NSW GOVERNMENT | TAFE NSW

WELDING BAY
DESIGN STANDARD

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TAFE NSW would like to pay our respect and acknowledge Aboriginal and Torres Strait Islander Peoples as the Traditional Custodians of the Land, Rivers and Sea. We acknowledge and pay our respect to the Elders; past, present and emerging of all Nations.

TAFE NSW Granville Electrotechnology Workshop

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This document was commissioned by TAFE NSW and prepared by JHA Consulting Engineers (NSW) Pty Ltd.

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The project team retains responsibility for the coordination, design, procurement, and delivery of welding workshop systems which will include taking all reasonable steps to make sure that the welding workshop systems design, and selection complies with all applicable Australian Standards required by the NCC, WHS Legislation, Statutory planning approval processes, TAFE NSW Procedures & Policies, and all other relevant statutory requirements.

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P1	30 June 2022	Draft 1	N/A – Initial Draft
A	29 July 2022	Final 1	Update as per review and comments
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TAFE NSW Wetherill Park

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INTRODUCTION

1 INTRODUCTION

1.1 OVERVIEW

This document forms part of the TAFE NSW ITN Design Book and is to be read in conjunction with the overarching design principles described in the TAFE NSW ITN Design Principles, the TAFE NSW ITN Design Procedures and other relevant TAFE NSW Design Standards.

This Design Standard provides specific guidelines for the planning, design, operation and maintenance of welding bay design within built environment projects across TAFE NSW.

This Design Standard applies to all welding bay projects including new facilities and replacements within and refurbishment of existing facilities.

1 INTRODUCTION

1.2 AUDIENCE

The table below broadly defines the diverse audience this Design Standard is written for and the roles they play through the design, selection and delivery process.

Table 1 Who should use this Design Standard?

Group	Members	Group's Roles
Consultants	▪ Architects ▪ Engineers ▪ Project Managers	▪ Guidance tool to design team ▪ Outline TAFE NSW technical requirements
TAFE NSW Project Team	▪ Program Managers ▪ Design Managers ▪ Strategic Planning ▪ Procurement ▪ Facility Management ▪ Sustainability ▪ Logistics ▪ Systems Group	▪ Assist with project design brief preparation ▪ Provide technical outline to manage project ▪ Outline space specific technical expectations
TAFE NSW Operations & End Users	▪ Teaching Staff ▪ Education Planning & Services Delivery ▪ Student Experience Group ▪ Product Group ▪ Change Management ▪ Student support groups ▪ Industry Partners	▪ Outline space specific technical expectations ▪ Assist to understand and properly utilise/operate the installed systems
Contractors	▪ Construction Contractors	▪ Outline TAFE NSW technical requirements ▪ Assist with preparation of TAFE NSW quotes, and plant selection/suggestions
Suppliers	▪ Welding bay system suppliers ▪ Welding bay system manufacturers	▪ Outline TAFE NSW technical requirements ▪ Assist with preparation of TAFE NSW quotes, and plant selection/suggestions

1 INTRODUCTION

1.3 STANDARDS & DOCUMENTS

The following standards and documents, as relevant to the project, should be read in conjunction with this Design Standard when designing, documenting & delivering welding bay systems. This list is not exhaustive and other documents may apply.

1.3.1 EXTERNAL REQUIREMENTS

Statutory Requirements

The planning and design must incorporate the relevant requirements as stipulated by the following Statutory Authority bodies:

- National Construction Code / Building Code of Australia
- State Environmental Planning and Assessment Legislation
- All Commonwealth, State and Local Government Legislation
- Any conditions of consent identified through the statutory approvals process
- Insurance Council of Australia
- Fire & Rescue NSW
- Australian Communication Authority
- Principal Certifying Authority (person qualified to conduct a Certification of Crown Building Works)
- Clean Energy Council
- Electricity Distributor's (Network) Requirements
- Electricity Retailer's Requirements
- NSW Wiring and Installation Rules
- Work Health and Safety Act
- Disability Discrimination Act
- Safe Work NSW Authority Requirements
- Any other authority having jurisdiction
- The Australian Dangerous Goods Code. ADG Code

External Certification Schemes

- Green Building Council of Australia (GreenStar) and other recognised certification schemes (e.g. GECA, etc)

NSW Government Policies

- Workplace Design Principles (NSW Department of Planning, Industry and Environment)
- Work Cover Authority requirements
- OH&S Regulations
- Local Council regulations having jurisdiction on this project
- Roads and Maritime Services
- The Australian Dangerous Goods Code. ADG Code
- New South Wales Health Commission
- Department of Environment and Conservation
- Smart Infrastructure Policy
- Better Placed - Design objectives for NSW (Government Architects NSW)
- NSW Government Resource Efficiency Policy (GREP)
- NSW Government Net Zero Plan Stage 1 2020-2030

1 INTRODUCTION

1.3 STANDARDS & DOCUMENTS

1.3.2 TAFE NSW REQUIREMENTS

TAFE NSW Design Standards

- Any other Design Standards relevant to the project

TAFE NSW Policies

- Environmental Sustainability Policy
- Reconciliation Action Plan
- Diversity and Inclusion Policy
- Work Health and Safety Policy
- Disability Inclusion Action Plan and Implementation Guide

1 INTRODUCTION

1.3 STANDARDS & DOCUMENTS

1.3.3 STANDARDS

Australian Standards

Code Standards	Description
AS 1170.4-2007	Structural design actions Earthquake actions in Australia
AS 1428.1 & 1428.2	Design for access and mobility
AS 4254.1 & 2	Ductwork for air-handling systems in buildings
AS 4289	Oxygen and Acetylene Reticulation Systems
AS/NZS 3000	Wiring Rules
AS/NZS 3001	Electrical Installations- Transportable structures and Vehicles including their site supplies
AS/NZS 3008	Electrical Installations - Selection of Cables
AS/NZS 3013	Electrical Installations - Wiring Systems for Specific Applications
AS/NZS 3017	Electrical Installations - Testing and Inspection Guidelines
AS/NZS 3100	Approval and Test Specification - General requirements for electrical equipment (Parent specification for essential safety requirements)
AS/NZS 3112	Approval and Test Specification - Plugs and Socket Outlets
AS/NZS 3131	Plugs and Socket Outlets for use in Installation Wiring Systems
AS/NZS 3190	Approval and Test Specification - Residual Current Devices
AS/NZS 3760	In-service Safety Inspection and Testing of Electrical Equipment
AS/NZS 5601.1:2013	Gas Installations
AS/NZS 60065	Audio, Video and Similar Electronic Apparatus - Safety Requirements
AS/NZS 60529	Degrees of protection provided by enclosures (IP Code)
AS/NZS 61000.6.1	Electromagnetic Compatibility (EMC) - General standards: Immunity for Residential, Commercial and Light Industrial Environments
AS/NZS 61000.6.2	Electromagnetic Compatibility (EMC) - General standards: Immunity for Industrial Environments
AS/NZS 61000.6.3	Electromagnetic Compatibility (EMC) - General standards: Emission Standard for residential, Commercial and light-industrial environments
AS/NZS 61009.1	Residual current operated circuit breakers with integral overcurrent protection for household and similar uses (RCBOs)
AS/NZS 61439.1	Low Voltage Switchgear and Control gear Assemblies Part 1
AS/NZS 61439.2	Low Voltage Switchgear and Control gear Assemblies Part 2

1 INTRODUCTION

1.4 DEFINITIONS

1.4.1 ABBREVIATIONS

Abbreviations	Description
A/C	Air Conditioning
AFFL	Above Finished Floor Level
AH	After Hours
AHU	Air handling unit
AS	Australian Standard
ASP3	Level 3 Accredited Service Provider
ATS	Automatic Transfer Switch
AS/NZS	Australian / New Zealand Standard
BMCS	Building Management and Control System
CO_2	Carbon Dioxide
CT	Current Transformer
DB	Distribution Board
DBYD	Dial Before You Dig underground search
DIN	Switchboard industry standard rail mounting system for control and metering equipment
DSSO	Double Switched Socket Outlet
ELF	Extra Low Frequency
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EMSS	Energy Management System Software
EMS	Energy Management System
EV	Electrical Vehicle
EPO	Emergency Power Off
FCU	Fan coil Unit
GUI	Graphic User Interface
HDUPVC	Heavy Duty Underground PVC
IP	Ingress Protection rating is a numerical two digit code to indicate the degree of dust and moisture provided by an enclosure of electrical switchboard, outlets or equipment
ITN	Interconnected Training Network
LV	Low Voltage
MEN	Main Earth Neutral

1 INTRODUCTION

1.4 DEFINITIONS

Abbreviations	Description
MDB	Main Distribution Board
MSB	Main Switchboard
MSSB	Mechanical Services Switchboard
MTS	Manual Transfer Switch
MV/LV	Medium Voltage / Low Voltage
NMI	National Metering Identifier
NTTA	National Association of Testing Authorities
NCC	National Construction Code of Australia
QA	Quality Assurance
RCBO	Residual Current Circuit Breaker with Overcurrent Protection
RCD	Residual Current Device
SLD	Single line Diagram
SSO	Switched Socket Outlet
UPS	Uninterruptable Power Supply
USB	Universal Serial Bus
VCD	Volume control damper
WHS	Workplace Health and Safety

1 INTRODUCTION

1.4 DEFINITIONS

1.4.2 TERMS

Terms	Description
Supply	"Supply", "furnish" and similar expressions mean "supply only".
Provide	"Provide" and similar expressions mean "supply, install and commission".
Approved	"Approved", "reviewed", "directed", "rejected", "endorsed" and similar expressions mean "approved (reviewed, directed, rejected, endorsed) in writing by the TAFE NSW appointed delegate".
Current Standard	That particular version of a specific standard that is legally in force at the time when the design is completed.
“Equivalent to” or “Equal to”	The contractor is not to assume that any product is equal to or equivalent to a specified item until it has been agreed to in writing by the Superintendent.
Give notice	"Give notice", "submit", "advise", "inform" and similar expressions mean "give notice (submit, advise, inform) in writing to the TAFE NSW appointed delegate".
Must	Use of the word “must” indicates that the requirement is mandatory.
Obtain	"Obtain", "seek" and similar expressions mean "obtain (seek) in writing from the TAFE NSW appointed delegate".
On Approval	Any proposed device, method or change will be submitted in writing and cannot be assumed to be accepted until approval is provided by the Superintendent in writing.
Preferred	Use of the word ‘preferred’ indicates that the requirement will be met unless there are compelling reasons to the contrary. Cost is not a compelling reason in this circumstance.
Proprietary	"Proprietary" mean identifiable by naming manufacturer, supplier, installer, trade name, brand name, catalogue, or reference number.
Samples	Includes samples, prototypes and sample panels.
Should	Use of the word "should" indicates that the requirement will be met unless there are compelling reasons to the contrary. Cost is not a compelling reason in this circumstance.
this Design Standard	TAFE NSW Welding Bay Design Standard

APPLICATIONS

2 APPLICATIONS

2.1 SCOPE

2.1.1 HOW THIS DESIGN STANDARD APPLIES

Compliance

This Design Standard is intended to support and assist the selection, design and procurement of welding bay systems.

This Design Standard must also be read in conjunction with:

- Statutory and legislative requirements
- Contractual agreement with TAFE NSW
- The project brief and relevant project requirements
- Any other TAFE NSW Design Standards

Where there is a conflict between this Design Standard and any statutory or legislative requirement, the higher standard applies.

Contractual responsibility

The contents of this Design Standard does not relieve any consultant, contractor or supplier from their contractual responsibility relevant to the project.

It remains the responsibility of the consultant, contractor or supplier to fully complete, coordinate and identify any errors or omissions in the documentation produced for the welding bay design.

Queries

Any project specific queries are to be raised through the TAFE NSW project lead, or project manager as applicable.

If this document appears to contradict or deviate from good industry practice or any statutory requirements, this is to be brought to the attention of the TAFE NSW project lead responsible for the delivery of the welding bay design project.

2 APPLICATIONS

2.1 SCOPE

2.1.2 WELDING BAY SYSTEMS COVERED BY THIS STANDARD

This standard outlines the general welding bay scope as follows:

- Training Bay
- Demonstration Bay
- Welding Bay Partition and Flooring
- Welding Bay Curtain
- Ventilation
- Supervision
- Electrical Supply
- Switchboards
- Components
- Lighting
- Welding Isolation Panels and Earthing
- Reticulated Gas
- Work Health & Safety

In addition to general welding bay design covered by this Design Standard, welding bay designers must liaise, consult and collaborate with TAFE NSW stakeholders and user groups to include specific welding bay design, operation and maintenance requirements for the following faculty specialist areas:

- Engineering Services
- Welding, fitting, machining, metal fabrication, carpentry and other building services trades
- Any other specialist faculty or learning areas not covered by this Design Standard

2 APPLICATIONS

2.2 PROJECT APPLICATION

2.2.1 PROJECT TYPES

This Design Standard is intended to support the welding bay design and delivery of a variety of physical environments including but not limited to the project types below:

Major Capital Works & Special Projects

- All new building and major refurbishment projects must comply with this Design Standard

Minor Works

- All buildings alterations and additions must comply with this Standard

Mini-Minor Works

- All minor fitouts should make every effort to comply with this Standard

2 APPLICATIONS

2.2 PROJECT APPLICATION

2.2.2 PROJECT DESIGNER

The designer or consultant must be an experienced and suitably qualified welding bay designer covered by professional indemnity and public liability insurance in accordance with the TAFE NSW contract and relevant industry requirements.

At the completion of the briefing stage and at every design stage, the welding bay designer must obtain endorsement of the proposed design from the TAFE NSW project team to proceed to the next stage.

In addition to the project deliverables, the welding bay designer has the following obligations:

- Review of all documents and specifications provided by the installer to maintain quality of the installation in accordance with the design
- Review of samples provided by the installer to maintain quality of the installation in accordance with the design
- Inspect the new installation for compliance with the project design documentation, NCC and relevant standards

2.2.3 PROJECT INSTALLER

The welding bay installer or contractor must be an experienced and suitably qualified welding bay designer covered by professional indemnity and public liability insurance in accordance with the TAFE NSW contract and relevant industry requirements.

At the completion of every design stage, the welding bay installer must obtain endorsement of the proposed design from the TAFE NSW project team to proceed to the next stage.

In addition to the project deliverables, the welding bay installer has the following obligations:

- To provide detailed on-site measurement, co-ordination with building elements and other services to establish final set-out, location of equipment allowing for maintenance access envelope requirements
- To provide detailed programs including milestones indicating shutdowns, temporary requirements to maintain occupancy, staging of works and commissioning prior to handover
- To provide manufacturer's workshop, equipment specifications and construction drawings, schedules and details

2 APPLICATIONS

2.3 PROJECT DESIGN DOCUMENTS

2.3.1 DESIGNER DELIVERABLES

The welding bay designer or consultant must prepare and submit all reports, design documents and certification as required to fully describe the design and to suit the scale and complexity of the project. The minimum documentation is as indicated below, and any specific items noted in the specific technical sections:

Site investigation and audit

A detailed site investigation and audit must be undertaken for the entire existing welding bays including but not limited to infrastructure, equipment, benches, electrical systems, ventilation systems. This must include:

- An assessment of the condition, available spare capacity and compatibility for the intended existing equipment and/or system and whether it is suitable for re-use
- A due diligence review of any non-conformances to any applicable standards and authority requirements
- List all non-compliance items with TAFE NSW standards and/or any other reference documents provided
- Any site constraints, potential hazards or risks
- An outline of the findings, outcomes and recommendations

Return Services Brief

Return Services Brief must be prepared and submitted to:

- Identify and qualify the strategic deliverables to be achieved
- Incorporate all site audit investigation findings and outcomes
- Indicate demolition, disconnection, making safe, dismantling and de-commissioning of existing redundant systems
- Identify site storage, disposal and removal of redundant equipment and their associated interfaces including control, wiring, ductwork, piping and drainage etc.
- Outline staging of works in accordance with the construction deliverables satisfying stakeholder and user group requirements
- Where existing sections of the building are to remain operational during construction, advise if any temporary services are necessary to maintain accessible services to the building
- List relevant standards and codes which will be applied to the project
- Outline welding bay design criteria, including but not limited to ventilation rates, building envelope characteristics, quantity of bays, fittings and equipment
- Provide outline of proposed welding bay design concepts
- Provide welding bay general layout, plant locations and spatial considerations, and access provisions
- If relevant to the project, identify welding bay related Green Star initiatives and their design requirements
- Outline any spare capacity allowances

- List any proposed departures from this TAFE NSW standard, or other TAFE NSW standards, including, justification, and implications
- List type of proposed welding hood(s)
- List proposed types of welding and shop gases to be provided, and the specific types of welding services that are to be provided

Budget Cost Summary

Budget Cost Summary must be prepared and submitted identifying costs for all welding bay systems at each specific project milestone, in accordance with the project specific program. It is to outline any assumptions and exclusions.

Proposed alternate innovative design

Any proposed alternate innovative welding bay design solutions must undertake a cost / benefit analysis study. This must identify capital costs, ongoing energy and maintenance costs, along with a qualitative analysis illustrating the reliability, longevity, and maintenance regime for the alternative proposal against the option put forward by the standard.

Design Calculations

Refer to relevant technical sections for details.

Risk Management Report

Risk Management Report must be prepared and submitted identifying:

- Safety and design requirements for construction, operation and maintenance
- The origin of all identified risks
- Work to be carried out in hazardous and confined spaces
- Asbestos retention and/or removal
- Hazardous goods handling and storage areas
- Any specific stakeholder insurance risk requirements
- Potential latent conditions including the process for early resolution to agree costs involved prior to proceeding with works and to avoid / mitigate construction delays

Certification

Certification must be submitted to the Principal Certifying Authority / person qualified to conduct a Certification of Crown Building Works in accordance with the NCC, statutory and regulatory authority requirements, this Design Standard any other relevant TAFE NSW Standard.

2 APPLICATIONS

2.3 PROJECT DESIGN DOCUMENTS

Specification Documentation

Specification Documentation must incorporate and further develop the detail of the welding bay design including requirements of all relevant report findings and outcomes, along with the inclusion of the following as a minimum:

- Address the design principles and strategies of this Design Standard
- Address the project specific design strategies
- Clear description of welding bay service scope of works
- List of codes and standards that the project design is in compliance with
- A comprehensive project-specific scope of welding bay systems, area layout, plant items and equipment, installation details, power and control wirings, fittings, access and interface requirements, schedules of equipment and all associated technical requirements
- Detailed demarcation requirements for the specified works with existing installations, and works by others
- Be co-ordinated with the latest reference documents and each trade services design input
- Commissioning, testing and quality monitoring framework during the construction works
- TAFE NSW staff training and handover procedures
- Identify working and final documents and record requirements
- Identify a comprehensive Operating and Maintenance Manual requirements
- Installer deliverables as detailed in Section "2.3.2"

Welding Bay Drawings

Welding bay Drawings shall include (as necessary) the following:

- Title block, drawing lists and legend of symbols
- Site plan where relevant
- Welding bay layouts proposed and demolition works
- Schematics and plan drawings - where relevant: floor layout, wiring layouts, ventilation layouts, pipe layouts
- Typical installation details and part plans

2 APPLICATIONS

2.3 PROJECT DESIGN DOCUMENTS

2.3.2 INSTALLER DELIVERABLES

The welding bay installer or contractor must prepare and submit all reports, design documents and certification as required to suit the scale and complexity of the project. The minimum requirements for deliverables are as indicated below, and as noted in the specific technical sections.

Welding gas system installers must provide proof of relevant qualifications and experience for gas fitting and alarm systems in reference to the NSW Gas Fitting Acts and Regulations.

Samples

Submit samples as per the project specific specification, and any items identified in the technical sections of this standard.

Alternative Design Verification

Where alternatives are proposed, provide an alternative design assessment report indicating compliance with the welding bay design intent and design criteria. Provide all supporting technical data, and associated installation methodology which must be compliant with statutory requirements.

Risk Management Report

Risk Management Report is to be prepared and submitted identifying:

- Safety in Design requirements for construction and installation
- The origin of all identified risk
- Any potential welding bay hazards
- Any work to be carried out in hazardous and confined spaces
- Asbestos retention and/or removal
- Hazardous goods handling and storage

Interruption of Supply Notices

Notice of interruption of supply is to be submitted for acceptance when undertaking any planned interruption of supply to existing areas of an occupied building.

Construction and fit-out of the Welding Facility

The welding bay contractor will construct the welding bays and associated areas as designed. Services and equipment will be new and will be installed as designed.

Commissioning and Testing

The welding bay contractor must develop and submit a project specific commissioning and testing plan in accordance with their quality assurance plan. This must be consistent with the builder's construction program including:

- All defined handovers including staged areas
- All milestones

- Notice for witness upon completion of all acceptance testing and commissioning activities
- Completion of all mandatory site tests in compliance with standards and authority requirements
- Detail of testing for each system and associated sub- component
- All acceptance testing and commissioning records and certificates
- All commissioning and test reports and certificates indicating observations and results of tests, commissioning and compliance or non-compliance with statutory authority requirements
- All final and acceptance test records in suitable format for the inclusion in Operating and Maintenance manuals

Workshop Drawings

Submit further developed detailed design drawings, addressing method of installation, layouts, temporary works and staging, minor alterations in construction, approved value engineering initiatives and alternative designs.

As-built Drawings

Submit revised As-installed drawings, revised equipment schedules, illustrating as –installed mounting and fixing details and final as installed condition for record and maintenance purposes. As-built drawings to be provided in the following formats: full size PDF, CAD / DWG, Revit Model (if available for the project).

Warranties

Submit warranties for all installed works covering the welding bay contractor's works and installed plant. Specific warranties are to be provided for major welding bay plant. Refer to technical sections of this specification for any extended warranty requirements.

Installation Certification

Installation Certification is to be submitted to the Principal Certifying Authority / person qualified to conduct a Certification of Crown Building Works in accordance with design documents, NCC/BCA, statutory and regulatory authority requirements, this Design Standard or and any other relevant TAFE NSW Standard.

Operating and Maintenance Manuals

Prepare and submit an operating and maintenance manual with the inclusion of the following project specific detailed requirements:

- Table of contents: As per contractual requirements
- Directory: As per contractual requirements
- Format: As per contractual requirements
- Installation description: General description of installation.
- Systems descriptions: Technical description of the systems installed, written to ensure that the Proprietor's staff fully understands the scope and facilities provided. Identify function, normal operating characteristics, and limiting conditions.
- Systems performance: Technical description of the mode of operation of the systems installed.

2 APPLICATIONS

2.3 PROJECT DESIGN DOCUMENTS

- Certificates:
  - Installation certificates certifying installation in compliance with the project design documentation, all statutory & authority requirements, the NCC, and TAFE NSW Standards
- Certificates (where relevant):
  - Certificates from Authorities
  - Product certification
  - Contractor waterproof sealing of penetrations certificate
  - Contractor fire and smoke sealing penetrations certificate
  - Contractor acoustic sealing of penetration certificate
  - Seismic restraint mounting certification
  - Calibration certificates at acceptance testing and final testing
  - Supply authority completion forms and inspection records
  - Inspection and contractor rectification records
- Drawings and technical data: As necessary for the efficient operation and maintenance of the installation
- Equipment descriptions:
  - Name, address, telephone and facsimile numbers of the manufacturer and supplier of items of equipment installed, together with catalogue list numbers
  - Schedules of fittings, plant and equipment to include identification locations, metering and control settings, performance figures and dates of manufacture. Provide a unique code (Asset) number
  - Schedules of fittings, plant and equipment to include cross-reference to the record and diagrammatic drawings and schedules, including easy to find spare parts schedule, for each item of equipment installed
  - Schedules of fittings, plant and equipment to include manufacturers' technical literature for all plant items, equipment, switchgear, metering and controls and all other welding bay equipment installed, assembled specifically for the project, excluding irrelevant matter. Mark each control device and plant item and the like welding bay equipment product data sheet to clearly identify specific products and component parts used in the installation, and data applicable to the installation
  - Generic brochures are not acceptable. Provide project specific technical data of items installed
  - Mounting and fixing to product data to illustrate relations of component parts. Include typed text as necessary
- Manufacturer’s product data for proprietary equipment, including:
  - Technical specifications and drawings
  - Verification reports
  - Performance and rating tables
  - Recommendations for installation and maintenance
  - Schedule of proposed major products that are not specified as proprietary items
  - Product certification
- Operation procedures:
  - Manufacturer's technical literature as appropriate
  - Safe starting up, running-in, operating and shutting down procedures for systems installed. Include logical step-by-step sequence of instructions for each procedure including automatic and manual control override procedures

  - Compile a welding bay user interface guide to include all operating instructions to enable user to configure equipment to achieve a reliable, energy efficient, safe and fully functional operation
- Maintenance procedures:
  - Manufacturer's technical literature as appropriate. Register with manufacturer as necessary. Retain copies delivered with equipment
  - Detailed statutory switchboard maintenance testing and recording
  - Safe troubleshooting, disassembly, repair and reassembly, cleaning, alignment and adjustment, and checking procedures. Provide logical step-by-step sequence of instructions for each procedure
  - Schedule of spares recommended to be held on site, being those items subject to wear or deterioration and which may involve the Proprietor in extended delivery times when replacements are required. Include complete nomenclature and model numbers, and local sources of supply
  - Schedules of equipment, local sources of supply, and expected replacement intervals
  - Instructions for use of tools and testing equipment
  - Emergency procedures, including telephone numbers for emergency services, and procedures for fault finding
- Records and Documents:
  - All construction drawings should be revised to ensure inclusion of all additions, modifications and alterations during the construction stage to be submitted as As-built drawings, to same scale and format
  - All fabrication and workshop drawings should be revised to ensure inclusion of all additions, modifications and alterations during the construction stage to be submitted as As-built drawings, to same scale and format
  - All welding bay system, control and alarm schematics and layouts, welding gas, mechanical water, ventilation and wiring diagrams
  - Control and equipment schedules including mechanical service characteristics, controls and communications
  - All licensed versions of computerised software required to program and monitor systems
  - All security code access, usernames and passwords, configuring, data base and recovery protocols stored in digital format on an external hard drive, required to reset and access all energy management software
  - Equipment asset numbered schedules, identifying condition and use with unique label
  - Dangerous Goods Consultants Report where relevant
- Commissioning and Testing Records:
  - Contractors completed self-regulated inspection & test plans for each welding bay system installed
  - Completed logbooks and the like
- Warranties

2 APPLICATIONS

2.3 PROJECT DESIGN DOCUMENTS

Installation Certification

Installation Certification is to be submitted to the Principal Certifying Authority / person qualified to conduct a Certification of Crown Building Works in accordance with design documents, NCC/BCA, statutory and regulatory authority requirements, this Design Standard or and any other relevant TAFE NSW Standard.

DESIGN STRATEGIES

3 DESIGN STRATEGIES

3.1 USER WELL-BEING

Create a safe environment for occupants with user friendly interfaces that are readily accessible.

Strategy	Requirement
Safety	Identify potential hazards and undertake a risk assessment to implement safe installation, operational procedures and ongoing maintenance methods.
Safety	A method of safe access is to be established for welding bay installations for periodic cleaning, repair or replacement of equipment. Earthing of welding bays to provide a safe environment for occupants.
Accessibility	Create an environment that promotes equitable access for all users regardless of ability. Teaching and learning areas to be accessible and clear from any obstructions.
User Interface	Enable familiar interface with WHS operating instructions to facilitate intended use of bays and associated equipment.

3 DESIGN STRATEGIES

3.2 ADAPTABILITY

Welding bay installations to be consistent across TAFE NSW sites, and allow for future upgrade provisions.

