm

Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Surface submerged in water (Top)	1												
		2												
		3												
		4												
②	Surface submerged in water (Bottom)	1												
		2												
		3												
		4												
③	Surface submerged in water (Left)	1												
		2												
		3												
		4												
		5												
④	Surface submerged in water (Right)	1												
		2												
		3												
		4												
		5												

INSPECTION REPORT FOR DRY FILM THICKNESS									
Particular	Casing of Upstream Side (Guard Gate)								
Measuring time	After completion of final painting (Final Coal tar Epoxy Resin Paint)at shop								
Measuring date/month/year									
Portion	Submerged	Specified thickness	320 µm	Minimum thickness	224 µm				
Total Painting Area/Length	7.9 m^2	Need to Inspection	16 point	Activity Inspection	16 point				
Result	Minimum thickness	In-house	µm	Witness	µm				
	Average of thickness	In-house	µm	Witness	µm				

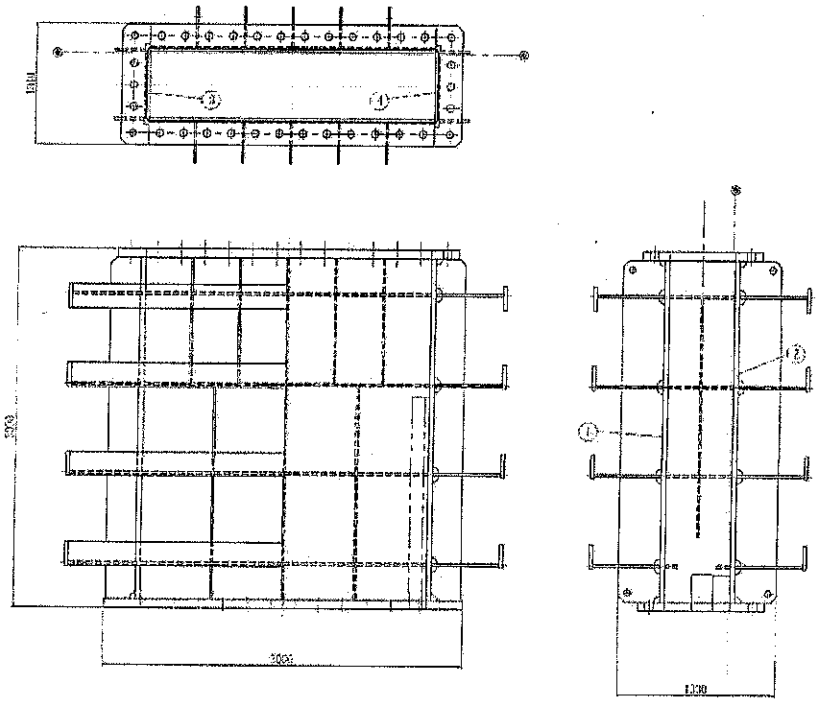
Measuring Point



Data												Unit: µm	
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Surface submerged in water (Top)	1												
		2												
		3												
		4												
②	Surface submerged in water (Bottom)	1												
		2												
		3												
		4												
③	Surface submerged in water (Left)	1												
		2												
		3												
		4												
④	Surface submerged in water (Right)	1												
		2												
		3												
		4												

INSPECTION REPORT FOR DRY FILM THICKNESS									
Particular	Bonnet (Guard Gate)								
Measuring time	After completion of final painting [Final Coal tar Epoxy Resin Paint] at shop								
Measuring date/month/year									
Portion	Submerged	Specified thickness		320 µm		Minimum thickness		224 µm	
Total Painting Area/Length	16.1 m^2	Need to Inspection		33 point		Activity Inspection		34 point	
Result	Minimum thickness		In-house	µm		Witness		µm	
	Average of thickness		In-house	µm		Witness		µm	

Measuring Point

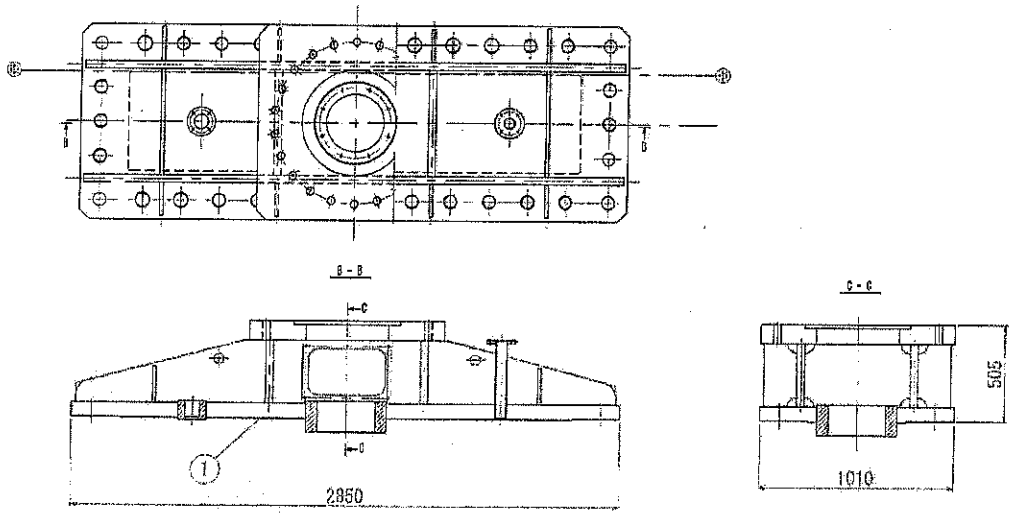


Data												Unit: µm
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Surface submerged in water (Upstream Side)	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
		9												
		10												
		11												
		12												
		13												

Data													Unit: μm
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
②	Surface submerged in water (Downstream Side)	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
		9												
		10												
		11												
		12												
		13												
④	Surface submerged in water (Left)	1												
		2												
		3												
		4												
④	Surface submerged in water (Right)	1												
		2												
		3												
		4												

INSPECTION REPORT FOR DRY FILM THICKNESS								
Particular	Bonnet Cover (Guard Gate)							
Measuring time	After completion of final painting (Final Coal tar Epoxy Resin Paint) at shop							
Measuring date/month/year								
Portion	Submerged	Specified thickness	320 μm	Minimum thickness	224 μm			
Total Painting Area/Length	2.8 m^2	Need to Inspection	6 point	Activity Inspection	6 point			
Result	Minimum thickness	In-house	μm	Witness	μm			
	Average of thickness	In-house	μm	Witness	μm			

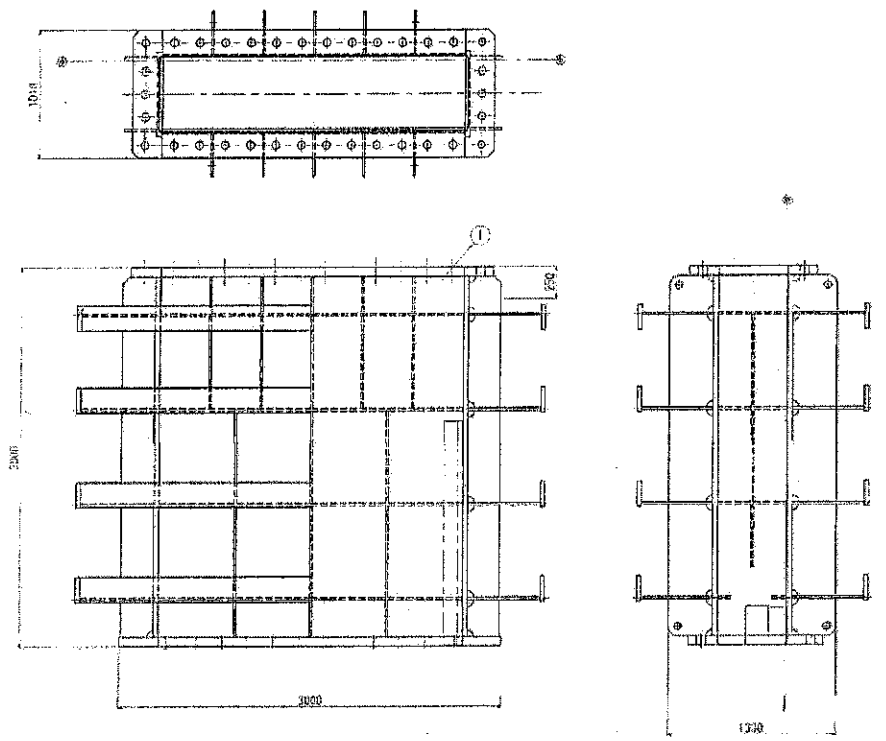
Measuring Point



Data												Unit: μm	
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Surface submerged in water	1												
		2												
		3												
		4												
		5												
		6												

INSPECTION REPORT FOR DRY FILM THICKNESS									
Particular	Bonnet (Guard Gate)								
Measuring time	After completion of final painting (Final Epoxy Resin Paint) at shop								
Measuring date/month/year									
Portion	Exposed	Specified thickness		200 μm		Minimum thickness		140 μm	
Total Painting Area	4.8 ㎡	Need to Inspection		10 point		Activity Inspection		10 point	
Result	Minimum thickness		In-house		μm	Witness		μm	
	Average of thickness		In-house		μm	Witness		μm	

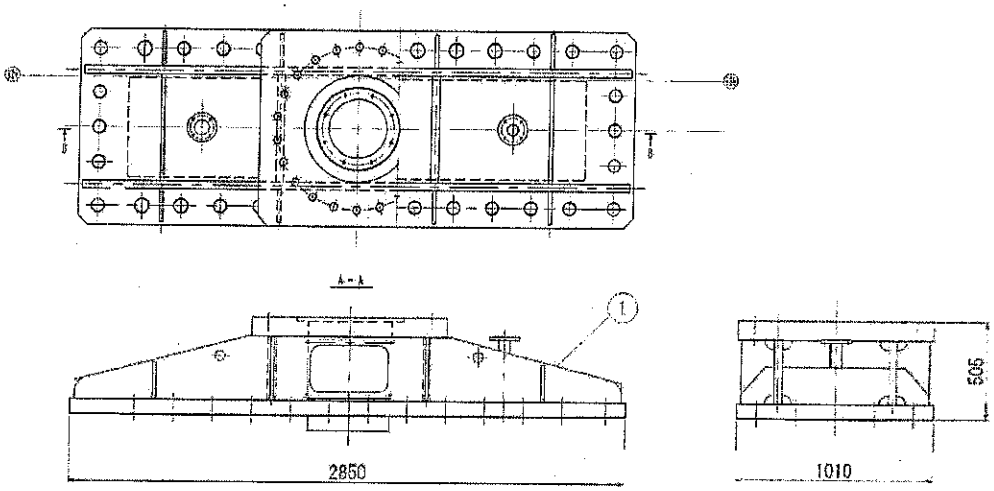
Measuring Point



Data											Unit: μm
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Exposed Surface	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
		9												
		10												

INSPECTION REPORT FOR DRY FILM THICKNESS									
Particular	Bonnet Cover (Guard Gate)								
Measuring time	After completion of final painting (Final Epoxy Resin Paint) at shop								
Measuring date/month/year									
Portion	Exposed	Specified thickness		200 μm		Minimum thickness		140 μm	
Total Painting Area	8.7 m²	Need to Inspection		18 point		Activity Inspection		18 point	
Result	Minimum thickness		In-house		μm	Witness		μm	
	Average of thickness		In-house		μm	Witness		μm	

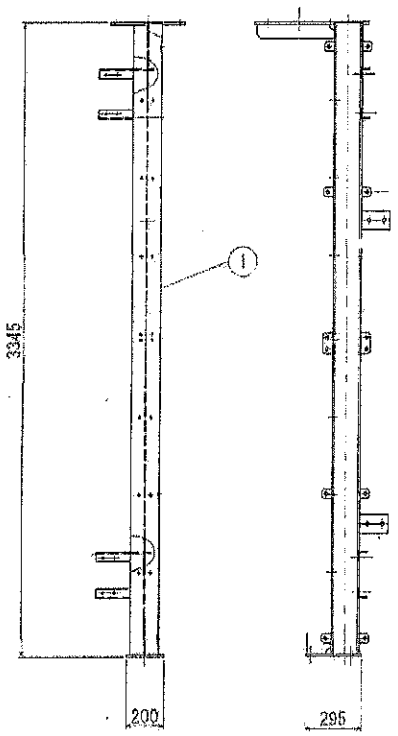
Measuring Point



Data												Unit: μm	
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Exposed Surface	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
		9												
		10												
		11												
		12												
		13												
		14												
		15												
		16												
		17												
		18												

INSPECTION REPORT FOR DRY FILM THICKNESS									
Particular	Indicator (Guard Gate)								
Measuring time	After completion of final painting (Epoxy Resin Paint) at shop								
Measuring date/month/year									
Portion	Exposed	Specified thickness		200 μm		Minimum thickness		140 μm	
Total Painting Area	4.4 ㎡	Need to Inspection		10 point		Activity Inspection		10 point	
Result	Minimum thickness		In-house		μm		Witness		μm
	Average of thickness		In-house		μm		Witness		μm

Measuring Point



Data												Unit: μm	
Measuring point			a (upper)		b (bottom)		c (left side)		d (right side)		Average		Minimum	
			In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness	In-house	Witness
①	Exposed Surface	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
		9												
		10												

Test and Inspection procedure of Hydraulic Cylinder at shop for Guard Gate

CONTENTS

1. GENERAL

This procedure is applied to the shop inspections and tests for Hydraulic Cylinder of Guard Gate for Hushan Reservoir Raw Water Pipeline II Engineering Project "湖山水庫第二原水管工程 ".

1.1 Standards and/or codes

The shop inspections and tests are performed in accordance with the following standards and/or codes.

The shop inspection is performed in accordance with the following standards and/or codes.

1) The technical specification for this project	
2) CNS	Chinese National Standards (Taiwan)
3) AISC	American Institute of Steel Construction
4) ASTM	American Society of Testing and Materials
5) ANSI	American National Standards Institute
6) ASME	American Society of Mechanical Engineers
7) AWS	American Welding Society
8) EN	European Standards
9) BS	British Standards
10)DIN	Deutsche Industrial Norman
11)JIS	Japanese Industrial Standards
12) Technical Standards for Gate and Penstock	Electric Power Civil Engineering Association, Japan
13)JSSC	Japanese Society of Steel Construction
17)Dam and Weir Technical Standards	Japan Association of Dam & Weir Equipment Engineering
18)Dam and Weir Inspection Essentials	Japan Association of Dam & Weir Equipment Engineering

The methods and criteria of the shop inspections and tests conform to the above and/or equivalent Standards approved by the Owner in advance.

