Civil Service Commission Appeal

Applicant Name:	Ruben Flores
Current Position and Grade:	Capital Projects Inspector GS 053
Position and Grade Applying For:	Engineering Lead Technician GS 057
Exam Plan:	13815-0325

Reason for Disqualification:
Applicant does not have the required education for this position.

Minimum Qualifications:

Education and Experience: An Associate's Degree in Engineering or Drafting Technology, or a closely related physical science field, plus four (4) years increasingly responsible para-professional engineering experience including one (1) year of lead or supervisory experience; or 30 hours of college credits in Engineering, Drafting Technology or a closely related physical science field and (8) eight years of construction or engineering related experience including one (1) year of lead or supervisory experience.

Licenses and Certificates: Some positions may require a Texas Class "C" Driver's License or equivalent from another state by time of appointment.

Applicant Qualifications:

Education: GED

Experience:	Supervisor/Sub-Contractor	04/1994 – 07/1998	4 yrs 3 mos
	General Maintenance Worker	05/2016 – 06/2024	8 yrs 1 mo
	Capital Projects Inspector	11/2024 – Date of app	0 yrs 4 mos

Comments:

Mr. Flores does not have an Associate's degree in Engineering or Drafting Technology, or a closely related physical science field. Because he does not have an Associate's degree, to qualify for this position, he needs 30 hours of college credits in Engineering, Drafting Technology or a closely related physical science field and (8) eight years of construction or engineering related experience including one (1) year of lead or supervisory experience.

Mr. Flores meets the experience requirements. He does not meet the education requirements. The transcript provided does not include any college credit hours related to engineering, drafting technology, or a closely related field.

Applicant provided additional information regarding welding certification, please refer to **Attachment C.**

Applicable City Rules and Policies:

Ordinance 8065 – Civil Service Commission Rule 5, Section 1 (a). **(Please refer to Attachment A)**

Application and Appeals Policy **(Please refer to Attachment B)**

Prepared By: Jennifer Fulmer
Reviewed By: Karla Mora
HR-HCM Review: Erica Salamanca Date: 04/22/2025

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Civil Service Commission Appeal

Recruitment Factsheet

Exam Plan Title: **Engineering Lead Technician 13815-0325**

Recruiting Department: **Environmental Services**

Total Applications Rec'd/took the Exam:	**29**
# of Internal Applicants:	9
# of External Applicants:	20
Total # of Applicants who failed the Exam (supplemental questions):	**9**
Lacked Education:	2
Lacked Experience:	7
Lacked Ed & Exp:	0
Other:	0
Total # of Applicants who failed the application review	**16**
Lacked Education:	0
Lacked Experience:	11
Lacked Ed. & Exp.:	5
Other:	0
Total # of Applicants who passed the application review	**4**
Qualified City Employees:	2
Qualified External Applicants:	2

Rev. 07/18/2024

Appeal Form

To Whom It May Concern:

I, Ruben Flores **, hereby appeal my disqualification to take the examination for:** Engineer Lead Technician **[Examination Title]**

Date notified of disqualification: 3/28/2025

Disqualified Under CIVIL SERVICE RULE (C.S.C.) and/or HUMAN RESOURCES (HR) POLICY: Check all boxes that are applicable.

Lacks Minimum Qualification – Rule 5.1.(a) [x] Convicted of a felony, or a misdemeanor – Rule 5.1.(b) [ ]
Human Resources Policy: Dismissed from Public Service [ ] Dismissed from City Employment [ ]
OTHER [ ] _____(write specific C.S.C. Rule or HR Policy you are appealing)

C.S.C. Rule 5.1.(a) Applicant Does Not Meet Minimum Qualification	YES	NO
Do you meet the educational requirements as stated in the job specification for this position?	[x]	[ ]
Can you provide official proof of Education or other requirements, official transcripts, original or certified copies of diplomas?	[x]	[ ]
Do you meet the minimum required experience as stated in the job specification for this position?	[x]	[ ]
Did you list your education and/or experience on your application?	[x]	[ ]

Detail your qualifying experience (use additional paper if necessary)

I provided my El Paso Community College official transcripts along with my Combination Welder Certificate.
The education and training I received is a closely related science field and meets the minimum requirements that are specified on the Engineer Lead Technician job posting education requirements.
The only thing in question on this appeal is my education. I am requesting for CSC to afford me an opportunity to elaborate more on my education in person.

C.S.C. Rule 5.1.(b) Conviction of Felony or Misdemeanor	YES	NO
Is your conviction job related to the position sought?	[ ]	[ ]
Will the conviction hinder your ability to perform the duties of this position?	[ ]	[ ]

Please detail why your conviction will not affect your job performance. Please submit any supporting documentation regarding this issue.

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HR Policy: Dismissed from Public Service HR Policy: Dismissed from City Employment	YES	NO
Are the circumstances of your dismissal related to the duties of the position being sought?	☐	☐

Please detail the circumstances involving your dismissal from public service. Please provide any supporting documentation regarding this issue.

Other _____ (cite specific Rule or HR Policy you are appealing).

Please explain what you are appealing

Name: Ruben Flores **Address:** [redacted] **City/State/Zip** El Paso, Tx. [redacted]

Telephone: [redacted] **Person ID #:** [redacted] **(Neogov)**

Stamp

Applicant Signature: Ruben Flores **Date:** 4/01/2025

Received by CSC

Please note: In accordance with the Texas Public Information Act, information from your application and/or résumé is subject to release to the public.

The electronic transmission of this appeal form via e-mail will constitute a signature:

Check signifies electronic signature ☒

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SUPPLEMENTARY WORK EXPERIENCE

City of El Paso
300 N. Campbell, 1st Floor, El Paso, TX 79901
915-212-0045
http://www.elpasotexas.gov

NAME:(Last, First, Middle)	Person ID#	SS #: (last 4 digits)
Flores, Ruben	[redacted]	[redacted]

Additional experience for the position of : Engineer Lead Technician

WORK EXPERIENCE

DATES:	EMPLOYER:	PHONE NUMBER:
From: 11-18-25 To: Present	City Of El Paso	915-212-0045

ADDRESS:(Street, City, State, Zip Code)
7969 San Paulo El Paso, Tx. 79907

POSITION TITLE:	SUPERVISOR:
Capital Projects Inspector	Sebastian Viramontes

HOURS PER WEEK:	SALARY:	MAY WE CONTACT THIS EMPLOYER?
40	21.47 hr	[X] Yes [ ] No

DUTIES:
Conduct detailed inspections of construction projects, including buildings, streets, and drainage improvements, to ensure compliance with technical specifications, safety regulations, and environmental laws.
Review and analyze engineering designs and construction plans to verify adherence to specifications, codes, and ordinances.
Supervise a team of contractor workers assign to the job site, provide guidance, and evaluate performance. Ensure a safe and efficient work environment.
Identify technical issues or discrepancies on construction sites and work with contractors to resolve problems, ensuring projects stay on track and within specifications.
Oversee the City's safety programs, ensuring all projects comply with safety regulations. Respond to hazardous material incidents and environmental concerns on construction sites.
Participate on construction methods, safety protocols, and regulatory compliance.
Prepare and present technical reports, inspection results, and safety recommendations to management and contractors.
Monitor the progress of construction projects, ensuring timely completion and compliance with all contractual and regulatory requirements.
Assist in managing public works projects by ensuring construction documentation is accurate, tracking project statuses, and reviewing contractor proposals, pay estimates, and invoices.
Regularly meet with management to discuss all projects covering progress, and safety to ensure all relevant laws, ordinances, and codes, and recommend corrective actions when necessary.
Conduct investigations into technical or property-related issues reviewing plats and plans to ensure survey measurements coincide.
Perform inspections in a field environment, dealing with adverse weather, rough terrain, and hazardous materials, ensuring safety and regulatory compliance at all times.