Strategy	Requirement
Consistency	Ensure consistency of plant manufacturer and type within buildings for a given site.
Compatibility	New installation works where practical are to be compatible with existing installations to provide a seamless installation across the site.
Future growth	Allow spare capacity in major plant or spatial allowances for future plant installation to support any future expansion.
Environment	Address the longevity of the installation subject to the environmental conditions of the area such as high ambient levels of salt, pollution, dust, moisture and/ or temperatures, equipment and the like.
Innovation	TAFE NSW supports innovation across all scales of project delivery. Where a consultant/contractor identifies an opportunity to implement innovative solutions these may be submitted to the TAFE NSW project lead for review.

3 DESIGN STRATEGIES

3.3 UNDERSTANDING CONTEXT

Address the project scope, construction, cost, maintenance, sustainability and quality requirements.

Strategy	Requirement
Project Type	Facilitate the specific project scale, site conditions and campus location.
Construction	Resilient and robust construction to allow reliable use within the installed environment.
Cost	Undertake a holistic cost-effective design to mitigate procurement, installation, and ongoing maintenance costs and support the longevity of the proposed welding bay installation.
Selection	Select components that are readily available from local suppliers.
Maintenance	Facilitate ongoing monitoring procedures, and enable installation and maintenance without any access constraints or the need for dismantling or demolition.
Sustainability	Incorporate energy saving initiatives that allow the user to monitor energy usage and provide reporting to mitigate operational energy consumption.
Quality	Assess, evaluate and verify performance, method of installation, commissioning and testing to meet functional and operational requirements and achieve longevity of the installation in accordance with warranties provided.

TECHNICAL SECTIONS

4 TECHNICAL SECTIONS

4.1 GENERAL

This Design Standard is intended to support and assist the selection, design and procurement of welding bay systems. Mandated details of systems, as defined by government codes and standards (NCC Section J for example), will not be reproduced in this standard. Instead, this section seeks to provide a guide for the selection and design of those welding bay systems which will be required by TAFE NSW.

General, high-level comments are provided as to type and configuration of the welding bay design which TAFE NSW expects to be used to meet its needs. It is expected that these comments will then be further developed by the designers, installers and suppliers in conjunction with TAFE NSW to generate the final installation meeting TAFE NSW's needs.

The typical TAFE NSW welding facility consists of:

- A demonstration area, where a teacher can demonstrate all aspects of welding to a number of students – anticipated to be up to 20 at any one time
- Multiple training bays in which individual students can practice their welding skills safely and in isolation
- Material storage
- Sundry areas that are associated with the welding process (such as grinding, cutting, bending etc.)

A welding facility may be included as part of a large metalwork shop.

4 TECHNICAL SECTIONS

4.2 TRAINING BAY

4.2.1 ARRANGEMENT

The standard layout of a welding bay for training purposes (referred to as a training bay in the following) is shown on the plan in "Figure 1" . The legend following "Figure 1" defines the numerals shown in "Figure 1".

As an overview a training bay will have:

- A welding bench and stool
- Space for welding equipment and tools
- Service provisions including power, nominated gases, lighting and fume extraction
- Protective partitions and curtains
- Electrical monitoring and isolation equipment to improve the safety of the welding process for students

The preferred, clear internal dimensions of a training bay are 2000mm x 2000mm as per the plan of "Figure 1". Where the available space is constrained, such as may occur in the refurbishment of an existing facility, the bay dimensions may be reduced to an absolute minimum of 1800mm x 1800mm on approval. Larger bays may be provided where they fit naturally into the space available or where there is a project-specific requirement to provide larger bay dimensions.

As per the plan below, "Figure 1", the standard training bay will have a welding bench on the left hand side when looking into the bay. This is preferred for right-handed welders. Where between 5 and 10 training bays are to be provided, one bay should be provided that is the mirror-image of the standard bay – suitable for left handed welders. Between 10 and 20 bays provide 2-off mirror imaged bays.

As per the plan the specific contents of the training bay should be:

Welding Bench

A sturdy, stable welding bench (refer to Section "4.6" below for bench details).

Splash-back

A metal ‘splash-back’ designed to reduce the damage to the training bay walls due to sparks, mechanical impact or welding equipment misuse. The splash-back will typically consist of 3mm thick aluminium or protected steel extending the width of the welding bench plus 100mm on each side of the bench. The splash-back will wrap around the side wall and extend to 50mm in front of the bench (when installed in its final position). Vertically the splash-back shall extend from 50mm below the top-plate of the bench to 500mm above the plate or 10mm above the back of the welding table – whichever is the higher. The splash-back shall be fixed to an insulating backboard (e.g. fibre cement board) with bolts (round head on the welding bay side) that do not contact any metal framework behind. The edges will be bevelled and there will be no sharp edges or points. There will be no gaps between the splash-back and the backboard that can capture sparks or metallic dust/fragments.

4 TECHNICAL SECTIONS

4.2 TRAINING BAY

Once the bench is fully installed (including bolting into the floor) the contractor will measure the conductivity between each section of the splashback and the electrical earth to confirm that the splashback is indeed insulated from the latter. The resistance shall exceed 1MΩ. The intent is to ensure that metal on the table top cannot inadvertently establish a link to the electrical earth via the structural components of the welding bay.

Shadow-board

A wall-mounted shadow-board located immediately beside the welding bench (on top of the splashback) will be provided for the neat storage of tools. It will accommodate:

- A chipping hammer
- A wire brush
- Tongs
- MIG Pliers
- and will have 50% spare capacity

The shadow-board will be provided complete with supporting pegs and painted/stencil shadows for tools. Shadow-board pegs will have an upturn to reduce the likelihood of tools falling off and sufficient pegs per tool will be provided to ensure it is held securely. The board will be non-flammable.

The contractor will obtain samples of each tool type from the TAFE NSW staff to ensure that the shadow-board is appropriate to accommodate the tools.

Local lighting

An LED light will be provided over the bench to ensure a light level of 240lx horizontally over the work bench. It will be positioned so as to reduce shadowing by the body of the student, the tools on the shadow-board or by the fume extraction arm. Refer to Section "4.13" for details of the LED lighting to be provided. A light switch will be installed for all bays at a central teacher's location.

Fume Extraction

A fume extraction head on a flexible arm will be provided over the bench to remove welding fumes. This will be equivalent to Ezi-duct Ezi-arm (2.2m version for the standard bay but generally selected to fit the space). Refer to the section on ventilation (Section "4.7") for details. The fixing point for the arm will be at high level (2100mm from the lowest fixed point to the floor) such that the ducting and supports associated with the arm do not limit activities in the bay (e.g. does not limit work on the bench, storage of equipment beside the bench or unnecessarily block the light on the bench).

Although the flexible fume extraction arm is the preferred approach. Other solutions such as downdraft systems or vents in the rear wall of the training bay may be considered – although most of these will require significant modification and redesign of the welding bench.

4 TECHNICAL SECTIONS

4.2 TRAINING BAY

Safety Isolation

The welding bench is to be electrically isolated from the building earthing system to ensure that misuse of the welding system cannot affect the electrical wiring. Refer to the previous section on the metal splashback which will serve as a measurable point of isolation between the bench and building earth.

Power Outlets

Industrial power outlets for welders to be positioned adjacent to the isolation panel.

- 1 x 32A 3-phase, 5 round pin
- 1 x 20A 3-phase, 5 round pin
- 1 x 15A single phase, 3 flat pin

These will be protected by independent, upstream 30mA Residual Current Protection that is built into the circuit overload protection.

Power outlets for general use, typically located on the opposite side of the bench to the isolation panel.

- 2 x 10A single phase, 3 flat pin power sockets with a hinged cover. To be used for general tasks (such as grinding or helmet charging). These will be protected by standard 30mA Residual Current Devices and will be labelled ‘Not to be used for Welding’.

These will be protected by standard 30mA Residual Current Devices, integrated into the circuit overload protection at the upstream electrical distribution board. These outlets will be labelled ‘Not to be used for Welding’.

Outlets will be typically mounted above 1600mm in order to:

- Avoid both mechanical damage and damage from sparks/hot metal
- Allow unobstructed access to the controls

Welding Mat

An insulating, flame retardant welding mat of the minimum dimensions 900mm x 900mm, as shown in the plan, will be provided on the floor, both to insulate the student from the floor.

A welding mat equivalent to Sparksafe Pyramid Welding Mat and of size 1100m x 900mm is recommended. It shall be provided in front of the welding bench. In addition to insulating the student from the floor, this mat will provide improved traction, protects the floor from dropped items and reduces noise from dropped items.

4 TECHNICAL SECTIONS

4.2 TRAINING BAY

Gas Outlets for Reticulated Gases

Typically three reticulated gas outlets will be provided although specific projects may have additional/different requirements. The three standard gases to be provided are:

- An argon gas outlet, complete with shutoff valve and pressure gauge, will be provided over the location shown for the TIG welder (at 1600mm height). The outlet will be provided with a Quick Connect fitting and will be supplied with Argon gas via a copper or stainless steel pipe reticulation system sized to support the gas flow. The piping will originate from a connection manifold designed to support a minimum of two type G gas cylinders. Secure mounting points and chain restraints will be provided for the cylinders in an appropriate, well ventilated and secure location to be selected on site. The outlet will be well labelled (with Traffolyte labelling over the outlet) as “Argon. TIG” along with the nominal system pressure. The manifold will be similarly labelled. Both ends will have a peacock blue colour plate to match the gas cylinder colouring.

- An argon-CO_2 gas outlet, complete with shutoff valve and pressure gauge, will be provided over the location shown for the MIG welder (at 1600mm height). The outlet will be provided with a Quick Connect fitting and will be supplied with an Argon – CO_2 gas mix via a copper or stainless steel pipe reticulation system sized to support the gas flow. The piping will originate from a connection manifold designed to support a minimum of two type G gas cylinders. Secure mounting points and chain restraints will be provided for the cylinders in an appropriate, well ventilated and secure location to be selected on site. The outlet will be well labelled (with Traffolyte labelling over the outlet) as “Argon CO_2. MIG” along with the nominal system pressure. The manifold will be similarly labelled. Both ends will have a colour plate to match the gas cylinder colouring (green stripe on blue background).

- A compressed air outlet, complete with shutoff valve, will be provided on the wall on the rear right-side of the welding table when facing the table (at 1600mm height) or sufficiently high to clear the metal splash-back – whichever is higher. A compressed air hose can hang in the space between the welding table and the wall. The outlet will be provided with a Quick Connect fitting and will be supplied with compressed air via a copper or stainless steel pipe reticulation system sized to support the gas flow. The piping will originate from an air compressor and receiver that is sized to suit the facility (minimum 200 litre receiver, 200 litre/minute) and located at a convenient, accessible location to be selected on site. Provide a power outlet of appropriate rating for the compressor. The compressed air outlet will be well labelled (with Traffolyte labelling over the outlet) as “Compressed Air” along with the nominal pressure. Each compressed air outlet is to be sized as a minimum to 120 L/min.

Surveillance

A colour CCTV camera over the work area to be used by the teacher for supervision of the student. Refer to the section on supervision, Section "4.8" for details.

Document Holder

A document holder will be provided to accommodate A3 documentation, made from minimum 2mm thick aluminium. The document holder will be wall mounted at the location as shown in "Figure 1". It will be provided with a hinged top that, when closed, protects the papers inside from welding sparks. The dimensions of the holder will be 440mm (L) x 40mm (D) x 320mm (H) (internal). The hinged top will drop down to allow easy access to the A3 documents and when closed will not easily be dislodged.

The bolts or screws that fix the holder to the wall will not obstruct the insertion or extraction of documents and should preferably penetrate outside of the document-holding area.

Welding Stand

Where nominated for specific projects a free-standing welding stand may be provided in lieu of, or in addition to, training bay welding benches. The construction details for a typical TAFE NSW welding stand are provided in Appendix "A.3". On a project-by-project basis other welding stands may be specified and centered, for example, around requirements to weld pipes, bar, RHS or other sections. Any free-standing stand will be bolted to the floor with a minimum of 4-off bolts to limit unintentional movement during set-up and welding.

A welding tray (refer to Appendix "A.4" for typical design details) may also be required with the welding stand. Refer to the specific project brief for specific project requirements.

Spent Electrode Receptacle

A small receptacle/bin will be provided close to the welding bench in which spent electrode ends can be easily placed by dropping directly from the electrode clamp. The receptacle must be able to handle the high temperatures of the electrode stubs and must be easily removed for emptying. As paint cannot typically endure the high temperatures, a painted metal bin would not be acceptable.

4 TECHNICAL SECTIONS

4.2 TRAINING BAY

Welding Clamp/ Positioner

A welding clamp shall be provided to suit the welding table used. A design for a typical TAFE NSW welding clamp is provided in Appendix "A.2".

Internal Curtains

Preferably internal slat curtains will be provided to protect welding machines sitting beside the welding table from sparks and other debris from the welding process. The location of the curtain is shown indicatively in "Figure 5". The curtains will be suspended from the bracket that would be at higher than 2m to avoid injury by collision. Ideally the bracket shall be hinged to enable the curtains to be pushed back out of the way when not in use.

Layout

It is unlikely that electrical cables will need to be run within partitions between bays. Where cables do need to be run in the partition, surface mounted cables or conduit would not be permitted. The partition should be designed with metal sections to conceal and protect the cables.

All gas pipework and electrical cables will be run behind the bay's rear wall . Surface mounted cables, pipework or conduit will not be permitted..

Specialised bay sizes may be required on a project-by-project basis for various purposes (e.g. students in wheelchairs, where students are expected to weld large projects etc).

In bays where a REALWELD trainer is to be used, the bench will be omitted.

The following figures show indicative layouts.

4 TECHNICAL SECTIONS

4.2 TRAINING BAY

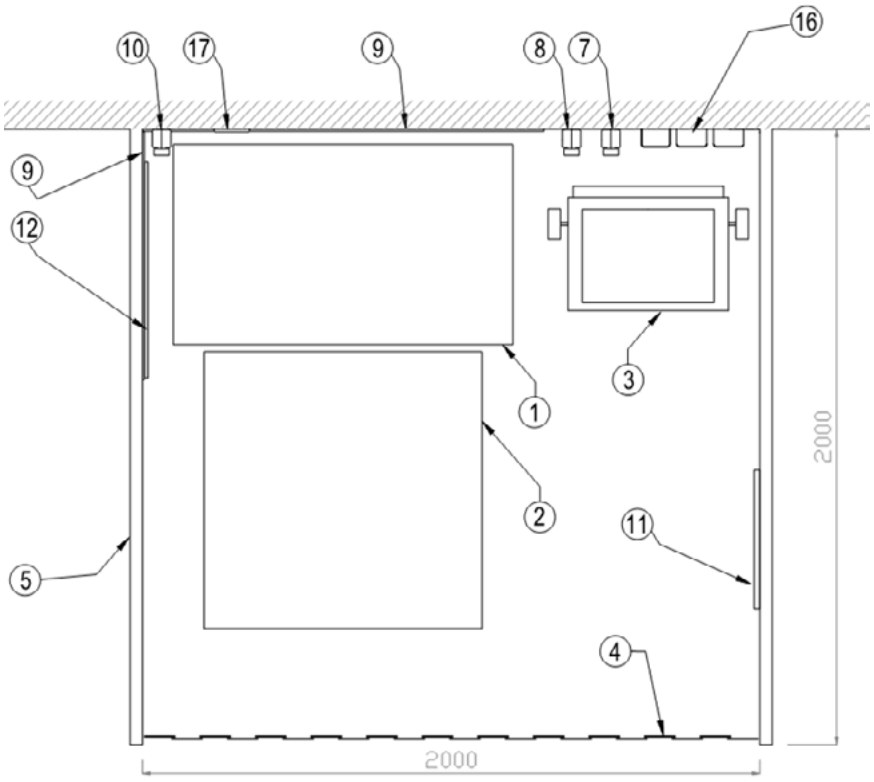


Figure 1: Plan view at 2m height (below light fixture and fume extraction arm ducting. Refer to the following legend to identify components in this plan.

LEGEND

1. WELDING BENCH 1100mm x 650mm
2. RUBBER WELDING MAT 900mm x 900mm
3. WELDERS STACKED ON TROLLEY
4. SLAT WELDING CURTAINS
5. FIBRE CEMENT BOARD PARTITION
6. FUME HOOD
7. TIG GAS OUTLET
8. MIG GAS OUTLET
9. METAL SPLASHBACK MOUNTED ON REAR WALL
10. COMPRESSED AIR OUTLET
11. A3 DOCUMENT HOLDER
12. SHADOW-BOARD TOOL HOLDER
13. LED CHAIN SUSPENDED LIGHT
14. FLEXIBLE FUME EXTRACTION ARM
15. INTERCONNECTING FUME EXTRACTION DUCTING
16. WELDING POWER OUTLETS
17. GENERAL PURPOSE POWER OUTLET
18. REAR WALL OF WELDING BENCH
19. INTERNAL SLAT CURTAINS

4 TECHNICAL SECTIONS

4.2 TRAINING BAY

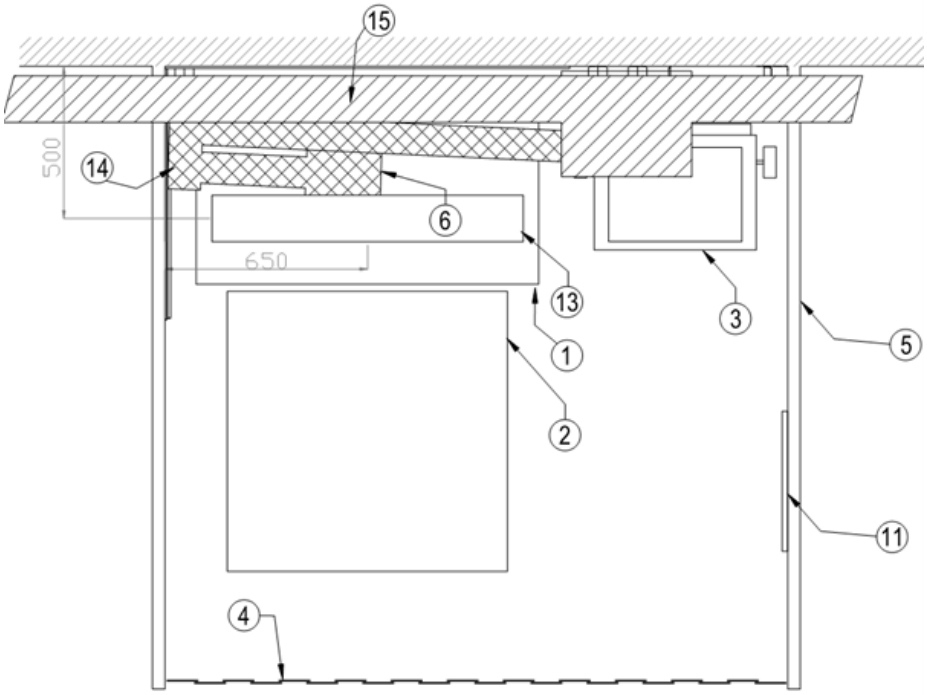


Figure 2: Plan view at 2500mm height. Above light fixture and fume extraction ducting. Refer to the legend above to identify components.

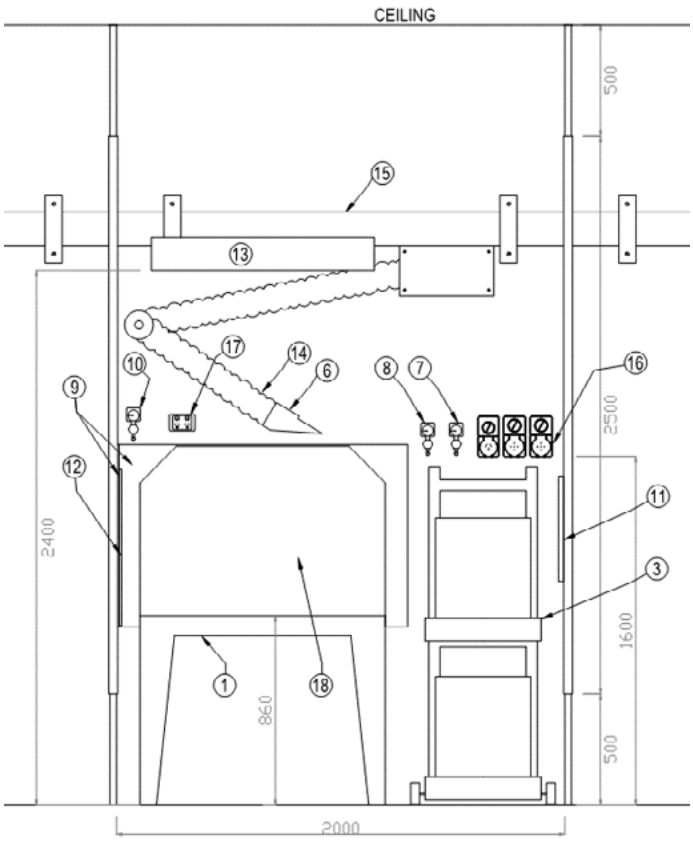


Figure 3: Elevation of typical training bay from within the bay entry. Refer to the previous legend to identify individual components.

4 TECHNICAL SECTIONS

4.2 TRAINING BAY

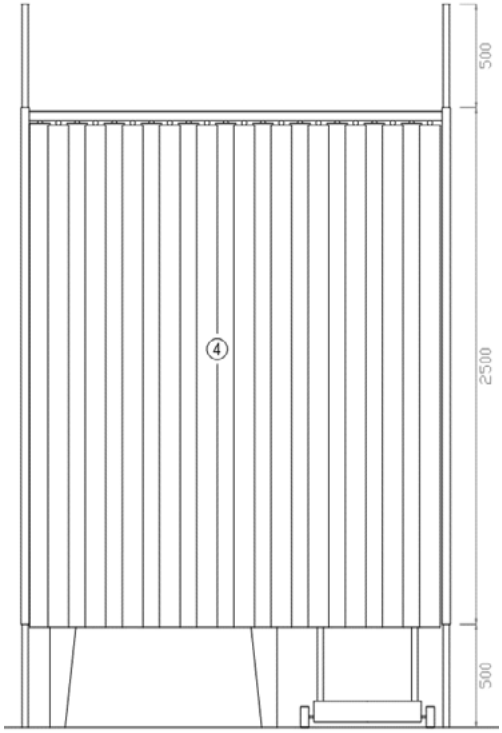


Figure 4: Training bay elevation from outside the bay.

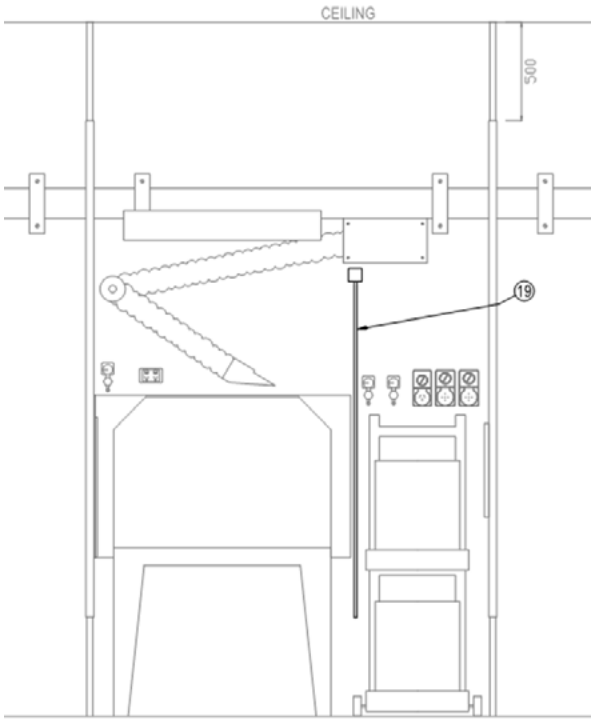


Figure 5: Internal curtains to protect welders from welding sparks (19).

4 TECHNICAL SECTIONS

4.2 TRAINING BAY

4.2.2 CLEARANCES

Lighting over the welding bench or circulation area within the bay shall not be mounted below 2100mm. The light will be mounted entirely forward of the tool shelf. Nothing over the bench or bay circulation area that has the potential to block light from the bench will be mounted below the light.

The lowest fixed point for the ventilation arm (refer to Section "4.7") will also be no lower than 2100mm. The flexible ventilation arm will be able to be retracted entirely above 2100mm. Refer to the mechanical standard for details.

A space of minimum width 700mm will be provided to accommodate a welder or welders on wheels beside the bench. This space will be unobstructed so that welders can be wheeled in and out without interference.

The bench will be bolted to the floor in a position that ensures 50mm of space between the bench and the walls in all directions. It is recommended to have 100mm clearance between the welding table and the wall on the left-hand side when looking at the elevation in "Figure 3" above. This will allow a gap for a compressed air hose beside the bench.

4.2.3 TRAINING PROCEDURES

A document holder will be provided for each bay. Refer to the previous section on document holders. The document holder will be installed away from the welding bench at high level.

This document holder will be the receptacle for training procedure documents. The contractor will provide training procedure documents for each bay, based on input provided by the facility's teachers.

4.2.4 WELDER TYPES

Welding units will be provided to each training bay. The types of units to be provided will be determined on a project-by-project basis.

The welding units must be securely mounted on a mobile trolley. The trolley must fit beside the welding bench in the training bay. Where two welding units are provided for a training bay, the trolley is to be vertically tiered to support both units with the heaviest at the bottom.

The welding units are to be fixed to the trolley:

- In a manner to keep the centre of gravity as low as possible to avoid the trolley toppling over
- In a manner that solidly fixes each welding unit to the trolley without voiding the welding unit's manufacturer warranty
- In a manner that does not interfere with the ventilation of each welder
- In a manner that ensures all controls and indicators are available to the operator without impediment
- With a chain to allow the trolley to be fixed to the wall when it is in place beside the welder's bench (as further insurance against toppling over)

4 TECHNICAL SECTIONS

4.2 TRAINING BAY

- With a method to hold the welding cables up off the ground so that they are not run over by the trolley when moved
- The trolley will be provided with wheels, axles and shelves that are selected to support the weight of the welders. Bracing, crosspieces and other structure will be provided to ensure sufficient strength of the trolley shelving
- Fixing of the welder to the trolley should be robust so that the welder cannot fall off when moved or knocked
- The trolley handle should be on the same side of the trolley as the front of the welders so that the trolley can easily be removed and reinserted into spaces

4 TECHNICAL SECTIONS

4.3 DEMONSTRATION BAY

4.3.1 ARRANGEMENT

A demonstration bay will be provided to allow the teacher to demonstrate procedures to gathered students. The demonstration bay will be centred around a large demonstration bench. The demonstration bay may also be used for the welding of larger workpieces that cannot easily fit within a training bay.

Demonstration Bench - Free-standing

A free-standing, island demonstration bench 2200mm (L) x 1000mm (D) x 850mm(H) will be provided with 1200mm clearance on one long side (teacher side) and minimum 2000mm clearance on the other three sides to allow the gathering of students around a demonstration.

A larger bench or a different shaped bench may be provided where there is a functional benefit, on approval. For instance, the demonstration bench may be designed as an arc in order to improve visibility of a demonstration to students.

The recommended clearances may not be achievable in all instances and may be reduced where necessary on approval.

Details of the demonstration bench itself are provided in Section "4.6.2"

A plan of this typical bench size is provided below.