1.2 Reports for submission

Reports for submission are as follows.

1) Material test and inspection report (Material lists and mill certificates for principal members)
2) Welding test and inspection report (Non Destructive Test report)
3) Shop assembly inspection report and functional test report
4) Painting inspection reports (Dry film thickness reports)
5) Certificates and/or test reports for purchased products

2. MATERIAL TEST AND INSPECTION for HYDRAULIC CYLINDER

2.1 Confirmation of Material

All materials used for this project conform to JIS or equivalent Standards approved by the Owner in advance.

Their conformance with the specification is checked on certificated mill test report (Material Certificate).

2.2 Chemical Composition

The chemical composition of raw materials is checked on the Material Certificate.

2.3 Mechanical Properties

The mechanical properties of raw materials are checked on the Material Certificate.

2.4 Material Certificate

The following material certificates of principal component are to be prepared and submitted;

Table 2-1 Object component of material

Item	Principal component
Hydraulic Cylinder	Hydraulic cylinder tube , piston rod, piston, lock nuts, tube flange and head and cap cover

2.5 Non Destructive Test

Material for cylinder rod is to be carried out NDT (UT) if the material is forgings.

3. WELDING TEST AND INSPECTION

3.1 Visual Inspection

-Excess weld metal, leg length and throat thickness
-Undercut
-Pit on bead surface
-Overlap
-Boxing and build-up welding
-Crack

Acceptance Criteria of Welding is shown in Table 3-1.

Table 3-1 Acceptance Criteria of Welding

Item	Criteria
Excess weld metal, leg length and throat thickness	Conform to Table 3-2
Undercut	Conform to Table 3-3
Pit on bead surface	a) Pit on butt welds, T-joint consisting a cross section, or corner joint is not allowed for principal member. b) Except above Clause a), (3-pits or less / each joint) and (3-pits or less / m of joint length) are allowed. When the size of the pit is 1.0 mm or smaller, 3-pits are considered as 1-pit for these criteria.
Overlap	Overlap is not allowed.
Boxing and build-up welding	a) Boxing shall be done for the ends of fillet joints. For the portion where boxing is not possible, return welding shall be applied. b) Defect like lack of build-up welding is not allowed on the end of butt joints.
Crack	Crack is not allowed on and around bead. Any suspicious portion shall be checked with non-destructive test.

Table 3-2 Tolerance of Excess Weld Metal, Leg Length and Throat Thickness

Item	Condition	Tolerance
Height of excess metal of butt weld	For plate thickness(mm) $t \leq 12$ $12 < t \leq 25$ $25 < t$	 3.0 mm (max) 4.0 mm (max) 6.0 mm (max)
Leg length and throat thickness of fillet weld	In relation to 10% of the length except for 50 mm from both edges of a weld line	Within -1.0mm

Table 3-3 Tolerance of Undercut

Plate thickness (mm)	Standard allowance	Maximum allowance
$t \leq 6$ $t > 6$	0.3mm 0.5mm	0.6mm 0.8mm
Note	Acceptable for butt joint of principle component members when 90% of the weld line is within the above ranges, and for other joint 80%.	Undercut deeper than the above shall be repaired.

3.2 Non Destructive Test (Radiographic Test : RT)

The full penetration butt-welding joint on the cylinder tube shall be inspected by Radiographic Test.

1) General

Radiographic test (RT) is performed to the butt welds. Radiographic test is in accordance with JIS Z 3104.

All defects exceed the criteria are removed and repaired. The replacement weld and contiguous parts to the original weld are retested.

2) Radiographic Test Lengths

Radiographic Test Lengths are 100% of the full penetration butt-welding length.

3) Radiographic test Photographing method

The arrangement of identification marks on radiograph films is shown on Figure 5-1.

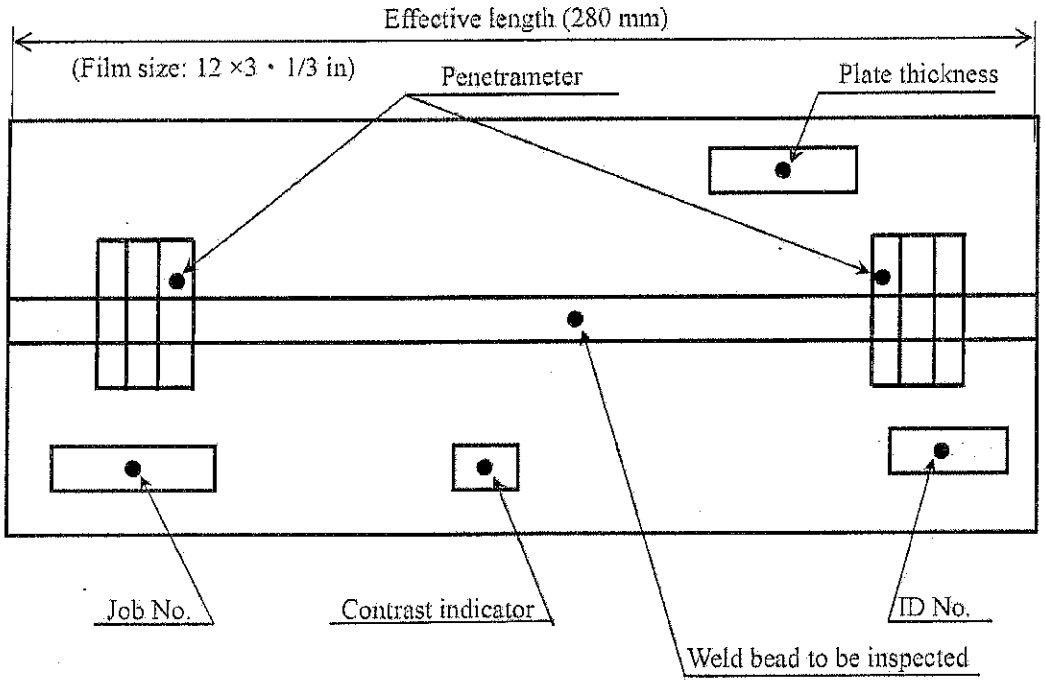


Figure 3-1 Arrangement of identification marks

4) Radiographic test Acceptance Criteria

Radiographic test classification is in accordance with JIS Z 3104 "Methods of Radiographic Test and Classification of Radiographs for Steel Welds"

Acceptance criteria for radiographic test are shown in Table 3-4.

Table 3-4 Acceptance Criteria for Radiographic Test

Type of flaw	Thickness of base metal t ≤ 50mm	50 < t
Non-Flaw	Acceptable	Acceptable
Type-1	Class-2 or more	Class-1
Type-2	Class-2 or more	Class-1
Existing Type-1 and 2	Class-2 or more	Class-2 or more
Type-3 and 4	Reject	Reject

4. TEST AND INSPECTION OF HYDRAULIC CYLINDER

The quality, dimension and specified function of the hydraulic Cylinder is checked and confirmed. Test and Inspection Method and Acceptance Criteria are shown in Table 4-1.

Table 4-1 Test and Inspection Method and Acceptance Criteria

No.	Part	Item	Method and Criteria
1	Hydraulic cylinder	Material	- Material Certificate
		Visual	- As shown in drawing
		Dimension and tolerance	- As shown in drawing - Tolerance of Cylinder length ±3.0 mm - Tolerance of Cylinder length from Cap end to cylinder rod at most contraction ±3.0 mm - Stroke ±3.0 mm - Cylinder rod diameter See Table 4-2 - Cylinder tube outside diameter ±0.8 mm - Cylinder tube inside diameter See Table 4-3
		Pressure proof test	- Not permit any outer leakage (testing condition: 1.5 × design pres. /2 min.) Not permit any deformation during pressure proof test
		Inner Leakage test	- Testing condition: 1.0× design pres. /10 min. Acceptance criteria to be informed after detail design of cylinders
		Operation test (No loading condition)	- Not permit any vibration and noise during operation. - Not permit any outer leakage during operation - Measurement of lowest operating pressure. See Table 4-4
		Coating of Piston Rod	-Hard chromium plating Required plating thickness 50 μm×2 layer
		Function Test of Dogging Device	-Confirmation of Dogging Device Function
2	Paint Material for cylinders	Material	- Check of inspection certificate by manufacturer

Table 4-2 Diameter of Piston Rod

Unit: mm

Rod Diameter	tolerance of finish dimensions	Circularity & Cylindricality
63, 80	−0.030, −0.076	0.046
100, 120	−0.036, −0.090	0.054
140, 160, 180	−0.043, −0.106	0.063
more than 180, not less than 250	−0.050, −0.122	0.072
more than 250, not less than 315	−0.056, −0.137	0.081

Table 4-3 Inside Diameter of Cylinder Tube

Unit: mm

Inside Diameter of Cylinder Tube	Case of using seal other than piston ring	
	tolerance of finish dimensions	Circularity & Cylindricality
180	+0.100, 0	0.100
more than 200, not more than 250	+0.115, 0	0.115
more than 250, not more than 300	+0.130, 0	0.130
more than 300, not more than 400	+0.140, 0	0.140
more than 400, not more than 500	+0.155, 0	0.155
more than 500, not more than 600	+0.175, 0	0.175

Table 4-4 Lowest operation pressure

[Unit :MPa]

Shape of Piston packing	Nominal pressure	In case that rod packing is not V-packing		In case that rod packing is V-packing	
		The pressure is supplied from the cap side.	The pressure is supplied from the head side.	The pressure is supplied from the cap side.	The pressure is supplied from the head side.
V	7	0.5	0.98	0.74	1.5
	14	Rated Pressure ×6%	Rated Pressure ×12%	Rated Pressure ×9%	Rated Pressure ×18%
	21				
U, O	7	0.29	0.59	0.44	0.9
	14	Rated Pressure ×4%	Rated Pressure ×8%	Rated Pressure ×6%	Rated Pressure ×12%
	21				

5. PAINTING INSPECTION

5.1 Surface Preparation Inspection

Blast cleaned surface is checked in accordance with SSPC-SP10 (ISO 8501-1, Sa 2 1/2), before shop primer painting at the steel mill shop or manufacture shop.

5.2. Visual Inspection

The criteria of visual inspection for painting are as follows:

1) Painted surface shall be smooth and free from unevenness (For instance, no remarkable run nor blister).
2) Prime or preceding painted layer shall not be seen through.
3) Hue and gloss shall be identical to the designated color.

5.3 Dry Film Thickness Inspection

After surface preparation, following paints are applied;

① Epoxy Zinc Rich Primer after surface preparation within 4 hours (Dry film thickness 50 μm)
② Epoxy Resin Paint (Dry film thickness 45 μm × 2 layer)
③ Epoxy Resin Paint (Dry film thickness 30 μm × 2 layer)

Total dry film thickness: 200 μm

The painted surface of cylinder is inspected for two inspection units per square meter of coating area, but at least three inspection units or more.

中英對照表

封面

Test and Inspection Procedure at Shop for Guard Gate Dimensional, Welding, Painting and Assembly Inspection	閘閥室防護閘門之尺寸、電銲、塗裝及組配之工廠測試及檢驗程序書

目錄

P.1

GENERAL	概述
This procedure is applied to the shop inspection for Guard Gate of the project for Hushan Reservoir Raw Water	本程序書適用於湖山水庫第二原水管工程之閘閥室防護閘門之工廠測試及檢驗

Pipeline II Engineering Project "湖山水庫第二原水管工程 ".	
Standards and/or codes	標準 和/或 代碼
The shop inspection is performed in accordance with the following standards and/or codes.	工廠測試及檢驗按照以下標準和/或代碼進行。
The technical specification of this project	本計畫之技術規範
CNS Chinese National Standards (Taiwan)	中國國家標準
AISC American Institute of Steel Construction	美國鋼結構學會
ASTM American Society of Testing and Materials	美國材料試驗協會
ANSI American National Standards Institute	美國國家標準學會
ASME American Society of Mechanical Engineers	美國機械工程師協會
AWS American Welding Society	美國焊接協會
EN European Standards	歐洲規範
BS British Standards	英國國家標準
DIN Deutsche Industrial Norman	德國標準協會
JIS Japanese Industrial Standards	JIS： 日本工業標準
Technical Standards for Gate and Penstock Electric Power Civil Engineering Association, Japan	社團法人電力土木技術協會(原日本水門鐵管協會)－ 水門鐵管技術基準
JSSC Japanese Society of Steel Construction	日本鋼構造協會
Dam and Weir Technical Standards Japan Association of Dam & Weir	堰壩技術標準－日本堰壩施設工程協會

Equipment Engineering	
Dam and Weir Inspection Essentials Japan Association of Dam & Weir Equipment Engineering	堰壩檢查要領－日本堰壩施設工程協會
Reports for submission	提交報告
Reports for submission are as follows;	提交報告如下
1) Material test report (Material lists and mill certificates for principal members)	材料測試報告（材料清單和主要構件之材質證明）
2) Welding test report (Non Destructive Test report)	電銲測試報告(非破壞檢驗報告)
3) Shop assembly inspection report (Including operation test reports)	工廠組立檢驗報告(包括功能測試報告)
4) Painting inspection reports (Dry film thickness reports)	油漆檢驗報告(乾膜厚度檢驗報告)
5) Certificates and/or test reports for purchased products	市購品之證明書及測試報告

P.2

SCOPE OF TEST AND INSPECTION	測試及檢驗範圍
Scope of Test and Inspection	測試及檢驗範圍
Test and inspection are performed in accordance with the item and category as indicated in the following Table 2-1.	本工廠檢驗程序書依據下列類別及項目表實施
Table 2-1 Scope of test and inspection	測試及檢驗範圍
Description	說明
Material inspection	材料檢驗
Welding inspection	電銲檢驗
Visual check	目視檢查
Non destructive test	非破壞檢驗
Shop assembly	工廠預組
Dimension inspection	尺寸檢驗
Water Pressure test	水壓試驗
Leakage test	滲漏試驗
Operation test	操作測試
Painting inspection	油漆檢驗
Dry film thickness inspection	乾膜厚度檢驗