REASON FOR LEAVING:
Still employed

Note: I understand that this information will not be added to my original online application and will only be used to further evaluate the position indicated on this form. RF Initials or [ ] check for electronic initials

Signature [signature] Date 3-28-2025

Please note: The electronic transmission of this supplement via e-mail will constitute a signature.

Supplementary Work Experience Form - 1216

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SUPPLEMENTARY WORK EXPERIENCE

City of El Paso
300 N. Campbell, 1st Floor, El Paso, TX 79901
915-212-0045
http://www.elpasotexas.gov

NAME:(Last, First, Middle)	Person ID#	SS #: (last 4 digits)
Flores, Ruben	[redacted]	[redacted]

Additional experience for the position of : Engineer Lead technician

WORK EXPERIENCE

DATES:	EMPLOYER:	PHONE NUMBER:
From: 1992 To: 1994	John Gamertsfelder Land Surveying Co.	Unknown

ADDRESS:(Street, City, State, Zip Code) Castle Town El Paso, Tx. 79925

POSITION TITLE:	SUPERVISOR:
Land Surveyor Helper	John Gamertsfelder

HOURS PER WEEK:	SALARY:	MAY WE CONTACT THIS EMPLOYER?
40	4.25 hr	☒ Yes ☐ No

DUTIES: I was a survey engineer helper; my duties were to assist with the range rod. Gained knowledge in how to examine land plats. Gained experience in obtaining elevation measurements and learned how to navigate in the desert using plats and maps. Gained experience using Theodolite, level and rod. Land surveyed was deep in the deserts of Sierra Blanca and East El Paso.

REASON FOR LEAVING: Owner of company moved to another state.

Note: I understand that this information will not be added to my original online application and will only be used to further evaluate the position indicated on this form. RF Initials or ☒ check for electronic initials

Signature [signature] Date 3-28-2025

Please note: The electronic transmission of this supplement via e-mail will constitute a signature.

SUPPLEMENTARY WORK EXPERIENCE

City of El Paso
300 N. Campbell, 1st Floor, El Paso, TX 79901
915-212-0045
http://www.elpasotexas.gov

NAME:(Last, First, Middle)	Person ID#	SS #: (last 4 digits)
Flores, Ruben	[redacted]	[redacted]

Additional experience for the position of : Engineer Lead Technician

WORK EXPERIENCE

DATES:	EMPLOYER:	PHONE NUMBER:
From: 4/1994 To: 7/1998	Guillermo Lopez Construction	915-275-6871

ADDRESS:(Street, City, State, Zip Code)
Yandell Dr. El Paso Tx. 79907

POSITION TITLE:	SUPERVISOR:
Supervisor/ Sub-contractor	Guillermo Lopez

HOURS PER WEEK:	SALARY:	MAY WE CONTACT THIS EMPLOYER?
40	$70,000	☒ Yes ☐ No

DUTIES:

As a Construction Supervisor and Contractor, I reviewed and analyzed project plans, forecasting project durations and coordinating material procurement to ensure timely and efficient project execution. I generated and followed detailed blueprint specifications for building remodeling and welding projects, ensuring compliance with building codes and regulations. I built and installed various structures while supervising a team of employees performing diverse labor duties, ensuring adherence to project specifications and high-quality standards. Throughout the projects, I was involved in plan modifications, identifying innovative solutions for improving efficiency and meeting client needs. I prepared accurate estimates and proposals, providing clients with detailed cost projections and timelines. Additionally, I trained employees on the proper use of equipment and new construction methods, while managing daily job site operations, delegating tasks, and conducting morning safety meetings to ensure adherence to safety protocols. I closely monitored project progress to ensure deadlines were met and construction standards were maintained. This role allowed me to gain extensive experience in plan generation and review, project estimation, safety procedures, and hazardous material handling. Key projects included concrete placement, asphalt/concrete driveways, manufacturing of steel trusses, stairways, and steel stair railings.

REASON FOR LEAVING: Construction company closed.

Note: I understand that this information will not be added to my original online application and will only be used to further evaluate the position indicated on this form. RF Initials or ☒ check for electronic initials

Signature [signature] Date 3-28-2025

Please note: The electronic transmission of this supplement via e-mail will constitute a signature.

Supplementary Work Experience Form - 1216

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SSN: *****[redacted] Student No: 88135141 Date of Birth: [redacted]

Date Issued: 28-JAN-2025
OFFL

Page: 1

Record of: Ruben Flores
Issued To: Ruben Flores
[redacted]

Course Level: Credit

Current Program
Major : EC-4, 4-8, EC-12

SUBJ	NO.	COURSE TITLE		CRED GRD	PTS R
INSTITUTION CREDIT:					
Spring 95					
BASK	3006	COLLEGE PREP MATH	(M)	3.00 NC	0.00
BASK	3022	BASIC READING	(M)	3.00 CR	0.00
PSYC	3101	INTRO TO PSYCHOLOGY (C)		3.00 D	3.00
Ehrs: 6.00 GPA-Hrs: 3.00 QPts: 3.00 GPA: 1.00					
Good Standing					
Spring 96					
BASK	3003	WRITING (M)		3.00 W	0.00
BASK	3006	COLLEGE PREP MATH	(M)	3.00 W	0.00
BASK	3023	COLLEGE PREP READING	(M)	3.00 W	0.00
CISC	3109	INTRO TO COMP PROGRAM		3.00 F	0.00
Ehrs: 0.00 GPA-Hrs: 3.00 QPts: 0.00 GPA: 0.00					
Academic Probation					
Spring 98					
BASK	3003	WRITING (M)		3.00 W	0.00
BASK	3006	COLLEGE PREP MATH	(M)	3.00 W	0.00
BASK	3023	COLLEGE PREP READING	(M)	3.00 W	0.00
Ehrs: 0.00 GPA-Hrs: 0.00 QPts: 0.00 GPA: 0.00					
Academic Probation					
Spring 2006					
EDUC	1300	MASTER ACADEMIC EXCELLENCE (C)		3.00 A	12.00
READ	0309	EFFECTIVE COLLEGE READING (M)		3.00 B*	9.00
Ehrs: 6.00 GPA-Hrs: 3.00 QPts: 12.00 GPA: 4.00					
Academic Probation					
Summer 2006					
HIST	1301	HIST OF US TO 1865 (C)		3.00 D	3.00
HIST	1302	HIST OF US SINCE 1865 (C)		3.00 C	6.00
********** CONTINUED ON NEXT COLUMN **********					

SUBJ	NO.	COURSE TITLE		CRED GRD	PTS R
Institution Information continued:					
PSYC	2306	HUMAN SEXUALITY (C)		3.00 B	9.00
Ehrs: 9.00 GPA-Hrs: 9.00 QPts: 18.00 GPA: 2.00					
Academic Probation					
Fall 2006					
GOVT	2305	AMERICAN GOVT & POLITICS (C)		3.00 C	6.00
GOVT	2306	STATE & LOCAL GOVERNMENT (C)		3.00 C	6.00
MATH	0303	INTRODUCTORY ALGEBRA (M)		3.00 W	0.00
SPCH	1315	FUND OF EFFECT SPEECH (CF)		3.00 C	6.00
Ehrs: 9.00 GPA-Hrs: 9.00 QPts: 18.00 GPA: 2.00					
Academic Probation					
Spring 2007					
ARTS	1301	ART APPRECIATION (C)		3.00 F	0.00
GEOL	1301	PRINCIPLES EARTH SCIENCES (C)		3.00 W	0.00
TECA	1354	CHLD GROWTH/DEVELOPMENT		3.00 B	9.00
Ehrs: 3.00 GPA-Hrs: 6.00 QPts: 9.00 GPA: 1.50					
Academic Suspension					

********** TRANSCRIPT TOTALS **********

	Earned Hrs	GPA Hrs	Points	GPA
TOTAL INSTITUTION	33.00	33.00	60.00	1.81
TOTAL TRANSFER	0.00	0.00	0.00	0.00
OVERALL	33.00	33.00	60.00	1.81

CORE CURRICULUM NOT COMPLETE

********** END OF TRANSCRIPT **********

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An official signature is white with a teal background. Reject this document if the signature is distorted.