4 TECHNICAL SECTIONS

4.3 DEMONSTRATION BAY

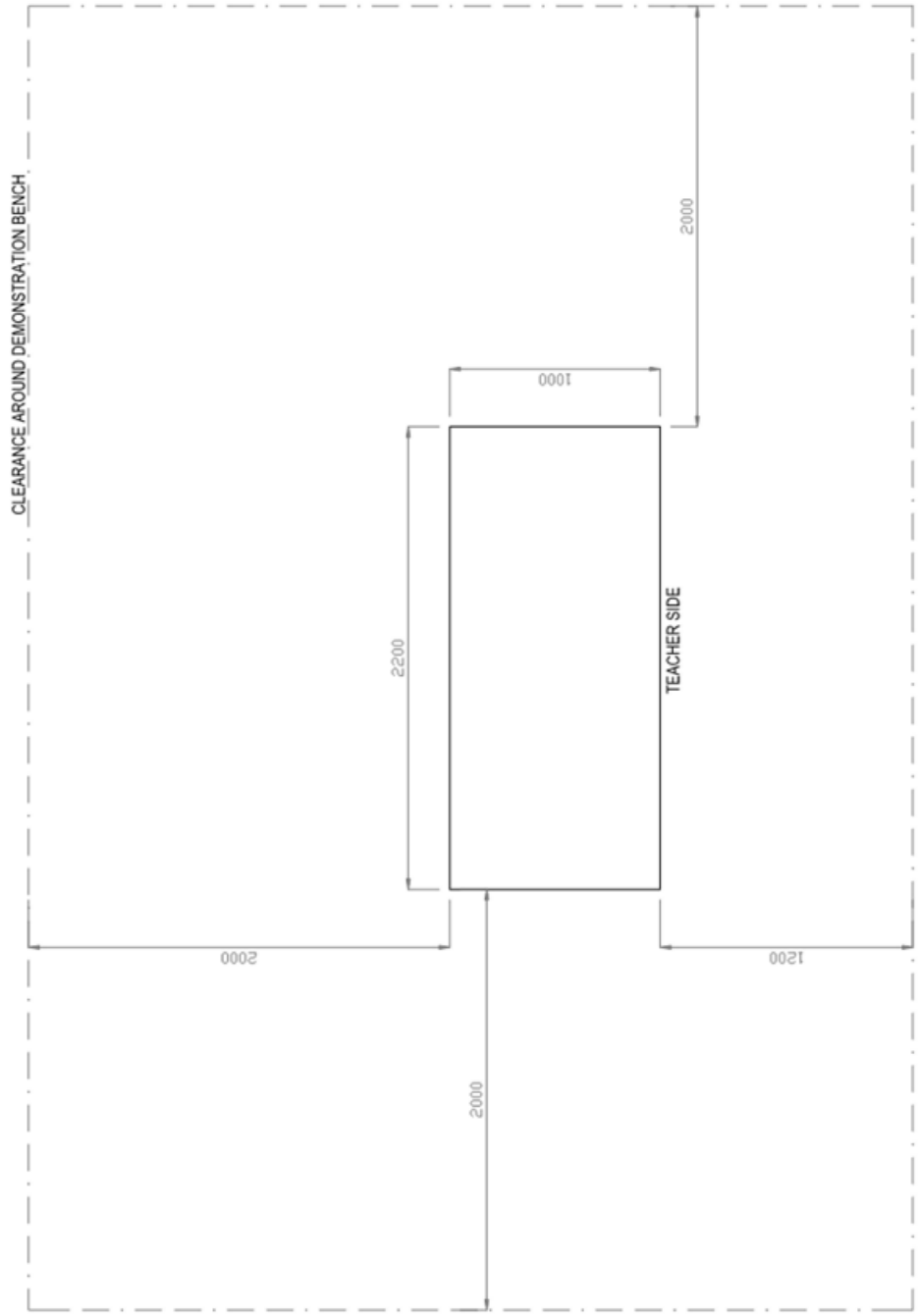


Figure 6: Dimensions and clearances around a free-standing demonstration bench.

4 TECHNICAL SECTIONS

4.3 DEMONSTRATION BAY

Demonstration Bench – Combined Training Bays

Where available space is insufficient to provide a dedicated, free standing demonstration bench, a demonstration bench may be provided by utilizing two side-by-side, mirror-imaged training bays, as per the plan below. The training bays will each be a minimum 2000mm x 2000mm size as shown in the plans in Section "4.2.1" when utilized for demonstration purposes.

A single bench will be provided with dimensions 2200mm (L) x 800mm (D) x 850mm (H), mounted centrally across the two training bays. The bench will have the same characteristics and requirements as the demonstration bench described above except that services (electrical outlets and gas) will be wall-mounted rather than mounted on the table. Refer to the relevant sections for service details to training bays.

The welding bay curtains shall extend from the front of the bench back to the standard training bay curtains at the entries to the bays. A dual row of shorter length curtains will extend over the table to the rear of the table and will descend to around 5mm above the table. The dual row of curtains will be installed to provide maximal overlap to reduce the chance of accidental arc exposure. A 20mm bar (fixed in place but removable) will be provided on each side of the curtains to stop workpieces accidentally pushing through the curtain to the next bay.

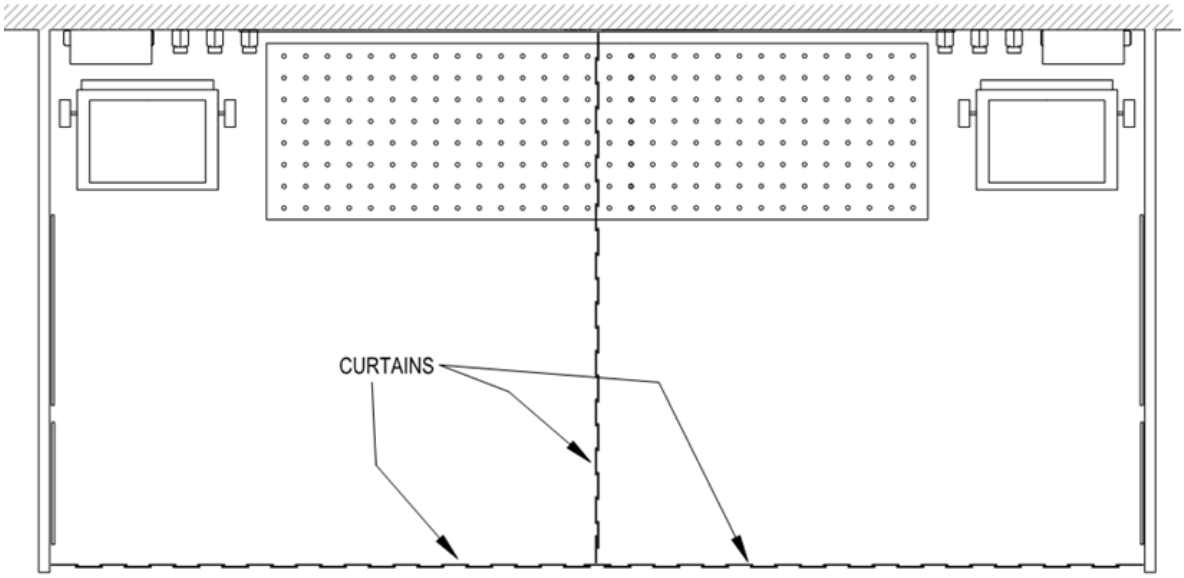


Figure 7: Demonstration bay consisting of adjoined, mirrored training bays (plan). Note minor alterations necessary to accommodate the single large bench, including relocation of the shadow-boards and compressed air outlets.

4 TECHNICAL SECTIONS

4.3 DEMONSTRATION BAY

The curtains shown in the plan will be able to be easily unclipped and temporarily removed to allow for unobstructed demonstrations. A solid, light-weight, non-flammable panel will be easily fixed in position at the centre of the bench. The panel will extend from the table surface to 2000mm high and will be fixed in position by flat hooks at the rear (top and bottom) and barrel bolts at the front (top and bottom). The panel may be made from Flexishield Sonic System acoustic modular panel or equivalent.

Curtains will extend sufficiently far past their minimum endpoints, and with sufficient overlap, to ensure that there are no gaps through which arc-flash can be accidentally seen.

4.3.2 CLEARANCES

Where combined training bays are used for demonstration purposes the clearances of Section "4.2.3" shall apply.

Where there is a free-standing demonstration bench then the clearances around the bench as outlined in "Figure 6" will apply. Light fixtures over the welding bench shall not be mounted below 2300mm above floor level.

The lowest fixed point for the ventilation arm will also be no lower than 2300mm. The flexible ventilation arm will be able to be retracted entirely above 2300mm. Refer to the TAFE NSW Mechanical Standard and Section "4.7" of this document for further details.

These height clearances are greater than in the case of training bays due to the requirements of greater visibility/viewability of the area.

4 TECHNICAL SECTIONS

4.4 WELDING BAY PARTITION AND FLOORING

Welding bay partitions will be:

- Non-flammable
- Solid, flush and smooth-surfaced
- Impact resistant
- Durable
- Able to withstand a minimum force of 1500N applied horizontally, and

15mm thick Villaboard fibre cement sheeting is an acceptable partition material with a welded support frame. The partition will consist of a double thickness of such sheeting with a cabling space between where it is necessary to reticulate cables through the partition. Exposed electrical cables will not be permitted. The frame shall support the Villaboard panels on channel or angle so that damaged sections can easily be replaced. The panels will be held in position without movement, ideally in 1200mm x 1200mm panels and with no protruding fasteners, clamps or other components that can catch on clothing or cables.

Other solutions to fibre cement may be proposed to the project manager. Acceptance of alternatives must be in writing.

A minimum gap of 300mm and a maximum gap of 500mm will be provided beneath the panels. The recommended gap is 500mm from the floor.

The panels will extend to at least 2100mm above the floor with a minimum of 500mm gap above the partition for air flow. The panels will be bolted to the floor and to a channel structure mounted off the ceiling and wall.

Figure 8: Welding bay partitions. Ideally the front and rear vertical support columns would extend all the way to the ceiling to provide the partitions with greater rigidity.

4 TECHNICAL SECTIONS

4.4 WELDING BAY PARTITION AND FLOORING

The bay partition panels must be able to be easily cleaned using standard detergents and water without risk of damage.

Floors should preferably be concrete polished to level 1 (100 grit). Other sturdy, non-flammable flooring options may be proposed. The floor must be level and even. Where welding benches are located there is a requirement that the benches will not rock between the legs which places a requirement on the evenness of the floor in the area of the bench.

Above the welding bays, welding demonstration area and other areas associated with the welding process, sound absorber panel equivalent to Megasorber FM will be provided on the ceiling – fixed between panels as recommended by the manufacturer. Lighting and other ceiling mounted equipment will be supported through the channels dividing absorber panels as shown below.

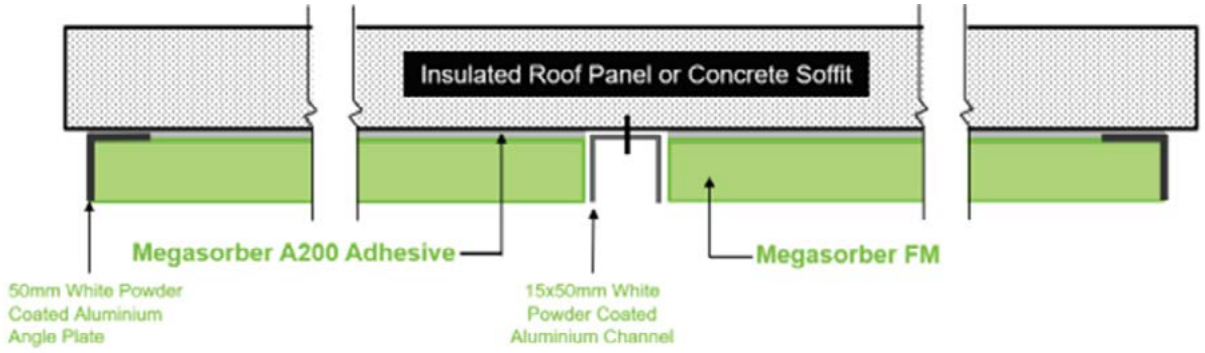


Figure 9: Ceiling mounted acoustic absorbers.

4 TECHNICAL SECTIONS

4.5 WELDING BAY CURTAIN

Welding bay curtains will be:

- Of a strip type to allow free movement through the curtain
- Approved for use for welding
- Durable
- Fire retardant
- Of a translucency to reduce arc-flash to acceptable levels for constant use adjacent to a trafficable area whilst allowing external light into the bay
- UV stabilised
- Made of a material that will not crack or harden
- Made of a material that will not warp to the extent that it opens sight-lines into the bay

The curtains will finish between 300mm and 500mm above the floor. Connectors and supports above the bay entry will be robust. Fasteners/ connectors will be of a type recommended by the curtain manufacturer.

The curtains will be:

- Fixed in position and not able to slide along a rail
- Designed to the following, in order to ensure there are no gaps through which arc-flash can be accidentally seen:
  - Extend sufficiently past their minimum end points
  - Have sufficient overlap; and
  - Sit appropriately without the need for adjustment

The curtain support structure shall be a minimum of 2200mm above floor level to allow personnel and material such as REALWELD trainers to pass beneath. The curtain mounting height and fixing type will allow simple removal by a person standing on the floor, while being sufficiently secured to prevent accidental dislodgement during normal use.

The curtains will have integral eyelets to eliminate tearing at fixture points. Material thickness of at least 2mm is recommended.

The same material should be used for internal curtains intended to protect the welders from sparks on the welding bench.

Figure 10: Strip type welding bay curtains. The curtains will not be able to slide along the rail at the top. It will be possible to remove individual strips for replacement.

4 TECHNICAL SECTIONS

4.6 WELDING BENCH AND STAND

4.6.1 TRAINING BAY WELDING BENCH

A welding bench will be provided in each training bay. Standard training bay benches will be:

- Steel
- Fixed height
- 1100mm (L) x 650mm (D) x 855mm (H)
- Capable of supporting 200kg static load
- Durable and sturdy
- Non-flammable
- Unable to warp due to heat from normal welding practices
- Sit flat on the floor and not rock between legs

Adjustable-height benches and larger benches may be required to suit special uses, assessed on a project-by-project basis.

The bench will have a replaceable surface that is:

- High quality carbon steel, stainless steel or other approved material that is resistant to corrosion, scratching and weld spatter
- Installed flat to within +/- 1mm over the surface. Supporting ribs beneath the surface may be necessary to achieve this degree if flatness.
- Without dead-end holes that will gather debris

The bench will have no shelf, front cross-bar or front bracing installed beneath the bench top in order to allow a seated student to place their legs beneath the bench.

An acceptable bench design is provided in Appendix "A.1". Note that this design must be scaled appropriately to comply with the required bench dimensions as described above or as appropriate where the size of the training bay is scaled up. Refer to the image below for an example of this design. Note a small tray is visible at the top of the bench-back. This should be provided, as per the design in Appendix "A.1" and with minimum 500mm length, to accommodate consumables such as welding rods. The image below is relevant to the welding bench only.

4 TECHNICAL SECTIONS

4.6 WELDING BENCH AND STAND

A surface such as the CertiFlat fabBLOCK 3D Welding Table top (or equivalent) may also be used for the table top, fastened in place from below and in a manner to ensure that the table top meets the table top manufacturer's specifications. The drawing in Appendix "A.1" may be modified to accommodate this bench top. This bench top is shown in the image below.

For each bench provide one welder's stool that is sized appropriately for the bench. The stool should be four-legged with no castors and a height that is 200mm less than the front edge of the bench – allowing 200mm for a student's legs. The stool shall be height adjustable +/- 100mm from this height with a simple mechanism for the adjustment that does not rely on gas springs (e.g. butterfly height adjustment mechanism). The stool will be provided with a swivel-mount timber seat.

4 TECHNICAL SECTIONS

4.6 WELDING BENCH AND STAND

4.6.2 DEMONSTRATION BAY WELDING BENCH

Island-type Bench

A welding bench will be provided for demonstration purposes. The overall recommended dimension has been provided in Section "4.3.1".

The demonstration bench will be:

- Steel
- Fixed height
- Capable of supporting 200kg static load at any point on the surface
- Durable
- Non-flammable
- Unable to warp due to heat from normal welding practices
- Sturdy, sit flat on the floor and not rock between legs
- Mechanically fixed to the floor with fasteners on the inside of the legs
- Legs will not splay out beyond the surface to create a trip hazard

The bench will have a replaceable surface that is:

- High quality carbon steel, stainless steel or other approved material that is resistant to corrosion, scratching and weld spatter
- Installed flat to within +/- 1mm over the surface
- With a central section 1000mm x 1000mm with 16mm diameter threaded holes on a regular lattice of between 50mm x 50mm and 100mm x 100mm to allow for clamping and other fixing methods
- With wings on both sides of the central section that are of solid steel 9mm thick (or greater) with support ribbing as necessary
- With rounded edges and corners so as not to catch on clothing, cables or hoses
- Without dead-end holes that will gather debris
- Fixed from below

A plan of the bench is given in "Figure 11" below, with elevations (in directions shown by the arrows in the plan) provided in the subsequent figures. These figures are intended to show the requirements of the bench but the details of how they are arranged is not critical – suffice to say that any detailed design must be focussed on ease of use by the teacher and safety of use.

4 TECHNICAL SECTIONS

4.6 WELDING BENCH AND STAND

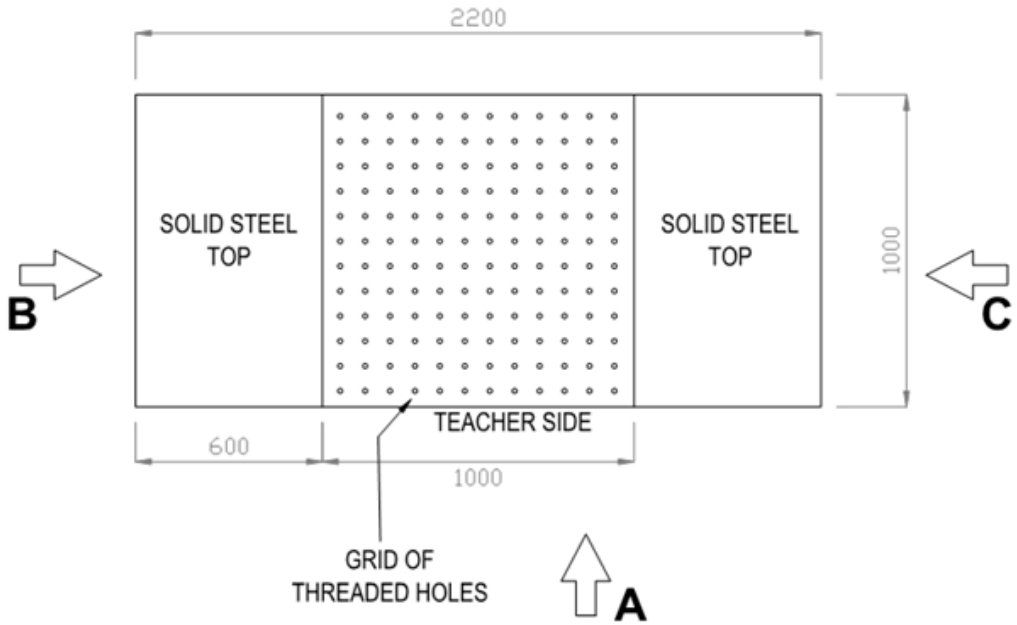


Figure 11: Plan of demonstration bench. In this design care must be taken with the join between the solid and perforated tops to avoid a channel/hollow at the join that can accumulate debris.

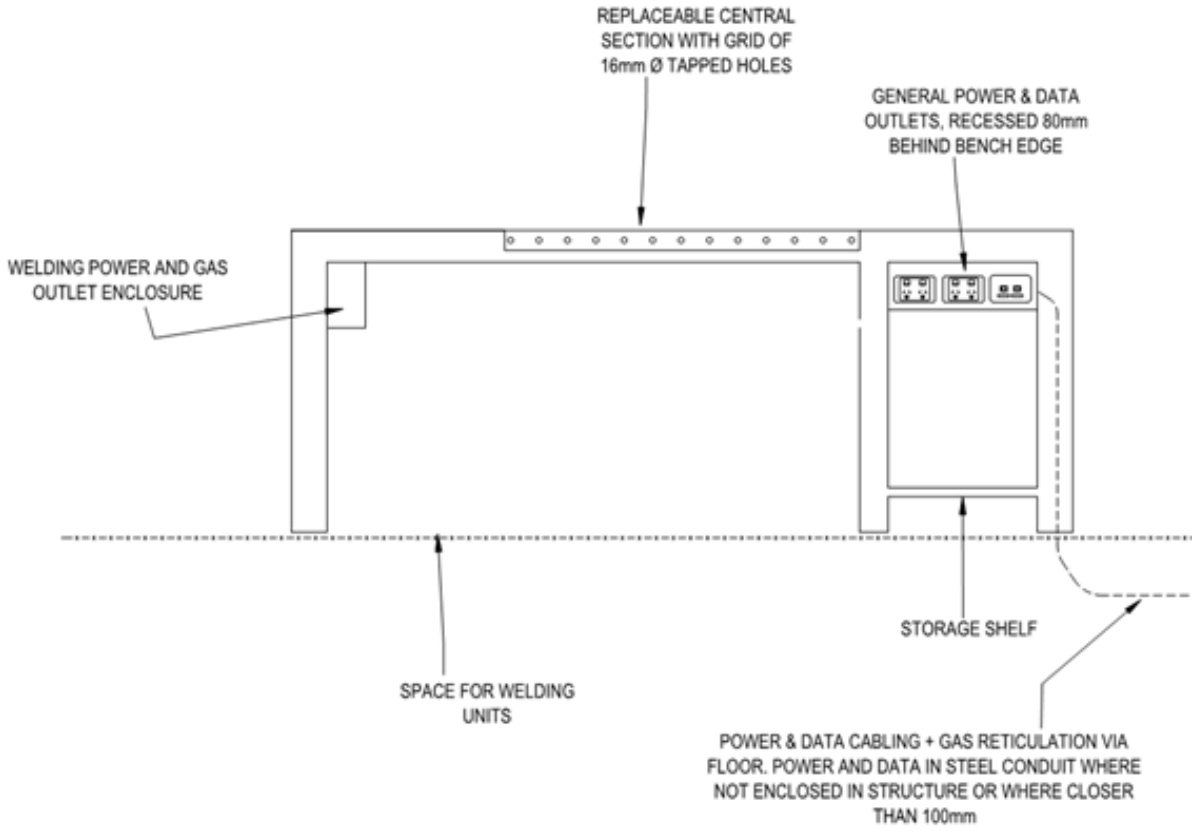


Figure 12: Elevation 'A' in above plan.

4 TECHNICAL SECTIONS

4.6 WELDING BENCH AND STAND

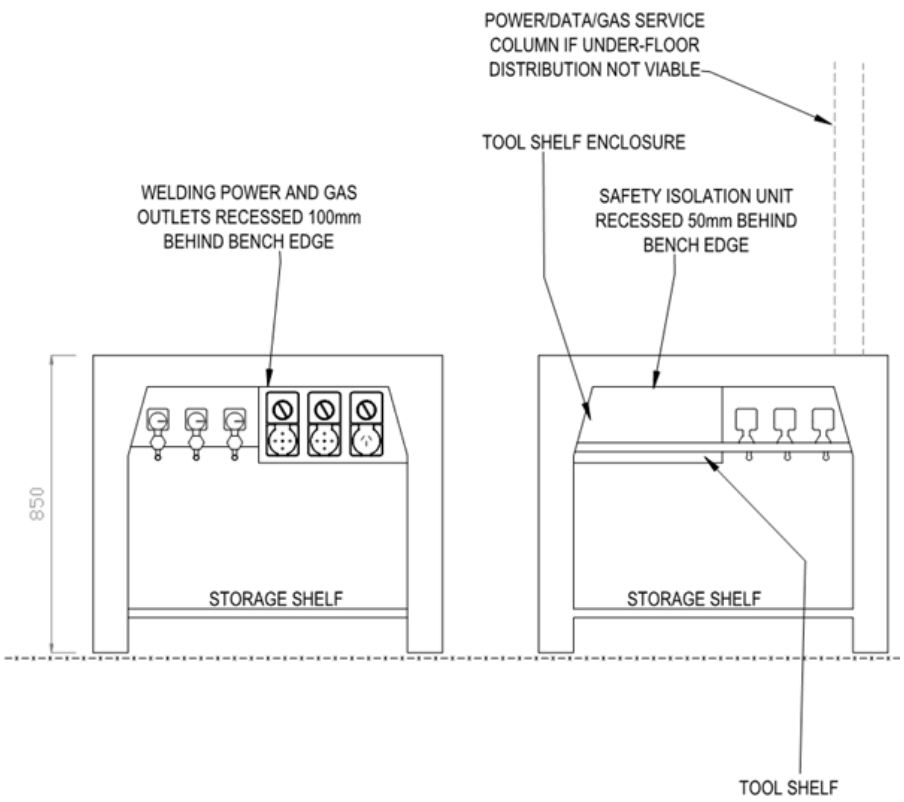


Figure 13: Elevation in direction 'B' as shown on the plan (left). Elevation in direction 'C' as shown on the plan (right).

Island-type Bench Requirements

The island-type demonstration bench shall be provided with:

Material Storage Shelf

A shelf under one wing of the bench below the solid surface (with no holes). The shelf will be at 100mm AFFL and will extend at least over the full area of the solid wing surface. This avoids sparks and debris falling onto the items stored on the shelf.

Vacant Space for Welding Equipment

A vacant area beneath the 'other' solid wing of the bench. This allows for welding units to be placed under the bench in an area where sparks and dust will not fall onto them from the bench.

Tool Shelf

A small shelf that is 250mm wide will be located below the table top will be provided for the purpose of storing tools. This shelf will be located on the side of the table above the storage shelf and will run the depth of the table (between legs). The shelf will have around 200mm clearance between the underside edge of the bench above and the shelf surface below to enable the teacher to see into the shelf. The shelf will be provided with a 10mm lip on each side to stop tools falling to the floor. The shelf will be provided with a close-fitting, non-flammable rubber insert/mat to reduce noise when returning tools to the shelf.

4 TECHNICAL SECTIONS

4.6 WELDING BENCH AND STAND

Welder's Mat

An insulating, flame retardant welding mat of minimum dimensions 900mm x 900mm will be provided on the floor at the teacher's location.

A welding mat equivalent to Sparksafe Pyramid Welding Mat and of size 1100m x 900mm is recommended. It shall be provided in front of the welding bench. In addition to insulating the teacher from the floor, this mat will provide improved traction, protects the floor from dropped items and reduces noise from dropped items.

Spent Electrode Receptacle

A small receptacle will be provided close to the welding bench in which spent electrode ends can be easily placed by dropping directly from the electrode clamp. The receptacle must be able to handle the high temperatures of the electrode stubs and must be easily removed for emptying. An unpainted metal bin would be appropriate.

Welding Clamp

A welding clamp will be provided to suit the table. The clamp will be designed to fix to the table.

For instance, a clamp equivalent to Hare & Forbes SC-60 shall be provided for a welding table with a grid-array of 16mm diameter mounting holes.

Power Outlets

Power outlets will be built into the bench immediately below the surface. These will be recessed into the side of the bench and mounted so as a connected cord will not to protrude beyond the edges of the benchtop. Typically recessing 60mm between the surface of the socket and the edge of the bench would be appropriate. The switches to the outlets must be set far enough below the surface of the bench to allow easy access given the recess depth. Power outlets will be provided on the fully covered side of the bench without a shelf and will include:

- 1 x 32A 3-phase, 5 round pin
- 1 x 20A 3-phase, 5 round pin
- 1 x 15A single phase, 3 flat pin

These will be in close proximity to the welding units.

On the opposite side of the bench (also on the teacher's side but above the shelf and beneath the fully covered table surface, provide:

- 4 x 10A single phase, 3 flat pin sockets
- 2 x RJ45 Cat 6A data outlets (to be used for camera connectivity)

Gas Outlets

Beneath the bench the following gas outlets will be provided:

- An argon gas outlet, complete with shutoff valve and pressure gauge. The outlet will be provided with a Quick Connect fitting and will be supplied with Argon gas via a copper or stainless steel pipe reticulation system sized to support the gas flow. The piping will originate from a connection manifold. The outlet will be well labelled (with Traffolyte labelling over the outlet) as "Argon. TIG" along with the nominal system pressure. The labelling will have a peacock blue colour plate to match the gas cylinder colouring.