Guard Gate	防護閘門
Mark [◎] is witnessed by the inspector.	標示[◎]者須經檢驗人員見證。
Mark [○] is carried out by ourselves and test reports are submitted.	標示[○]者於此報告送審後，由我方執行。
Mark [ ] is carried out by ourselves and/or witnessed by the inspector.	標示[ ]者須經檢驗人員見證後，由我方執行。
※Operation test is performed at manufacture's factory.	操作測試於製造工廠實施。
The Inspector means The Employer or third party inspector	檢驗人員意指業主或第三機構檢查人員
Third party: JAPAN INSPECTION CO., LTD	第三機構：日本檢查株式會社
Schedule of Test and Inspection	測試及檢驗日程
The plan of Test and inspection schedule is shown in the following Table 2-2.	測試及檢驗日程如下表 2-2 所列。
Table 2-2 Test and Inspection Schedule	測試及檢驗日程
Test and Inspection	測試及檢驗
Material Inspection	材料檢驗
Equipment Inspection and Test	設備檢驗及測試
Shop Assembly Inspection and test	工廠預組檢測
Welding Inspection	電焊檢驗
Painting Inspection	油漆檢驗
PLAN	日程
Mar.2019	2019 年 3 月
Jul.2019	2019 年 7 月
Nov.2019	2019 年 11 月
Dec.2019	2019 年 12 月
ditto	同上
Object	標的物
Main Material Steel Plate	主構件鋼板
Hydraulic Cylinder	油壓缸
Hydraulic Unit	
Guard Gate	防護閘門

P.3

Time Schedule for Oversea Inspection	海外檢驗預定時程表
Draft Time Schedule for Oversea	海外檢驗預定時程表如下列表 2-3 所

Inspection of shop assembly is shown in the following Table	示。
In shop inspection, the following two gates are inspected simultaneously.	工廠檢驗：下列 2 門須同步檢驗
Control Gate	控制閘門
Guard Gate	防護閘門
Time Schedule	時程
time	時間
item	項目
Introduction	簡介
Non destructive test	非破壞檢驗
Lunch time	午餐時間
Dimension Inspection	尺寸檢查
Painting Inspection	油漆檢查
Meeting	會議
note	附註
Include the confirmation of previous inspection	包含前所檢驗之確認
Test	測試
item	項目
Introduction	簡介
Water Pressure Test	水壓測試
Preparation and Cleaning	預備及清理
Lunch time	午餐時間
Operation Test	操作測試
Meeting	會議
note	附註
Water will be filled in the Gate during the night	水於夜間注入閘門
Details are to be submitted later.	細節將在稍後提交。

P.4

MATERIAL INSPECTION	材料檢驗
Certificated mill test reports	材料證明及測試報告
All materials used in this project are in conformity with JIS or equivalent standards.	本計畫所採用材料須符合 JIS 標準或同等標準。

Their conformance with the specification is checked on certificated mill test reports.	依據材料證明及檢驗報告檢查是否符合規範。
Main components and equipment is shown in table 3-1	主要構件及設備如表 3-1 所示。
Table 3-1 Main Component and Equipment	主要構件及設備
Equipment	設備
Component	組件
Material	材料
JIS or other Standards	JIS 標準或其他標準
Casing	門框
Connecting Flange	連結法蘭
Beam	橫樑
Casing Body	門框本體
Sliding Plate	滑動鈑
Bonnet	閘箱
Connecting Flange	連結法蘭
Body	本體
Beam	橫樑
Sliding Plate	滑動鈑
Bonnet Cover	閘箱帽蓋
Connecting Flange	連結法蘭
Rib	肋條
Boss	凸面；輪鼓
Bush	軸襯
Gate Leaf	閘門門扉
Skin Plate	面鈑
Beam	橫樑
Seal Plate	水封鈑
Rubber Seal	橡膠水封
Hoist	吊門機
Cylinder Tube	油壓缸管
Rod	昇桿
Chemical Composition	化學成分
The chemical composition of raw materials is checked on the mill sheet	原材料之化學成份須依據材料表(材料證明)檢查。

(Mill Certificate).	
Mechanical Properties	機械性能
The mechanical properties of raw materials are checked on the mill sheets (Mill Certificate).	原材料之機械性質須依據材料表(材料證明)檢查。

P.5

WELDING INSPECTION	電焊檢驗
All welds are inspected in accordance with the following methods. The specified welds are inspected by Non Destructive Test.	所有焊道須依據下列方式檢驗.所規定之焊道須以"非破壞檢驗"方式檢驗。
Visual inspection	目視檢查
All welds are visually inspected in accordance with Technical Standards for Gate and Penstock. Welds are acceptable to the following visual inspection using the gauge.	所有焊道須依據水門鐵管技術基準檢驗；利用儀錶目視檢查下列各項研判焊道是否合格。
Visual inspection acceptance of weld profiles is shown in Table 4-1.	目視檢查焊道是否合格，其描述如下表 4-1 所示。
Acceptance of weld profiles	焊道合格之描述
Item	項目
Undercut	凹陷
Piping porosity	管狀氣孔
Crater	坑洞
Crack	裂痕
Reinforcement	補強電焊
Over lap	重搭
Arc strike	弧擊
Underrun	通過標準
Acceptance	合格標準
Undercut acceptance is shown in Table 4-2.	焊道凹陷合格標準如表 4-2
Piping porosity acceptance is shown in Table 4-3.	氣孔合格標準如表 4-3
All craters shall be filled to the full cross section of the weld, except for the end of	除外部跳焊末端有效長度外，所有坑洞須填滿至焊道橫斷面所示。

intermittent weld outside of their effective length	
Welds shall have no cracks.	焊道不得有裂痕
Reinforcement acceptance is shown in Table 4-4.	補強電焊合格標準如表 4-4
Over lap is not acceptable.	焊道不得重搭
Arc strike is not acceptable.	焊道不得弧擊
A filet weld in any single continuous weld shall be permitted to underrun the nominal fillet size, provided that the undersize portion (-1mm) of the weld does not exceed 10% of the length of the weld except 50mm at the both ends of the weld.	任何單一連續焊接之填角焊須符合公稱尺寸之通過標準，所提供焊道不足部位(少於 1mm)不得超過 10%之焊道長度，其兩端 50mm 範圍除外。
Acceptable value on undercut	焊道凹陷合格標準
Thickness	厚度
Control limit	控制極限
Permissible limit	容許極限
Undercut which depth is under the control limit is permitted in case of its hole length is within 90% of butt welded joint length in any stress members, or within 80% of all other welded joint length.	任何承受應力桿件若其孔長在對焊焊道長度 90%以內或焊道全長之 80%，凹陷深度在控制極限以下是被允許的。
Undercut which depth is under the permissible limit is not permitted.	凹陷其深度在容許極限以下是不被允許的。
Acceptable value on piping porosity	管狀氣孔之合格標準
Joint type	焊道型式
Butt joint, T joint or corner joint of the principal member	主構件之對焊、T 形焊道或角隅焊道
All other groove	其他型式開槽
Number of piping porosity	管狀氣孔數量
Not permitted	不允許
≦3:the number of piping porosity in each joint or in any 1000mm length of weld, provide that if the diameter of piping porosity is ≦1mmΦ, 3 piping porosities is regarded as 1 piping	少於 3 個：每一焊道或任何 1000mm 長焊道其管狀氣孔直徑≦1mmΦ 者，3 個管狀氣孔被視為 1 個管狀氣孔

porosity.	

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Acceptable value on reinforcement of weld	補強電焊之合格標準
Thickness	厚度
Main structure of gate	閘門主結構
Discharge pipe under pressure	壓力下之排水管
Other main structure under pressure	壓力下其他閘門主結構
Non Destructive Test	非破壞檢驗
General	總則
Radiographic test (RT) is performed on full penetration butt weld joints.	放射線檢驗(RT)在全滲透對接焊縫上執行
Ultrasonic test (UT) is also performed on full penetration butt weld joints.	超音波檢驗(UT)在全滲透對接焊縫上執行
Liquid Penetrant test (PT) is performed on all welds on Gate leaf, Seal Seats of Casing and Side Guide including Siding Plate of Bonnet.	對門扉及門框之所有銲接縫均需辦理滲透液探傷檢驗法（PT）檢驗。
Non Destructive test is conducted by the engineer who has the qualification of the level 2 or 3.	非破壞檢驗執行工程師須具有第 2 級或第 3 級水準之資格。
Radiographic test is in accordance with JIS Z 3104.	放射線檢驗須依據 JIS Z 3104 規範實施。
Ultrasonic test is in accordance with JIS Z 3060.	超音波檢驗須依據 JIS Z 3060 規範實施。
Liquid Penetrant test is in accordance with JIS Z2343.	
All defects observed are removed and repaired. The replacement weld and contiguous parts to the original weld are retested.	所有被查獲之瑕疵須消除及修繕。原焊道從新電焊及鄰近部位須再檢驗。
Examination ratio	檢驗率
Examination ratio of RT and UT	
The examination ratios are shown in Table 4-5.	檢驗率如下表 4-5 所示：
Table4-5 Examination ratios of RT and UT	表 4-5 RT 和 UT 的檢驗比率

Items	項目
Full Penetration Butt weld	全滲透對接焊縫
RT	放射線檢驗
UT	超音波檢驗
Guard Gate	防護閘門
above 20%	20%以上
Remarks	附註
RT is applicable to the plate thickness less than 50mm basically.	基本上 RT 放射線檢驗適用於鈑厚小於 50mm 者
UT is applicable to the plate thickness more than 50mm basically or the portion where RT is impossible.	基本上 UT 超音波檢驗適用於鈑厚大於 50mm 者或 RT 放射線檢驗無法執行部位。
RT has priority over UT.	RT 優先於 UT。
RT is relatively easy to apply. Most of defects such as cracks, blowhole, incomplete fusion, slag inclusion, and incomplete penetration may easily be detected. This RT is basically employed in this project.	RT 相對容易應用。 可以容易地檢測到大多數缺陷，例如裂縫，氣孔，不完全熔合，夾渣和不完全滲透。 該 RT 基本上用於該項目。

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Examination ratio of PT	PT 的檢查比率
The examination ratio of PT is shown in Table 4-6.	PT 的檢查比率如表 4-6 所示。
All welds on Gate leaf, Seal Seat of Casing and Side Guide incl. Siding Plate of Bonnet	門扉上的所有焊縫，套管密封座和側導板包括。 帽子側板
Guard Gate	防護閘門
Object for NDT	非破壞檢驗之標的
Full Penetration butt welds on Gate leaf, Bonnet and Upstream side Casing	在門扉，閥蓋和上游側套管上的全滲透對接焊縫
Object for PT	施作 PT 的構件
All welds on Gate leaf	門扉上的所有焊縫
All welds on Seal Seats of Casing (Gate frame)	密封座（門框）上的所有焊縫
All welds on Side Guide and Siding Plate of Bonnet (Gate frame)	閥蓋側導板和側板上的所有焊縫（門框）

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Execution engineer's qualification	執行檢驗工程師之資格
Engineer's qualification is below,	工程師之資格如下所列：

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Radiographic examination	放射線檢驗
Photographing method	放射線檢驗方法
The arrangement of identification marks on radiograph films is shown in Figure 4-1.	攝影膠片上識別碼之安排如示意圖 Figure 4-1.
Effective length	有效長度
Film size:	膠片規格
Penetrate meter	滲透儀
Plate thickness	鈑厚
Job No.	工作編號
Contrast indicator	對比指示器
Weld bead to be inspected	需檢驗之焊道
ID No.	識別號碼
Figure 4-1 Arrangement of identification marks	圖 4-1 識別標記的排列
Acceptance Criteria	接受準則
Radiographic classification is in accordance with JIS Z 3104 [Methods of radiographic examination for welded joints in steel]. Then acceptance is shown in Table 4-6.	放射線檢驗依據 JIS Z 3104[鋼材焊道放射線檢驗方法]分類，接受標準如 4-6 表所示。
Acceptance in the radiographic examination	放射線檢驗標準
Kind of flaw	缺陷種類
Flaw of class 1	缺陷分類
Combined flaws of class 1 with class 2	第 1 級及第 2 級缺陷之組合
Acceptance	接受
Grade 2	第 2 級
Unacceptable	不接受

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Ultrasonic Test	超音波檢驗
Ultrasonic Test is in accordance with JIS Z 3060 [Method for ultrasonic examination for welds of ferritic steel].	超音波檢驗依據 JIS Z 3060[含鐵鋼材焊道超音波檢驗方法]實施
The acceptance is equal to or better than Class 2 when using L-disregard level.	當使用 L 無視等級時，接受等於或優於等級 2。
Classification of discontinuities according to region of echo height and indication length	根據回波高度和指示長度的區域對不連續性進行分類
Penetrant Test	滲透液檢驗
The liquid penetrant test method shall conform to the requirement of JIS Z 2343 "Non-destructive testing – Penetrant testing—".	液體滲透試驗方法應符合 JIS Z 2343"無損檢測 - 滲透液檢驗 -"的要求。
The acceptance is shown as follows;	驗收如下所示
Cracks are not allowed on and around weld bead.	焊縫上和周圍不允許出現裂縫。
Liner indications (independent or continuous) are not allowed on and around weld bead	焊縫上和周圍不允許有襯墊指示（獨立或連續）
Circular indication, which major axis over 2mm is not allowed on and around weld bead.	焊縫上和周圍不允許有長軸超過 2mm 的圓形指示。
Scattered indications is not allowed on and around weld bead.	焊縫上和周圍不允許有分散的跡象。

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SHOP ASSEMBLY INSPECTION	工廠組立檢驗
The gate equipments are assembled in the shop, and dimensional inspections and visual check on welds (see 4.1) are performed at manufacture's factories.	閘門設備於工廠預組，焊道之尺寸檢驗及目視檢查(見4.1節)在製造者工廠實施。
Shop assembly position	工廠組合部位
The gate is temporarily assembled in the installation position.	閘門於安裝位置預組。
Dimensional tolerances at shop assembly	工廠組合尺寸公差
Dimensional inspection is carried out for	所有設備必須執行尺寸檢查，其公差

all equipments, and tolerances are shown in Table 5-1. Detailed tolerances are shown in each check sheets.	如表5-1所示。詳細公差於各別檢查表標示。
Dimensional tolerances	尺寸公差
Gate	閘門
Symbol	符號
Point to be measured	量測點
Tolerance	公差
High Pressure Slide Gate	高壓滑動閘門
Gate leaf width (Left side)	閘門寬度(左側)
Gate leaf width (Right side)	閘門寬度(右側)
Gate leaf height	閘門高度
Gate leaf depth	閘門厚度
Distance between horizontal main beam	主橫梁之間
Skin plate thickness	面鈑厚度
Gate slot	閘門開槽
Casing height from gate center to bottom	閘門中心至門底之閘框高度
Casing height from gate center to top	閘門中心至門頂閘框高度
Bonnet cover height	閘箱帽蓋高度
Upstream side casing length	上游側閘框長度
Downstream side casing length	下游側閘框長度
Inside dimension of pipe width (upstream side)	管寬之內面尺寸(上游側)
Inside dimension of pipe height (upstream side)	管寬之內面尺寸(上游側)
Inside dimension of pipe width (downstream side)	管寬之內面尺寸(上游側)
Inside dimension of pipe height (downstream side)	管寬之內面尺寸(上游側)
Casing width	閘箱寬度
There is no tolerance on the reference standard. This tolerance is in house tolerance.	此公差並無參考標準，此公差為公司內部公差。
This tolerance based on JIS G 3193	此公差依據 JIS G 4304。
Hydraulic Test	水壓試驗
Test condition	試驗條件