Cassandra M. Lachica-Chavez, Ph.D
Executive Director of Admissions and Registrar

Western Technical College

El Paso, Texas

This is to Certify that

Ruben Flores

Has completed all requirements in the certificate program of

Commercial Driver Training ~ 200 hrs.

Issued *December 19,* 20 *18* in witness whereof, signature affixed

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WESTERN TECHNICAL COLLEGE
wt
EL PASO TEXAS

COLLEGE FOR THE REAL WORLD

Program Director

School Director

SEAL

Accredited by The Southern Association of Colleges and Schools
Commission on Occupational Education Institutions

David L. Carrasco Job Corps Center

THIS IS TO CERTIFY THAT

RUBEN FLORES

has satisfactorily completed the COMBINATION WELDER course
(D. O. T. No. 819.384-010) on this 19th day of NOVEMBER, 19 92.

The Student has met the necessary skill performance and general education requirements and is recommended for employment in this occupation and therefore merits this

Diploma

Director, Basic Education

Director, Vocational Training

Deputy Center Director

Center Director

Operated for the U. S. Department of Labor by the Texas Educational Foundation, Inc

Hammond & Stephens Co., Fremont, Nebr

Contact Information -- Person ID: [redacted]

Name:	Ruben Flores	Address:	[redacted] El Paso, Texas [redacted] US
Home Phone:	[redacted]	Alternate Phone:	
Text Messaging Mobile No:		Email:	[redacted]
Former Last Name:		Month and Day of Birth:	[redacted]

Personal Information

Driver's License:	Yes, Texas , [redacted] , Class A
Can you, after employment, submit proof of your legal right to work in the United States?	Yes
What is your highest level of education?	Some College

Preferences

Are you willing to relocate?	No
Types of positions you will accept:	Regular
Types of work you will accept:	Full Time
Types of shifts you will accept:	Day , Weekends , On Call (as needed)

Objective

My objective is to use my experience and knowledge to advance in the work place and help people. Provide excelent customer service. Learn new things to conduct work efficiently.

Education

College/University
El Paso Community College
1/1994 - 1/2007
El Paso, Texas

Did you graduate: No
Major/Minor: Early Childhood Education
Degree Received: No Degree

Professional
David L Carrasco Job Corps
3/1991 - 4/1992
El Paso, Texas

Did you graduate: Yes
Major/Minor: Combination Welder Blueprint Reading
Degree Received: Certification

Work Experience

Capital Projects Inspector
11/2024 - Present

City of El Paso
elpasotexas.gov
7969 San Paulo Dr.
El Paso, Texas 79907
915-212-0045

Hours worked per week: 40
Monthly Salary: $3,435.20
# of Employees Supervised: 10
Name of Supervisor: Jesus Sebastian Viramontes - Engineer Associate
May we contact this employer? Yes

Duties

My duties are to inspect contractor's work and follow contract specifications. Ensure that all safety measures are being adhered to by reviewing TCP and inspecting set up; to include that all contractor employees are wearing their PPE. Review plans of streets and existing surveyed plot plans with engineers and contractors for forecasted job sites. Evaluate streets and identify damaged pavement, damaged concrete and determine what needs to be replaced. Work closely with laboratory companies to ensure quality of products being used. Communicate with contractor to point out discrepancies or to assist in problem solving if and when issues arise. Take note of all daily activities and of incidents if any. Discuss with contractor next day work activities for proper planning.

Constantly use temperature gauges / measuring tools to test and measure material, placement of concrete and asphalt. Inspect elevation markings and determine if elevations need to be corrected for proper onsite ponding or proper water flow for storm drains. Inspect ADA ramps for proper installments and ensure it meets ADA specifications along with contract specifications.
Keep track of contractor activities for proper and correct payouts. Identify materials used and work produced, measure areas worked on and generate itemized sign off reports for contractor payments.
Safety and Quality are part of my duties, by ensuring safety and quality my responsibility is to supervise contractor employees by diligently observing if they are being safe and are producing quality work. Interact with citizens (residents of the area being worked on) and answer any questions or concerns they may have.
Generate daily reports on progress of work, to include observations and next workday plans. These reports are sent to management by E-mail.
Regularly meet with engineers and other inspectors to discuss blueprints and new ideas for efficiency and quality.

Reason for Leaving
I'm still employed with the City of El Paso Streets and Maintenance Department.

Over the road commercial driver
7/2024 - 10/2024

On Line Transport
7180 Copper Queen
El Paso, Texas 79915
915-781-3380

Hours worked per week: 40
Monthly Salary: $4,000.00
# of Employees Supervised: 0
Name of Supervisor: Hilda Castillo - Human Resources
May we contact this employer? Yes

Duties
My duties were to conduct pretrip inspections of the tractor and trailer as well as post trips. Deliver trailer to Michigan, Indiana or Ohio. I worked with a team member and normally weekly miles were about 1,400, on occasions we did drive 6,500.

Reason for Leaving
Looking for better opportunities. To be able to grow in a rewarding position.

General Maintenance Worker
5/2016 - 6/2024

Pride Industries
1733 Pleasanton Rd
Ft Bliss, Texas 79916
915-568-3320

Hours worked per week: 40
Monthly Salary: $3,200.00
# of Employees Supervised: 10
Name of Supervisor: Jesus Garcia - Roads & Grounds Supervisor
May we contact this employer? Yes

Duties
My duties were to manage a team of ten employees to conduct sidewalk, street, curb and gutter repairs. review Roads & Gounds repair service orders and ensure that work to be performed was covered in the scope of the Roads & Grounds maintenance contract. Review road blueprints with management to discuss cost, organize and schedule service orders, plan road closures for road repairs. Worked closely with safety department to plan Traffic Control Protocol using existing survey plans, advise Military police and Fire Department of road closures, scope of work being performed and duration of construction. Contacted Utility services to inform them of excavating sites so that they go and mark underground utility lines. Contact Enviromental services and advise them of job site and work being performed, material being used. I obtained environmental training in HAZMAT transportation, emergency response and containment.
In my position, it was my responsibility to delegate job duties to 10 employees, evaluate performance of each employee monthly. I was assigned 5 laborers and 5 helpers. Conducted morning safety meeting and ensured that employees under me possessed a complete set of PPE, wore it and worked safely throughout the day.
Other duties were to review and follow maintenance contract to include the reviewing of paving, concrete, striping and street signs MUTCD Guidelines to ensure quality of placement and quality of product being used on project. In charge of ordering and purchasing Concrete,

Asphalt and other material to perform the job. Inspect tools and machinery/ schedule maintenance of equipment.
In this position I had the ability to problem solve and modify work plans, after discussing with management, safety department and obtaining their approval of such modifications. It was my responsibility to conduct in process inspections and final inspections, certify completion of road projects.
I used my knowledge and experience to train employees so that they could apply correct methods of performing their job duties. Together we brainstormed and came up with solutions to difficult problems that we encountered.