4 TECHNICAL SECTIONS

4.6 WELDING BENCH AND STAND

- An argon-CO_2 gas outlet, complete with shutoff valve and pressure gauge, will be provided over the location shown for the MIG welder (at 1600mm height). The outlet will be provided with a Quick Connect fitting and will be supplied with an Argon – CO_2 gas mix via a copper or stainless steel pipe reticulation system sized to support the gas flow. The piping will originate from a connection manifold. The outlet will be well labelled (with Traffolyte labelling over the outlet) as “Argon CO_2. MIG” along with the nominal system pressure. The labelling will have a colour plate to match the gas cylinder colouring (green stripe on blue background).
- A compressed air outlet, complete with shutoff valve, will be provided on the wall on the rear right-side of the welding table when facing the table (at 1200mm height). A compressed air hose can hang in the space between the welding table and the wall. The outlet will be provided with a Quick Connect fitting and will be supplied with compressed air via a copper or stainless steel pipe reticulation system sized to support the gas flow. The piping will originate from an air compressor that is sized to suit the facility. The compressed air outlet will be well labelled (with Traffolyte labelling over the outlet) as “Compressed Air’ along with the nominal pressure.

These gas outlets will be recessed sufficiently back from the front of the bench that a connected hose will not be bumped by passers-by. The connection point shall be directed downwards so that a connected hose will leave in a vertical direction (not shown in the elevations). The pressure gauge shall be mounted to the side of the shutoff valve and connection point where possible in order to reduce the vertical height occupied by the system.

Reticulation To Bench

The preference is for services (gases, power and data) to be reticulated to the demonstration bench below the floor or chased into the floor. Where this is not possible, then a suitably sized service pole to the ceiling may be provided on a side corner of the bench to reticulate the required services (as above). The power, data and gas outlets would be positioned as noted above. Power and data reticulated through a concrete floor will be reticulated in fully sealed PVC conduit. The conduit will be installed as low as possible within the slab. Gas piping concealed under concrete is to be installed in compliance with AS 4289. It shall be installed in a conduit that protects it for its entire length, and leaves the piping free to expand independently of the concrete. Conduits installed within the concrete floor slab will be protected with a strip of hardened 6mm steel directly above it to further protect from potential drilling or impact.

For the cable and pipe runs within the table, all cables and pipework will be concealed within the metalwork of the table with screw-off covers to allow replacement when necessary.

Lighting

General lighting coverage to the bench shall be provided to ensure 300lx over the bench as outlined in Section "4.13.2".

4 TECHNICAL SECTIONS

4.6 WELDING BENCH AND STAND

Demonstration Monitor

A 55” 2 mega-pixel flat screen monitor will be provided above the demonstration bench to provide good visibility to students standing in front of the bench. In particular the monitor will be able to display close-up images of the welding setup that would be difficult to display to students otherwise. The monitor will be tilted downward to aid visibility and lighting will be designed so as to generate no significant reflections on the display. Preferably the screen will be mounted to the side of the bench so that it is not exposed to rising welding gases and with the bottom edge at 2200mm AFFL. If this height is not practical due to architectural limitations then the screen may be placed over the bench with the bottom edge of the screen at 1900mm AFFL so as not to interfere with activities on the bench. This latter is shown in the elevation below. The monitor will turn off automatically once powered on for 5 hours.

A minimum of two 10A power sockets and one Cat 6A data outlet will be provided on or in the ceiling to support the monitor and local decoder. Suitably robust brackets will be provided to support the monitor and associated devices.

Cameras

A ceiling-mounted 1080p colour PTZ camera will be focused downwards onto the bench. It will be supported at a height, and provided with a lens to ensure a clear, undistorted view of the bench top. It will be centrally mounted above the bench and behind the demonstration monitor (from the viewer’s perspective).

A flexible head 1080P colour document camera will be provided for use on the bench, to be moved around to provide a clear view of the welding setup.

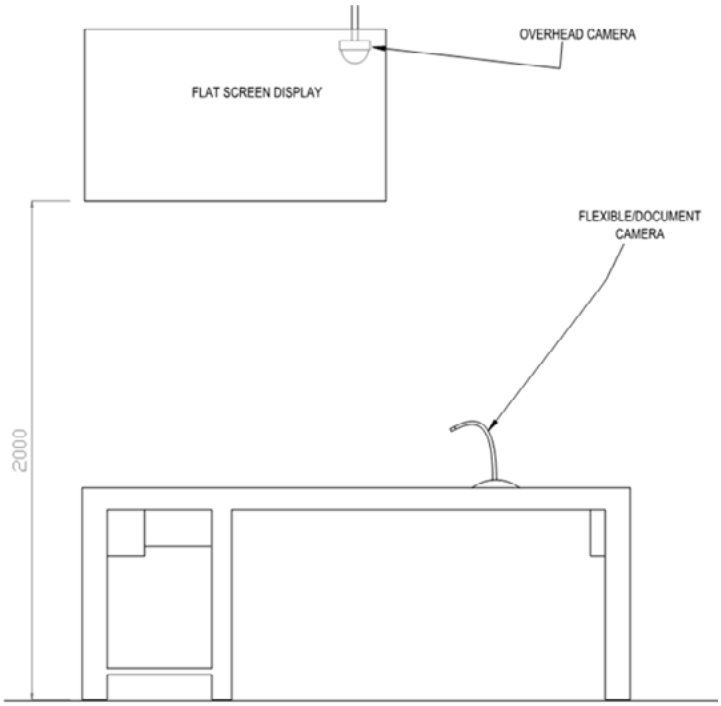


Figure 14: Elevation of demonstration bench from the student side for the case where the monitor height is limited to less than 2200mm to the bottom edge.

Data Outlets

Beneath the bench RJ45 connectors will be provided in a protected location for both the document camera and for a possible (future) Xiris XVC-1000 weld camera. These outlets will be recessed 60mm behind the edge of the table to protect protruding cables from passers-by.

Camera Recording, Control and Display

Images from the cameras will be recorded when operational. Raid 5 storage sufficient for all cameras operating for 20 days will be provided with automatic overwrite of the oldest images. It will be possible to download stored images over the TAFE's local area network, using standard video protocols, as required. Stored images will be time stamped. The system will allow audio to be recorded along with the camera images. A suitable microphone will be provided at the location of the PTZ camera above the bench. All necessary supporting equipment will be provided. The audio will be synchronised with the images.

At a convenient, near-by location on a wall an AV control panel will be provided that allows:

- Selection of which camera is to be displayed on the main monitor (ceiling camera, document camera or Xiris camera)
- Setting of the PTZ configuration of the ceiling camera
- On-off control of the cameras and monitors
- A record button to allow recording of all camera images until turned off
- Controls for the easy search and retrieval of stored images to allow display on the monitor
- Scalers or other devices necessary to ensure that the camera images are clearly displayed on the monitor

At the same point a small (14") wall-mounted screen will provide the same image as the main monitor so that the teacher can see what is being displayed on the main monitor.

It is important that this screen and controls are in a protected location that is not exposed to sparks etc. from welding and at/above 1700mm high to limit physical contact; yet the teacher must be able to easily view the screen from the teaching position at the demonstration bench.

All AV control equipment will be provided to allow the real-time or stored image viewing of all cameras. This will include small PoE switch to support the Xiris camera and the cabling, conversion, switching, storage and processing equipment associated with the three cameras. This equipment will be installed in a ventilated, wall-mounted rack to be installed at high level in an area of the welding facility that least exposes the electronics to damage by fumes or physical contact. Power will be provided to this location as necessary on a circuit that is not shared with other equipment. Direct ventilation (cooled air) will also be provided to this location. Cables will be run to/from this location to the associated AV components in a concealed manner. Shielded cables will be used on all AV/TCP/IP cables to eliminate interference from welding machines that use high frequencies. Proper AV earthing practices will be used – separate from the welding machine earths as far as is practicable.

The contractor will provide the ceiling-mounted camera and the document camera. The system will not require further upgrade or programming in order to display and record Xiris camera images.

Additional equipment will be provided, including a decoder, that allows remote viewing of stored images at a nominated PC via the TAFE's local area network. Allow for data points to be provided in the welding bay at locations necessary for this functionality. Data points will be cabled back to the nearest comms room with cabling to match the latest TAFE NSW ICT Cabling Standard. Allow for all cable patching as necessary.

Only systems without ongoing licensing fees will be used. If a system with a one-off licencing fee is provided then this will be paid by the contractor on the TAFE's behalf.

Fume Extraction

At the free-standing demonstration bench a fume extraction arm equivalent to Eziduct Ezi-Flex fume arm will be provided. The fixing point for the arm will be at high level behind the monitor screen (see previous monitor details) and will not block the view of the overhead camera. This arm will have a noise level lower than 60dB at the minimum required air-flow rate (refer to Section "4.7").

Combined Training Bay Demonstration Bench

In this case, most of the above services will be provided via the standard training bay setup.

The flat screen display monitor will be installed outside of the training bays with the bottom of the monitor at 2200mm and positioned so as not to interfere with bay curtains etc. The overhead camera will be located directly over the bench in one of the training bays. Set-up of the PTZ camera and review of real-time and stored images will be via a laptop and the TAFE NSW WiFi network. The contractor will provide an appropriate laptop loaded with the appropriate software and set up to allow all functions as defined above for the island-bench demonstration situation. The contractor will liaise with the TAFE NSW ICT Group to ensure trouble-free and simple operation for the teacher.

It will be possible to provide additional laptops with the same functionality should any individual project require it.

4.6.3 DELIVERABLES

Please refer to Section "2.3 Project Design Documents" for project deliverables, and specific system deliverables as noted in this section.

4 TECHNICAL SECTIONS

4.7 VENTILATION

4.7.1 FUME EXTRACTION AND HOODS

Fume Extraction for Training Bays

- Fully adjustable and movable / flexible proprietary built individual welding hood /arms must be provided. It will be possible to pull the extraction point to any desired location on the welding bench and have it stay in place to extract fumes
- Fixed hoods should only be provided where welding arms are not practical, or for minor refurbishments of existing systems. In this instance the designer is to seek formal approval from TAFE NSW prior to proceeding
- Welding arm/hood head must have provision for rotation in the vertical and horizontal plane for maximum versatility
- Students must be instructed to locate the hood immediately adjacent to the fume source
- Welding arms must not block the lighting over the bench, even when retracted
- Fixed ductwork, and arm anchor point must be set such that they cannot interfere with welding work, an approximate height is 2100. This must be confirmed with TAFE NSW for each project
- Adjustable hoods should have provision to be raised up to 1.8m above finished floor level to accommodate large jobs. This must be confirmed with stakeholders for each project
- Minimum exhaust flow rate should be 280 litres / second per hood, or as specified by the arm / hood manufacturer

- Grouping multiple hoods / arms together to a common extraction system should be considered to optimise spatial and ongoing plant servicing. For large installations consider multiple groups / systems; connecting more that approximately 6 hoods / arms to one system should be avoided, to allow provision to operate some hoods without having to activate all the hoods in the space
- Each extraction systems must be activated / deactivated via manual pushbutton with indicator light mounted a clearly labelled control panel located in prominent location for the teacher to use
- Auto shut down of the system outside of normal operating hours is to be provided
- A green indicator light (equivalent to RS PRO 222-2466), indicating that the hood is active should be provided above each welding bay
- The welding exhaust systems must be designed to ACGIH Industrial Ventilation, Figure VS-90-01 and 02
- General exhaust systems are not acceptable as a replacement for dedicated hood exhaust systems
- Baffles and Welding curtains should be provided to ensure effective fume removal
- Provide specialist exhaust fans, selected and supplied by the welding hood supplier
- Exhaust ducting must be high pressure stainless steel ducting, with vertical discharge away from occupiable areas, and in compliance with AS1668.2
- Air flows to the extraction hoods must be designed / installed / balanced such that minimal noise is generated from the hood operation
- The noise produced within the space by the ventilation systems should not exceed 52dB(A), or as recommended by the project acoustic engineer. Note that a local fume extraction arm may exceed this level in the vicinity of the extraction point however the sound level at 1m from the extraction point should not exceed 62 dB when operated at the extraction rate specified in Section "4.7.1"

Fume Extraction for Demonstration Bench

A fume extraction arm will be provided for the demonstration bench. This will have the same characteristics as the extraction arm for the training bays except that it is required to be mounted at higher level (lowest fixed point of 2300mm) and have a longer reach to cover any point on the demonstration table.

Lower sound levels are particularly desirable for the fume extraction arm at the demonstration bench. This arm may be of a different type to meet this requirement.

4 TECHNICAL SECTIONS

4.7 VENTILATION

4.7.2 GENERAL SHOP VENTILATION

General ventilation systems are detailed in the TAFE NSW Mechanical Services Design Standard. In addition to the details noted in this standard:

- General exhaust extraction must be provided at the highest points of the space to prevent build-up of gases at high level
- The general exhaust system should provide as a minimum 10 air changes per hour exhaust, and must comply with AS 1668.2
- The system acoustic performance should have the same requirements as the fume extraction; refer to the previous section for details
- The general exhaust should be activated / deactivated, via similar arrangement to the welding hoods, refer to the fume extraction section
- The general extraction / ventilation system must have a normal speed operation, and a boost option which can be activated by the teacher for a pre-set duration of augmented the extraction flow rate
- Consideration should be given to automatic activation of the boost option based on feedback form local welding fume sensors, refer to the fume monitoring section for further details
- Adequate make up air provisions must be provided to accommodate all the exhaust streams from the space. This make up air may be required to be tempered, refer to the TAFE NSW Mechanical Services Design Standard for further details
- General ventilation noise produced within the workshop area by the ventilation systems should not exceed 52dB(A). Close to fume extraction points a higher maximum of 62dB(A) would be acceptable

4.7.3 FUME/GAS MONITORING

- Local fume monitoring should be provided for welding fumes
- Carbon monoxide, nitrogen dioxide and iron oxide sensors should each be provided at 3 points within the space
- These sensors should be connected to indicator lights at the teacher's control panel. The option of interlocking them with the general exhaust system and gas supply solenoid valves should also be considered
- Provide a combustible gas sensor at a high point in the workshop. This sensor will activate at or below the Lower Explosive Limit and will activate a dedicated warning light at the teacher's control panel
- Threshold settings for triggering alarms or augmented ventilation should be based on relevant standards, and as recommended by the fume monitor supplier
- All sensors should have a five-year warranty

4.7.4 DELIVERABLES

Please refer to Section "2.3 Project Design Documents" for project deliverables, and specific system deliverables as noted in this section.

4 TECHNICAL SECTIONS

4.8 SUPERVISION

4.8.1 TRAINING BAY REQUIREMENTS

Camera and Display Type

A 720p or 1080p, colour CCTV camera is to be provided above each training bay at a high level location to provide an unobstructed, angled view of the bay. The camera will not be directly exposed to welding fumes, will not be easily accessible (i.e. out of student reach) and will be provided with a lens so as to cover the bay without wasted coverage and with minimal distortion.

The camera will be equivalent in functionality to the Samsung Wisenet Dome Camera CT-HCD-7070R with lens selected to suit the size of the training bay and the very close proximity of the subject.

The cameras will be selected so as to work well above the colour mode threshold at the light level within the bay.

The cameras will link to a video server/storage unit using H.264 compression. A flat-screen monitor/display will be provided. The display will be 70cm or larger and will be installed in a space as directed on site – so as to be readily available to the teacher. The display will have an aspect ratio to suit the camera images. The display will have pixels exceeding the CCTV cameras used so that the images can be displayed on 1:1 pixel basis to avoid interpolation.

The display will be provided with controls to allow the teacher to select the camera for either real-time viewing (uncompressed image) or for the selection of historical footage from any camera. The controls will have the ability to search through stored images to a specific date and time and will allow digital pan, tilt and zoom within the image where the image does not occupy the entire display.

The control system will also allow a tiled display of multiple cameras on the display and will allow an operator to turn on/off all cameras individually or as a whole.

Storage sufficient for 15 days storage from each camera at continuous operation will be provided. All recorded images will be viewed with an associated time of recording.

4 TECHNICAL SECTIONS

4.8 SUPERVISION

All control and processing equipment, as well as all cabling will be provided. It is recommended that IT equipment that does not require local access (e.g. storage, video servers) be located in a local IT comms room. For other equipment, or if installation in a local comms room is not possible, it is recommended that this equipment be installed at the same location as the AV electronics for the demonstration bench coverage (Section "4.6.2"). It is recommended that two points at which camera views can be selected and viewed be provided – one on the wall-mounted control touchscreen/display provided for the demonstration area monitor and one at a LAN-connected PC (to be nominated on site).

The storage and switching system may be combined with the demonstration bench coverage system.

Provide any decoder necessary to allow remote viewing of real-time and stored CCTV images at a nominated PC via the TAFE's Local Area Network.

The cameras and recording will operate continuously during normal school hours. After hours the camera recording will be based on motion detection at the relevant camera. Sufficient lighting will remain on after hours to ensure that the cameras may still continue to monitor the area in night-time (black and white) mode.

Confirm with the camera manufacturer that the camera will not be damaged by the intensity of the arc. It is not expected that the camera will not display blooming or smear during the welding process when the arc is visible.

Camera Location

The camera will be mounted above the lighting on the opposite side of the bay to the welding table but will be angled to ensure an unobstructed view of the table. The image below shows an indicative location for the camera.

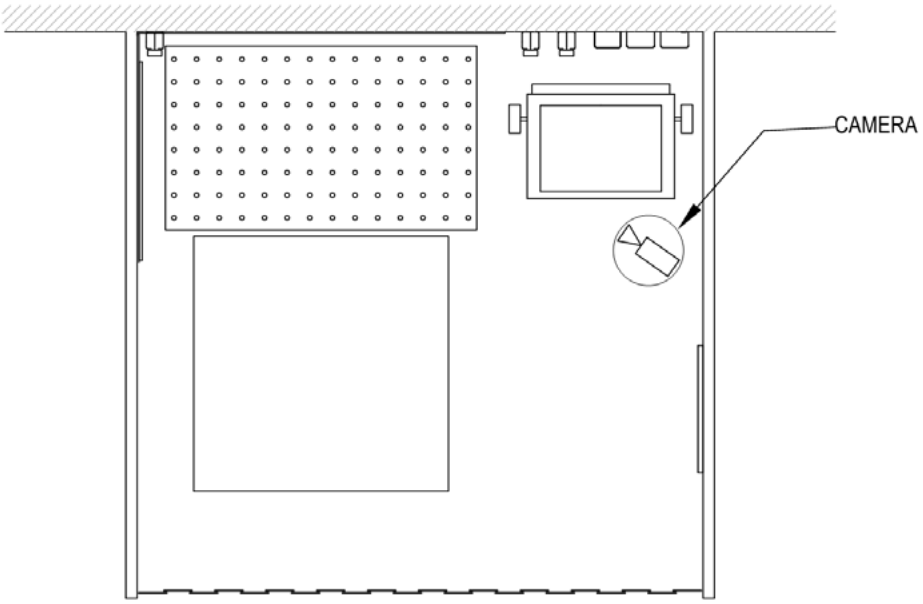


Figure 15: Typical CCTV camera location over a training bay.

4 TECHNICAL SECTIONS

4.8 SUPERVISION

4.8.2 WORKSHOP REQUIREMENTS

In addition to the CCTV cameras over the training bays (Section "4.8.1") and cameras over the demonstration bench (Section "4.6.2"), additional 1080P CCTV cameras will be provided in other student-accessible rooms/areas. At least one camera will be provided per room/area to ensure a reasonably complete coverage of student activities. All entrances to the area will be covered by a camera. A camera will be provided at any gas cylinder storage area and will be positioned and selected to ensure a good image of the area is achieved both during the day and night and at all times of year.

The images from these cameras will be treated in the same way as the images from the training bays. They will be stored and retrievable at will.

4.8.3 IMAGE STORAGE

Storage sufficient for 15 days of operation of all connected CCTV surveillance cameras at maximum image rate is to be provided. Storage will be in a RAID 5 system.

Stored images will be time and date stamped.

4.8.4 DELIVERABLES

Provide all cameras, housings, brackets, cabling, power supplies, IT switches, storage, video server software and video server hardware to ensure a fully operational system.

Cameras, software or equipment with annual licences should not be installed. Cameras, software or equipment with one-off licences may be used if the licence fee is paid by the contractor on behalf of the TAFE (with the TAFE registered as the equipment owner).

4 TECHNICAL SECTIONS

4.9 FIRE

4.9.1 DETECTION

Where fire detection is required in the area by the BCA (or is called up by the project specific brief – e.g. for insurance purposes), thermal detectors will be provided throughout at maximum spacings as outlined as AS1670.1:2018 for the appropriate detection system. Detectors will not be placed directly above welding locations. At least 500mm spacing will be ensured between the top of the welding bay partitions and the finished ceiling to ensure smoke propagation out of the bays.

Given the propensity for fires to ignite in this area, a manual call point will be provided at a prominent location near the main/emergency exit point. This call point will be within the field of view of a CCTV camera so that someone using the call point is easily recognisable.

All detectors and manual call points will be cabled back to the building's Fire Indicator Panel. Where there is no building Fire Indicator Panel an addressable Fire Indicator Panel will be provided at a location compliant with AS1670.1. Where there is a main site Fire Indicator Panel at a different location, the new panel will be of a compatible type and will be networked with it in a manner compliant with AS1670.1.

All new works will be compliant with AS1670.1.

4.9.2 WARNING

Occupant Warning speakers to AS1670.1:2018 or EWIS speakers to AS1670.4:2018 will be provided throughout the area to ensure advanced warning of a fire. The speakers will be installed at locations least likely to be exposed to high temperatures and fumes.

Where there is an existing warning system on site, this will be augmented as necessary to incorporate the new speakers. Where there is not an existing warning system on site, the appropriate head-end warning components will be provided at the Fire Indicator Panel.

All new works will be compliant with AS1670.1:2018 (or with AS1670.4:2018 where there is an EWIS system on site).

4.9.3 SUPPRESSION

Provide a minimum of 2-off dry powder ABE type 5kg extinguishers at wall-mounted locations in the area. At least one extinguisher shall be located within 2 to 20m of the workshop distribution board.

The extinguishers will be identified by the appropriate standard labelling on the wall above and will be conveniently located to the training bays. They will be located in positions where stored material is unlikely to accumulate in front and that are within the field of view of a surveillance CCTV camera.

Sprinklers are not required unless called up specifically for the building by the current BCA or by the relevant fire engineering report.

4 TECHNICAL SECTIONS

4.10 ELECTRICAL SUPPLY

4.10.1 DESIGN

Calculations

Utilise PowerCAD software to validate the design methodology to AS/NZS 3000 and AS/NZS 3008.1 for the following:

- Maximum demand of proposed welding bays
- Cable sizing and selection in accordance with proposed installation method
- Cable tray and conduit sizing
- Voltage drop calculations
- Fault level calculations
- Fault loop impedance

Utilise PowerCAD software to perform over current and short circuit protection calculations to validate each circuit breaker selection, trip unit and settings for the proposed electrical installation.

Provide time/current coordination curves for each selected circuit breaker to demonstrate the proposed electrical design has achieved the grading fault protection and discrimination for each protective device.

In addition, utilise the PowerCAD software to estimate the power factor correction and active harmonic filter sizing.

Maximum Demand

A maximum demand assessment must be undertaken in accordance with AS/NZS 3000 to include design input from:

- TAFE NSW Design Standards
- All trade services electrical loads including mechanical, welders, equipment
- All existing equipment to re-connected
- Liaison and consultation with user groups and stakeholders to include specialised equipment loads

Mains Supply

Site Investigation

Undertake a site investigation to document site conditions, existing equipment to be re-connected, where spare capacity is required and to review the origin of electrical supply capacity available for the proposed project.

4 TECHNICAL SECTIONS

4.10 ELECTRICAL SUPPLY

Point of Supply

Make a planning assessment to review the preferred point of supply from an existing switchboard to accommodate the proposed project electrical load requirements.

Where existing spare capacity is found to be insufficient an additional supply to the site is required. A supply network authority application must be prepared which addresses the following:

- Proposed location for point of supply considering the impact of the site conditions
- Indicate existing or proposed location of the main switchboard on a site plan
- Indicate the service or consumer mains route and length of run
- Maximum demand assessment details

The supply network authority should respond with a network connection offer, which may include an aerial supply connection, underground supply connection, or type of substation i.e. pole mounted, kiosk or surface chamber type.

If a substation is required, an accredited Level 3 service provider must be engaged.

4.10.2 DELIVERABLES

Please refer to Section "2.3 Project Design Documents" for project deliverables, and specific system deliverables as noted in this section.

4 TECHNICAL SECTIONS

4.11 SWITCHBOARDS

4.11.1 WORKSHOP DISTRIBUTION BOARD

Distribution Board

A dedicated workshop distribution board must be provided. The distribution board must:

- Be located such that the switchboard is easily accessible from the welding workshop without needing the exit the area. All access clearances and egress requirements as outlined in AS3000:2018 must be met
- Incorporate lockable removable doors and removable hinged escutcheon
- Have as-built type written distribution board schedules provided for each chassis section
- Provide control and interface section A3 drawings placed within distribution board holders
- Be fed from the building main distribution board
- Be fitted with DIN rails for mounting of controls in dedicated sections
- Be fitted with RCBOs for all circuits where required by AS3000. Minimum 16A rating for lighting circuits and 20A rating for power circuits
- Incorporate a main switch rated at 160A minimum
- All circuit breakers/RCBOs shall have a fault rating of 10kA or greater
- Provided with an emergency shut-off contactor. This will interrupt power to all welding and heavy machinery power outlets in the workshop and will be activated (shut off) by two well labelled, red, shrouded emergency stop buttons at either end of the training bay area (one to be in close proximity to the demonstration bench). See ‘Emergency Power Off’ Section

Note that, due to the requirement for each outlet that is for use by welders to have a dedicated RCBO (refer to Section "4.12.1") more circuits and more RCBOs are required than would typically be necessary for an area of this size. The distribution board will, therefore, also need to be larger than anticipated.

Technical Requirements

- Assembly: Configured for installation to be accommodated within cupboard space
- Access: Ensure access available to busbars, terminations and the like
- Doors: Maintain clearances from cupboard doors
- Fault Level: Calculated from campus main switchboard or main distribution board fault rating or 10kA – whichever is greater
- Form of segregation: Form 2 minimum. Insulation may be used for segregation if the insulation is guaranteed for 25 years it its expected usage
- Ingress protection: IP42 minimum
- Gland plate: Where multiple cables are passing through a gland, sealants are to be applied to maintain IP integrity

- Main Switch: Segregated and/or shrouded from remaining distribution board. The local main switch should be four pole (with late neutral break and early neutral make). All exposed conductors within the board that are upstream of the main switch will be fully protected from accidental contact (IP4X)

4.11.2 LOCATION OF DISTRIBUTION SWITCHBOARD

All new distribution boards serving the general welding area should be dedicated to that workshop area and must be located in a readily accessible, well labelled location within the welding area itself. In this way the teacher does not need to leave the teaching space in order to reset circuit breakers or Residual Current Devices.

Preferably the distribution board will be located within a dedicated, lockable, non-combustible smoke sealed electrical cupboard within the area.

Unenclosed switchboards should only be considered during replacement of existing switchboards. Position of unenclosed switchboards must be carefully considered to avoid paths of egress.

4.11.3 COMPONENTS

Switchgear and Control gear

All switchgear must be selected to provide discrimination between upstream and downstream devices.

In general, discrimination must be arranged so that in the event of a fault, only that switchgear immediately upstream of the fault should operate to clear the fault. For the purposes of this clause, devices include circuit breakers or fuses.

Where existing switchgear is being reused or remains in place at completion of the works, discrimination must be achieved between new and existing devices and details of protection settings submitted must include existing devices.