The high pressure slide gate is tested under the following condition (See Table 5-2). In this case, the gate is confirmed that there is no leakage from metal joints and no permanent damage.	高壓滑動門門之測試條件如表5-2所示。在此條件下，確認閘門無滲漏且無永久的損壞。
Test pressure & holding time	水壓測試及持續時間
Design pressure	設計壓力
Test pressure	測試壓力
Holding time	持續時間
Hydraulic Test	水壓試驗
Design pressure	設計壓力
Test pressure	測試壓力

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Leakage volume	滲漏量
Acceptable leakage volume of water seals is 2 liters per minute.	容許滲漏量為 2 公升/分鐘。
Operation Test	操作測試
The operation test is performed at manufacture's factories.	操作測試於製造者工廠實施。
The operational performance of the gate is checked by the operation test.	閘門操作功能以操作測試來檢查。
Check items and criterion are shown in Table 5-3	檢查項目及準則如表 5-3 所示。
Check items and criterion on operation test（Gate）	閘門操作測試檢查項目及準則
Check items	檢查項目
Rated capacity	額定容量
Hoisting speed	吊門機啟閉速度
Voltage of electric motor	馬達電壓
Electric current of electric motor	馬達電流
Insulation value of motor	馬達絕緣值
Temperature rise of bearing, motor and reducer	馬達及減速機溫度昇高容忍度
Vibration	振動
Operation of limit switches	極限開關動作
Operation of gate position indicator	開度指示器運轉

Criterion	準則
Ambient temperature	周遭環境溫度
Abnormal vibration is not permitted	不得有異常振動
Normal	正常
Electric current and Insulation value of motor are to be added later.	稍後將添加電動機的電流和絕緣值。
PAINTING INSPECTION AT SHOP	工廠油漆檢查
The dry film thickness and appearance are inspected in accordance with Painting Specification.	根據塗漆規範檢查乾膜厚度和外觀。
Water seal seat, guide ledge, main wheel track seat, pressure seat, and other Gate Frame	水封座，導軌，主輪軌道座，壓力座和門框
The painted surface is inspected on four detection units per meter of length, and four test units still be inspected for less than one meter of member.	在構件塗漆表面每米長度需檢測四個點，不到一米的構件仍然需檢測四個點。
Object	物體
Side Guide of Bonnet	閥蓋側導架
Gate leaf and other related members	門扉和其他相關構件
The painted surface is inspected for two inspection units per square meter of coating area, and the deficiency still be tested on four inspection units.	塗漆表面每平方米檢查兩個點，不足部分仍需檢驗 4 個點。
Object	物體
Gate leaf	門扉
Surface submerged in water of Casing	浸沒在水中的構件(Casing)表面
Surface submerged in water of Bonnet except Side Guide	除了側導板外，浸沒在水中的構件(Bonnet)表面
Surface submerged in water of Bonnet Cover	浸沒在水中的構件(Bonnet Cover)表面

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Hoist and other members exposed to the air	暴露在空氣中的吊門機和其他構件
The painted surface is inspected for two inspection units per square meter of coating area, but at least three inspection	每平方米塗層區域檢查塗漆表面兩個檢查單元，但每個構件或每側至少檢查三個或更多檢查單元。

units or more inspected per member or per side.	
Object:	構件
Hoist	吊門機
Surface exposed to the air of Bonnet	暴露在空氣中的 Bonnet 表面
Surface exposed to the air of Bonnet Cover	暴露在空氣中的 Bonnet Cover 表面
Indicator	開度指示器
Details are shown in each check sheets.	詳細信息顯示在每張檢查表中。
Specified Thickness	規範漆膜厚度
Painting portion	油漆部位
For the surface submerged in water	浸於水中之表面
For the surface exposed to the air, including Hoist and etc.	對於暴露在空氣中的構件表面，包括吊門機等。
Specified Thickness	規範漆膜厚度
TEST FOR PURCHASED PRODUCTS	市購品測試
The purchased products which are hydraulic cylinder, hydraulic unit and position indicator are checked and confirmed to be good enough for use. Certificates and/or the test reports are submitted.	市購品如油壓缸、油壓單元及開度指示器須檢查確認其使用良好，證明書及測試報告已送審。

Test and Inspection procedure of Hydraulic Cylinder at shop for Guard Gate

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Test and Inspection procedure of Hydraulic Cylinder at shop for Guard Gate	閘閥室控制閘門油壓缸之工廠測試及檢驗程序書

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GENERAL	總則
Standards and/or codes	標準 和/或 代碼
Reports for submission	提交報告
MATERIAL TEST AND INSPECTION	材料試驗和檢驗
Confirmation of Material	材料核准
Chemical Composition	化學成分
Mechanical Properties	機械性能
Components to be tested	測試構件
Non Destructive Test	非破壞性檢驗
WELDING TEST AND INSPECTION	焊接試驗和檢驗
Visual inspection	目視檢驗
Non Destructive Test(RT)	非破壞性檢驗 (射線檢驗 : RT)
TEST AND INSPECTION OF HYDRAULIC CYLINDER	油壓缸的試驗和檢驗
PAINTING INSPECTION	塗裝檢驗
Surface Preparation Inspection	表面處理檢驗
Visual Inspection	目視檢驗
Painting Film Thickness Inspection	塗裝厚度檢驗

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GENERAL	總則
This procedure is applied to the shop inspections and tests for Hydraulic Cylinder of Guard Gate, for Hushan Reservoir Raw Water Pipeline II Engineering Project "湖山水庫第二原水管工程"	本程序書適用於"湖山水庫第二原水管工程"閘閥室防護閘門油壓缸之工廠檢驗。
Standards and/or codes	標準 和/或 代碼
The shop inspections and tests are performed in accordance with the	工廠測試及檢驗按照以下標準和/或代碼進行。

following standards and/or codes.	
The technical specification for this project	此工程之技術規範
Chinese National Standards (Taiwan)	中國國家標準
American Institute of Steel Construction	美國鋼結構學會
American Society of Testing and Materials	美國材料試驗協會
American National Standards Institute	美國國家標準學會
American Society of Mechanical Engineers	美國機械工程師協會
American Welding Society	美國焊接協會
European Standards	歐洲規範
British Standards	英國國家標準
Deutsche Industrial Norman	德國標準協會
Japanese Industrial Standards	日本工業標準
Technical Standards for Gate and Penstock Electric Power Civil Engineering Association, Japan	社團法人電力土木技術協會(原日本水門鐵管協會)－水門鐵管技術基準
Japanese Society of Steel Construction	日本鋼構造協會
Dam and Weir Technical Standards Japan Association of Dam & Weir Equipment Engineering	壩堰技術基準－日本壩堰設施技術協會
Dam and Weir Inspection Essentials Japan Association of Dam & Weir Equipment Engineering	壩堰技術基準－日本壩堰設施技術協會
The methods and criteria of the shop inspections and tests conform to the above and/or equivalent Standards approved by the Owner in advance.	工廠測試及檢驗之方法和標準符合業主事先批准的上述和/或同等標準。
Reports for submission	送審報告
Reports for submission are as follows.	送審報告如下
Material test and inspection report (Material lists and mill certificates for principal members)	材料試驗和檢驗報告（材料清單和主要構件之材質證明）
Welding test and inspection report (Non Destructive Test report)	焊接試驗和檢驗報告（非破壞檢驗報告）
Shop assembly inspection report and	工廠組立檢驗報告和功能測試報告

functional test report	
Painting inspection reports (Dry film thickness reports)	塗裝檢驗報告（乾膜厚度報告）
Certificates and/or test reports for purchased products	購買產品的證書和/或測試報告

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MATERIAL TEST AND INSPECTION for HYDRAULIC CYLINDER	油壓缸的材料試驗和檢驗
Confirmation of Material	確認材料
All materials used for this project conform to JIS or equivalent Standards approved by the Owner in advance.	本工程使用的材料均符合 JIS 或業主事先批准之同等標準。
Their conformance with the specification is checked on certificated mill test report (Material Certificate).	確認材料試驗報告（材質證明）符合規範的要求。
Chemical Composition	化學成分
The chemical composition of raw materials is checked on the Material Certificate.	確認材料（材質證明）的化學成分
Mechanical Properties	機械性能
The mechanical properties of raw materials are checked on the Material Certificate.	材質證明上檢查原材料的機械性能。
Material Certificate	材料證書
The following material certificates of principal component are to be prepared and submitted	應準備和提交主要構件材質證明
Object component of material	分項構件的材料
Item	項目
Principal component	主要組成部分
Hydraulic Cylinder	油壓缸
Hydraulic cylinder tube , piston rod, piston, lock nuts, tube flange and head and cap cover	油壓缸管，活塞桿，活塞，鎖緊螺帽，管法蘭和帽蓋
Non Destructive Test	非破壞檢驗
Material for cylinder rod is to be carried out NDT (UT) if the material is	如果材料是鍛件，則用於活塞桿的材料應進行 NDT（UT）。

forgings.	

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WELDING TEST AND INSPECTION	焊接試驗和檢驗
Visual Inspection	目視檢驗
Excess weld metal, leg length and throat thickness	過度焊接金屬、腳長及喉深
Undercut	焊蝕
Pit on bead surface	焊道凹坑
Overlap	焊瘤
Boxing and build-up welding	環焊和堆焊
Crack	裂縫
Acceptance Criteria of Welding is shown in Table 3-1	焊接驗收標準如表 3-1 所示
Table 3-1 Acceptance Criteria of Welding	表 3-1 焊接驗收標準
Item	項目
Criteria	標準
Excess weld metal, leg length and throat thickness	過度焊接金屬、腳長及喉深
Conform to Table 3-2	符合表 3-2
Undercut	焊蝕
Conform to Table 3-3	符合表 3-3
Pit on bead surface	焊道凹坑
a) Pit on butt welds, T-joint consisting a cross section, or corner joint is not allowed for principal member. b) Except above Clause a), (3-pits or less / each joint) and (3-pits or less / m of joint length) are allowed. When the size of the pit is 1.0 mm or smaller, 3-pits are considered as 1-pit for these criteria.	a) 主要構件不允許對接焊縫，T 形接頭包括橫截面或角接頭。 b) 除上述條款 a）外，（3 個或更少/每個接頭）和（3 個或更少/ m 的接頭長度）是允許的。 當凹坑的尺寸為 1.0mm 或更小時，對於這些標準，3 坑被認為是 1 坑。
Overlap	焊瘤
Overlap is not allowed.	不允許焊瘤
Boxing and build-up welding	環焊和堆焊
a) Boxing shall be done for the ends of fillet joints. For the portion where boxing is not possible, return welding shall be applied. b) Defect like lack of build-up welding is not allowed on the end of butt	a) 環焊應在圓角接頭的末端進行。對於無法環焊的部分，應採用回焊。 b) 對接接頭末端不允許缺少堆焊。

joints.	
Crack	裂縫
Crack is not allowed on and around bead. Any suspicious portion shall be checked with non-destructive test.	焊道周圍不允許出現裂縫。 任何可疑部分都應進行非破壞檢測。
Table 3-2 Tolerance of Excess Weld Metal, Leg Length and Throat Thickness	表 3-2 過量焊接金屬、腳長及喉深之公差
Item	項目
Condition	條件
Tolerance	公差
Height of excess metal of butt weld	對接焊縫多餘金屬的高度
For plate thickness(mm)	適用板厚（mm）
max	最大值
Leg length and throat thickness of fillet weld	填角焊的腳長及喉深
In relation to 10% of the length except for 50 mm from both edges of a weld line	相對於焊接線兩邊 50 mm 的長度的 10%
Within -1.0mm	在-1.0mm 內
Table 3-3 Tolerance of Undercut	表 3-3 焊蝕公差
Plate thickness	板厚
Standard allowance	標準容許值
Maximum allowance	最大容許值
Note	備註
Acceptable for butt joint of principle component members when 90% of the weld line is within the above ranges, and for other joint 80%.	當 90%的焊縫在上述範圍內時，可接受主要構件的對接，對於其他接頭，可接受 80%。
Undercut deeper than the above shall be repaired.	比上述更深的焊蝕應予以修復。

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Non Destructive Test (Radiographic Test : RT)	非破壞檢驗（放射線檢驗：RT)
The full penetration butt-welding joint on the cylinder tube shall be inspected by a radiographic test.	應通過放射線照相檢驗檢查圓筒管上的全滲透對接焊縫。
General	總則
Radiographic test (RT) is performed to the butt welds. Radiographic test is in accordance with JIS Z 3104.	對接焊縫進行放射線照相測試（RT）。放射線照相試驗符合 JIS Z 3104。

All defects exceed the criteria are removed and repaired. The replacement weld and contiguous parts to the original weld are retested.	超出標準的所有缺陷都要被移除和修復。 更新焊縫和原始焊縫的連續部件將重新測試。
Radiographic Test Lengths	放射線檢驗長度
Radiographic Test Lengths are 100% of the full penetration butt-welding length.	射線照相測試長度是全滲透對接焊長度的 100%。
Radiographic test Photographing method	放射線檢驗拍攝方法
The arrangement of identification marks on radiograph films is shown on Figure 5-1.	射線照相底片上識別標記的排列如圖 5-1 所示。
Effective length (280 mm)	有效長度(280 mm)
Film size	底片大小
Penetrameter	穿透計
Plate thickness	板厚
Job No.	工作號碼
Contrast indicator	對比指示器
Weld bead to be inspected	應檢查之焊道
ID No.	識別號
Figure 3-1 Arrangement of identification marks	圖 3-1 識別標記的排列
Radiographic test Acceptance Criteria	放射線檢驗驗收標準
Radiographic test classification is in accordance with JIS Z 3104 "Methods of Radiographic Test and Classification of Radiographs for Steel Welds"	放射線檢驗分類符合 JIS Z 3104"放射線檢驗方法和鋼焊縫射線照相分類"
Acceptance criteria for radiographic test are shown in Table 3-4.	放射線檢驗驗收標準如表 3-4 所示。
Table 3-4 Acceptance Criteria for Radiographic Test	表 3-4 放射線檢驗驗收標準
Type of flaw	缺陷類型
Thickness of base metal t ≤ 50mm	基本金屬厚度 t ≤ 50mm
Non-Flaw	無缺陷
Acceptable	可接受
Type-1	類型 1
Class-2 or more	2 級或更多
Class-1	1 級
Type-2	類型 2
Existing Type-1 and 2	現有類型 1 及類型 2