Reason for Leaving
I wanted to explore the trucking industry. I received training from Western Tech College and obtained my commercial driver license.

Detention Officer
2/2001 - 1/2009

El Paso County Sheriff's Office
3850 Justice St
El Paso, Texas 79938
915-538-2292

Hours worked per week: 40
Monthly Salary: $3,500.00
Name of Supervisor: Lt. Loyda - Jail Annex Lieutenant
May we contact this employer? Yes

Duties
My duties were to maintain facility security and supervise inmates. Conducted head counts, feed, transport inmates to the hospital or to downtown detention facility. During my years there I obtained lots of training in many areas and subjects that are required by the state of Texas.

Reason for Leaving
My wife was starting college and needed help with our kids. I started working for myself as to make my own schedule. I did general maintenance on homes like painting, drywall repairs, also got small contracts with welding. My wife graduated and I went to work for Pride Industries.

Certificates and Licenses

Type: CDL class A

Number: 13167956

Issued by: Texas Department of Public Safety

Date Issued: 2 /2024 Date Expires: 4 /2032

Skills

Office Skills

Typing:
Data Entry:

Languages

Spanish - Speak, Read, Write

Additional Information

Technical

Combination Welder Blueprint reading Certification
Commercial Driver Training certification

Technical

I have the ability to trouble shoot and repair. Ability to calculate materials needed to perform the jobs.
Ability to forecast and schedule work to be performed.
I have the ability to motivate employees and lead by example.
My communication skills are excellent.

References

City of El Paso has chosen not to collect this information for this job posting.

Resume

Text Resume

Attachments

Attachment	File Name	File Type	Created By
Credit hours.pdf	Credit hours.pdf	**Proof of Education**	Job Seeker

Job Code	Current Job Title	Type of Position	Current Grade	FLSA Status	Education Requirement	Experience Requirement	Lead or Supervisory Experience Requirement
	Engineering Support Group						
13810	Engineering Associate	Classified	PM 126	Exempt	BA	0	0
13811	Environmental Team Leader	Classified	PM 126	Exempt	BA	2	
U5440	Contract Compliance Officer	Unclassified	PM 123	Non-Exempt	BA	1	0
13813	Engineering Specialist	Classified	GS 61	Non-Exempt	AA or 60 College Credit Hours	6	0
13815	Engineering Lead Technician	Classified	GS 57	Non-Exempt	AA or 30 College Credit Hours	4 or 8	1
13820	Engineering Senior Technician	Classified	GS 55	Non-Exempt	AA or 30 College Credit Hours	2 or 4	0
13823	Environmental Lead Field Technician	Classified	GS 54	Non-Exempt	AA or 30 College Credit Hours	2 or 4	0
U5460	Computer Aided Design Drafting (CADD) Technician	Unclassified	GS 53	Non-Exempt	AA	2	0
13825	Environmental Senior Field Technician	Classified	GS 53	Non-Exempt	AA or 30 College Credit Hours	2 or 4	0
13830	Engineering Technician	Classified	GS 52	Non-Exempt	AA or 30 College Credit Hours	1 or 2	0
U5480	Construction Inspector	Unclassified	GS 49	Non-Exempt	30 College Credit Hours/HSD	2 or 4	0
13835	Environmental Field Technician	Classified	GS 49	Non-Exempt	AA or 30 College Credit Hours	0 or 2	0
13840	Engineering Aide	Classified	GS 47	Non-Exempt	HS/GED	0	0

City of El Paso

Engineering Lead Technician

CLASS CODE	13815 GS 057	**SALARY**	$24.63 - $37.88 Hourly $1,970.58 - $3,030.76 Biweekly $4,269.60 - $6,566.64 Monthly $51,235.18 - $78,799.71 Annually
ESTABLISHED DATE	August 20, 2006	**REVISION DATE**	February 23, 2025

Minimum Qualifications

Education and Experience: An Associate's Degree in Engineering or Drafting Technology, or a closely related physical science field, plus four (4) years increasingly responsible para-professional engineering experience including one (1) year of lead or supervisory experience; or 30 hours of college credits in Engineering, Drafting Technology or a closely related physical science field and (8) eight years of construction or engineering related experience including one (1) year of lead or supervisory experience.

Licenses and Certificates: Some positions may require a Texas Class "C" Driver's License or equivalent from another state by time of appointment.

General Purpose

Under direction, plan and coordinate work of assigned subordinates or personally perform expert level unusual aspects of providing technical support to assist engineering professionals with a broad range projects or programs, including those of an interdisciplinary or interdepartmental nature.

Typical Duties

Review or prepare the most difficult or unusual design plans in support of construction, site development, streets, drainage, water or sewer line, or storm drain engineering projects according to specifications and in compliance with pertinent codes and ordinances, as assigned. Involves: Check for adherence with technical procedures and engineering instructions. Verify survey measurements, and existing facility, utility, and structure data. Recommend alternatives regarding technical aspects of plans to meet planning, design and cost problems encountered. Analyze plans for compliance with applicable ordinances, regulations and specifications. Assist technicians in overcoming drafting and computational difficulties encountered, gathering inspection data and resolving disputes.

Coordinate and oversee the most complex site inspection and surveying projects, as assigned. Involves: Perform inspections of project construction to verify data and compliance with contract specifications. Measure, observe and discuss progress of work and related problems with colleagues and contractor personnel. Ensuring compliance with professional and technical standards. Monitor work progress and verify that work conforms to developer's contract. Prepare completion certificate. Issue and track equipment.

Perform highly specialized environmental, hazardous materials (HAZMAT), and safety inspections of City owned properties and construction sites, as assigned. Involves: Conduct regular and special inspections of existing and under construction facilities, noting discrepancies and non-compliance problems. Recommend corrective and compliance actions. Estimate costs of corrections, design solution alternatives and compliance plans. Write technical specifications for safety and environmental equipment and modifications, prepare drawings and diagrams as appropriate. Advise contractors in safety and environmental compliance regulations. Develop and draft specifications and drawings for environmental improvement projects. Prepare reports of inspections and potential problems, alternate methods of work and solutions implemented by responsible engineer. Assist in environmental aspects of landfill linings, measure and monitor methane gas releases and levels. Monitor underground storage tank removal for compliance to standards.

Administer City environmental safety program as assigned. Involves: Develop and write safety and environmental specifications, and implement approved safety recommendations. Prepare, schedule and conduct pertinent remedial and informational training sessions for City employees. Respond to HAZMAT spills and analyze asbestos hazards by gathering information about spills, testing for hazardous substances, determining and recommending evacuation requirements, arranging clean-up actions, and identifying responsible parties.

Perform the most difficult or unusual special investigations, as requested. Involves: Research controversial property line questions. Gather statistical and engineering data, and review sources such as records, files and drawings. Confer with interested department personnel and other agencies. Develop alternatives and recommend technical corrective actions.

Oversee public works projects and property assessment records management, as assigned. Involves: Ensure preparation of construction documents includes design data such as drawings, specifications, grading requirements and legal descriptions of land for City to acquire rights of way. Track project status. Conduct final reviews of contractor project bid proposals. Make final check on pay estimates and contractor invoices. Direct information retrieval.

Supervise assigned personnel. Involves: Schedule, assign, instruct, guide, check and evaluate work. Arrange for or engage in employee training and development. Enforce personnel rules and regulations, and standards of work conduct, attendance and safety. Counsel, motivate and maintain harmonious working relationships among subordinates. Recommend staffing and employee status changes. Interview applicants and recommend selection.