Allow to modify settings of protective devices on existing equipment within their capability to improve discrimination if necessary.

All switchgear and circuit breaker protection equipment must be:

- A consistent manufacturer/brand throughout the building installation and for the area under modification
- Fully coordinated and selected where possible to fully discriminate and cascade and offer fault current limiting features in the range
- Compatible with existing switchboard busbar arrangement
- Installed to match the existing manufacturer/brand when practically available

Metering

Separate private metering of the lighting and power will be provided where the project is required to comply with Section J8 of the BCA. Where this is not a requirement, the project may nevertheless deem l necessary to provide local metering of lighting and power in order to ascertain electricity usage in the area.

4.11.4 RESIDUAL CURRENT DEVICES

Residual Current Devices

Residual Current Device (RCD) protection should be provided on all nominated sub-circuits, as listed above and as per the requirements of AS/NZS 3000. Generally, all RCDs should be combined with circuit over-current and fault protection devices in the form of RCBOs.

All RCD and RCBOs should be of the same manufacturer as the switchgear used throughout the installation.

All RCDs/RCBOs used to protect welding outlets shall be of type B (as defined by IEC60755) that responds to frequencies other than the power frequency – 50Hz. Each outlet for the use of a welder shall be provided with RCD protection whether or not is deemed necessary by AS3000.

4.11.5 EMERGENCY POWER OFF (EPO) ISOLATION

An emergency power off facility will be provided to allow quick shutdown of all welder outlets and outlets for heavy/dangerous machinery. Emergency Power Off (EPO) pushbuttons must be:

- Accessible to staff
- Located at points in the workshop area that can be reached quickly and that are unlikely to be occluded
- Coordinated and located adjacent to local gas shutdown
- Reviewed by the project Crown Certifier
- Provided with shroud to prevent any accidental operation
- Provided with a reset facility at the distribution board – along with indicator lights to show when the system has tripped and when power is available
- Provided with a clear label with operating instruction. The indicator lights and reset buttons must also be clearly labelled
- Separated by 500mm from other room controls to avoid inadvertent operation
- Control of motorized circuit breaker or low-dropout-voltage contactor serving an EPO chassis section of distribution board
- The reset button must be provided with labelling regarding safe reset of the system – including the need to ensure that all supplied outlets are turned off before resetting

The EPO will not affect lighting, communications, AV, safety equipment or any area outside of the workshop. At least one EPO pushbutton should be located near to the demonstration bench.

4.11.6 SURGE PROTECTION

Surge Protection

Surge protection must be incorporated as follows:

- Incoming supply section of main switchboard where the main switchboard is a component of the works. This surge protection should be 200kA rated service entry standard
- Incoming supply to the distribution board. This surge protection should be 40kA rated and of the same manufacture as the upstream diverter (where present)
- Each individual outgoing circuit serving audio-visual, communication, security equipment and the like where served from the workshop board. This surge protection should be 20kA rated and of the same manufacture as the upstream diverter

All surge protection must be earthed to the manufacturer's recommendations and protected against overload with the manufacturer's recommended circuit breaker.

4.11.7 CONSTRUCTION

Internal Switchboard

All internal switchboards must be constructed:

- To be compliant with AS/NZS 3000, AS/NZS 61439.1 and AS/NZS 61439.2 and supply authority requirements
- To allow uniform accessible layout of modular functional protective device and cable access compartments in a tier arrangement allowing for spare poles and/or expansion of additional tier cubicles
- To incorporate busbar capacity and arrangement allowing for spare capacity for future electrical growth
- To incorporate metering, BMCS interface and control cubicles to satisfy TAFE NSW requirements
- To comply with quality manufacture and installation of switchboard to WH&S, statutory authority and regulation requirements
- To IP42 unless a sprinkler is located within the room or cupboard, then IP56
- To allow readily accessible easy access for operation and maintenance clearance in accordance with AS/NZS 3000
- To allow easy shipment in modular sections as required for installation and access within designated space
- With steel metalwork to achieve a rigid assembly, modular extruded framework, reinforced and stiffened panels and sheeting free from deflections, distortion, or misalignment
- To allow configuration of switchboard assembly to accommodate busbars, protective devices, functional units, metering equipment, incoming and outgoing cabling reticulation and terminations, interface and control termination equipment and the like
- To allow access for maintenance and any future extension and modification without the removal of equipment

- To achieve the form, design, compartmentation and segregation requirements to busbars, functional units, protective devices, cabling and terminations
- With colour coded active neutral and earth insulated busbars sized to deliver the current carrying capacity for active conductors so that the final temperature must not exceed 900C and full-sized neutral busbar conductor must be provided
- With spare cable reticulation and busbar capacity extended to serve all spare poles
- To permit access for thermographic maintenance testing
- With doors sized no greater than 800mm, with resilient neoprene dust seals around perimeter of door openings. All door mounted equipment terminals must be shrouded, and doors provided with an earth cable to maintain continuity
- To incorporate escutcheons of maximum 1200mm height, matching door width, to all mains voltage sections of the switchboard to prevent any potential exposure to live parts whilst door is open and be provided with fixings and handles to readily and safely be able to remove and reassemble and fix in position the escutcheon without a tool
- All labelling to be Traffolyte
- Metering will be provided to match existing distribution board metering in the building. Where this facility is in a new building, metering will be provided to match new distribution board metering throughout the building and the BCA requirements. This includes connectivity to a central monitoring system

If installed in a building where there is no distribution board metering, metering will be provided to meet the BCA section J8 requirements however the metering will be locally readable and need not be provided with a central monitoring facility.

4.11.8 DELIVERABLES

Design Submissions

Submit switchboard/distribution board specification and drawings which must indicate the following as a minimum:

- Switchboard specification including construction and functional requirements
- Single line diagrams
- Switchroom and cupboard location, elevation and layout drawings
- Metering methodology and metering installation schematics
- Power factor and active harmonic filter schematics

Installer Submissions

Submit switchroom and cupboard workshop drawings indicating location and dimensioned plan and elevation drawings of each wall incorporating the following as minimum:

- All switchboards including coordination of other services switchboards and indicating switchboard door swing maintenance clearances and egress in accordance with AS/NZS 3000

- Meter panel arrangement
- Inverters
- Active harmonic filters or power factor correction equipment

Submit the following testing reports as a minimum:

- Cable termination testing records
- Phase balancing records
- Metering settings calibration records

Manufacturer Workshop Submissions

Submit switchboard workshop drawings which must indicate the following as a minimum:

- Design parameters
- Construction details
- Equipment technical schedules
- Busbar arrangement assembly details
- Detailed dimensions of all modular components and overall assembly
- Elevation and general plan views indicating compartmentation and segregation of switchgear with busbars
- Switchboard section, chassis arrangement indicating number of poles and spare capacity
- Details of gland plates and cable management routes within assemblies
- Interface and control section and wiring details
- Door details and opening arrangement
- Plinth details and ventilation openings
- Mounting seismic restraint details
- Labels and warning labels

Submit the following switchboard manufacturer's technical data for all components as a minimum:

- Makes, types and model numbers of items of equipment
- Type test certificates for components, functional units and assemblies including internal arcing-fault tests and factory acceptance test data
- Submit the following design calculations as a minimum:
  - PowerCAD over current and short circuit protection calculations and indicate each circuit breaker selection, trip unit and settings within equipment schedule for the proposed electrical installation
  - Time/current coordination curves for each selected circuit breaker indicating the resultant performance grading fault protection and discrimination for each protective device

Submit the following testing and commissioning reports as a minimum:

- Factory acceptance testing
- Site acceptance testing
- Integrated commissioning and testing

4 TECHNICAL SECTIONS

4.12 COMPONENTS

4.12.1 SOCKET OUTLETS

Accessory Types

The designer must incorporate the following accessory types to suit the application and scale of the project.

Socket Outlets

All socket outlets provided in welding training bays for the connection of welders will be switched Clipsal Industrial 56 series (or equivalent). Each will be independently protected by an RCBO (refer to Section "4.11.4") and each will also be provided with a 'power available' indicator to allow the user to determine when the circuit protection has tripped.

General purpose outlets in the training bays will be equivalent to Clipsal WSC227F2X-RG where mounted 700mm above the welding bench or Clipsal Industrial 56 series when mounted below 700mm.

Outlets throughout the workshop area that are intended for use for welders or industrial equipment will be switched Clipsal Industrial 56 series (or equivalent). General 10A outlets throughout the workshop (not in training bays) will be switched and impact resistant.

All outlets will be labelled using Traffolyte indicating the DB and circuit breaker of circuit origin.

In surface mounted applications (i.e. where recessing is not possible), horizontal/vertical mounting blocks must be used and mounted to the structure as per manufacturer recommendations. All mounting screws must be fully isolated from electrical cabling. The cable entry cut-outs into the mounting block must be appropriately sealed to prevent access to electrical cabling.

External Socket Outlets

All socket outlets installed external to a building or in damp situations should have a minimum ingress protection rating of IP56. All external socket outlets should be installed in a position that does not obstruct a path of travel or introduce a trip hazard, i.e. wall mounted or adjacent to garden beds.

4.12.2 ISOLATORS

All isolators used will be capable of interrupting supply on-load as well as under fault conditions. Isolators will be Clipsal Industrial 56 series (or equivalent).

4 TECHNICAL SECTIONS

4.12 COMPONENTS

4.12.3 MOUNTING HEIGHTS AND LOCATIONS

Outlets within training bays that are for welder use will be mounted at 1600mm AFFL beside the welding bench – above the likely location of welding machines. Other outlets (not intended for welders) will be mounted at the same height on the wall on the opposite side of the bench.

All accessories must be mounted at the following heights, except where mounted on workstations, joinery, skirting ducts etc or where required to be mounted at a different height by Australian Standards or the NCC.

4.12.4CABLE MANAGEMENT

All cables will be concealed. Where not possible, permission from the project superintendent will be sought to run cables in surface-mounted conduit. No surface mounted conduit will be permitted within welding bays.

All cabling will be supported either on tray, catenary or by direct fixing. Adhesive fixing is not acceptable.

4.12.5VOLTAGE REDUCTION DEVICES

Voltage reduction devices (to reduce the voltage at the electrode with respect to the welders 'negative' terminal whilst the system is idle, will be provided with welders.

4 TECHNICAL SECTIONS

4.13 LIGHTING

4.13.1 LIGHTING TYPE

Interior Luminaires

All internal luminaires installed must:

- Be mounted at a height less than 3m AFFL to mitigate need for accessible lifting devices, or otherwise be located to be readily accessible with safe lifting device
- Where mounting heights of luminaires are greater than 3m AFFL such as within double height workshop spaces, locate luminaires within readily accessible areas to enable safe lifting devices to be located in close proximity to luminaires for periodic cleaning, repair or replacement
- Luminaires to be readily and easily accessible to be lifted within ceiling space
- Be mounted and independently fixed to structure
- Maintain sufficient space around the luminaire to allow for the removal and replacement of luminaire or associated driver, without damage to ceiling or structure and/or disassembly or relocation of any other equipment or services
- Minimise cut out size to fit within ceiling trim and allow future replacement of luminaire, associated control and re-wiring without damage to ceiling

All internal luminaires will be:

- LED
- Flicker free
- High efficiency type
- Designed for 50,000 hours of operation
- With minimum 3 year warranty and
- With 4000°K colour temperature
- Maintainable from below
- Provided with an IK10 impact resistant diffuser
- Minimum of IP42 from below and (unless recessed) above

Fittings over training bay benches will be equivalent to Industralight 1000mm long BX-Series Industrial Batten set to 25W with constant current driver. These will be mounted over the centre of the bench at high level out of the field-of-view of the welder to avoid interference with automatic-dimming welding masks. This larger format fitting is used but dimmed down in order to reduce shadowing over the table that would become more evident with a smaller light source.

Over stand-alone demonstration benches, LED lighting will be provided at high level (at 2300mm or above) and arranged to provide light uniformly over the work bench. The light fittings will be positioned so as to reduce shadowing by the body of the teacher, the display monitor and overhead camera, or by the fume extraction arm when in its normally retracted position at high level.

4 TECHNICAL SECTIONS

4.13 LIGHTING

Over general workshop areas with ceilings of 3000mm or higher, use lighting equivalent to Industralight BX-Series 55W Industrial Batten with constant current driver. For lower ceiling heights use Industralight BX-Series 30W Industrial Batten with constant current driver or equivalent fittings with glare reduction design.

All internal lighting shall be either recessed (where the ceiling construction permits)., surface mounted or 4-point chain suspended to eliminate swinging due to air currents but to allow movement from accidental collision. All power supply cables will be concealed where possible.

Drivers will be located in a well ventilated (compliant with manufacturer's warranty requirements) and accessible space.

External Luminaires

All external luminaires installed must:

- Incorporate reflector to project lighting within a downward forward or side throw to illuminate specific area served
- Incorporate highly durable primer, dual powder coating and anti-corrosive protective treatment
- Be located on walls and soffits of awnings
- Have a secure adjustable mounting bracket arrangement and fixing method of luminaires to accommodate pole, soffit or wall mounting
- Where located less than 4m AFFL provide vandal resistant IK 10 rated luminaires with anti-tamper fixings
- Have readily accessible wiring, control gear and associated lighting control assemblies
- Avoid bollard lighting to building entry areas, footpath, vehicle areas including driveway
- Avoid up lighting of trees

4.13.2 LIGHTING LEVELS

Maintained lighting levels of 240 lux with a uniformity of 0.7 must be provided over all training bay welding table or other workshop surfaces. 240 lux should also be maintained over welder controls.

300 lux and 0.7 uniformity shall be provided over the demonstration bench with the centre of the bench illuminated from at least two sides.

Over remaining workshop spaces 200lux should be provided.

In other areas, lighting levels will comply with those outlined in the AS1680 series of standards.

A maintenance factor of 0.7 shall be used for lighting calculations in the facility.

4.13.3 SWITCHING

Standard: To AS/NZS 3133.

All training bay lights will be centrally switched from the same location that the fume extraction arms are switched.

Some general workshop lighting will be switched at the main entry to the space. This will allow an occupant to navigate safely to a main lighting panel where the remainder of the lights can be operated. It is recommended that this main lighting panel be collocated with the switching panels for fume arms and for CCTV surveillance. It is recommended that the lighting control be integrated with the CCTV control touch screen. It will be possible to over-ride such integrated lighting control by accessing the lighting control relays at the local distribution board.

General: Construct the face plate impact resin and mechanism so that the mechanism cannot be displaced during normal operation, using retaining screws.

Colour: Generally white in general learning and office areas unless otherwise instructed by design team.

Indicators: Provide red indicators above switch toggles, to be visible with switches "on".

Switch Mechanisms: Rating to be minimum 15 A, 250 V a.c. and rated for reactive load switching. All switch panels must be designed to switch inductive loads and must switch no more than 70% of their rated current.

Environment: Weatherproof (IP56) and impact resistant (IK10) light switch enclosures are to be installed in all workshop areas, plantrooms, switchrooms, external areas, and the like. In addition chemical resistant industrial type light switches should be considered for workshop applications where exposed to chemicals.

Labelling: All light switches greater than three gang should have wax-filled engraved labelling that clearly indicates which area and which light bank is controlled by which switch. Engraving should be in letters 4mm high.

Where a light switch is also to control a separate device (such as a fan) that is not on the same lighting circuit, a double-pole light switch must be provided. The double pole light switch must be rated for the switching of separate phases where necessary.

4.13.4SWITCH GROUPS

Lighting will be switched in logical groups. A light switch at the main entry door will illuminated fittings sufficient for safe travel to the main lighting control panel. Where there is a second possible entry point a switch at that location will also illuminated fittings sufficient for safe travel to the main lighting control panel. A switching system equivalent to C-Bus will be used to allow the flexible switching of fittings.

Where a room is larger than 40m^2 the switching must be subdivided so that there is no area >50m^2 per switch.

Switching must be well labelled and logically labelled so that it is clear which groups of lights are activated.

4 TECHNICAL SECTIONS

4.13 LIGHTING

4.13.5 EMERGENCY & EXIT LIGHTING

Emergency and exit lighting will be provided throughout the workshop as required by the current issue of the BCA. All required emergency and exit lighting will comply with AS/NZS 2293.1:2018. An emergency lighting timer/test switch shall be provided at the local distribution board if not provided elsewhere and where a central monitoring system is not implemented on site.

4.13.6SPECIALISED WELDING HELMETS

Specialised welding helmets (auto-dimming visors, built-in illumination, or with other built-in readouts will be provided on a project-by-project basis. Where such helmets are to be used, a recharging cupboard should be provided with all necessary equipment to allow the simultaneous recharging of the fleet of helmets. Each helmet will have an individual, numbered storage point within the cabinet with recharger cabling lengths and positions selected so as not to result in a rat's nest of recharger cabling.

4 TECHNICAL SECTIONS

4.14 WELDING ISOLATION PANELS AND EARTHING

Previously, additional protection was used for welding training bays (i.e. monitoring of earth connections connectivity). This is no longer required. No additional isolation panel is required.

The existing approach is based on keeping the welding benches (both training and demonstration benches) fully isolated from the building earth.. This solution does not risk burning out building wiring due to misuse of a welder however it allows reduced protection of personnel than does a fully earthed system.

A prototype of a fully earthed system with protection of the building wiring is currently being carried out at Bega TAFE prototype. In the meantime, no additional protection (over and above earth leakage protection is to be provided.

4 TECHNICAL SECTIONS

4.15 WELDING GASES

4.15.1 SUMMARY

Welding gas system design requirements must be confirmed by TAFE NSW at the design stage for each project. This includes provision for reticulated, and portable gas systems.

Gas installation and associated controls must be carried out by a specialised industrial gas subcontractor.

Design

- Design calculations
- System selection

Systems

- Shielding Gases for electric welding
- Acetylene and Oxygen systems
- Compressed Air
- Cylinder storage systems
- Piping systems
- Manifolds
- Terminals and fittings

4.15.2DESIGN

Design Calculations

For estimation of system capacities utilise industry standards to estimate peak system loads, taking into consideration the following factors

Standards

- AS 4289 Oxygen and Acetylene gas reticulation systems: (systems size limits and pressure limits)
- AIRAH Handbook: (diversity factors, pipe sizes)

Initial Design allowances and considerations

- Incorporate 10% safety factor into the calculations

System Selection

General

Selection of the type of gas system shall take into consideration the following considerations:

- Life cycle costing
- Spatial limitations
- Delivery limitations – truck access, overhead clearances
- Ongoing maintenance and servicing
- Availability of suitable maintenance staff
- Availability of spare parts

4 TECHNICAL SECTIONS

4.15 WELDING GASES

4.15.3 SYSTEMS

The following subsections detail specific considerations for individual systems.

Shielding Gases for electric welding

- General design to AS2896 Section 2.4 and L.2 with the following amendments which are to be confirmed with TAFE NSW at the time of design
- Supply pressures – 8 bar to local regulator at welding benches (adjustable), or as needed to achieve welding equipment operation
- Shielding gases for electric welding: 4 L/minute / terminal
- Note AS 2896 Section 2.4.10 Liquefied gases in cylinders for CO_2 installations
- Provide flashback arrestors at all regulator outlets and torch inlets

Acetylene and Oxygen Systems

Acetylene and Oxygen systems will typically be provided via portable bottles. For details on these systems please refer to the TAFE NSW Mechanical Services Design Standard.

Natural Gas

Reticulated natural gas is not a general requirement for welding workshops but may be required for specific projects. Refer to the TAFE NSW Hydraulic Services Design Standard for standards governing the reticulation of natural gas.

Compressed Air

Compressed air services must be provided to service welding bays. Please refer to the TAFE NSW Mechanical Services Design Standard for details.

Cylinder storage systems

To comply with AS 4332 – The Storage and Handling of Gases in Cylinders.

General

- Clear signage must be provided to indicate specific storage locations for each gas
- For bottles gas minimum storage the greater of 1 week (connected) + 1 week (spare) – or 2 x minimum delivery time
- External bottle storage is preferred to comply with major storage requirements of AS4332
- Not underground or in basements
- Easy, level track access required
- No overhead power lines or building structures preventing offloading with articulated arms
- Concrete off-loading area
- Naturally ventilated

- Bottles not directly exposed to the sun
- A means to hold all bottles – empty and full) in position to ensure that the bottles cannot fall over
- Sufficient space so that the bottles for each type of gas used on site can be accessed without the need to move other bottles and with a separate space for empty bottles
- Compliance with AS 4289 for Oxygen and Acetylene gas reticulated systems
- Drains or sump pits to not be provided in bottle storage areas as per standards
- Limited (locked) access with robust gates or doors
- CCTV camera coverage of the access to the area. Security lighting (ensuring lighting throughout the night) over the access to ensure suitable CCTV visibility
- At least one cylinder trolley should be provided for each facility. The trolley must be complete with cylinder restraining straps and will be suitable for the carriage of up to two cylinders of types C, CD, D, E or F. The trolley should be equivalent to Storemasta Gas Bottle Trolley

Piping Systems

To comply with:

- AS 2896 –Medical Gas Systems, Section 4 installation requirement for pipelines (non-flammable gases and compressed air)
- AS 4289 – Oxygen and Acetylene gas reticulation systems
- AS 5601 for LG gas and NG systems – refer to the TAFE NSW Hydraulic Services Design Standard

General

- Designed to AIRAH Handbook: (diversity factors, pipe sizes) to suit capacities calculated in Section "4.6.2"
- Copper with brazed joints only except for Acetylene gas which shall be stainless steel joined in accordance with AS 4289

Manifolds

Cylinder Manifolds

- Automatic change over manifolds should be provided

Terminals and Fittings

General

- For workshops quick connect ¼ BSP type
- To suit equipment served
- Provide flash back protectors on all regulator outlets, and torch inlets

Confirm final details with TAFE NSW.

4 TECHNICAL SECTIONS

4.16 THEFT

Material and equipment theft is a consideration for welding workshops. Access to the area as a whole should be controlled by either electronic or keyed entry points at the perimeter. Gas bottles and bottle trolleys will be stored in a locked area. Consumables such as electrodes, wires etc. will be stored in locked cupboards.

Signs advising of CCTV coverage should be prominently displayed around the area.

WORK HEALTH & SAFETY

5 WORK HEALTH & SAFETY

5.1 GENERAL REQUIREMENTS

The ''Common Work Health & Safety Concerns'' table identifies common Work Health & Safety concerns arising from welding workshop systems that have been identified from past TAFE NSW projects. Each project team must demonstrate that all safety concerns raised have been addressed as part of their involvement with any project to which this Design Standard applies. The safety concerns listed in the table must be included in project-specific Safety-in-Design Registers to ensure that project teams demonstrate how they have been addressed through all phases of any project.

Please note the information in the table is:

- For guidance only,
- Not exhaustive and does not take into account specific circumstances and should not be relied on in that way, and
- Does not alleviate the respective TAFE NSW team, designer, supplier or contractor from their own Work Health and Safety obligations and duties.

Legend	Level of Risk	Action Required
H	High	Implement cost effective risk control measures and formalise procedures or management responsibility for reducing risk. Amend design to reduce risk, or seek alternative option. Only accept option if justifiable on other grounds.
M	Moderate	Incorporate cost effective risk control measures within the scope of long-term planning. Management responsibility must be specified. Check that risks cannot be further reduced by simple design changes.
L	Low	Manage by routine procedures. Check that risks cannot be further reduced by simple design changes.

5 WORK HEALTH & SAFETY

5.2 COMMON WORK HEALTH & SAFETY CONCERNS

Safety Issue Raised	Potential Control or Treatment measure	Reference to Design Standards / Statutory Requirements	Level of Risk	Phase: Delivery:	Phase: Construction, Supply, Installation	Phase: Operation and End use
Water leaks into rooms	Design of rooms to be watertight so that no leaks occur within room. No water services to be provided in switchboard residing in rooms, cupboard areas.	NCC/BCA	H	Y		
Fall hazard in Installation and servicing of high-level plant	Install plant at levels where they can be safely accessed with minimal fall hazard. Where plant must be installed at high level, all work to be performed using mechanical lifts, appropriate fall protection equipment, and appropriate PPE.		H	Y	Y	Y
Fall hazard for installation and servicing of roof top plant, and plant near drop offs	Install plant away from edge of roof, provide fall protection barriers. All work to be performed using appropriate fall protection equipment, and appropriate PPE.		H	Y	Y	Y
Risk of equipment falling	The design to incorporate restraints wherever equipment with a high centre of gravity is to be used (e.g. gas bottles, stacked welders etc). The restraints must be sized for the equipment to be restrained.		H	Y	Y	Y
Risk of electrocution while servicing active plant	Follow manufacturer's recommended service and installation procedures, ensure lockout of all equipment before starting work, do not work on live equipment, employ appropriate PPE, only properly qualified personnel are to undertake works on plant.		H	Y	Y	Y
Risk of sparks damaging equipment or starting a fire	Equipment will be stored under tables only where the table has a completely solid top with no holes. Equipment installed beside welding tables should be positioned such that ventilation holes are not directly exposed to sparks. No flammable items to be used within welding bays. Flame retardant welding mats. Consider using steel wool sandwiched between weldmesh to catch sparks behind grinders.		H	Y	Y	Y
Risk of burns due to touching hot metal	Ideally bench-top holders should be provided for the welding electrodes so that they cannot slide off the table and onto the floor. An appropriate receptacle for the stubs of used welding rods should be provided. Provision of appropriate gloves.		H	Y	Y	Y

5 WORK HEALTH & SAFETY

5.2 COMMON WORK HEALTH & SAFETY CONCERNS

Safety Issue Raised	Potential Control or Treatment measure	Reference to Design Standards / Statutory Requirements	Level of Risk	Phase: Delivery:	Phase: Construction, Supply, Installation	Phase: Operation and End use
Risk of exposure to toxic fumes	Proper tuition in the use and placement of the flexible fume extraction arms. Maintenance of 500mm gaps below and above partitions/curtains to allow air flow from the wider area ventilation to reduce concentration. Maintenance of high general ventilation air flow rates. Fume detection to detect high toxic fume levels. Exhaust discharge points to be located away from building air intakes, and occupants, and in such a way so fumes will not be entrained into the building. Use appropriate PPE, and working procedures.		H	Y	Y	Y
Risk of heat stroke from extreme interior temperatures	Interior spaces are to be designed with adequate ventilation and provision for cooling to maintain safe indoor temperatures. Should space interior temperature be considered unsafe, the space should be vacated.		M	Y	Y	Y
Risk of exposure to Ultraviolet radiation	Proper clothing and PPE. Proper training and enforcement of rules.		H	Y	Y	Y
Electric shock from equipment	Appropriate earth leakage and earth continuity monitoring. Voltage reduction devices on welder. Training. Keeping workspaces dry. Provision of towels to remove sweat. Rubber mats at welding benches.		H	Y	Y	Y
Electrical cable damage	Tie electrical cables up off floors and away from work benches. It us useful to have tie points at useful locations (e.g. on the side of the welding bench). Readily available biodegradable cable ties.		M	Y	Y	Y
Cuts from sharp edges	Provision of gloves. Training. Readily accessible used metal bin.		M	Y		Y
Metal dust, metal oxide dust accumulating in power receptacles.	Provide covers over unused sockets.		M	Y		

5 WORK HEALTH & SAFETY

5.3 SAFE OPERATING PROCEDURES (SOPS)

Operation of TAFE NSW welding bays requires compliance with WHS legislation and TAFE NSW risk management procedures. This includes the implementation of Safe Operating Procedures (SOPs).