Type-3 and 4	類型 3 及類型 4
Reject	拒絕

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TEST AND INSPECTION OF HYDRAULIC CYLINDER	油壓缸的試驗和檢驗
The quality, dimension and specified function of the hydraulic Cylinder is checked and confirmed.	檢查並確認油壓缸的質量，尺寸和指定功能。
Test and Inspection Method and Acceptance Criteria are shown in Table 4-1.	測試和檢驗方法和驗收標準見表 4-1。
Table 4-1 Test and Inspection Method and Acceptance Criteria	表 4-1 測試和檢驗方法和驗收標準
No.	編號
Part	部分
Item	項目
Method and Criteria	方法和標準
Hydraulic cylinder	油壓缸
Material	材料
Visual	目視
Dimension and tolerance	尺寸和公差
Pressure proof test	耐壓試驗
Inner Leakage test	內滲漏測試
Operation test	操作測試
(no loading condition)	（無負載條件）
Material Certificate	材料證書
As shown in drawing	如圖所示
Tolerance of Cylinder length	氣缸長度公差
Tolerance of Cylinder length from Cap end to cylinder rod at most contraction	氣缸長度從頂端到氣缸桿的公差最大收縮
Stroke	行程
Cylinder rod diameter	氣缸桿直徑
See Table 4-2	見表 4-2
Cylinder tube outside diameter	氣缸管外徑
Cylinder tube inside diameter	氣缸管內徑
See Table 4-3	見表 4-3
Not permit any outer leakage (testing condition: 1.5 × design pres. /2 min.)	不允許任何外部滲漏(測試條件: 1.5 × 設計壓力/2 分鐘)
Not permit any deformation during pressure proof test	在耐壓試驗期間不允許任何變形

Testing condition: 1.0× design pres. /10 min.	測試條件: 1.0×設計壓力/10 分鐘
Acceptance criteria to be informed after detail design of cylinders	氣缸詳細設計後要通知的驗收標準
Not permit any vibration and noise during operation.	操作期間不允許任何振動和噪音。
Not permit any outer leakage during operation	操作期間不允許任何外部滲漏
Measurement of lowest operating pressure	測量最低操作壓力
See Table 4-4	見表 4-4
Coating of Piston Rod	活塞桿塗層
Hard chromium plating	硬鉻電鍍
Required plating thickness	所需的電鍍厚度
Function Test of Dogging Device	閉鎖裝置的功能測試
Confirmation of dogging Device Function	確認閉鎖裝置的功能
Paint Material for cylinders	缸面油漆材料
Material	材料
Check of inspection certificate by manufacturer	製造商檢查檢驗證書
Table 4-2 Diameter of Piston Rod	表 4-2　活塞桿直徑
Unit	單元
Rod Diameter	桿直徑
tolerance of finish dimensions	最終尺寸公差
Circularity & Cylindricality	圓度和圓柱度
more than 180, not less than 250	多於 180, 不低於 250
more than 250, not less than 315	多於 250, 不低於 315
Table 4-3 Inside Diameter of Cylinder Tube	表 4-3　氣缸管內徑
Unit	單元
Inside Diameter of Cylinder Tube	氣缸管內徑
Case of using seal other than piston ring	使用活塞環以外的密封件的情況
tolerance of finish dimensions	最終尺寸公差
Circularity & Cylindricality	圓度和圓柱度
more than 200, not more than 250	多於 200, 不多於 250
more than 250, not more than 300	多於 250, 不多於 300
more than 300, not more than 400	多於 300, 不多於 400
more than 400, not more than 500	多於 400, 不多於 500
more than 500, not more than 600	多於 500, 不多於 600

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Table 4-4 Lowest operation pressure	表 4-4 最低操作壓力
Shape of Piston packing	活塞襯墊的形狀
Nominal pressure	標準壓力
In case that rod packing is not V-packing	如果活塞襯墊不是 V 型襯墊
In case that rod packing is V-packing	如果活塞襯墊是 V 型襯墊
The pressure is supplied from the cap side	壓力從帽蓋側供應
The pressure is supplied from the head side	壓力從頭側供應
Rated Pressure	額定壓力
PAINTING INSPECTION	塗裝檢驗
Surface Preparation Inspection	表面處理檢驗
Blast cleaned surface is checked in accordance with ISO 8501-1, Sa 2 1/2, before shop primer painting at the steel mill shop or manufacture shop.	根據 ISO 8501-1、Sa 2 1/2、檢查噴砂清理過的表面，在鋼鐵工廠或製造廠進行工廠底漆塗裝之前。
Visual Inspection	目視檢驗
The criteria of visual inspection for painting are as follows:	塗裝的目視檢驗標準如下：
Painted surface shall be smooth and free from unevenness	塗漆表面應光滑，無不均勻
(For instance, no remarkable run nor blister).	（例如，沒有明顯的垂流或起泡）
Prime or preceding painted layer shall not be seen through.	不得透視底漆或在塗漆層前。
Hue and gloss shall be identical to the designated color.	色調和光澤應與指定的顏色相同
Dry Film Thickness Inspection	乾膜厚度檢測
After surface preparation, following paints are applied;	表面處理後，塗上以下塗料
Epoxy Zinc Rich Primer after surface preparation within 4 hours(Dry film thickness 50μm)	表面處理後 4 小時內施塗環氧樹酯鋅粉底漆（乾膜厚度 50μm）
Coal Tar Epoxy Resin Paint(Dry film thickness 45μm×2 layer)	環氧樹脂漆柏油漆（乾膜厚 45μm×2 層）
Total dry film thickness:140μm	總乾膜厚度：140μm
The painted surface of cylinder is inspected for two inspection units per square meter of coating area, but at least three inspection units or more	對每平方米塗層區域的兩個檢查單元檢查圓筒的塗漆表面，但至少檢查三個或更多檢查單元

附件三

工程規範第 11280 章 閘閥室閘閥及附屬設施

第 11280 章
閘閥室閘閥及附屬設施

1. 通則

1.1 本章概要

1.1.1 本章規定有關湖山水庫第二原水管工程各項閘閥及其相關設施之設計、材料、設備、製造、施工及檢驗與試驗之一般要求，其他相關事宜或規範詳見合約各章節及或工程圖樣之規定。

1.1.2 承包商所提供之材料及製品，其品質及運轉性能均需符合本章及本工程合約各項規範與圖說之相關規定。

1.1.3 有關電氣工程之施工，除應依照各項規範相關章節之規定辦理外，承包商之分包商亦須具備甲級電氣承裝資格，且須經機關及監造單位之認可方得以負責現場電氣安裝工作。

1.1.4 閘閥操控及監視系統之規範另詳第 13411 章-閘閥電氣設施。

1.2 工作範圍

由承包商負責提供功能完整且能符合本章所訂定各項要求之閘閥及各項機電設施，以供本工程管理維護之用。水工機械工作項目如下：

區分	分項工作名稱/內容	數量	備　註
閘閥室	控制閘閥(高壓滑動閘閥)	1組	
	防護閘閥(高壓滑動閘閥)	1組	
	油壓系統	1組	
	現場控制盤及相關電氣管線	1式	另詳電氣規範
	遠方監視系統及相關電氣管線	1式	另詳電氣規範

為完成本項閘閥設施所需之人力、材料、器具、設備、場地、動力、運輸及其他施工所必須之工作均屬之。

1.3 相關準則

除另有規定者外，依本工程契約規定必須提供之設備與材料、製作及試驗等，均需符合下列各標準於訂約時最新版次之有關要求；如需採用下述表列以外之其他標準時，須提出所採用之標準與本節適用標準之比較表以供審查，並經機關及監造單位之正式核定後採用之。

1.3.1 中國國家標準（CNS）

CNS 8499 G3164 熱軋不銹鋼鋼片及鋼板

1.3.2 美國鋼結構學會（AISC）

鋼結構建築之設計、製造與安裝規範

1.3.3 美國材料試驗協會（ASTM）

(1) ASTM A167 耐熱鎳鉻不銹鋼板、鋼片、鋼條

(2) ASTM A276 不銹鋼棒與型鋼

(3) ASTM A480 灰鐵鑄造物

(4) ASTM D2240 橡膠硬度之硬度計試驗法

1.3.4 日本標準

(1) JIS/Japanese Industrial Standard 日本工業標準

(2) 社團法人電力土木技術協會(原日本水門鐵管協會)－ 水門鐵管技術基準

(3) 日本鋼構造協會/JSSC - 溶接開先標準・解說

1.4 資料與文件送審

1.4.1 提送包括廠商資料、設備型錄、性能資料、測試報告、操作說明手冊、保養手冊及安裝說明書等產品資料。

1.4.2 提送閘閥設計計算書，計算書之主要內容包含但不限於面板、橫梁、縱梁、端梁、導履及其軌座、閘閥重量及重心位置、提吊力、吊座或吊耳等項。

1.4.3 提送油壓式吊門機設計計算書，計算書之主要內容包含不限於提吊馬力、共同基座及各主要機件之強度分析或安全度計算；以及各項市購部品或構件之選用依據等資料。

1.4.4 提送閘閥門框、門扉等結構之詳細製造及施工圖；其中，各項機械加工部件均應明確標示加工裕度與配合公差。

1.4.5 提送吊門機組合圖及各項零件之加工圖；其中，各項機械加工部件均應明確標示加工裕度與配合公差。

1.4.6 提送各項埋設件及電氣管線配置圖。

1.4.7 提送吊門機電氣控制線路圖。

1.4.8 專章提送施工計畫書，其內容包含但不限於閘閥與吊門機之製造、銲接、塗裝、運輸、安裝、管線配佈等項。

1.4.9 提送品質管制計畫書，其內容應符合公共工程委員會所頒佈之各項施工及檢驗程序與章節；本項品質管制計畫書得併入本工程整體計畫書，或專章提送分項品質管制計畫書。

1.4.10 其他屬於機關或監造單位所特別指定之資料與文件。

1.5 品質保證

1.5.1 材料、製品、設備以及工地安裝與檢驗(含試運轉)等品質管制作業，必須依照本工

程各項規範與特定條款辦理。

1.5.2 於設備安裝前後所辦理之一切檢驗與試驗，不論監造單位認可或合格與否，均不解除承包商在保固期滿前對本工程所應負之履約責任與義務。

1.5.3 閘閥保固

(1) 除另有規定者外，廠商對本閘閥包含門框、門扉、吊門機及電控設備等功能與品質，自正式驗收合格日起保固 3 年。

(2) 廠商應於工程驗收合格後一週內出具保固保證書，由機關(或監造單位)核存；在保固期間如因產品瑕疵或施工不良故障或損壞，廠商應即免費修復或更換新品。如承包商未能及時完成修復、或不依約履行修復工作，機關得依相關規定辦理，承包商不得異議。

(3) 於第一年保固期間內，承包商應免費辦理本產品之檢查與維護服務兩次；辦理保固期間之檢查與服務前，承包商應正式提報機關約定日期與派員會同，否則該次檢查與服務視同無效。

1.6 運送、儲存及處理

1.6.1 材料、製品、設備之運輸須遵照本合約及公路法規之相關規定辦理。

1.6.2 設備未正式驗收／移交機關之前，不論該項設備或器材安裝完成與否及施工所需設備與機具皆歸承包商負責保管；如有損壞或遺失等情事，乙方應負責修繕、重建或賠償。

1.6.3 依契約規定應運抵工地之所有器材與設備，乙方應設置具備保護措施之妥善存置場地，並負保管與保全之完全責任。

1.6.4 乙方應於事前詳細勘查運輸動線，針對運輸路線既有之電力、通訊、交通號誌、陸橋、平交道、人行天橋及各項管線所可能造成之阻礙，若有需要辦理管線或桿柱之遷移作業時，概由承包商負責向有關單位申請辦理及負擔一切應繳付之相關規費。

1.6.5 乙方所提供之任何製品或器材運抵工地後，應即報請監造單位及或機關查驗與核對後方可使用，不合格之製品或器材應即運離工地，不得提出任何費用補償要求、或藉此要求變更工期。

1.7 運轉試驗

1.7.1 承包商應確實掌握工程期限及圖說審查程序所需時間，於試運轉前應完成試運轉程序書/計畫書之核定作業，如因試運轉所需書面資料作業延誤以致無法辦理試運轉作業、進而影響竣工期限時，承包商應負完全責任，並不得要求任何補償或變更工期。

1.7.2 所有控制箱或配電盤於配線完成後，須經絕緣試驗、耐壓試驗、導通試驗及施行試操作，以驗證各項動作程序及信號指示燈之確實性。

1.7.3 所有驅動機及吊門機應在組裝完成後於工廠內施行無載試運轉，以確認各轉動機件

之轉動順暢性。

1.7.4 承包商應在監造單位及或機關會同下辦理閘閥之無水與有水運轉試驗及耐壓試驗，施行閘閥試運轉試驗時，將閘閥放置於關閉狀態，先進行門扉各部與門框組配關係之查驗及進行必要之調整，其後分別啟動驅動機或吊門機以啟閉閘閥多次，再分別檢查門扉與門框之組配關係、及檢查驅動機或吊門機組各部組件狀況。

1.7.5 吊門機組分別測試運轉時，各轉動機件應無異聲運轉順暢，運轉速度應符合規範設計要求；對於所有極限開關、指示計、控制系統之功能及安全設備之作用等是否正常，及電動機之溫昇、電壓與電流等均應加以檢核與紀錄，並進行必要之調整與檢修。

1.7.6 閘閥檢驗與試壓

A. 工廠檢驗與試壓

a. 承攬商應於進行工廠內組配前二個月，提送工廠檢驗與試驗程序書以供主辦機關審查核定，並據以辦理閘閥之工廠內檢驗與試驗作業；該程序書之內容包含但不限於構件尺寸檢驗、銲接檢驗、塗裝檢驗、組配檢驗、水壓試驗、檢驗表格、第三公證機構等項。