Knowledge, Skills, and Abilities

- Application of comprehensive knowledge of engineering design principles, and manual and computer aided design drafting (CADD) techniques and methods.
- Application of comprehensive knowledge of engineering related mathematics, statistics and cost estimation.
- Application of comprehensive knowledge of construction, land development or related engineering technology principles, procedures and techniques.
- Application of comprehensive knowledge of field surveying.
- Application of comprehensive knowledge of Federal, State, and Local environmental protection laws; hazardous chemical and other forms of pollutants.

- Application of comprehensive knowledge of safe work practices and procedures.
- Conceptualize and draft design drawings based on engineering requirements such as compliance plans for facilities, and develop applications of technical procedures in support of engineering projects such as cost effective methods for verifying compliance.
- Simultaneously monitor details of numerous projects.
- Identify variances from plan specifications to resolve problems and minor disputes regarding discrepancies between designs and construction.
- Review and interpret federal and state laws, and enforce codes with firmness, tact and impartiality.
- Collect and analyze data, prepare construction and equipment cost estimates and specifications, technical reports, and allied spreadsheets, charts and graphs pertaining to assigned activities.
- Assist in development of alternate methods of labor, equipment and materials utilization to ensure project, property, facility assets meet regulatory standards.
- Express oneself clearly and concisely, both orally and in writing to communicate safety and environmental concerns and compliance requirements, and to respond to public information requests as authorized.
- Firmly and impartially exercise delegated authority to supervise, motivate, train and evaluate subordinates. Establish and maintain effective working relationships with all levels of management, fellow employees, the public and contractor personnel.

Other Job Characteristics

- Safe operation and care of personal computer or network work station, including CADD, word processing, spreadsheets and database software, surveying and standard drafting instruments and; time and distance measuring devices, and motor vehicle through city traffic.
- Frequent: close visual concentration to draft design drawings with CADD and GIS software.
- Occasional: exposure to adverse weather conditions, heavy equipment operations, walking, standing and climbing on rough terrain and construction sites, and hazardous materials when responding to alleged spills.
- Occasional: stooping, bending, lifting and carrying objects and equipment (up to 30 lbs). Subject to call back, and working flexible hours, weekends, holidays and mandatory overtime.
- Operation of motor vehicle through City traffic.
- Some positions must pass a criminal background check, and obtain and maintain federally mandated security clearance for working at an airport.

Classification Status

(Ord. 016439 08/22/06), (HR 09/03/08), (HR 07/04/10), (CC 07/29/12), (HR 01/15/20), (HR 05/22/22), (HR 09/11/22), (HR 03/12/23), (HR 09/10/23), (HR 09/08/2024), (HR 02/23/25)

As provided under Classification and Compensation Ordinance 8064, Section 2.2, General purpose and typical duties summarized are only illustrative of work customarily assigned and performed. Typical requirements shown may be more specifically defined by additional job analysis. Equivalencies for education or experience shown may be more specifically defined by CSC approved guidelines.

Attachment A

RULE 5

Application and Promotional Process and Lateral Transfer Process

Section 1. Filing of Applications.

Except as otherwise provided for herein, applicants for all positions, must file an application with the Human Resource Department not later than the date specified in the job posting and in the manner prescribed in the job posting.

The Human Resources Director, subject to appeal to the Commission, will refuse to examine an applicant, or after examination to certify him as eligible and will remove his name from the eligible list for any of the following reasons, in each case to be fully documented:

(a) He is found to lack any of the minimum requirements established in the classification for the position and grade for which he applies; or

(b) He has been convicted of a felony, or a misdemeanor within seven (7) years from date of conviction, end of parole, or release from prison, which is determined to be job related to the position sought; or (Amended 8/25/09,11/2/10)

(c)He is found by the Commission to have committed any act, either while in the service of the City or otherwise, or to have any deficiency or disqualification which, in the judgment of the Commission, would be sufficient to constitute a just cause for discharge from the Civil Service as defined in Article VI, Section 6.13-3 of the Charter.

Section 2. Appeals from Disqualification from Examination.

a. Applicants who are disqualified from taking an examination may appeal to the Civil Service Commission provided they appeal within three (3) working days from the date of the notice. The three (3) working day period begins the date the notice was emailed. Individuals who appeal must file a written rebuttal in a format prescribed by the Human Resources Director. If the applicant fails to update their contact information or respond within the timelines set, no further action will be taken. (Amended 8/21/07, 8/25/09, 9/17/13)

b. Untimely appeals will not be accepted.

c. If the examination is held before the appeal is heard and determined by the Commission, the Human Resources Director may allow the applicant to take the examination conditionally pending the Commission's determination. If a conditional applicant fails to achieve a passing grade on an examination, the appeal shall be administratively dismissed and the appeal will not be forwarded to the Commission and no further action will be taken. (Amended 8/25/09)

Section 3. Frequency and Examination.

Examinations will be given whenever needed to fill a vacancy for which an adequate list does not exist. (Amended 12/11/84, 1/24/89, 8/21/07)

Section 4. Eligibility.

A person is eligible to take promotional examinations after actual service in a regular position for six months and when he fully meets the qualifications for the class as specified in the job description. The six months of actual service will be deemed to have been met if the employee successfully completes the six months of service by the date the first component of the examination is administered, and the employee is recommended for regular status. (Amended 10/21/97, 8/21/07, 8/25/09, 9/17/13)

Section 5. Seniority and Efficiency Points

Seniority points will be awarded to the score of City Employees provided that the minimum passing grade is achieved on the examination or evaluation. City Employees may receive a maximum of five additional points that can be added to their score for seniority points. (Amended 3/6/12, 3/7/17)

Section 6. Special Credit

Ratings for Veterans

A veteran, who has obtained a passing score, shall have his rating on an original entrance examination advanced five points. A veteran is defined as any person who has served on active duty in the Armed Forces of the United States, or any division thereof, including the Coast Guard, for a period of 180 days and presents a DD 214 indicating an honorable discharge from said service. (Amended 8/21/07, 8/25/09)

a. To qualify for an additional five-point increment based on disability, such disability must be at least 30 percent, certified by the most recent letter from the Veteran's Administration. (Amended 8/21/07)

b. Nothing in this provision will be construed to authorize or direct the placing of the name of any person on any eligible list who does not meet the physical standards set by the Human Resources Director for the position for which the eligible list has been created.

Section 7. Penalty for Deceit in Examination.

Where deceit in an examination is alleged, and the examinee denies the fact of deceit, or if the examiner in charge of the examination believes extenuating circumstances to exist, the examinee will be permitted to finish the examination, and a full report shall be submitted immediately to the Human Resources Director, who will conduct an appropriate investigation. Should the Director find that the applicant engaged in deceitful conduct in connection with the examination, the applicant will be disqualified. (Amended 8/21/07, 9/17/13)

Section 8. Duration of Eligible Lists.

The Human Resources Director will compile lists of eligible promotional candidates for job classifications and maintain them as necessary and appropriate. Eligible lists other than reinstatement and transfer lists will normally expire 6 months from the date they are certified unless extended by the Human Resources Director.. (Amended 1/24/89, 8/21/07, 9/17/13)

Section 9. Removal from the Promotional List of Persons Permanently Separated from Service.

The names of persons permanently separated from the service on account of resignation, discharge or other cause, will be removed from all promotional applicant lists by the Human Resources Director.

Section 10. Removal from Lower List if Appointed from Higher List.

Regular employees whose names are on promotional eligible lists of different grades or lists with different salary schedules will be removed from the lower grade promotional eligible lists or promotional lists with a lower salary schedule upon promotion to a higher grade position or one with a higher salary schedule. (Passed 3/28/91 and Amended 8/21/07)

Section 11. Required Licenses or Certificates

All employees who are required to have a license or certificate as a condition of employment shall maintain such licenses or certificates in a current status as long as their job specification requires it. Failure to maintain or obtain such license or certificate as required by the employee's job specification shall constitute just cause for disciplinary action as described in Rule 8. (Passed 8/25/09)

Section 12. Transfer to Same Class and Grade.