- All TAFE NSW welding bays require SOP documentation to be in place and current
- The handover process for new welding bays must include the provision of SOPs, consultation with TAFE NSW teaching and WHS staff, with training for staff as required
- The teaching delivery process must include the application of SOPs and demonstration to students so that students can operate the equipment and work in the welding environment safely

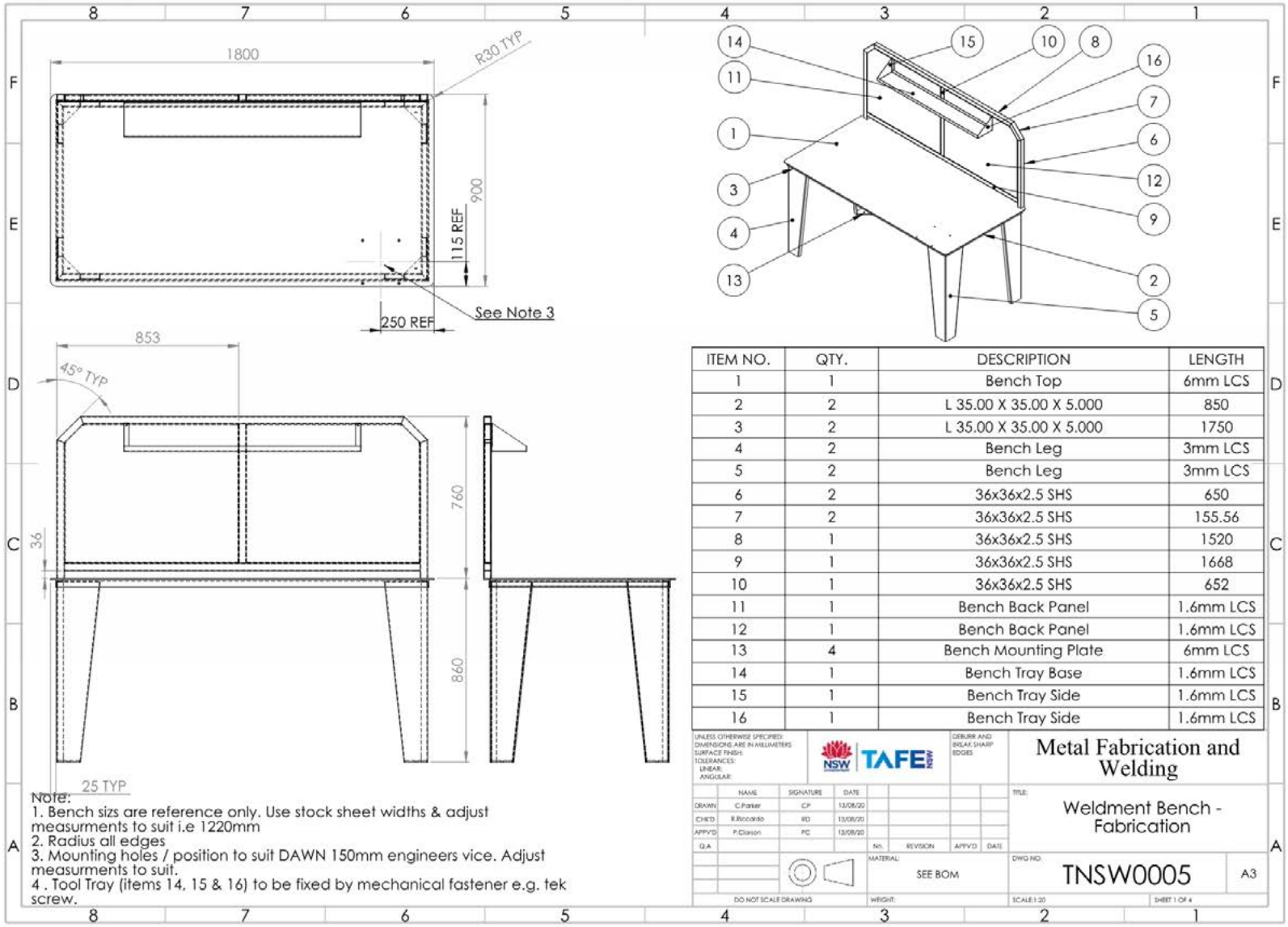
APPENDIX

A APPENDIX

A.1 WELDING TABLE DRAWINGS

A APPENDIX

A.1 WELDING TABLE DRAWINGS



ITEM NO.	QTY.	DESCRIPTION	LENGTH
1	1	Bench Top	6mm LCS
2	2	L 35.00 X 35.00 X 5.000	850
3	2	L 35.00 X 35.00 X 5.000	1750
4	2	Bench Leg	3mm LCS
5	2	Bench Leg	3mm LCS
6	2	36x36x2.5 SHS	650
7	2	36x36x2.5 SHS	155.56
8	1	36x36x2.5 SHS	1520
9	1	36x36x2.5 SHS	1668
10	1	36x36x2.5 SHS	652
11	1	Bench Back Panel	1.6mm LCS
12	1	Bench Back Panel	1.6mm LCS
13	4	Bench Mounting Plate	6mm LCS
14	1	Bench Tray Base	1.6mm LCS
15	1	Bench Tray Side	1.6mm LCS
16	1	Bench Tray Side	1.6mm LCS

Note:
1. Bench sizs are reference only. Use stock sheet widths & adjust measurments to suit i.e 1220mm
2. Radius all edges
3. Mounting holes / position to suit DAWN 150mm engineers vice. Adjust measurments to suit.
4 . Tool Tray (items 14, 15 & 16) to be fixed by mechanical fastener e.g. tek screw.

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:

DEBURR AND BREAK SHARP EDGES

NSW TAFE NSW

	NAME	SIGNATURE	DATE
DRAWN	C.Parker	CP	13/08/20
CHK'D	R.Riccardo	RD	13/08/20
APPV'D	P.Clarson	PC	13/08/20
Q.A			

No.	REVISION	APPV'D	DATE

MATERIAL: SEE BOM

DO NOT SCALE DRAWING

WEIGHT:

Metal Fabrication and Welding

TITLE: Weldment Bench - Fabrication

DWG NO. TNSW0005

A3

SCALE:1:20

SHEET 1 OF 4

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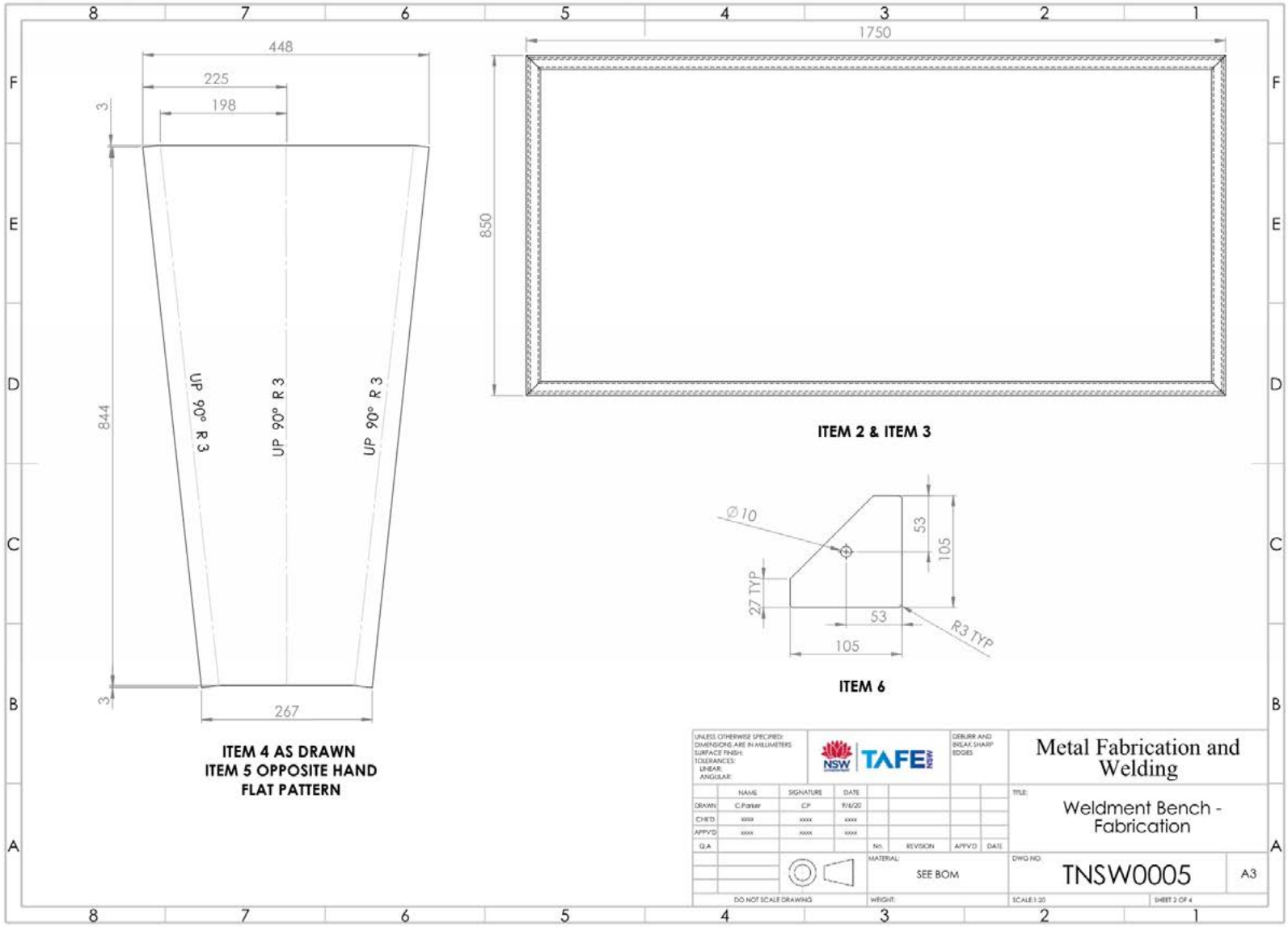

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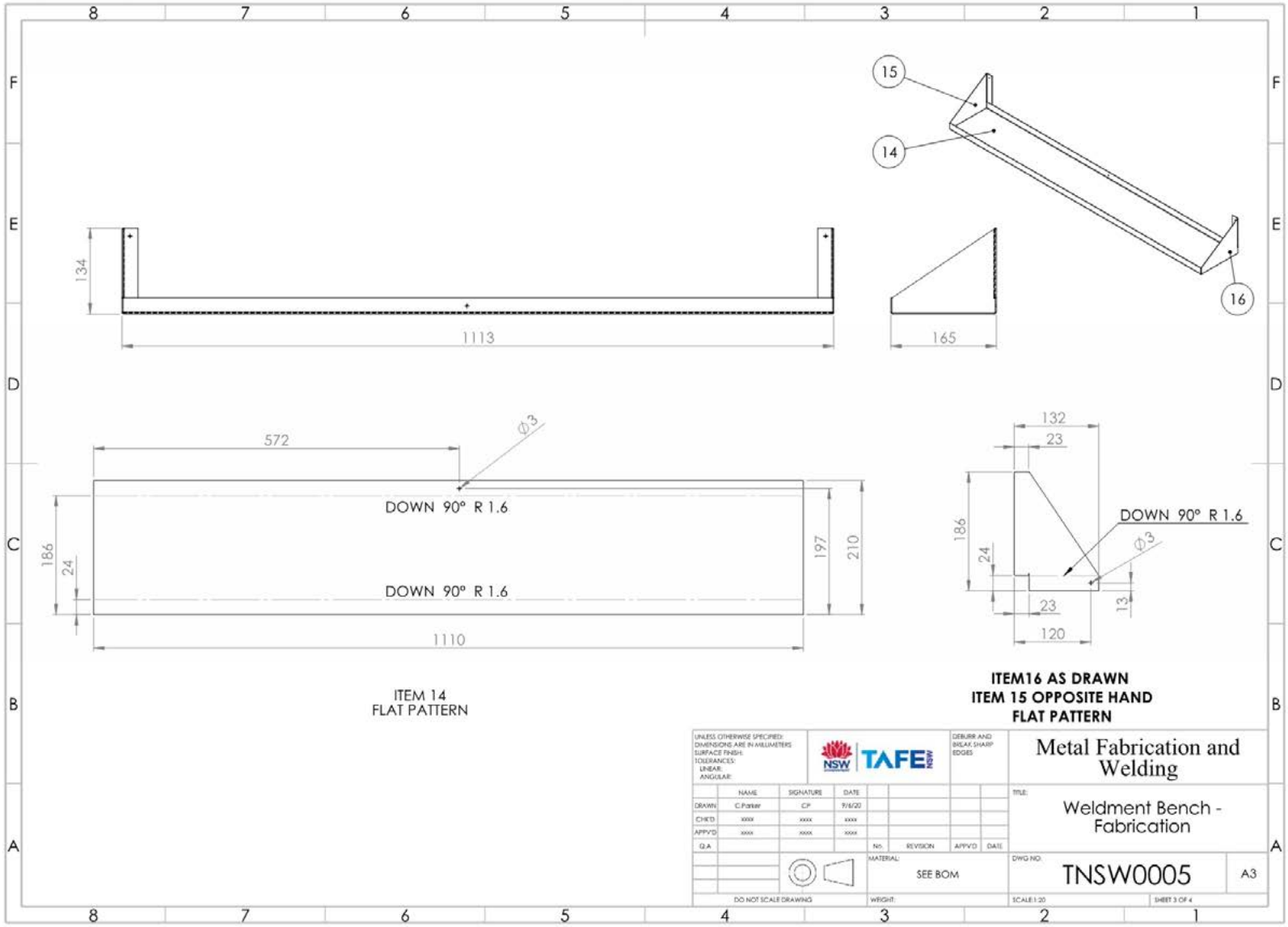

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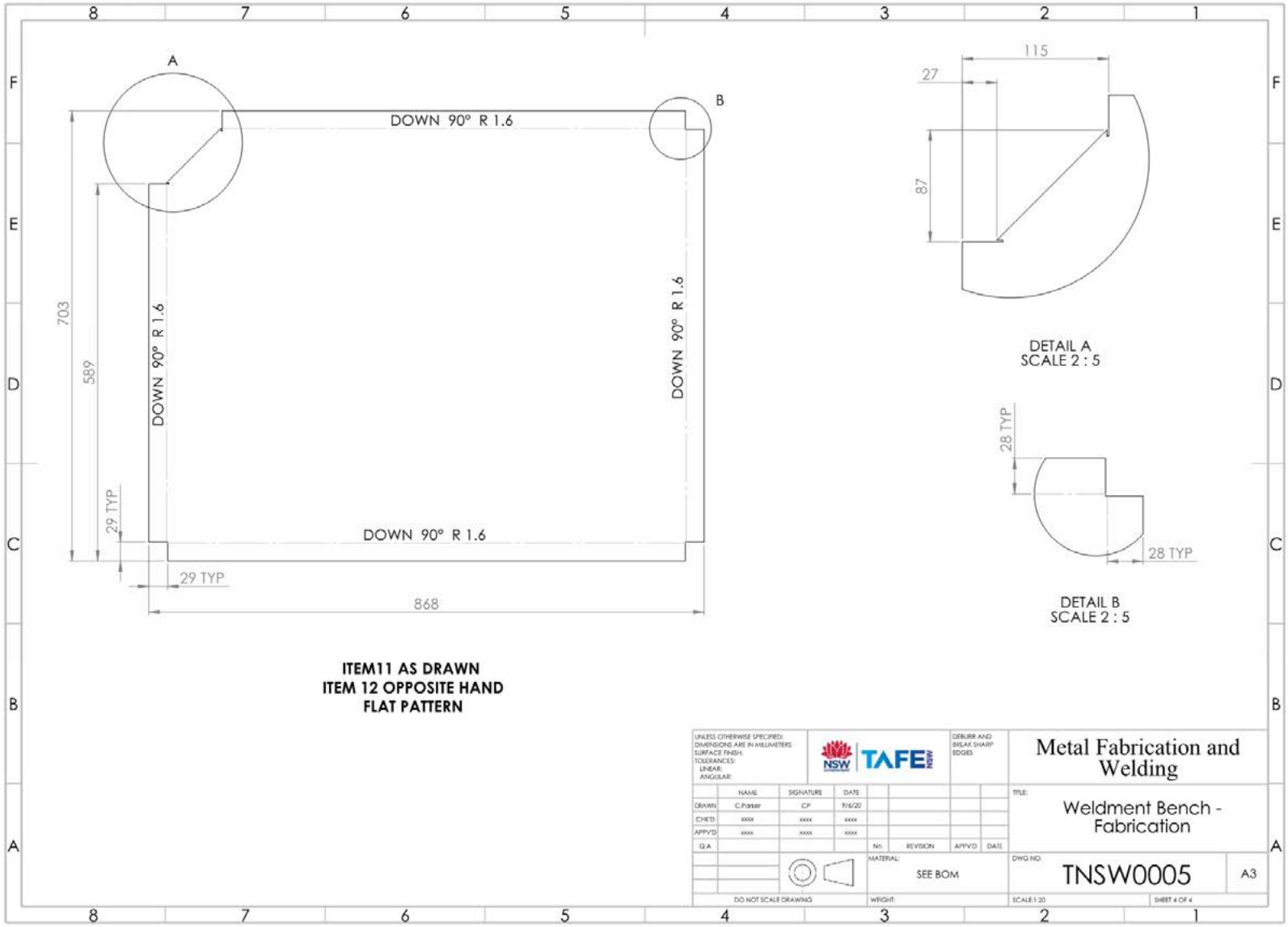

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A.2 WELDING CLAMP DRAWINGS

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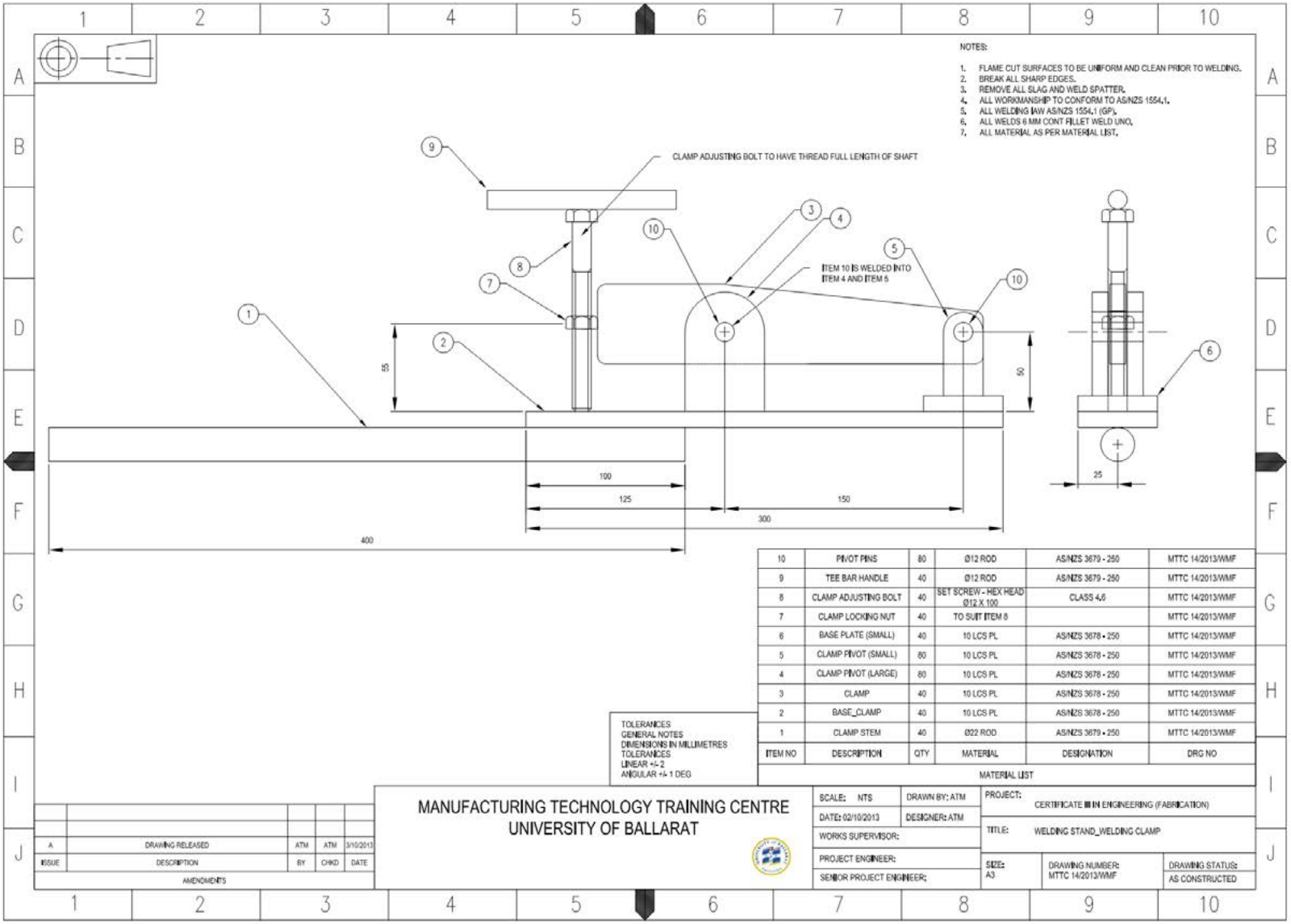

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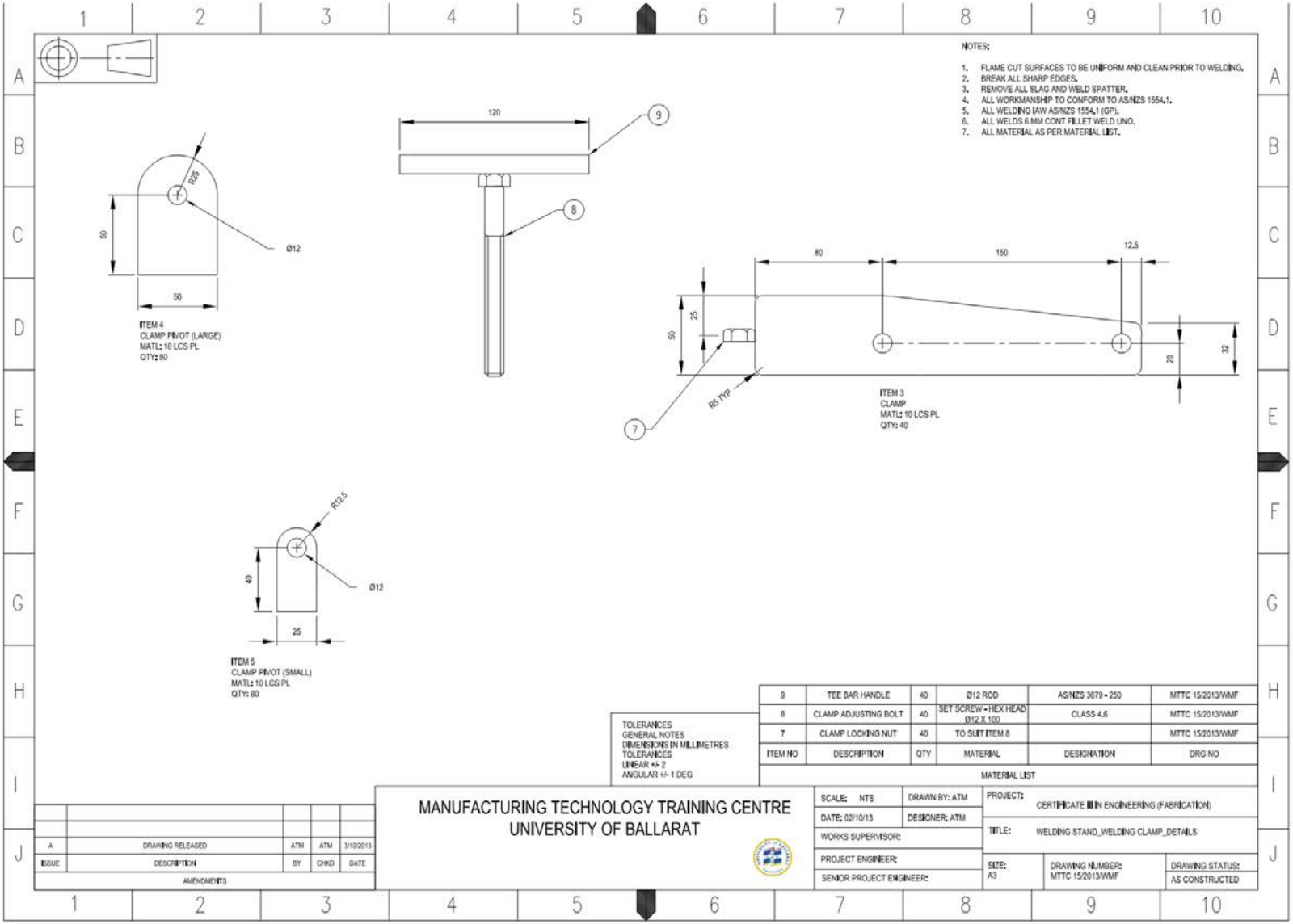

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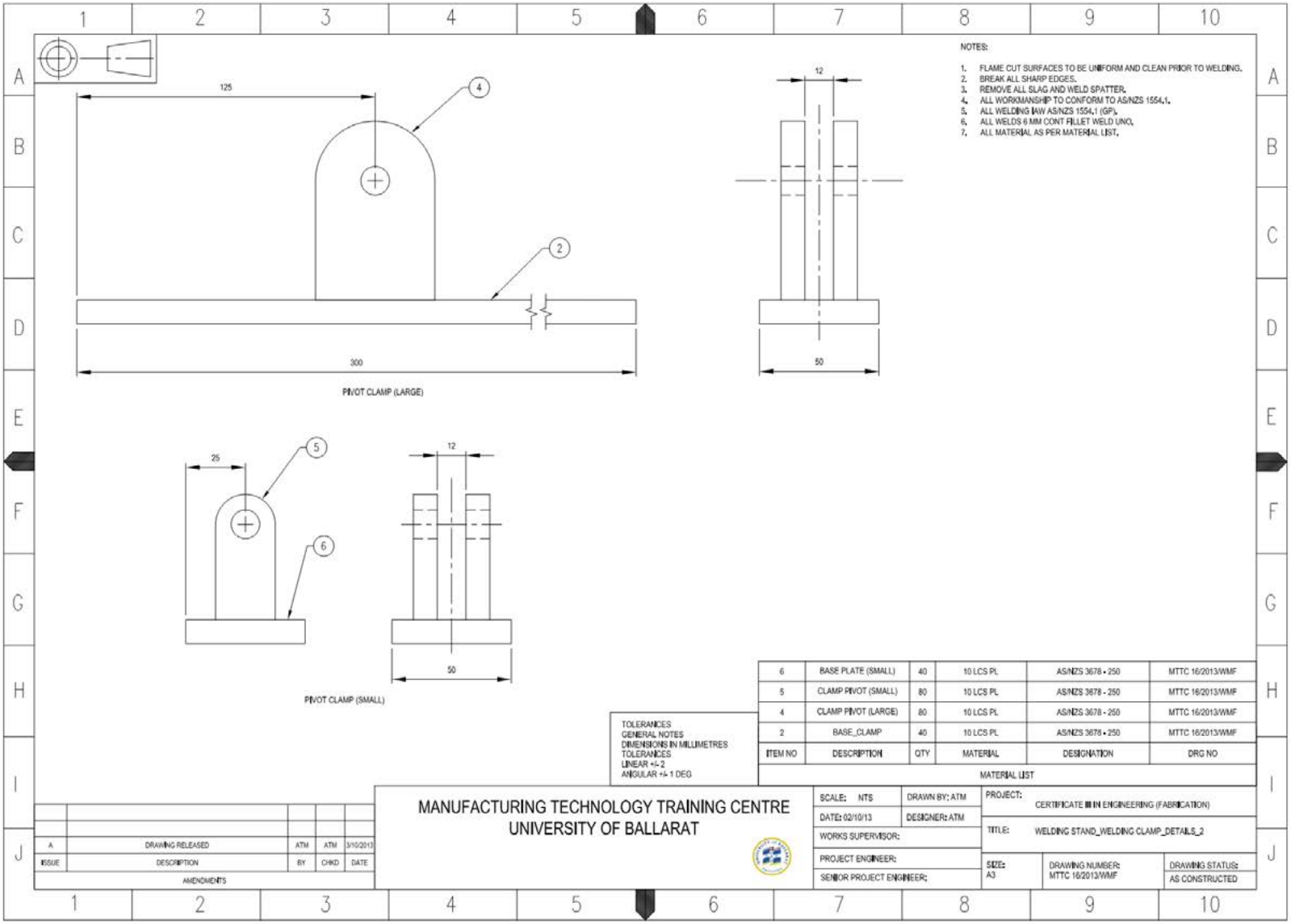