閘閥如為國外產製品時，則撰寫本項檢驗與試驗程序書之語言須為中文或中英文對照。

b. 完成工廠組裝程序之後，應辦理各該閘閥之廠內試壓檢驗作業，其試壓條件及允收標準規定如下：

*試驗壓力：須為設計壓力之 1.25 倍，並維持該壓力至少 10 分鐘以上。

*允收標準：於承受試驗壓力之情況下，容許漏水量為每分鐘不得大於 2.0 公升；所有金屬構件間之銜接處不得產生任何形式之滲漏或變形現象。

c. 相關工廠檢驗與試驗應由第三公證機構辦理及出具報告(紀錄)。

B. 工地檢驗與試驗

a. 作業文件：承攬商應於進行工地安裝前二個月，提送工地檢驗與試驗程序書以供主辦機關審查核定，並據以辦理閘閥之工地檢驗與試驗作業；該程序書之內容包含但不限於構件尺寸檢驗、工地銲接檢驗、工地塗裝檢驗、組配檢驗、無水試驗、有水試驗、使用表格等項。

b. 無水試驗之作業內容包含：各構件之裝配尺寸與精度、閥體升降順暢性、閘閥運轉速度、運轉數據(如電壓、電流、工作壓力...等)之紀錄。

c. 有水試驗之作業內容包含：閥體升降順暢性、閘閥運轉速度、量測漏水量、運轉數據(如電壓、電流、工作壓力...等)之紀錄。

d. 有水試驗之漏水量允收標準：

*水庫水位達到 EL.205.0m 及以上時，其允許漏水量不得大於每分鐘 2.0 公升。

*水庫水位未達到 EL.205.0m 時，其漏水量依下式遞減之。

允許漏水量=2.0x 試驗當時之水庫水位÷205.0(公升)

e. 針對防護閘閥之緊急關閉試驗之原則規定為：

*水庫水位未達 EL.205.0m 時，不辦理本項測試；契約執行期限內，水庫水位未能達到 EL.205.0m 時，則免辦理本項緊急關閉試驗。

*為珍惜水資源及確保相關設施與下游河道之安全，執行防護閘閥緊急關閉之試驗開度以不超過 30 公分為原則。

1.7.7 為完成本工程各項試運轉所需之人力、試驗設備、臨時材料與機具等項費用已包含於合約各該價目中，不另給價。

2. 產品

2.1 材料

2.1.1 所有材料及製品必須為新品，不得以舊品冒用，鋼料不得有裂痕、夾層、瑕疵等缺點，並符合 CNS/中國國家標準或符合材料規範表之各項要求。

材料規範表

材料種類	規格要求
一般結構用鋼	ASTM A36/A36M 或JIS G3101-SS400 / G3106-SM400 或CNS G3039 SS400 或採用更高強度等級之結構鋼材
銲接結構用鋼	JIS G3106 或CNS G3057 SM400A 或採用更高強度等級之結構鋼材
不銹鋼板	ASTM A240-Type304, 410 或 JIS G4304-SUS304, SUS410,SUS420J2
不銹鋼棒	JIS G4303 SUS304 或SUS316,SUS420J2
螺栓用合金棒鋼	JIS G4107 SNB7 或ASTM A193 Grade B7
鍛造碳鋼	JIS G3201 SF440A
機械結構用碳鋼	JIS G4051 S45C
結構用合金鑄鋼	JIS G5111 SCMn3B
鑄鋼	JIS G5101 SC450 或SC480
鑄鐵	JIS G5501 FC200 或G5502 FCD370

銲接結構用鑄鋼	JIS G5102 SCW410 或SCW480
青銅鑄	JIS H5111 BC3
鉻鉬鋼	JIS G4105 SCM440 或SCM430
普通螺栓、螺帽及墊圈	JIS B1180 F5T 或F7T
高張力螺栓、螺帽及墊圈	JIS B1180 F10T 或ASTM A325
耐蝕螺栓、螺帽及墊圈	JIS G4303 SUS304 或SUS316

2.1.2 各項製品之製造廠牌、性能、額定能量等有關資料應送請監造單位及機關核可後方可使用。

2.1.3 廠商應提出各種材料出廠試驗報告或進口證明送請機關（或監造單位）查核，機關（或監造單位）認為須檢驗者，廠商亦需配合辦理不得拒絕。

2.1.4 所使用之材料除特別規定者外，應符合上表所訂定之規範或其相當規範、或經機關及監造單位核可之同等品。

2.1.5 鋼材應不受輻射污染，須能符合行政院原子能委員會所訂之「放射性污染建築物事件防範及處理辦法」之規定，並提出證明。如為國外進口設備，亦應開具無輻射污染鋼鐵材鑑定證明，或運至國內時，依規定補做鑑定。

2.1.6 橡膠水封之材質需優良，其物理性質須符合下列規定：

物理性質	規範要求	試驗方法
(1)抗拉強度	最小 200kgf/cm^2	ASTM D412
(2)斷裂時之伸長率	最小 400%	ASTM D412
(3)硬度 Shore Durometer(Type A)	60 至 70	ASTM D2240
(4)比重	1.1~1.25	
(5)吸水率(重量計，70°C，48 小時)	最大 5%	ASTM D471
(6)壓縮變形	最大 30%	ASTM D395
(7)老化試驗(70°C，96 小時後之抗拉強度)	原強度之 80%以上	ASTM D573
註：橡膠水封須抽樣送驗並經機關及監造單位之正式認可後方可使用。		

2.1.7 油漆

油漆材料需符合 CNS 或 JIS 或同等規範之規定，並經機關及監造單位之正式認可者；如經機關或監造單位之指示，油漆應採樣送請經機關及監造單位認可且具備 TAF 認證合格之試驗機構進行下列規範或其相當規範之方法試驗或檢驗。

剝離試驗(方格試驗)——————————ASTM D3359 (CNS 10756)

乾膜厚度檢驗——————————————ASTM D1186

針孔試驗——————————————————ASTM G62

2.1.8 電氣材料另詳相關規範。

3. 設計

3.1 設計條件

3.1.1 基本設計條件

(1) 控制閘閥

閘閥型式	垂直滑動式高壓閘閥
門數	1 門
吊門機型式	油壓式吊門機 1 組
門孔淨寬度	2.000 公尺
門孔淨高度	2.000 公尺
水封型式	頂、側三面青銅水封
	底面橡膠水封
設計水頭	64.74m(考慮水錘現象需增加 30%)
底檻標高	EL.148.66m
吊門機運轉時最高水位	EL.213.40m(關閉)
	不平衡水頭(開啟)
閘閥操作方式	現場及遠端控制(建議現場控制)

(2) 防護閘閥

閘閥型式	垂直滑動式高壓閘閥
門數	1 門
吊門機型式	油壓式吊門機 1 組

門孔淨寬度	2.000 公尺
門孔淨高度	2.000 公尺
水封型式	頂、側三面青銅水封
	底面橡膠水封
設計水頭	64.74m(考慮水錘現象需增加 30%)
底檻標高	EL.148.66m
吊門機運轉時最高水位	EL.213.40m(關閉)
	平衡水頭(開啟)
閘閥操作方式	現場及遠端控制(建議現場控制)

3.1.2 設計載重

(1) 正常載重

閘閥全閉，上游承受設計水頭而下游面無水狀況之靜水壓。

(2) 異常載重

異常載重包括正常載重及地震所引起之動水壓力，動水壓力採用 Westergaard 公式計算之。水平地震係數取 0.2。

3.2 設計容許應力

3.2.1 結構鋼（含不銹鋼）容許應力

正常載重情形下，結構鋼之容許應力不得超過 AISC "Manual of steel Construction-Allowable Stress Design"、內政部營建署”鋼構造建築物鋼結構設計技術規範”、日本[2]水門鐵管技術基準[2]或其他經認可之標準、規範之容許應力規定。異常載重即風力或地震力併合其他載重時容許應力可按正常載重規定者提高 33%。面板雙向彎曲應力合併後之合成應力不得超過上述容許應力之 125%。

3.2.2 混凝土之容許承壓應力及貫穿剪應力

混凝土之容許承壓應力為 0.35fc，若支承構材之各邊均大於承載面時，該承載面之設計承壓強度可增加到$\sqrt{(A2/A1)}$倍，但不得超過 2 倍。A2 取為最大之正截頭角錐體或圓錐體之下底面積，且該錐體須能完全包容於支承構材內，其上底為承載面 A1，錐面之斜度為垂直 1 比水平 2。

混凝土之容許剪應力不得大於 $0.53\sqrt{fc}$；fc 為混凝土地 28 天齡期之規定壓力強度。

3.2.3 機械構件容許應力

吊門機及各式驅動機除其他規範另有規定、或經機關認可之市購特定產品之外，其主傳動機構之安全係數應依使用材料之極限強度與電動機額定扭矩(Rated Torque)

計算所得應力比須大於下表所列數據；再者，由電動機最大扭力計算所得之應力需小於使用材料降伏應力(Yielding Stress)之 90%。

使用材料安全係數表

材料種類	拉力	壓力	剪力
一般及電銲構造壓延鋼 Rolled Steel for General & Welded Structure	5	5	8.7
碳鋼鍛鋼品 Carbon Steel Forgings	5	5	8.7
機械構造用碳鋼 Carbon Steel for Machine Structure	5	5	8.7
不銹鋼棒 Stainless Steel Bars	5	5	8.7
碳鋼鑄鋼品 Carbon Steel Castings	5	5	8.7
鑄鐵品 Gray Iron Castings	10	3.5	10
青銅鑄品 Bronze Castings	8	8	10

3.2.4 各種閥類須為國內或國外自由地區生產之優良產品，承包商應提送完整中文版廠牌型錄資料以供機關及監造單位審查與認可使用；各閥類驅動設備機械構件之容許應力應符合本節 2.3.(D)之相關規定。

3.3 閘閥設計製造要點

3.3.1 閘閥包括門扉、門框及閘閥箱等構件，為銲接鋼結構，所有銲道應為連續銲。門扉由面板、橫梁、縱梁、水封、支承板、導履等所組成。門框及閘閥箱（含法蘭）應用高強度支承螺栓結合。安裝所需之支撐構件及預埋件亦均由廠商供應安裝，其費用已包含於工程總價。

3.3.2 閘閥門扉及閘閥箱（含法蘭、結合螺栓）須能抵抗內壓，閘閥箱頂蓋不但須能抗內壓，而且須能承受吊門機之全部推力，閘閥門框上裝設之水封及支承板均須為不銹鋼或銅鑄品，以平頭不銹鋼螺栓（TYPE 316）固定。

3.3.3 門扉橫梁之設計撓度不得超過全跨度之 1/1500。面板設計應考慮 2mm 之容許腐蝕裕度，門框及閘閥箱與水流接觸面之鋼板應另設計增加 3mm 之腐蝕及磨損裕度。

3.3.4 閘閥下游側須裝通氣管（不銹鋼材質）及通氣閥（附輔助閘閥），以免下游充水或緊急關閉時發生高壓真空，並減低噪音及振動。此閥型式應為自動排氣/進氣雙用

型，並附緩衝逆止裝置。閥之設計應能使管中積存的空氣急速逸出並可關閉閥門，防止管中水流溢出。主要構件包括閥體、閥蓋、擋板、浮筒、閥座及其配合連接管線之法蘭接頭及固定件等。閥體、閥蓋及擋板等均應為鑄鐵材質。擋板之設計應使浮筒不與空氣或水直接接觸，以防止浮筒太快關閉而遭致損壞。浮筒並應為不銹鋼製。此閥之直徑及工作壓力等級須配合流量及設計水壓加以選用。

3.3.5 為充水於防護閘閥及操作閘閥之管路，使防護閘閥上下游面水壓達到平衡以利平衡水頭開啟閘閥，閘閥上下游須用旁通管（不銹鋼材質）及 2 只串連之設置旁通閥連接。上游側旁通閥以人工操作，而下游側旁通閥則須用電動驅動器操作。旁通充水設備並應設有上下游面差壓錶及感知器並附壓力檢出器（電源為 110V、60Hz，輸出信號須為 4~20mA），以做為閘閥啟閉控制平衡水頭之用及傳輸壓力值至管理中心。

3.3.6 旁通管上游側裝設之水壓計，除了可測得水壓值，亦須將水壓值信號傳送至管理中心，以供隧道進口擋水閘閥充水閥開啟充水時，判斷其兩側水頭是否平衡。

3.3.7 廠商應負責於閘閥室屋頂梁上設置若干吊鉤，供本防護閘閥及操作閘閥之安裝以及日後維護時吊裝閘閥門扉、門框頂蓋、油壓缸等相關設備使用。廠商並應提出吊鉤結構及混凝土錨碇強度計算書、佈置圖與詳圖送機關審查核可，每支吊鉤之吊重原則上不得超過 15 噸；其相關費用已包括於工程總價中，不另計價。

3.4 吊門機設計要點

3.4.1 油壓式吊門機應含馬達、油壓泵、油壓缸、油壓控制閥、油壓配管、儲油槽、控制及檢視用之儀錶，而完成一整套完整之油壓系統。

3.4.2 吊門機之設計應能使閘閥在不平衡水頭下開啟，並須能在水庫最高水位 EL.213.40m 及最大設計流量 63.7CMS 之不平衡水頭下緊急關閉。

3.4.3 閘閥啟閉之速度為 0.1~0.15m/min。

3.4.4 吊門機額定容量應不小於最大吊重之 125%，此項最大吊重包括吊桿重量、閥體重量、水封板或支承板與門框摩擦力、導履與門框摩擦力、吊桿水封或油封摩擦力等。

3.4.5 馬達應配合油壓泵之輸出容量與轉速選用，其額定電壓為交流三相、220 伏、60 赫。

3.4.6 油壓泵須為正排量式(Positive Displacement Type)，全密閉水密型。油壓泵之額定流量應不少於設計流量之 115%，而其額定壓力則不得小於設計壓力之 125%。油壓泵應有二組，二組交互運轉供油，如有一組故障，應能及時自動啟動另一組供油。該系統並應設有一組手動油壓泵，以備緊急或平常維修調整油路設備之用。

3.4.7 油壓缸應根據 ASME VIII 節「壓力容器規章」或相同性質之規章標準設計及製造。油壓缸應銲製及留有所有進出油壓管、排油管及排氣管之管接頭。對於油壓缸所銲接處均應根據 ASME「無火式壓力容器規章」之規定實施全部之 X 光檢驗及一般外觀檢查。

3.4.8 油壓缸之活塞須包括活塞、活塞桿、活塞環和油封等組成。活塞頭須為鑄鐵或經認可之材質製成，並與活塞桿組成一體。其接頭處應設計為可拆裝式，以利維修之用。活塞環及油封必須設計為設計壓力之 150%下，能夠不使壓力油由活塞之一邊洩漏至另一邊。