Whenever an employee in any department of the City wishes to transfer to a position in another department, the employee must be recommended by the transferring department and must have not been disciplined or placed on a performance improvement plan in the last 12 months. Employee shall retain his grade and pay rate, provided: (Amended 7/31/07, 8/25/09, 9/17/13)

a. The position is in the same class and grade as the one from which transfer is made; or

b. The employee has been performing services substantially similar in nature and having similar requirements as to education and experience to those of the new position, as determined by the Human Resources Director. Seniority credit where applicable will be given to the employee for the number of years he has been performing similar work in the former department. (Amended 2/1/94 and 7/31/07)

Section 13. Transfer During Probationary Period.

a. In order to have a request for a transfer approved, a person must have completed a probationary period in the class to which transfer is being requested, except as provided in paragraph b.

b. In cases where a position is abolished, a transfer request may be made by either the employee or the City. In such cases, a transfer may be approved while the employee is still serving in a probationary period for the class to which transfer is requested, provided that the balance of the employee's probationary period not yet served be retained by the employee in the new department, and that the rules regarding transfer and the order of certification and all provisions regarding transfers are met. (Passed 1/2/85) (Amended 9/13/05)

Attachment B

ADMINISTRATIVE POLICIES AND PROCEDURES

Policy: Applications and Appeals Policy
Creation Date: October 18, 2011
Revision Date: August 5, 2013; May 30, 2015
Prepared By: HR Department
Approved By: City Manager
Legal Review: Elizabeth Ruhmann

DESCRIPTION: APPLICATIONS AND APPEALS POLICY

I. POLICY

It is the City's policy to allow all interested job seekers to apply for available positions and to provide a method for appealing a disqualification determination, pursuant to the procedures set forth in this policy.

II. PROCEDURES

A. Acceptance of Applications

1. The Human Resources Director or Designee will establish a filing period to accept applications for a particular position

    a. All job seekers must complete an application for a particular position through the City's online application system.
    b. A filing period with a specific closing date may be established for a job posting.
    c. When the need exists for a limited number of applicants, the filing period will only remain open until an adequate number of applications have been received.
    d. When necessary to fill positions for which there is a constant need for qualified applicants, or for hard to fill positions, the Human Resources Director may establish an open filing period and accept applications for employment on a continuous basis until all anticipated vacancies are filled, or the need for accepting and processing of applications no longer exists.

B. Review of Applications

1. Human Resources Director: As required, the Human Resources Director or designee will review applications and identify candidates based solely on qualifications.

   The Human Resources Director will permit education to substitute for experience as stated in the Equivalency Guidelines. Experience will be counted from the first day of entry into a qualifying job, to the day of the first component of the examination for which they have applied.

2. Hiring Official: When requested and as appropriate, applications may be referred to the hiring official to pre-screen.

C. Disqualification:

1. The Human Resources Director will refuse to examine an applicant, or after examination refuse to certify the applicant as eligible and will remove the name from the eligible list, for any of the following reasons, in each case to be fully documented:

   a) Lacks Minimum Qualifications: The applicant lacks the minimum qualifications established in the classification for the position:

      - Applicants lacking three (3) months or less of the required job related work experience at the time of list promulgation may be placed on the eligible list. However, applicants lacking the required experience will not be certified for the appointment until after it is determined by the Human Resources Director that they have met the minimum experience required. Applicants may be asked to provide additional details concerning current or past work experience.

   b) Criminal History: The applicant has a criminal history within the seven (7) years preceding the date the application was submitted, which is determined to be job related to the position sought. For purposes of this subsection, criminal history includes conviction of a felony or misdemeanor. Additionally, the dates of release from prison, probation and/or parole for the relevant convictions will be evaluated and factored into the determination. *All applicants for Public Safety positions may be subject to more stringent criminal history standards deemed to be job related by the respective department or as required by regulatory agencies, or;*

c) Dismissed from Public Service: The applicant has been dismissed from public service (to include City employment) for delinquency or misconduct, which is determined to be job-related to the position sought.

D. False Statement on Application

1. Any false statement knowingly made by an applicant in an application for admission to an examination or any other fraudulent conduct related to the application process will cause the Human Resources Director to:

a) Exclude the applicant from such examination;
b) Remove the applicant's name from any eligible list;
c) Remove the applicant permanently from the position if the applicant has secured appointment from such examination; and/or
d) Exclude the applicant from consideration for any City position for a period of two (2) years from the date the falsified application was submitted or discovered, whichever is later.

E. Appeals from Disqualification:

1. Appeals for disqualification from taking an examination, or from not being certified after examination, or from being removed from an eligible list, may be submitted as follows:

a) Regular Employee: A regular employee may file a written appeal to the Civil Service Commission. The appeal must be filed within three (3) working days on a form prescribed by the Human Resources Director. The three (3) working days period begins the date the notice was emailed to the applicant. Late appeals will not be accepted.

b) Original Applicant: With the exception of C.1.(b) above, Criminal History, which applicants may file a written appeal to the Civil Service Commission in the form and manner described, original applicants who are not regular employees may file a written appeal to the Human Resources Director. The appeal must be filed within three (3) working days on a form prescribed by the Human Resources Director. The three (3) working days period begins the date the notice was emailed. Late appeals will not be accepted.

c) Appeal Form: Applicants may obtain an appeal form by visiting the Human Resources Department website or office.

d) Timeline: Untimely appeals will not be accepted. If the employee or applicant fails to update their contact information or respond within the timelines set, no further action will be taken.

e) Administrative Dismissal: If the examination is held before the appeal is reviewed, the Human Resources Director may allow the applicant to take the examination pending the disposition of the appeal. If the applicant fails to achieve a passing grade on the examination, the appeal shall be administratively dismissed.

F. Application Retention and Reuse: Applications and/or supporting documentation filed with the City will become the property of the City. Applications for one examination will not be used for any other or later examinations.

G. Contact Information: An applicant may update contact information by logging onto their Personal Account Profile. All applicants have the responsibility to update their Personal Account Profile through the City's online application system with any changes in their contact information.

H. Non-Disclosure of Examinations: Examination questions, and answers to test questions that do or may reveal examination questions, are exempt from public disclosure under the Texas Public Information Act (the "Act"). Accordingly, requests for a copy of the examinations and/or such examination answers will be denied pursuant to the relevant provisions of the Act.

APPROVED BY:

FOR _____
TOMAS GONZALEZ, City Manager

DATE: July 14, 2015

Attachment C

Bring in this degree plan every time you meet with a counselor for advising and updating.

EL PASO COMMUNITY COLLEGE
COUNSELING DEGREE PLAN
2012-2013

MACHINING TECHNOLOGY

Welding

Certificate of Completion

MAJOR CODE: 17633

For more information on Gainful Employment Disclosure see page 146 in 2012-2013 catalog.