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A.3 WELDING STAND DRAWINGS

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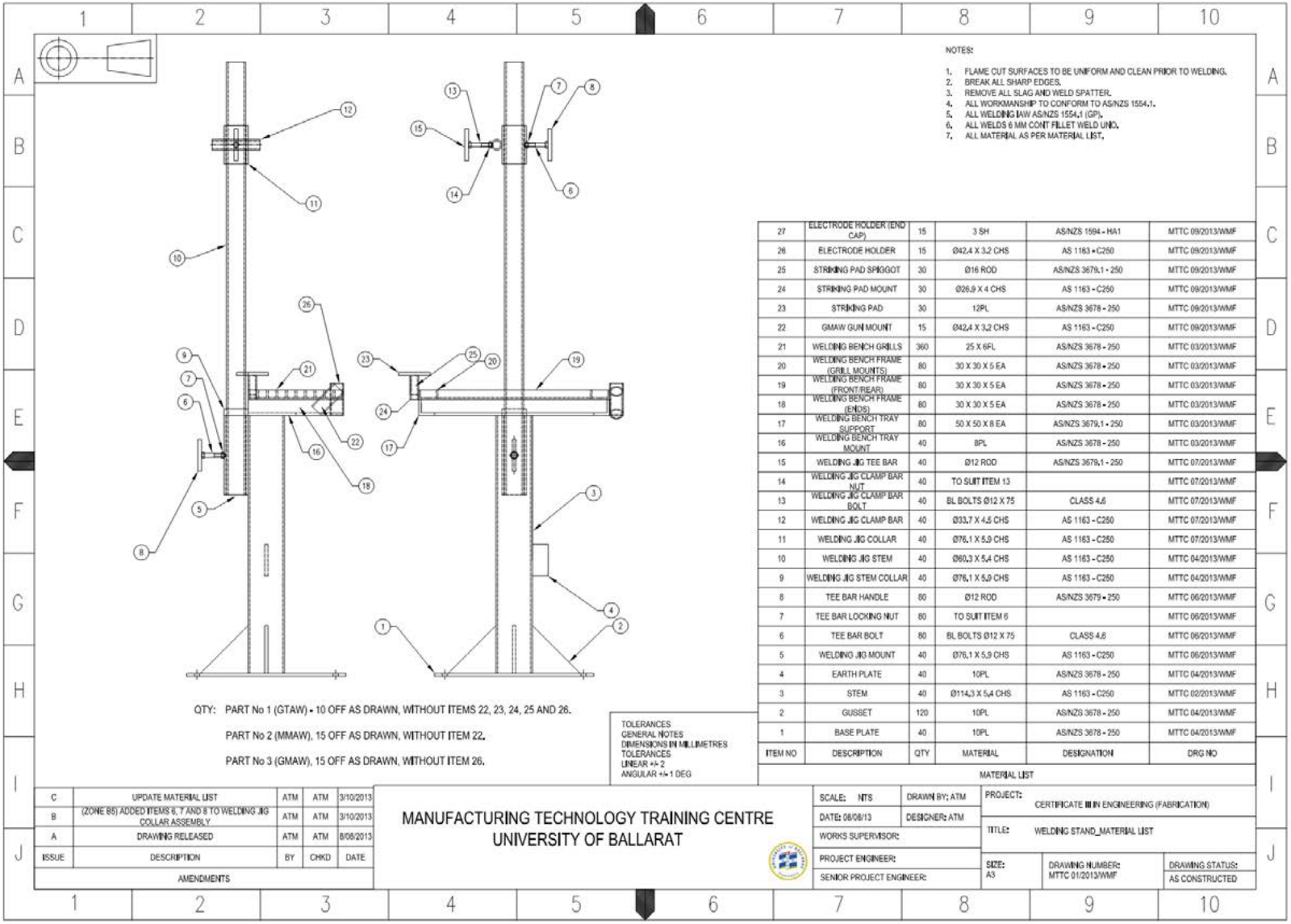

NOTES:

1. FLAME CUT SURFACES TO BE UNIFORM AND CLEAN PRIOR TO WELDING.
2. BREAK ALL SHARP EDGES.
3. REMOVE ALL SLAG AND WELD SPATTER.
4. ALL WORKMANSHIP TO CONFORM TO AS/NZS 1554.1.
5. ALL WELDING IAW AS/NZS 1554.1 (GP).
6. ALL WELDS 6 MM CONT FILLET WELD UNO.
7. ALL MATERIAL AS PER MATERIAL LIST.

ITEM NO	DESCRIPTION	QTY	MATERIAL	DESIGNATION	DRG NO
27	ELECTRODE HOLDER (END CAP)	15	3 SH	AS/NZS 1594 - HA1	MTTC 09/2013/WMF
26	ELECTRODE HOLDER	15	Ø42,4 X 3,2 CHS	AS 1163 - C250	MTTC 09/2013/WMF
25	STRIKING PAD SPIGGOT	30	Ø16 ROD	AS/NZS 3679,1 - 250	MTTC 09/2013/WMF
24	STRIKING PAD MOUNT	30	Ø26,9 X 4 CHS	AS 1163 - C250	MTTC 09/2013/WMF
23	STRIKING PAD	30	12PL	AS/NZS 3678 - 250	MTTC 09/2013/WMF
22	GMAW GUN MOUNT	15	Ø42,4 X 3,2 CHS	AS 1163 - C250	MTTC 09/2013/WMF
21	WELDING BENCH GRILLS	360	25 X 6FL	AS/NZS 3678 - 250	MTTC 03/2013/WMF
20	WELDING BENCH FRAME (GRILL MOUNTS)	80	30 X 30 X 5 EA	AS/NZS 3678 - 250	MTTC 03/2013/WMF
19	WELDING BENCH FRAME (FRONT/REAR)	80	30 X 30 X 5 EA	AS/NZS 3678 - 250	MTTC 03/2013/WMF
18	WELDING BENCH FRAME (ENDS)	80	30 X 30 X 5 EA	AS/NZS 3678 - 250	MTTC 03/2013/WMF
17	WELDING BENCH TRAY SUPPORT	80	50 X 50 X 8 EA	AS/NZS 3679,1 - 250	MTTC 03/2013/WMF
16	WELDING BENCH TRAY MOUNT	40	8PL	AS/NZS 3678 - 250	MTTC 03/2013/WMF
15	WELDING JIG TEE BAR	40	Ø12 ROD	AS/NZS 3679,1 - 250	MTTC 07/2013/WMF
14	WELDING JIG CLAMP BAR NUT	40	TO SUIT ITEM 13		MTTC 07/2013/WMF
13	WELDING JIG CLAMP BAR BOLT	40	BL BOLTS Ø12 X 75	CLASS 4.6	MTTC 07/2013/WMF
12	WELDING JIG CLAMP BAR	40	Ø33,7 X 4,5 CHS	AS 1163 - C250	MTTC 07/2013/WMF
11	WELDING JIG COLLAR	40	Ø76,1 X 5,9 CHS	AS 1163 - C250	MTTC 07/2013/WMF
10	WELDING JIG STEM	40	Ø60,3 X 5,4 CHS	AS 1163 - C250	MTTC 04/2013/WMF
9	WELDING JIG STEM COLLAR	40	Ø76,1 X 5,9 CHS	AS 1163 - C250	MTTC 04/2013/WMF
8	TEE BAR HANDLE	80	Ø12 ROD	AS/NZS 3679 - 250	MTTC 06/2013/WMF
7	TEE BAR LOCKING NUT	80	TO SUIT ITEM 6		MTTC 06/2013/WMF
6	TEE BAR BOLT	80	BL BOLTS Ø12 X 75	CLASS 4.6	MTTC 06/2013/WMF
5	WELDING JIG MOUNT	40	Ø76,1 X 5,9 CHS	AS 1163 - C250	MTTC 06/2013/WMF
4	EARTH PLATE	40	10PL	AS/NZS 3678 - 250	MTTC 04/2013/WMF
3	STEM	40	Ø114,3 X 5,4 CHS	AS 1163 - C250	MTTC 02/2013/WMF
2	GUSSET	120	10PL	AS/NZS 3678 - 250	MTTC 04/2013/WMF
1	BASE PLATE	40	10PL	AS/NZS 3678 - 250	MTTC 04/2013/WMF

MATERIAL LIST

QTY: PART No 1 (GTAW) - 10 OFF AS DRAWN, WITHOUT ITEMS 22, 23, 24, 25 AND 26.

PART No 2 (MMAW), 15 OFF AS DRAWN, WITHOUT ITEM 22.

PART No 3 (GMAW), 15 OFF AS DRAWN, WITHOUT ITEM 26.

TOLERANCES
GENERAL NOTES
DIMENSIONS IN MILLIMETRES
TOLERANCES
LINEAR +/- 2
ANGULAR +/- 1 DEG

ISSUE	DESCRIPTION	BY	CHKD	DATE
C	UPDATE MATERIAL LIST	ATM	ATM	3/10/2013
B	(ZONE B5) ADDED ITEMS 6, 7 AND 8 TO WELDING JIG COLLAR ASSEMBLY	ATM	ATM	3/10/2013
A	DRAWING RELEASED	ATM	ATM	8/08/2013

AMENDMENTS

MANUFACTURING TECHNOLOGY TRAINING CENTRE
UNIVERSITY OF BALLARAT

SCALE: NTS | DRAWN BY: ATM
DATE: 08/08/13 | DESIGNER: ATM
WORKS SUPERVISOR:
PROJECT ENGINEER:
SENIOR PROJECT ENGINEER:

PROJECT: CERTIFICATE III IN ENGINEERING (FABRICATION)
TITLE: WELDING STAND_MATERIAL LIST
SIZE: A3
DRAWING NUMBER: MTTC 01/2013/WMF
DRAWING STATUS: AS CONSTRUCTED

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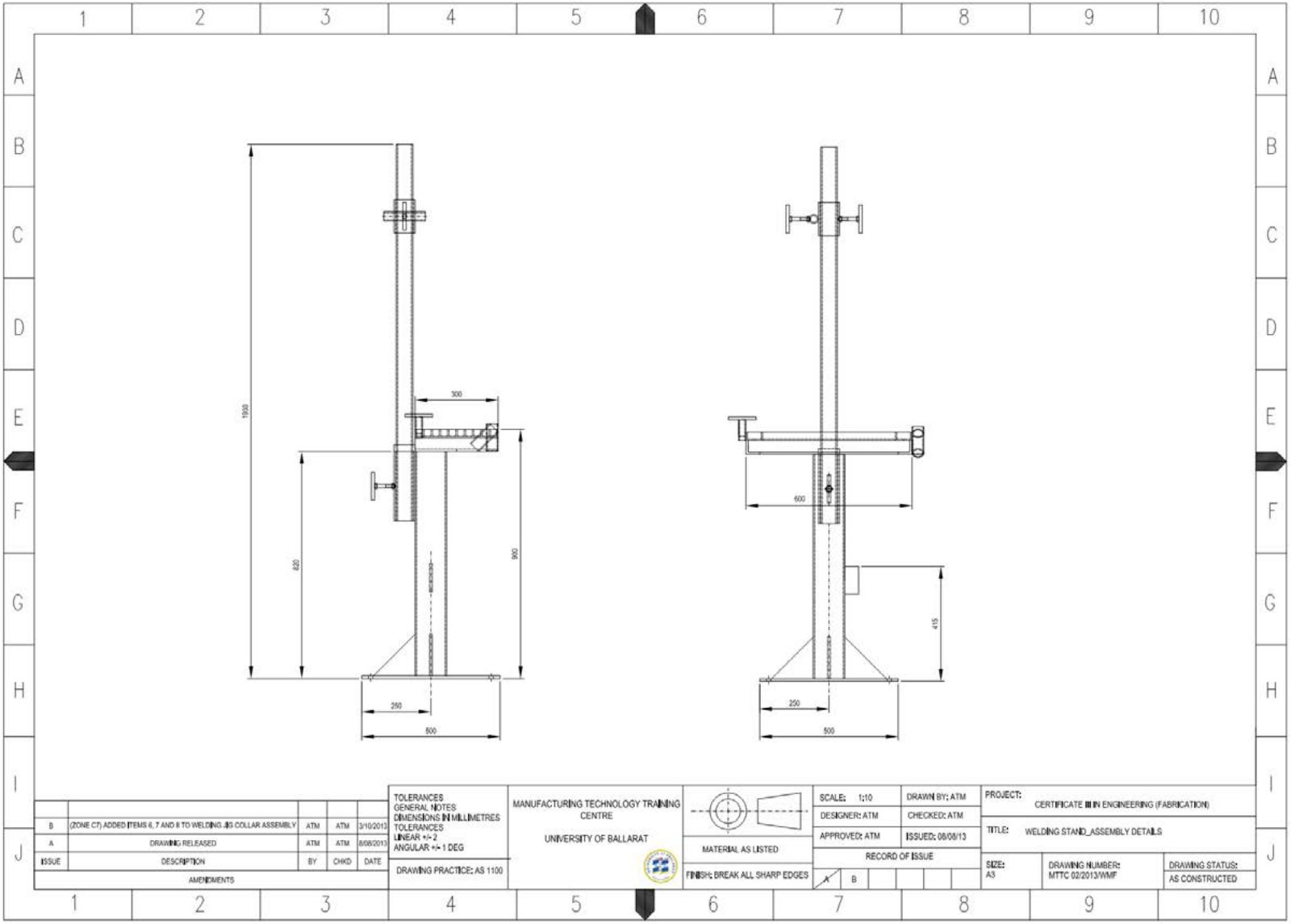
A.3 WELDING STAND DRAWINGS



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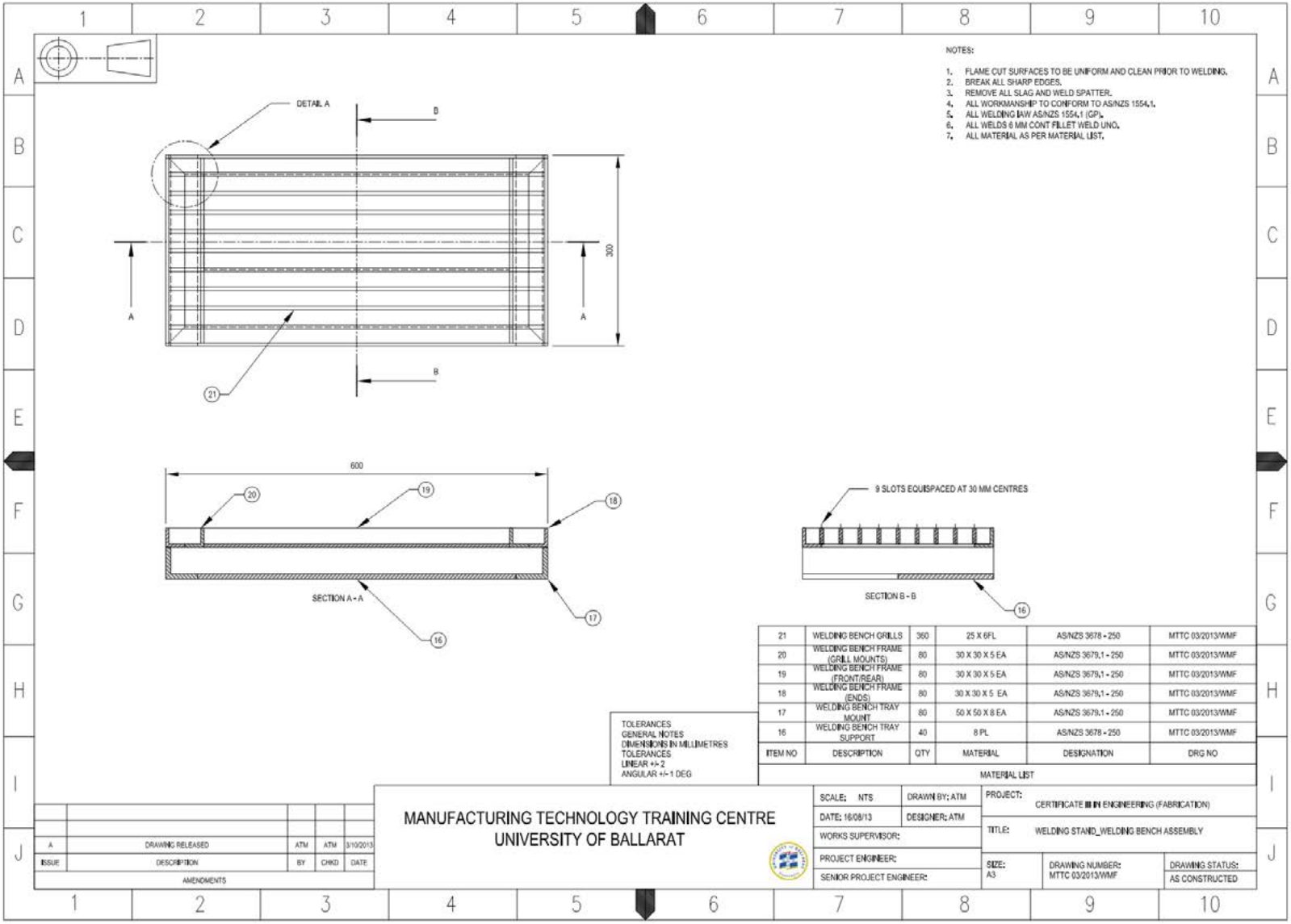

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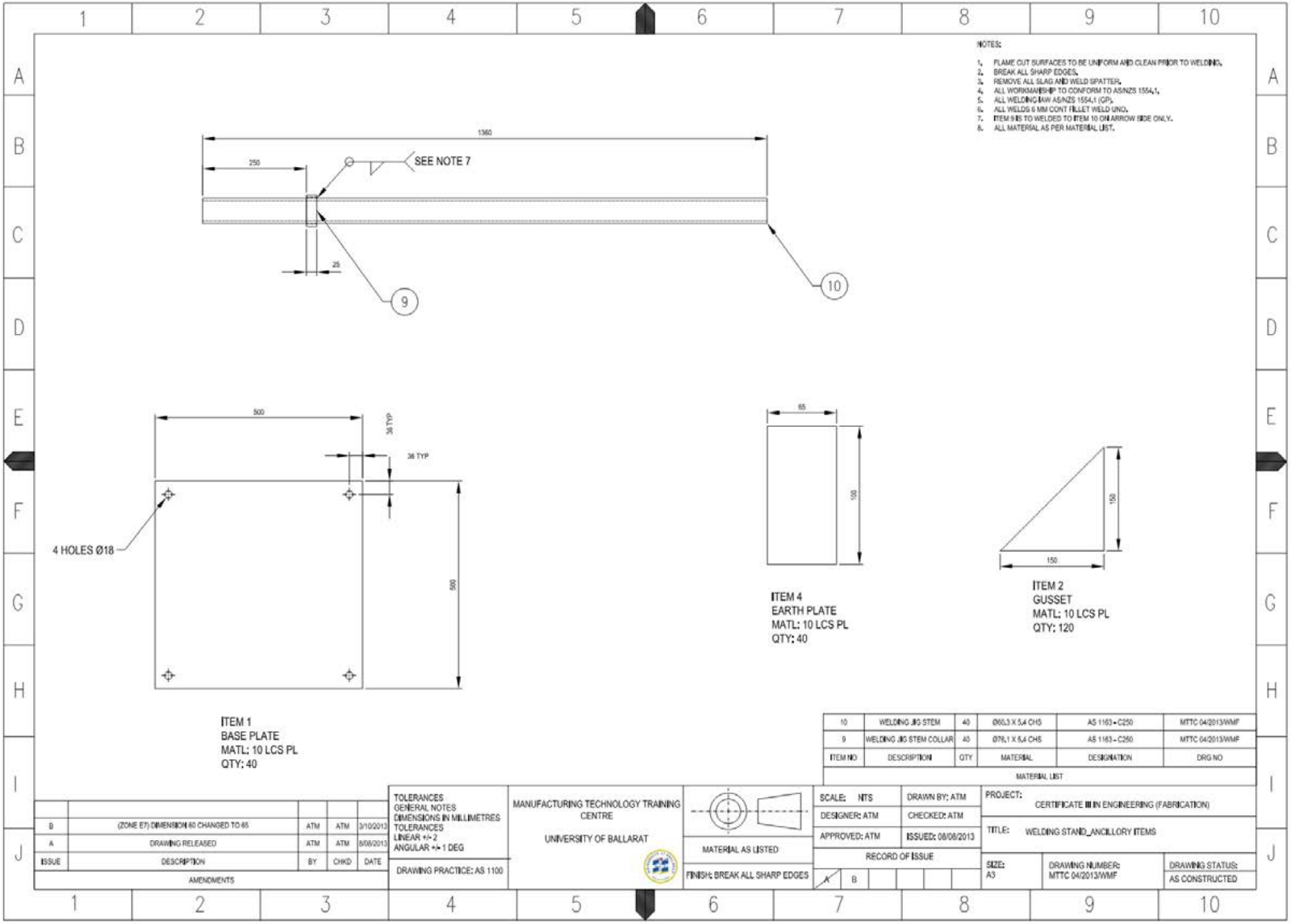

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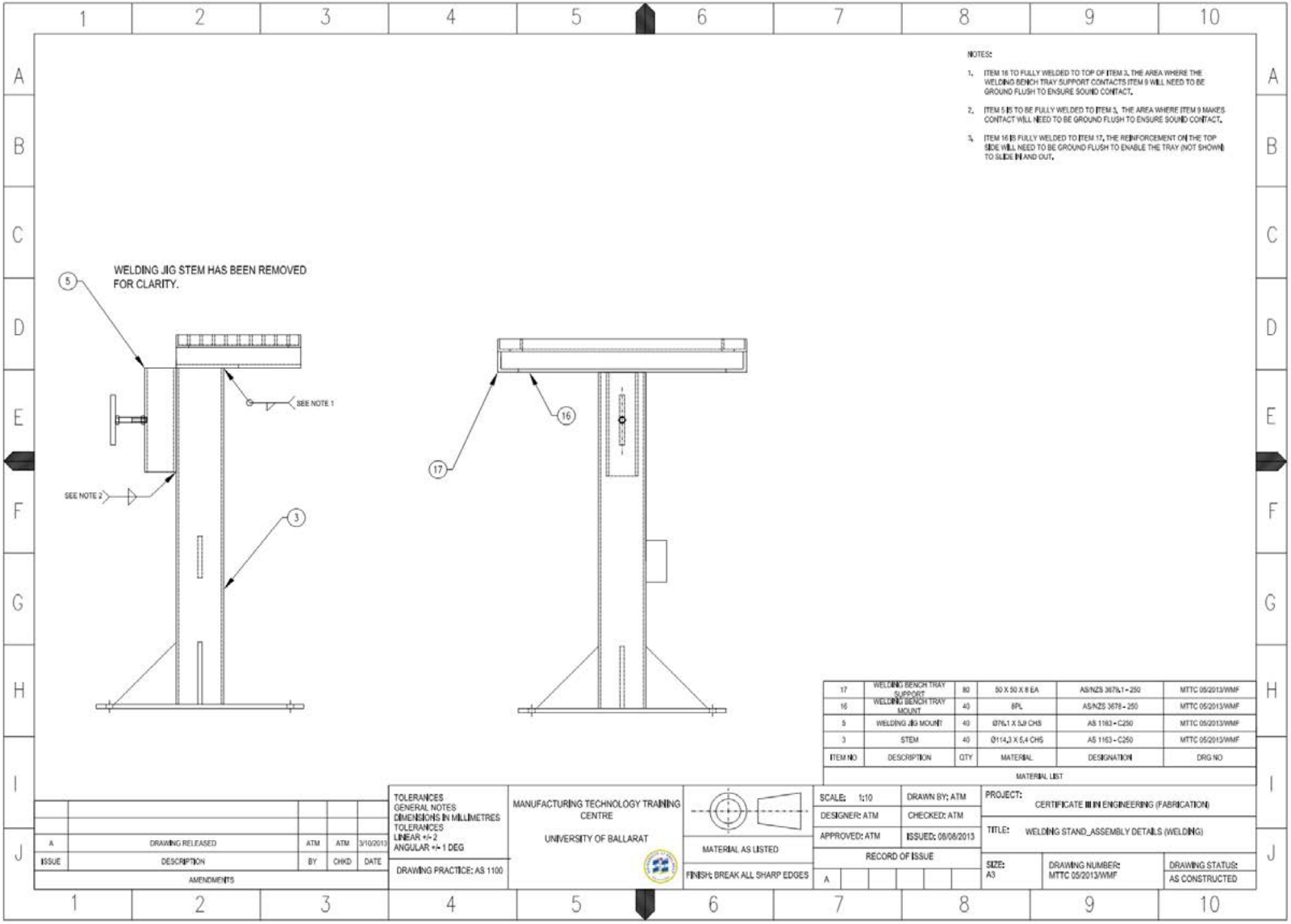

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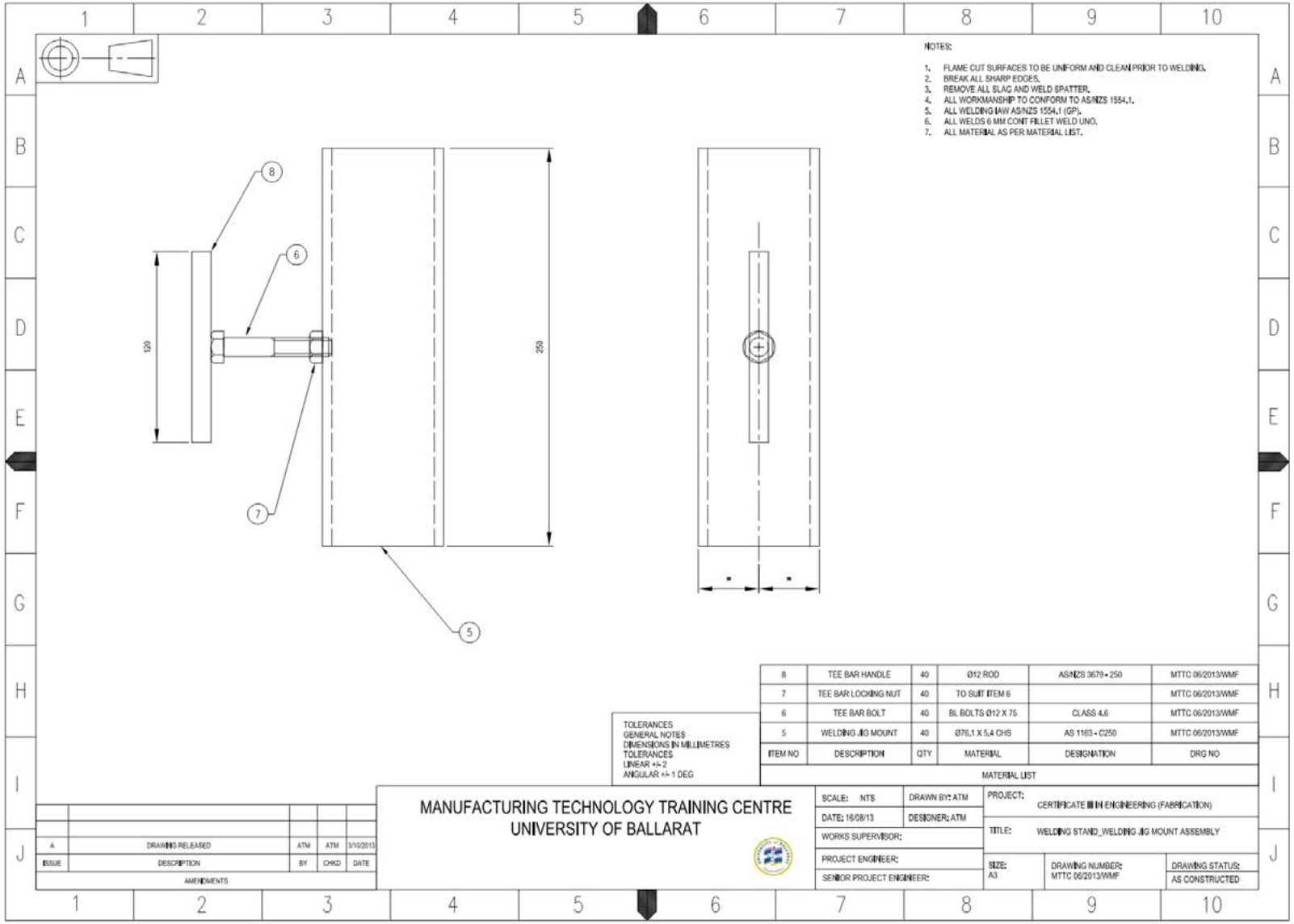