3.4.9 油壓缸之基座應設計能夠支撐整組油壓缸之作用力和自重，並將其作用力適當的經閘閥箱而傳至混凝土結構。

3.4.10 油壓缸應設有閘閥全開時自動及手動鎖定之裝置，當閘閥欲行關閉時，應先自動或手動釋放該鎖定裝置後再行關閉閘閥。在閘閥靠近全開位置時，油壓缸並應有緩衝裝置以防止閘閥與底檻之急劇衝撞。

3.4.11 油壓控制單元包括所有之關斷閥、流量控制閥、電磁方向控制閥、釋壓閥、控制及檢視用之儀錶以及閥類之固定件等以組成一完整可運轉之控制單元。

3.4.12 儲油槽須為不銹鋼板製成，其儲存容量應不少於所有油壓缸及油壓管容量總和之 150%。油槽並應附有安裝用之基礎螺栓以便固定於平台上。儲油槽須為全密型，並附有含空氣過濾之排氣管、過濾加油口、緩衝阻泥板、維修手孔、油位標尺和所有之連接管接頭等附件。

3.4.13 所有油壓管應選用適用油壓之油壓管，其管線接頭和閥類等均應選用適於 150%工作壓力等級。

3.4.14 吊門機之油壓系統應設計為可供防護閘閥及操作閘閥共同使用，而防護閘閥油壓吊門機及操作閘閥油壓吊門機並不允許同時動作；且各閘閥之啟閉均需先起動油壓泵，並經各別之油壓迴路，控制油壓吊門機活塞上下而達到閘閥啟閉。其油壓系統之設計壓力應不得大於 210kg/cm^2。

3.4.15 油壓式吊門機應包括閘閥全開、全閉極限開關以防止超行程運轉。

3.4.16 閘閥並應附現場開度指示器及遠方指示用開度傳訊器，並提供遙控需要配備必要之接點，以供遙控指示。現場開度指示器為指針直線移動式，指示器之驅動連桿連接於門扉配合閘閥之開度而連動，指示板、指針及驅動連桿以不銹鋼製成，板面刻度應配合閘閥實際開度刻製須清晰易見。

3.5 廠內檢驗

3.5.1 閘閥及其操作裝置應先在製造廠內組裝施行外觀、尺寸檢驗及水壓試驗，以確認其能符合本規範所要求之性能，其檢驗程序書(含檢驗表格)應先提送機關審查核可。檢驗及試驗應由經機關核可之獨立檢驗公司負責，檢驗及試車時程於實施前應提早通知機關，以利機關決定是否派人會同檢驗。

3.5.2 組裝完畢後，應實施開關多次，以確定其操作功能及開度指示器之正確性。

3.5.3 以 1.25 倍設計水壓試水壓 10 分鐘（一側有水、另一側無水），所有金屬接合處不漏水、軸封等零配件不產生永久變形。水封漏水量之每一分鐘不得大於 2 公升。

3.5.4 廠驗合格並經認可後始可送至現場工地安裝，廠商應檢送 3 份檢驗報告給機關備查。

3.5.5 所有廠商及獨立檢驗公司之檢驗及試驗所需費用均已包含於工程總價中，由廠商負責。

4. 製造

4.1 製造要求

4.1.1 概述

本工程各閘閥及各門框、導座、軌座、導輪之製造，須在承包商所屬或經核定之廠商工廠進行加工，並須符合圖面規定尺寸，其尺寸誤差有關水密部分為±1.5 mm，其他部分為±3 m/m，任何構件所用鋼料必須平直無扭轉、彎曲等缺點，構件製造過程中組配未妥前不得焊接，電焊部份未經檢查之前不得油漆，製成構件未經檢查合格不得運往工地儲存。

4.1.2 樣板

(1) 閘閥所有焊件尺寸應展開放樣，並經適當檢覆後方得製作樣板；使用 NC 放樣者，不在此限。

(2) 樣板加工妥善後，應置於原繪放樣線上，再予覆驗一次。

(3) 樣板如使用木材時其厚度不得小於 20 m/m，如使用鋼板其厚度應在＃26(0.45 m/m)以上。

4.1.3 劃線

(1) 廠商所聘之劃線技師，除應具備優良技術與經驗外其對本項工程之全部圖表，說明及附註等，均應事先查閱熟悉，並繪成工作圖，於放成實樣後，方可著手劃線、截切，倘於劃線放樣時，發現原圖樣互有出入，應即報請機關（或監造單位）工程師核對決定之。否則事後發現錯誤致不能接合或安裝時，其一切損失概由廠商負擔，不得要求補償。

(2) 標準尺應使用 JISB－7512 級不銹鋼卷尺，其精確度在 0.5 m/m 以內。

4.1.4 截切與彎製

(1) 鋼料須長直，於劃線切斷前，如生變形時，應先予以矯直，所用方法須經機關（或監造單位）同意，如矯正不當以致損傷鋼料或發生急彎及扭曲時，該項鋼料不得使用，其損失由廠商負擔。

(2) 較長尺寸之剪裁應使用自動氧炔焰截切機不得使用手動者。

(3) 裁剪後之鋼料需電焊成形者，應事先考慮焊接收縮，於剪切時應預留收縮裕度。

(4) 需做機械加工者，至少需預留 3 m/m 之加工裕度。

(5) 彎曲鋼板、型鋼及矯正鋼料，應使用不損傷鋼料之油壓或機械設備為原則，避免使用鐵鎚錘擊鋼料。

(6) 鋼板、槽鋼、角鋼等，不得以小片焊成，必須整體製成。

(7) 不論以何種方法切割，皆不得留有不齊切口及殘渣，並應以砂輪機磨平清除，使其整齊平直。

(8) 鋼料之彎製，應以冷彎為原則。

4.1.5 鑽孔

(1) 鋼料之鑽孔直徑，不得大於圖面規定之直徑，於廠內鑽孔。

(2) 除另有規定外，螺栓孔之孔徑須較螺栓標稱直徑大 1.5m/m，其形狀應為圓柱體，並與鋼料面垂直，且孔緣應勻整，而無破裂或凹凸之痕跡。

(3) 所有螺栓孔，皆須以電鑽或以鉸刀鉸至規定孔徑，不得以氧炔焰截切機、切割穿孔。

(4) 門扉之水封座板及水封壓板螺栓孔，應同時鑽孔。

4.1.6 廠內裝配

各構件製成後須在廠內裝配一次，務須各部分完全配合；其工料費，已包括在各有關項目單價內不另計價。各部尺寸、間隙與公差等必須與圖樣規定符合。

4.1.7 製造公差

(1) 真直度：除契約上另有規定者外，各構件之真直度應為±1.5mm 以下。

(2) 平面度：除契約上另有規定者外，各構件之平面度，在同一平面內其誤差，不得大於±1.0mm。

(3) 長度：構材端須密切承壓接著者，其長度公差不得大於 0.8mm，不必密切承接著者，長度在 10 公尺以內，其長度公差不得大於 1.5mm，長度大於 10 公尺者，不得大於 3.0mm。

4.1.8 機械加工應行注意事項

(1) 門扉面板：

A.面板之尺寸須符合圖示規定並成為直角。

B.除施工圖詳細標註者外，面板不准使用零星鋼板拼接。

C.水封座螺栓孔位置之誤差應在±1.0mm 以內。

(2) 門框及水封座：

A.門框以鋼板焊製者，應考慮電焊收縮裕度，並檢驗其扭曲情形。

B.各水封座之真直度、平行度，應在規定範圍內。

C.各水封座面應平直，不得有凹凸情形，如有凹凸不平應使用碳械加工。

D.各水封座之耐蝕鋼板與底座之接觸應緊密接觸，不得有間隙。

E.除依圖示所允許之接頭外，不宜增加接頭。

F.水封座彎曲面之彎製，應以冷彎為原則，不得加熱，宜使用彎曲機械或油壓機械彎製。

G.水封座彎曲面之彎曲度，應使用樣板或在實寸上複驗之。

(3) 軌座：

A.軌座之輪軌應以整支之耐蝕四角鋼，經銑床或龍門刨床等機械加工而成。

B.輪軌之加工精度應在規定公差內。

C.輪軌加工前之硬度應量取數點，求其平均值。

D.輪軌之真直度及平行度應在規定容許誤差範圍內。

(4) 導輪：

A.各部尺寸須在圖示公差內。

B.各輪外徑必需相同。

C.輪孔不得偏心。

D.軸承與輪壓緊配合時不得有鬆動情形。

E.熱處理後硬度應符合規範要求。

4.2 銲接

4.2.1 通則

(1) 所有銲接需採用自動潛弧銲(SAW)、手動掩護電弧銲(SMAW)或氣體掩護電弧銲(GMAW)、或經機關與監造單位核可之銲接程序及方法施工。

(2) 銲接尺寸及長度應符合設計圖上所規定者，其位置與銲接方式未經機關或監造單位認可不得變更；銲接部須經機械加工光製者，應在銲接完成後施行釋除應力退火。

(3) 銲接技術工必須具備工作經驗六個月以上，並於近期中在該工廠連續工作達兩個月以上，及

A.領有政府頒發之銲接技術士執照者。或

B.領有如台電、中油、中船、中鋼等國營事業單位所頒發之銲工證明文件者。或

C.經機關及監造單位核定依照 AWS、ASME、JSSC、JIS 等規範專案辦理檢定合格者。或其他經機關或監造單位認定者。

E.屬國外生產項目者，銲工資格從其產製國之相關規範或規定。

(4) 銲條應依據所用鋼料選用適合之國產優良產品，其採用 SMAW 工法之銲條直徑自 3.2mm 至 5.0mm，並需依照銲件厚度、接合型式、施銲位置等選用適當線徑；SMAW 銲條應依廠商規定使用乾燥器妥為保管，保護塗劑脫落或受潮之銲條不得使用。

(5) 交流電銲機應設置高靈敏度之防電擊保護裝置。

(6) 構件表面濕潤或暴露於雨水時不得施行銲接作業；除非經驗證具有適當保護措施，強風期間不得銲接。

(7) 承包商應依前節規定提出銲接作業施工規範(或銲接程序書)檢送監造單位認可，以作為本工程相關銲接作業之施工依據。

4.2.2 銲接前之準備

(1) 銲接面上之鋸齒狀突出物、毛邊、氧化層等，應以砂輪機完全磨除。

(2) 銲接面上之鐵銹、鎔渣、油脂、油漆及其他有礙銲接品質之物質均應完全清除。

(3) 構材之銲接邊緣需按施工圖示尺寸與型式正確加工；如使用氧焰切斷加工者，其切斷邊應以砂輪機研磨平整。

4.2.3 構件裝配

(1) 填角銲之接合部份應完全密接，在任何情況下不得有 1.5 公厘以上之間隙，如其間隙超過 1.5 公厘時，則角銲尺寸需增加與間隙等值尺寸。

(2) 對接之接合部份，其端緣間隙需十分精準，最大偏差量不得超過 2.0 公厘。

(3) 搭接兩接面間之間隙、及對接板底面與背板面間之間隙，均不得大於 1.5 公厘。

(4) 構件於銲接時得使用螺栓、夾鉗、楔子、繫材或其他適當工具、或使用點銲方式以保持與固定銲接構件，但應預留收縮裕度。

(5) 基本點銲尺寸為 4.0mm 銲腳 x 至少 50mm 銲接長度，相鄰兩點銲間之最大間隔不得大於 400mm。

(6) 點銲於正式銲縫位置者，須具備與正式銲接同等品質；產生龜裂或已破損之點銲，應於正式銲接前剷除並磨修平整；正式銲縫以外之點銲應完全去除。

4.2.4 銲接技術

(1) 銲條之種類與尺寸、電弧長度、電壓及電流等，需適合構材厚度、接合形式、銲接位置及施工上之相關條件。

(2) 銲接應儘可能採用平位銲接。

(3) 銲工資格、銲接工法、銲接條件、銲接管理等項，應完全遵照經核定之銲接作業施工規範(或銲接程序書)辦理。

4.2.5 銲接品質與矯正

(1) 銲接部份之露出表面應平整具有規則，並符合設計圖及銲接一般要求；無論任何情況，銲著金屬斷面不得小於設計斷面。

(2) 角銲應平直、並形成略為凹凸之理想形狀，其超銲之高度不得大於(0.1 倍銲腳尺寸+0.8)公厘。

(3) 對銲之頂底兩面，除特別規定外均宜適度加厚，但其加強厚度不得超過 3.0 公厘，超出部份應予磨除；銲道與母材接合及焊接所產生之弧面應平順。

(4) 銲接部不得有過度低陷或重疊。

(5) 不良銲接得採用下述方法修補之：

A.重疊或過度凸出部分- 採用鑿除或磨除多餘部分。

B.過度凹進、低陷、尺寸不足- 清理及磨修後補銲。

C.氣孔過多、含渣、內部龜裂、鎔合不足- 鑿除、磨修、重銲。

D.裂痕-以滲透液探傷檢驗(PT)或磁粉探傷檢驗(MT)確定裂痕位置與長度，鑿除不良銲道及部分母材後重新施銲。

(6) 去除銲接之一部或全部、或母材之一部份時，可使用鑿、磨或碳精棒氣弧炬(Air arc gouging)等方式，但須確保不傷損餘留之銲道或母材。

(7) 應根據鑿挖孔之大小適當選用補銲用之銲條直徑，其銲條直徑以不超過 4.0mm 為原則。

(8) 因銲接而造成變形之構件或鋼材，應以機械冷作方式或在機關人員之監督下以加熱方式矯正，加熱溫度及範圍應嚴格管制，被加熱面之溫度不得超過 600℃(暗紅色)；不銹鋼構件與鋼材嚴禁採用熱整形。

4.2.6 銲接檢驗

(1) 銲接部表面應辦理目視檢驗(VT)作業，檢查項目包含銲部尺寸及形狀、銲部外形之均勻性，及是否產生低陷、重疊、表面裂縫等缺陷，以及檢查銲部起點與終點之鎔合狀況等。

(2) 門扉及門框之所有銲接縫均需辦理 100%滲透液探傷檢驗法(Liquid Penetration Testing)檢驗，以檢查其銲接品質是否完好。PT 檢驗方法及判定基準依照 JIS Z2343 或機關規定之等同規範。

(3) 以銲接方式構成吊門機之主要構件如鼓輪、環型齒輪、梯桿、基座等項，承包商應遵照經核定之銲接程序施工，並提出電銲檢驗合格證明書，以供機關及監造單位查證。

(4) 相關檢驗與試驗費用已包含於詳細價目表中，承包商不得藉由因機關或監造單位指示辦理相關試驗與檢驗而要求加價或變更工期。

5. 閘閥油漆規範

5.1 概說

5.1.1 油漆工作包括金屬構件表面清理、塗裝準備及油漆施塗，所有設備之油漆除另有規定者外，須按本節規定辦理。

5.1.2 油漆材料需符合 CNS 或 JIS 或同等規範之規定，承包商應於油漆施工前檢附油漆廠牌、產品型錄及其相關技術資料送請機關及監造單位審核，經認可後方得據以施工。