Student Name _____ Social Security #/ID# _____ FA Student _____ VA Student _____

Student Signature _____ Date _____

Counselor Name _____ Counselor Signature _____

EPCC COURSE RUBRIC/TCC Number	REQUIRED COURSES TITLE	CREDIT HOURS	SEMESTER COURSE COMPLETED	GRADE	COMMENTS (Show origin of any transfer credit or remedial/prerequisite designations or substitution/waiver)
FIRST SEMESTER					
WLDG 1407	Introduction to Welding Using Multiple Processes	4			
WLDG 1413	Introduction to Blueprint Reading for Welders	4			
WLDG 1434	Introduction to Gas Tungsten Arc (GTAW) Welding	4			
SECOND SEMESTER					
METL 1305	Welding Metallurgy I	3			
WLDG 1435	Introduction to Pipe Welding	4			
WLDG 1457	Intermediate Shielded Metal Arc Welding (SMAW)	4			
WLDG 2451	Advanced Gas Tungsten Arc Welding (GTAW)	4			
SUMMER SESSION					
WLDG 1327	Welding Codes and Standards	3			
WLDG 2447	Advanced Gas Metal Arc Welding (GMAW)	4			
WLDG 2453	Advanced Pipe Welding	4			
	Total Credit Hours	38			

NOTE: STUDENTS SHOULD SUBMIT A GRADUATION APPLICATION TO RECEIVE THE CERTIFICATE OF COMPLETION

Students are advised to refer to the course descriptions for all courses identified in the degree plan to ensure they have completed the appropriate prerequisites.

Fall 2012
Curriculum and Instructional Development

THE SCIENCE OF WELDING: UNVEILING THE UNDERLYING PRINCIPLES

Welding, often perceived as just a craft, is deeply rooted in scientific principles. It's a sophisticated process involving physics, chemistry, and metallurgy. Understanding the science behind welding not only enhances a welder's skill but also opens doors to innovation and improved techniques. This blog post aims to ...re the fascinating science

The Physics of Welding: Heat, Electricity, and Metals

At its core, welding is about using heat to join metals. This heat can be generated through various processes, each based on different physical principles.

1. **Heat Generation**: In welding, heat is generated through electrical resistance (as in spot welding), direct application of flame (oxy-acetylene welding), or arc generation (as in TIG or MIG welding). The heat melts the metal at the welding point, allowing it to fuse.
2. **Electricity in Welding**: Electric arc welding utilizes electricity. The creation of an electric arc between an electrode and the base metal generates intense heat. This process is governed by Ohm's law and principles of electrical conductivity.
3. **Thermal Expansion and Contraction**: As metals heat, they expand and as they cool, they contract. This principle is crucial in welding, as improper handling of thermal expansion can lead to warping or internal stresses in the welded metal.

The Chemistry of Welding: Gas Reactions and Metal Properties

Chemistry plays a significant role, especially in understanding how different metals and gases react under high temperatures.

2. **Flux in Welding**: In processes like stick welding, the electrode is coated with flux which, when melted, forms a protective layer of slag over the weld, preventing contamination.
3. **Metal Properties**: Different metals have different chemical properties, like melting points and reactivity. Welders must understand these to select appropriate techniques and fillers.

Metallurgy in Welding: Understanding the Metal's Inner Structure

Welding transforms the internal structure of metals, a process governed by metallurgy.

1. **Crystal Structure of Metals**: Metals have a crystalline structure. Welding can alter this structure, affecting the metal's strength and ductility. Controlled heating and cooling (preheating and post-weld heat treatment) are used to manage these structural changes.
2. **Welding Metallurgy**: Different alloys behave differently when welded. Factors like carbon content in steel can significantly affect how a weld behaves and must be carefully managed.
3. **Metal Fatigue and Stress Concentration**: Repeated stress can lead to metal fatigue near welds. Understanding how welding affects the metal's fatigue strength is crucial in applications like bridge and aircraft construction.

Advances in technology continuously reshape the science of welding.

1. **Welding Simulation Software**: Software allows the simulation of welding processes, enabling prediction of outcomes like thermal distortion and stress concentration without actual welding.
2. **Automated and Robotic Welding**: These technologies rely on precise control of welding parameters, made possible through in-depth understanding of welding science.
3. **Material Science Developments**: Innovations in filler materials and the development of new alloys contribute to the evolution of welding techniques and capabilities.

Conclusion

Welding: A Blend of Skill and Science

The most skilled welders understand the science behind their craft. This knowledge enables them to choose the right process, materials, and parameters for each unique welding challenge.

Welding, in essence, is a scientific endeavor as much as it is an art form. The interplay of physics, chemistry, and metallurgy underlies every weld, from the simplest joint to the most complex welds in high-tech industries. As we continue to delve deeper into the science of welding, we not only refine our current processes but also pave the way for future innovations in this field. For anyone involved in welding, appreciating and understanding the science behind it is crucial for mastering the art and moving the field forward.

STATE OF RHODE ISLAND
Department of Education

Curriculum Definition

As part of an overarching strategy to align the work across Rhode Island, RIDE facilitated the development of a statewide definition of curriculum as a foundation for understanding and more equitable implementation.

Rhode Island is committed to ensuring all students have access to consistent and high-quality instructional materials.

Curriculum

Curriculum is a standards-based sequence of planned experiences where students practice and achieve proficiency in content and applied learning skills. Curriculum is the central guide for all educators as to what is essential for teaching and learning, so that every student has access to rigorous academic experiences. The structure, organization, and considerations in a curriculum are created in order to enhance student learning and facilitate instruction. Curriculum must include the necessary goals, methods, materials and assessments to effectively support instruction and learning.

Goals

Goals within a curriculum are the standards-based benchmarks or expectations for teaching and learning. Most often, goals are made explicit in the form of a scope and sequence of skills to be addressed. Goals must include the breadth and depth to which a student is expected to learn.

Methods

Methods are the instructional decisions, approaches, procedures, and routines that teachers use to engage all students in meaningful learning. These choices support the facilitation of learning experiences in order to promote a student's ability to understand and apply content and skills. Methods are differentiated to meet student needs and interests, task demands, and learning environment. Methods are adjusted based on ongoing review of student progress towards meeting the goals.

Materials

Materials are the tools selected to implement methods and achieve the goals of the curriculum. Materials are intentionally chosen to support a student's learning. Material choices reflect student interest, cultural diversity, world perspectives, and address all types of diverse learners.

Assessment

Assessment in a curriculum is the ongoing process of gathering information about a student's learning. This includes a variety of ways to document what the student knows, understands, and can do with their knowledge and skills. Information from assessment is used to make decisions about instructional

approaches, teaching materials, and academic supports needed to enhance opportunities for the student and to guide future instruction.

Curriculum Definition Resources

- Curriculum Definition One-pager
- Curriculum Definition Glossary
- Curriculum Definition Talking Points

Please email any questions about the content on this page to

curriculum@ride.ri.gov.

Advances in Welding Science & Technology, S.A. David, ed., ASM International, Metals Park, OH, 291, 1986.

KEYNOTE ADDRESS

THE PHYSICS AND CHEMISTRY OF WELDING PROCESSES

Thomas W. Eagar
Materials Processing Center
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

Abstract

Historically, welding processes have developed empirically and have been applied to technological problems with unusual quickness. As a result, a large number of processes have evolved, many of which are not well characterized from a scientific point of view. Many attempts have been made to categorize these processes, mostly with disappointing results; however, there have been a few categorizations which have proven useful. The first considers the thermodynamic stability of surface contaminants and describes how the temperature, pressure and chemical potential of the welding system can be changed to eliminate these contaminants. The second describes the heat intensity on the surface of the material and relates this to the maximum weld travel speed, the heat affected zone width, the equipment cost and the minimum sampling frequency necessary to control the process.

THE NEED FOR WELDING AND JOINING is ubiquitous; there are very few manufactured products that do not rely on welding or joining in some form. Indeed, only monolithic parts can be made without joining. Unfortunately, our methods are generally imperfect, either in properties or in affordability; and there is a constant search for improved processes.