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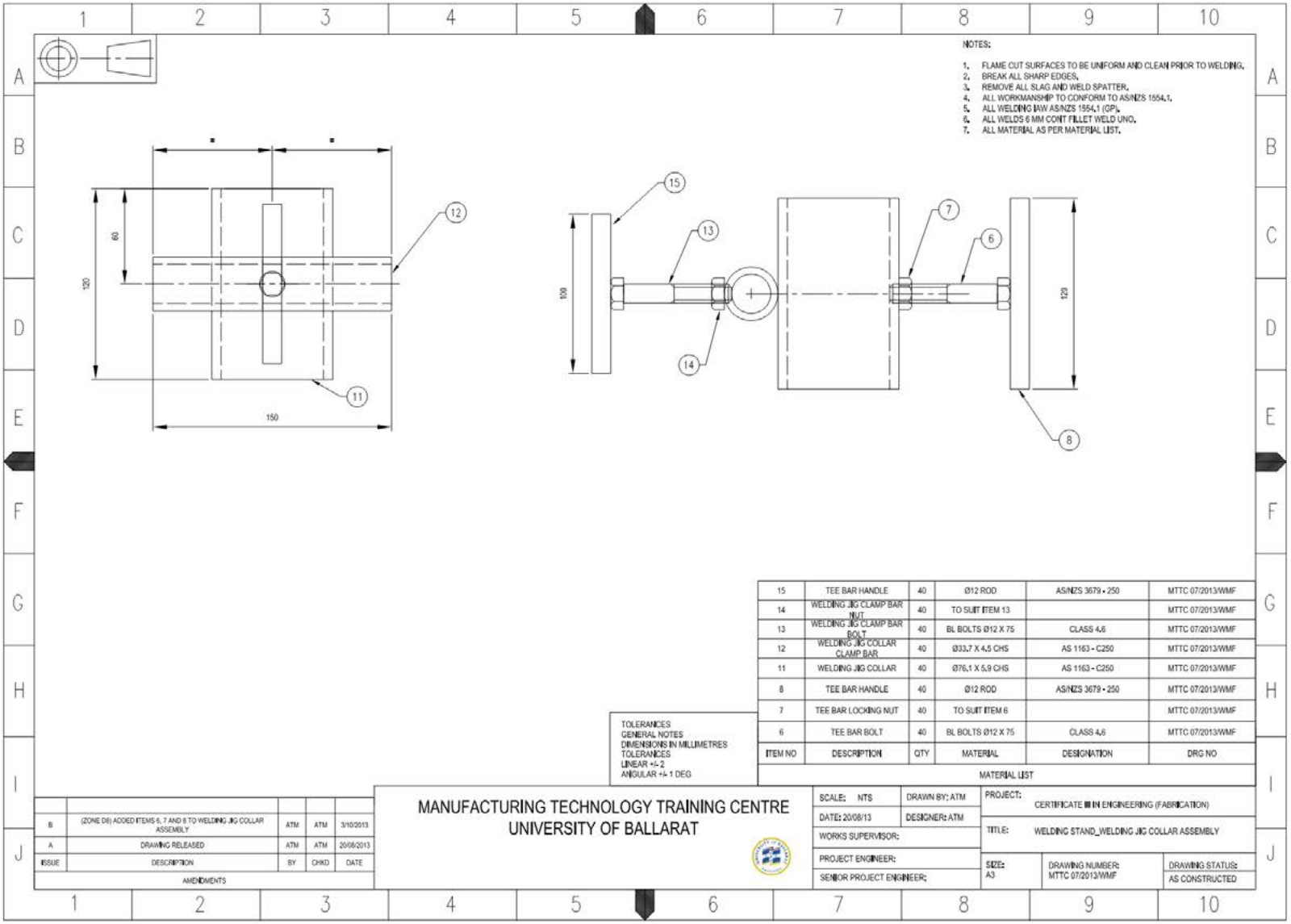

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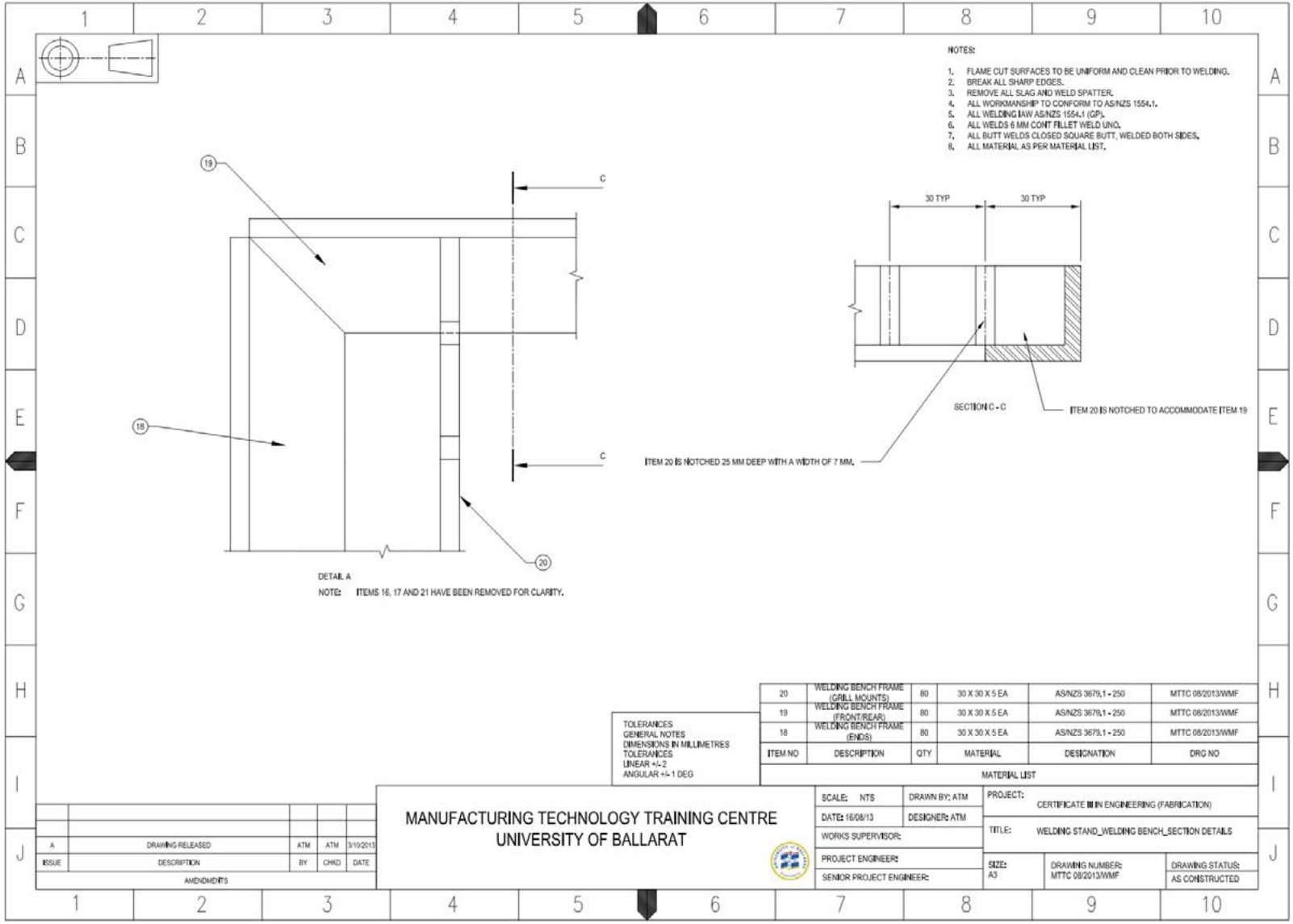

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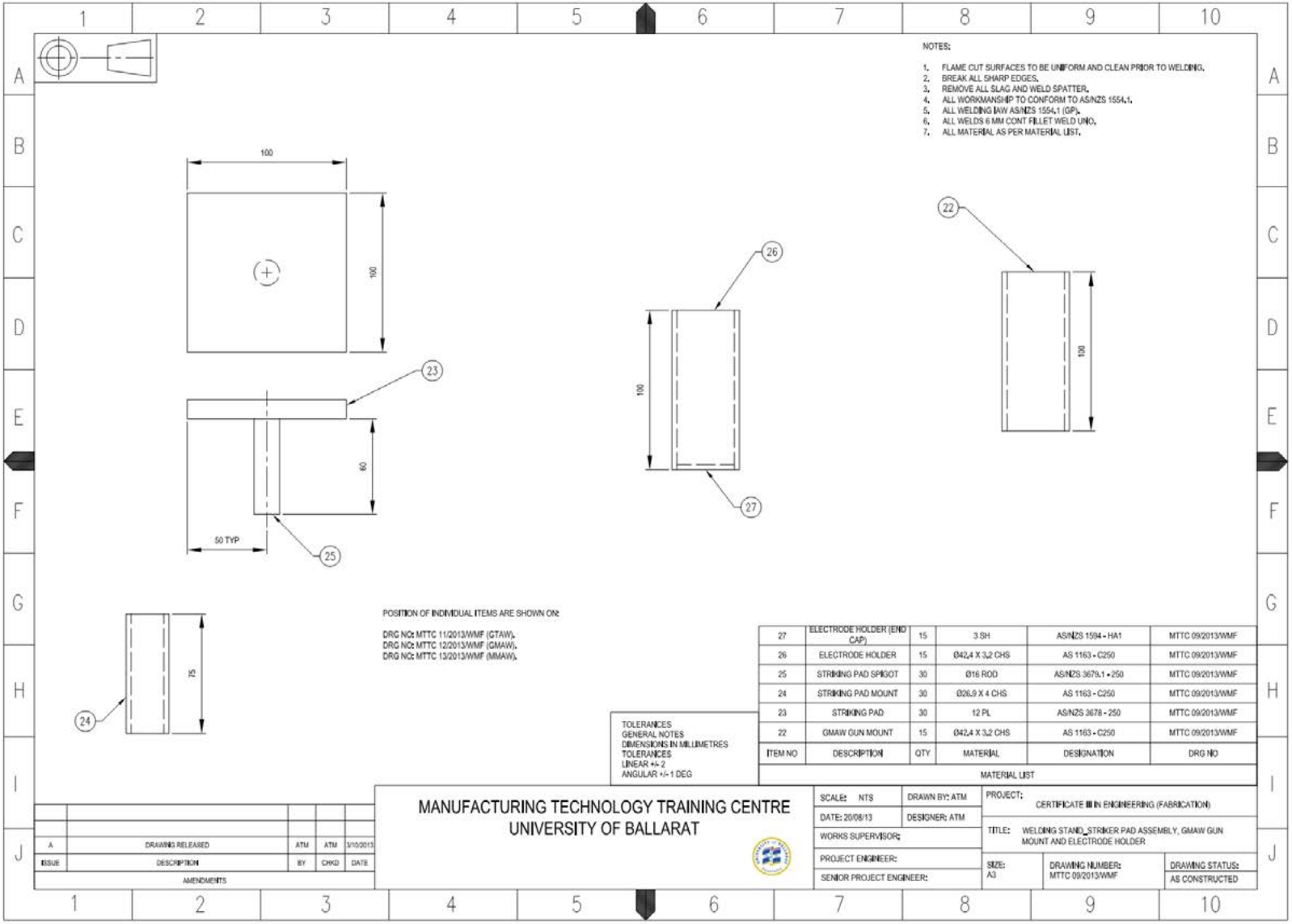

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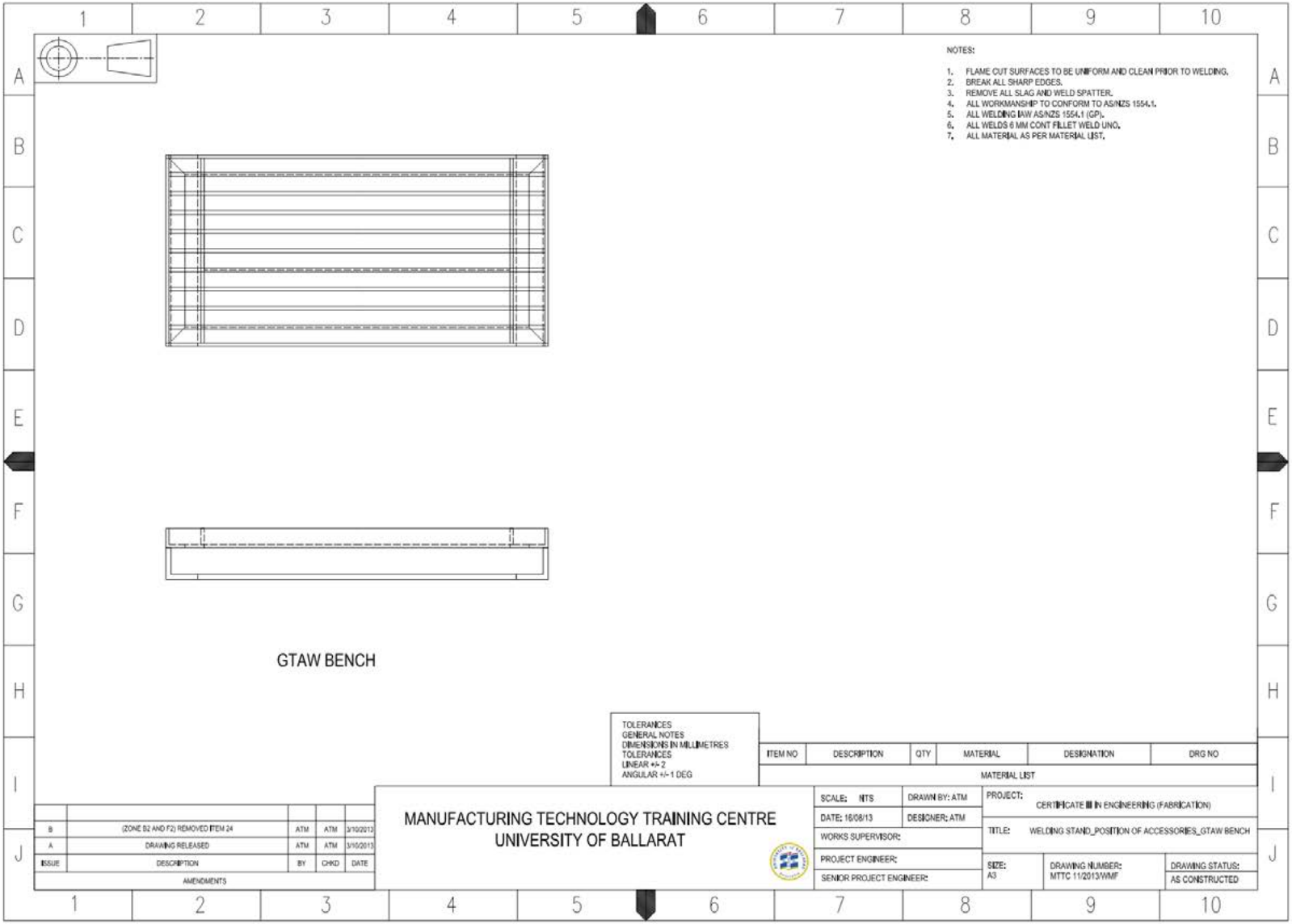

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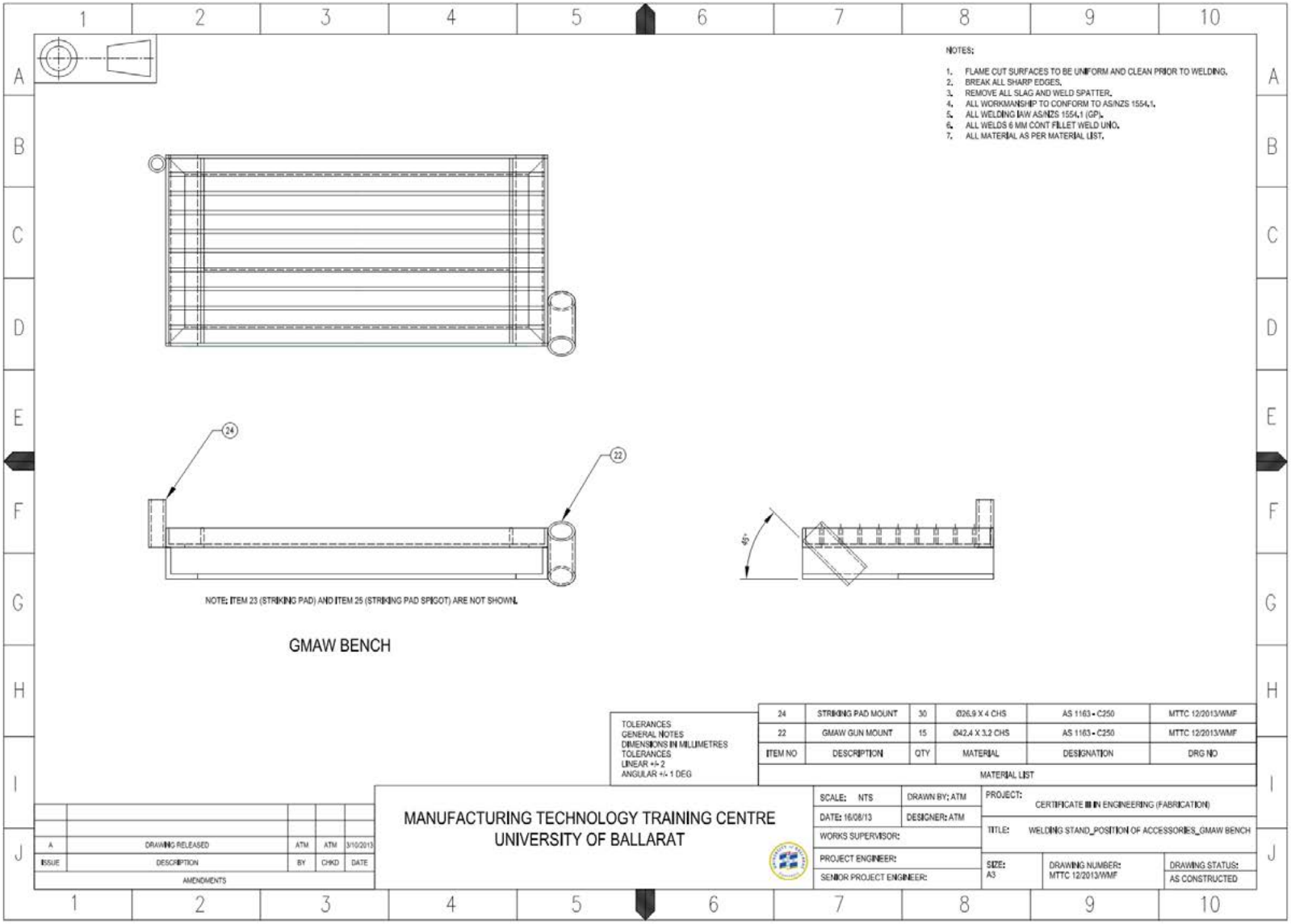

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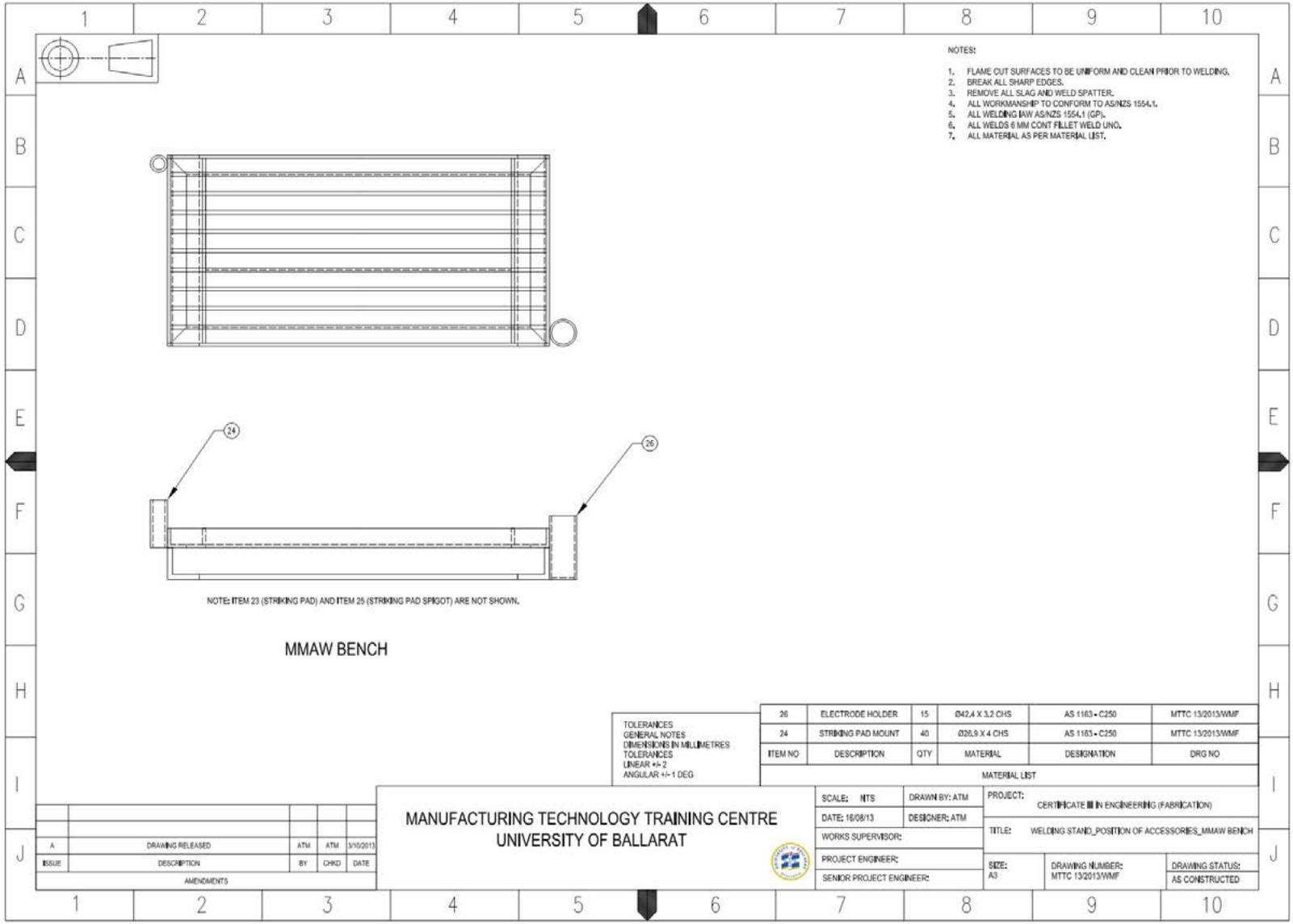

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A.4 WELDING TRAY DRAWING

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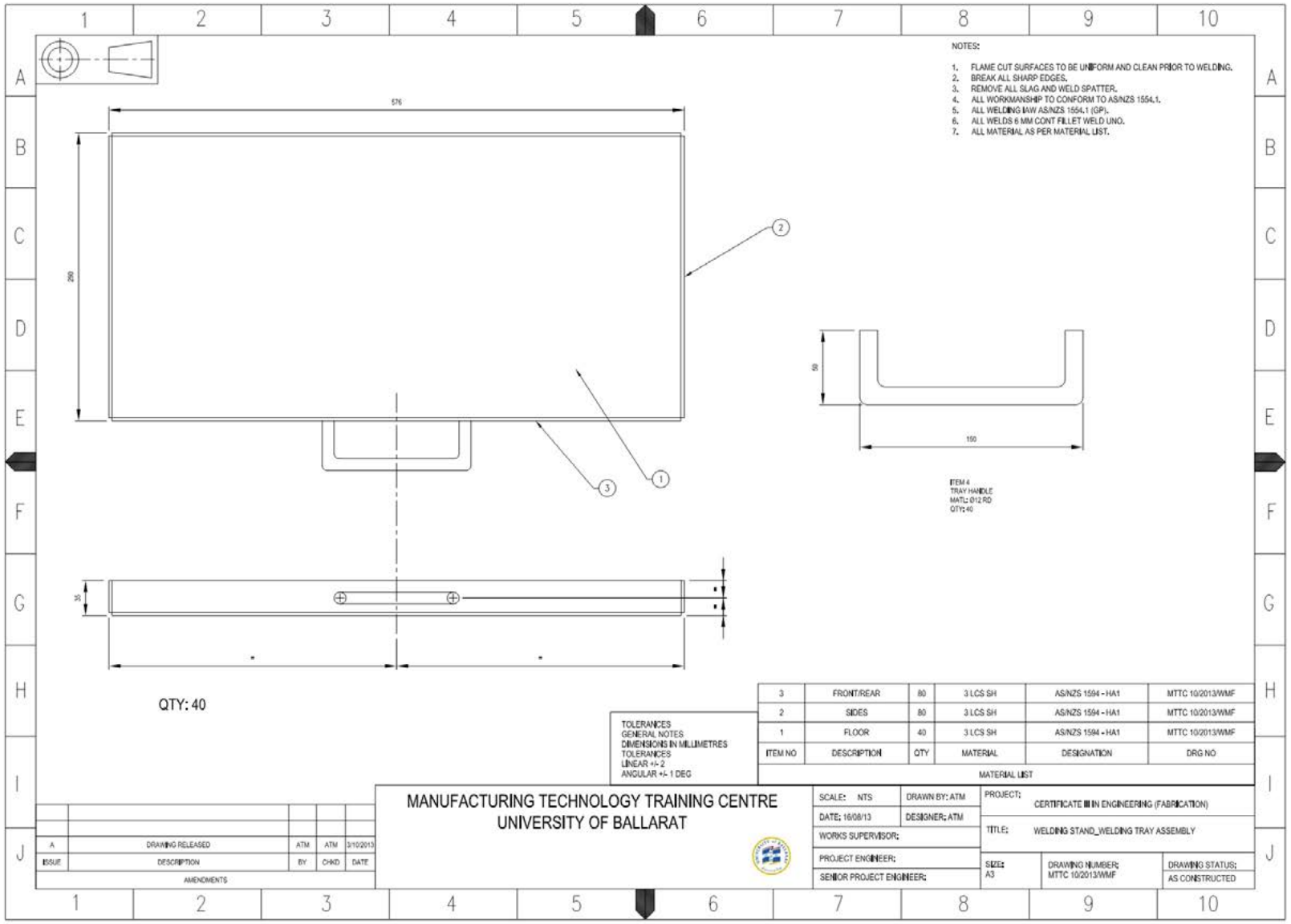

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