5.1.3 必要時，承包商應依據機關或監造單位之指示，會同採集油漆樣品送交經 TAF 認證通過之第三檢驗單位辦理各項試驗與檢驗。

5.1.4 青銅與不銹鋼材表面、滾動或滑動面及埋設於混凝土中之金屬面不須油漆。

5.1.5 雨天、潮濕(相對溼度 85%以上)及過熱或過冷(大氣溫度高於 35℃或低於 7℃)之天

氣，未經機關或監造單位認可適當處置前，不得進行任何形式之油漆工作。

5.1.6 所有新近完成之油漆表面應加以適當保護至油漆層確實乾燥為止；經油漆之物件或器材，於油漆尚未完全乾硬之前，不得搬動或於其上施行任何工作。

5.1.7 油漆材料應以製造廠出品之原裝方式運抵工作場所，容器上應完整保留原廠標註其型式、品名、批號、製造日期、有效期限...等，以作為施工辨別與各項查核之依據。

5.2 表面清理與準備

5.2.1 施塗油漆前，須油漆表面上之所有油脂、鐵銹、金屬黑皮及黏附之污物等均需完全清除，銲濺物、毛口或毛邊、或任何有礙塗裝之不規則表面，應於清理前完全去除或銲接填補。

5.2.2 表面清理可依去除物質之型式與範圍而採用溶劑清洗、砂輪研磨、器具刮削、噴砂等方法。

5.2.3 清理後之表面如積存沙粒或或灰塵，於施塗油漆前應完全清除；前一塗層之表面如受到汙染，應採用特定方式完全去除污染物之後，方可進行下一塗層之油漆工作。

5.2.4 清理用溶劑應使用礦油精、二甲苯或各種漆料之專用溶劑。

5.3 油漆程序

5.3.1 通則

(1) 油漆施塗後應產生一令人滿意之薄膜及光滑平坦之表面。

(2) 油漆塗料於使用前應徹底攪拌與過濾，並於施工中保持不變之適當濃稠度。

(3) 應於前一塗層完全乾硬或達到塗裝間隔時間後，方得施塗下一塗層。

(4) 於表面清理與準備完成後，應即施塗第一層底漆，表面噴砂完成後之最大間隔不得超過四小時，以避免該表面再次遭受污染；塗裝方式得採用無氣噴塗、壓力噴塗、毛刷施塗、或依據油漆生產廠商建議並經機關或監造單位認可之施工方法。

(5) 各類油漆應依據原廠所規定之條件與比例進行調拌、施塗，並遵行該油漆之間隔時間與時效之相關規定，逾時之油漆應予廢棄。

5.3.2 施塗程序

(1) 長期或間歇性淹浸於水中之構件表面，包含所有門扉、水封座、支撐座及導架等，應依下列規定辦理塗裝作業。

A.在工廠(已塗裝之市購產品除外)

以高壓噴砂法除去金屬表面之鱗片、黑皮、鐵銹及其他黏附物質，再以吸塵器或壓縮空氣、毛刷等徹底清除灰塵與鐵垢；其噴砂完成之表面應呈現近似白金屬色澤，其表面處理等級應符合 SSPC-SP10 標準。

表面處理後四小時內，應即施塗含鋅量 75%以上之環氧樹脂鋅粉底漆(Epoxy

Zinc Rich Primer)一至二層，其乾膜厚度至少 50 μm 以上。

其後再施塗環氧樹脂柏油漆(Coal Tar Epoxy Resin Paint)三層，每一塗層之乾膜厚度至少 90 μm，完成後之總乾膜厚度需達 320 μm 以上。

工地銲接接頭之兩側各 150mm 範圍內禁止施塗鋅粉底漆以外之任何塗料；工地強力螺栓接合處，以接合板外緣四周各加大 50mm 範圍內禁止施塗鋅粉底漆以外之任何塗料或沾染油脂，以確保摩擦接合所必須維持之有效摩擦係數。

除另有規定外，環氧樹脂柏油漆為黑色。

B.在工地

以手工具或電動工具清除因為運輸、安裝而受損之油漆表面及或鐵銹與污物，至處理度符合 SSPC-SP3 標準等級後，二小時之內補塗含鋅量 75%以上之環氧樹脂鋅粉底漆一至二層，其乾膜厚度至少 50 μm 以上。

面層施塗環氧樹脂柏油漆(Coal Tar Epoxy Resin Paint)至少三層，每一塗層之乾膜厚度至少 90 μm，完成後之總乾膜厚度需達 320 μm 以上。

工地銲接或栓接完成後，應以適當工具清除銲渣、底漆氧化層及一切有礙油漆施塗之有害物質，再依前述工地施塗程序及相關要求完成該接頭處之塗裝工作。

除另有規定外，環氧樹脂柏油漆為黑色。

(2) 曝露於空氣中之非耐蝕金屬表面，包含吊門機、驅動機、構架與基座及其他雜項設備之表面，依下列規定辦理：

A.在工廠(已塗裝之市購產品除外)

以高壓噴砂法除去金屬表面之鱗片、黑皮、鐵銹及其他黏附物質，再以吸塵器或壓縮空氣、毛刷等徹底清除灰塵與鐵垢；其噴砂完成之表面應呈現近似白金屬色澤，其表面處理等級應符合 SSPC-SP10 標準。

表面處理後四小時內，應即施塗含鋅量 75%以上之環氧樹脂鋅粉底漆(Epoxy Zinc Rich Primer)一至二層，其乾膜厚度至少 50 μm 以上。

其後再施塗環氧樹脂面漆(Epoxy Resin Paint)二層，每一塗層之乾膜厚度至少 45 μm，完成後之總乾膜厚度需達 140 μm 以上。

工地銲接接頭之兩側各 150mm 範圍內禁止施塗鋅粉底漆以外之任何塗料；工地螺栓接合處，以接合件外緣四周各加大 50mm 範圍內禁止施塗鋅粉底漆以外之任何塗料或沾染油脂，以確保摩擦接合所必須維持之有效摩擦係數。

環氧樹脂面漆之顏色由承包商提送標準色卡送請機關選定之。

B.在工地

以手工具或電動工具清除因為運輸、安裝而受損之油漆表面及或鐵銹與污物，至處理度符合 SSPC-SP3 標準等級後，二小時之內補塗含鋅量 75%以上之環氧樹脂鋅粉底漆一至二層，其乾膜厚度至少 50 μm 以上。

面層施塗環氧樹脂面漆至少二層，面漆塗層之乾膜厚度至少 90 μm，完成後之總乾膜厚度需達 140 μm 以上。

工地銲接或栓接完成後，應以適當工具清除銲渣、底漆氧化層及一切有礙油漆施塗之有害物質，再依前述工地施塗程序及相關要求完成該接頭處之塗裝工作。

適用本節指定之所有外露管件，應於驗收前全面再施塗面漆至少二層，每一塗層之乾膜厚度至少 30 μm，完成後之總乾膜厚度需達 200 μm 以上。

(3) 控制盤

在工廠，不銹鋼箱體經加工及開孔完成後，整組箱體需經過脫脂處理以清除油垢，再施以噴塗底漆一次及烤漆二次以上；或採用靜電粉體烤漆，塗裝膜厚為 50 μm 以上，箱體內外烤漆之顏色均為台灣區塗料油漆公會#41(藍灰色)或相同標準之規定或由機關指定。

如因運輸及安裝而傷損控制箱之烤漆，承包商應於工地以同批油漆修補，如傷損面積或範圍過大，則整只外箱需重新噴漆乙次，以求美觀。

5.4 油漆乾膜厚度檢驗

承包商應辦理包含表面處理在內之各塗層自主檢查，並留存經送審核定之自主檢查紀錄表；油漆乾膜厚度之檢驗標準如下：

5.4.1 水封座、導架、主輪軌座、承壓座等門框結構，以每公尺構件長度檢驗 4 個檢測單元為基準，不足一公尺長度部分仍須檢驗 4 個檢測單元。

5.4.2 門扉及其相關構件，以每平方公尺塗裝面積檢驗 2 個檢測單元為基準，不足部分仍須檢驗 4 個檢測單元。

5.4.3 吊門機及其他曝露於空氣中之構件，原則上以每平方公尺塗裝面積檢驗 2 個檢測單元為基準，但每一構件或每面至少檢驗 3 個檢測單元以上。

5.4.4 本節所稱檢測單元係由每處檢測 3~4 點構成，並以各檢測點之檢測平均值做為該單元該次檢驗之紀錄數據。

6. 施工

6.1 安裝一般規定

6.1.1 水閘閥的安裝須遵循廠商提供之安裝說明書。

6.1.2 依據施工製造圖、廠商說明及本章規定，裝設框架、門及栓緊器；包括必要之五金、附件、側柱及門頂擋板、固定器嵌入物、懸桿及支架。

6.1.3 閘閥與包括其它工程均安裝完成後，須經潤滑、測試及調節使操作順暢，並無翹扭或變形等弊端，其週邊應密封，不受室外天氣影響。

6.1.4 裝置工作務必與其他業者配合。

6.1.5 安裝框架及面板，使用鉛錘或水準儀，使其支撐於正確的位置。

6.1.6 調整和換新。

(1) 安設完成後，需調整五金及面板，使操作順暢。

(2) 更換彎曲不平或有其它損壞之門或框架。

6.2 主要構件安裝應行注意事項：

6.2.1 水封座安裝

(1) 水封座之水平或垂直面必須符合圖示。

(2) 水封面及基座應緊密接合。

(3) 注意底水封座與側水封座之垂直度。

(4) 水封座之固定螺栓必須確實固定。

(5) 水封座接頭如有使用焊接者，應注意磨平。

(6) 兩邊側水封座之寬度須符合圖示。

(7) 水封面之螺栓應無凸出或凹入者。

(8) 澆置混凝土時應使用木板加以保護水封座並無漏油。

6.2.2 輪軌、導軌及門框安裝

(1) 真直度及水平度應符合圖示。

(2) 軌距及兩軌平行度，應符合圖示。

6.2.3 輪與輪軌接觸

(1) 各輪踏面必須在同一平面上。

(2) 各輪須與輪軌緊密接觸。

6.2.4 水封安裝

(1) 水封應為新製品，尺寸品質正確，無損傷情形。

(2) 水封螺栓必須確實鎖緊。

(3) 水封必須與水封座緊密接觸，蓄水前可用燈光或噴水法檢查。

(4) 輪與側水封座閘之間隙需依照圖示規定。

7. 檢驗

7.1 一般規定

7.1.1 所有接合處應該用液體的滲透劑作測試。

7.1.2 已完成裝配需經過製造廠之測漏試驗以鑑定每一特定裝置是否耐抗流體靜壓力。

7.1.3 鑄件檢驗

(1) 鑄件之構造需均勻，不得含夾過多非金屬雜質；鑄件表面不需加工者，須以制式工法修鑿齊整與清除雜物。

(2) 包括承受水壓在內之主要鑄件，應於機械加工前報請機關或監造單位到廠檢驗。

(3) 鑄件之較小缺陷，其修鑿深度在鑄件厚度之 25%以內、且不影響鑄件之強度或使用功能者，得以經認可之銲接方式修補及研磨平整。修補工作需由合格銲接技術工執行，修補完成後須進行二次檢驗。

(4) 鑄件因聚集過多較小缺陷，致使機關或監造單位對該鑄件產生安全疑慮時，得拒絕驗收。

(5) 鑄件之缺陷鑿除後，其受應力之斷面小於原斷面之 50%、或其所受應力大於容許應力之 50%者，該鑄件應廢棄重鑄。

(6) 鑄件尺寸應與圖示值實質相符，不得因鑄造作業而縮減致鑄件之強度減少 10%或鑄造時產生之起始應力超過規定之容許值。

7.1.4 機械加工

(1) 無螺紋圓柱形機件配合之公差、裕度及規矩應符合 CNS 標準。

(2) 軸頸面及滑動面需精確加工到規定之光滑度，以使與軸承面及支承面能全面接觸。

(3) 所有螺栓鑽孔需準確定位、鑽頭尺寸應正確，銷孔應為光滑之圓柱筒狀、並與構件之軸線成直角。

(4) 所有軸承面及潤滑溝在組配前應完整清理及加注潤滑油脂。

7.1.5 銲接檢驗：銲接件之檢驗項目及檢驗頻率參照 4.3.6 節之相關規定。

7.1.6 塗裝檢驗：塗裝之檢驗項目及檢驗規定參照 5.4 節之相關規定。

7.2 閘閥各部尺寸容許誤差及測定位置

閘閥製造完成後須先在廠內裝配，以檢驗各部之尺寸。

各部容許誤差之計算公式及各部尺寸容許誤差及測定位置如表（a）、（b）

表中 ε_i＝容許誤差＝$\pm\frac{\varepsilon_0}{2}\left(1+\frac{L}{10}\right)$ mm 或依下表中規定

ε_0＝每 10m 長誤差基準值（mm） L＝構材長度（m）

（a）閘閥 （單位：mm）

項　　目	誤差基準值	容許誤差	測定位置及點位

	(ε_0)	(ε_1)	
閘閥寬度	8		上下端各一寬度
閘閥高度	8		上下端各一寬度
閘閥深度	6		各主橫樑二度
頂及側水封面與主承壓面間距離		+2 ,-0	各水封各二處
基準點兩對角線長之差	8		
側水封中心間距離		+10 ,-6	每2m高度
吊扣中心間距離	10		
相鄰兩主橫樑中心間距離	8		每對左右各一處
兩側導履踏面間距離	6		
吊扣中心與面板外側距離		±3	
面板底緣中心點與端點平直度	3		

(b) 水封座、支承座及導架　　(單位：mm)

項　　目	誤差基準值 (ε_0)	容許誤差 (ε_1)	測定位置及點位
淨跨距	8		上下各一處
導架(件)踏面間距離		+6 ,-0	上下各一處
側水封座水封面與底水封座中心間距離	8		左右各一處
側水封座、支承座及導架高度	8		各件各一處
基準點兩對角線之差	8		
水封面平面度		1.5	長度1m內
頂水封面中心至底水封面高度	8		

8. 計量及計價

8.1 計量：依契約詳細價目表及單價分析表相關項目及數量計量。

8.2 計價：依契約詳細價目表相關項目之單價及數量計價。

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