The perfect joint is one which is indistinguishable from the material surrounding it. Some processes, such as diffusion bonding, come very close to this ideal; however, such processes seem to be either cost intensive or restricted to a narrow group of materials. It is clear that there is no universal process which will perform adequately on all materials and in all geometries. As a result, a welding engineer must be able to wisely select the best process for a particular material in a given application. In order to do this, it is useful to categorize the various welding processes in a systematic, scientifically based manner. If this can be achieved, it may be possible to determine the strengths and weaknesses of a given process a priori.

Given the great economic importance of welding to any manufactured product, one might ask why a fundamental science has not developed around this field? There are several answers to this question. Firstly, welding itself is not a discipline but is a process. As with any process, it involves scientific principles from many different disciplines, e.g. physics, chemistry, mechanics, electronics, materials and the like. In this sense, there is a science base for welding already in existence. It is up to the welding engineer to search out the knowledge available in other fields and to apply it, judiciously, to the problems of welding. The study of welding cannot be expected to create new science. Rather, it is an eminently practical field of study which can bring the promises of science to each of us in our daily lives. It is this practical application of science which makes the study of welding so exciting for many of us.

Ironically, this great need for improved welding processes is the second reason why a fundamental science has not been built around welding. Virtually any new process which might be applicable to welding is tested on welding immediately after it is discovered. Some of the earliest experiments on electric arcs during the nineteenth century involved welding. Electron beams and lasers were used to weld small wires together within a few years after these new heat sources were discovered. It is even rumored that particle beams have been used to make welds. Some of these new heat sources were adapted for practical use in welding long before we understood the fundamentals of how the heat source interacts with the material. In many cases, our use of a given process has far exceeded our science base. As a result we often experience unexpected problems. Progress is being made, but it is slow. The papers in this

conference illustrate the areas of greatest concern in welding and joining today.

WELDING PROCESS FUNDAMENTALS

It would behoove us to develop a scientific framework which will allow us to evaluate existing and potential new welding processes. To do this, we must look back at what we are trying to achieve. As noted previously, we wish to form a joint which has indistinguishable properties from the material surrounding it. Ideally, one would like to merely place two parts in contact and achieve a perfect bond. There are two fundamental problems which prevent this. First, the surfaces of any material in the atmosphere is contaminated with either oxygen or water vapor or carbon dioxide. Second, the parts to be joined are solid and the surfaces to be joined do not mate perfectly. Diffusion bonding overcomes these chemical and geometric incompatibilities by application of heat and pressure. The heat allows the surface contamination to diffuse into the bulk. Further, the heat permits sufficient deformation or shape change to promote perfect mating of the surfaces. In materials such as iron, titanium or copper, which dissolve all or most of their usual surface contaminants, a nearly perfect bond can be made; but in aluminum or other metals with refractory oxides which are insoluble in the base metal, the process does not work so well.

Indeed, diffusion or other forms of solid state bonding achieve remarkable results. Even materials which are immiscible in both the solid and liquid states, such as iron and silver, can form interfacial bonds of exceptional strength. O'Brien, Rice and Olson achieved tensile strengths of nearly 100 ksi when bonding maraging steel with silver. (1) One of the reasons for this seemingly exceptional bond strength is that dislocations do not propagate across the bond interface; hence, near theoretical bond strengths are obtainable in principal. The theoretical iron-iron bond strength in the absence of dislocations is in excess of 1000 ksi; hence, even iron and silver which may not have a very high intrinsic bond strength can produce excellent interfacial tensile strength provided the interface is not contaminated or otherwise flawed.

Clearly then, we can achieve excellent results if we can eliminate the surface contamination. Since these are chemical bonds, we can look to chemical thermodynamics to determine how to eliminate them. The free energy of any bond is related to the temperature, pressure and chemical potential of the system, i.e.

$$G = G\ (T, P, \mu_i)$$

hence, to break a bond we must manipulate these fundamental variables. In fact this is clearly what we do in current practice, even if it is not a conscious decision. For some materials, notably silver, with a low chemical affinity for oxygen, a few hundred degrees centigrade will cause the surface oxide to decompose. Silver will also dissolve the oxygen, which is one reason why O'Brien et. al. found such good diffusion bonding at low temperatures. (1) Nonetheless, the temperature must be maintained (and other contaminants such as sulfur must be kept out of the system) if one is to avoid reformation of the surface film. The monolayer time-pressure is on the order of 10^{-9} atm-seconds, so it is not practical to clean the surface at high temperatures and later cool it unless one is operating at extremely high vacuums.

In materials other than silver with somewhat more stable oxides, such as copper or iron, higher temperatures are necessary to decompose the oxide. One can estimate the temperature necessary for decomposition of the oxide by reference to Ellingham diagrams (see Figure 1); however, one must be cautious and remember that such diagrams are based on all solids and liquids being in their standard states (which is usually the pure form) and all gases, such as oxygen being at one atmosphere pressure. If the material is alloyed, the relative activity of each metal component must be known in order to calculate a decomposition temperature. Since the atmospheric oxygen pressure is not very different from one atmosphere (at least in the logarithmic sense of thermodynamics), correction for the oxygen activity difference is not very important if one is operating in the atmosphere. However, if the system is operated in an inert gas or a vacuum, the oxygen potential may vary markedly. In such cases, we are using the second variable in the free energy function to assist in decomposition of the surface oxide. Reducing the partial pressure of oxygen and elevating the temperature can reduce oxides of intermediate stability. These effects of temperature and pressure on reduction of the oxide of any metal is readily calculated by chemical thermodynamics.

For more stable oxides, the partial pressure can be further reduced by addition of a reactive gas. The AWS Brazing Manual provides a useful graph, reproduced in Figure 2, of the relative stability of a number of metal oxides as a function of temperature and oxygen pressure, in the presence or absence of a reducing gas such as hydrogen. Clearly, any welding process engineer should understand the chemistry behind such a graph when considering diffusion bonding or brazing as a joining process for a given material.

The third variable in the free energy equation is the chemical potential of a species. The common method of altering this variable involves both temperature and the use of a flux. The flux provides a system of very low chemical potential for the surface contaminant; hence, the surface film will be absorbed into the flux. This is perhaps the most common method of

removing surface contamination, yet, the specific chemistry of most flux systems is poorly understood.

In his classification of welding processes, Houldcroft describes this requirement of elimination of surface contamination as the "shielding method." He lists vacuum, inert gas, reactive gas, flux, no shielding and mechanical exclusion as possible methods. (3) It should be recognized that each of these shielding methods (with perhaps the exception of the last one) can be quantified in terms of the free energy of the system, as defined by the temperature, pressure and chemical potential of the surface contaminant. In this way, one can determine whether a shielding method is appropriate for a given material.

It will be noted that temperature is a major variable in nearly all methods of removing surface contaminants. This suggests another fundamental ranking for joining processes, i.e. the method of heating. In his classification Houldcroft called this the "source of heat", yet again, this can be quantified to yield more information about a given joining process. As before, one should choose an intensive, rather than an extensive variable to describe the system. A number of different authors have suggested that the relevant quantity is the power density on the surface of the material.

One of the primary welding processes is fusion welding since this solves both the chemical and the geometric problems of joining two surfaces. Melting the base material permits the surface contamination to float or dissolve away while the liquid metal conforms perfectly to the solid mating surface. Hence, heat used for welding usually involves melting the surface.

If one considers a planar heat source diffusing into a very thick slab, the surface temperature will be a function of both the surface power density and the time. Figure 3 shows how this temperature will vary on steel with power densities from 400 watts/cm^2 to 8000 watts/cm^2. (4) At 400 watts/cm^2, it takes two minutes to melt the surface. If the 400 watts/cm^2 heat source were a point on the flat surface, the heat flow would be divergent and it might not even be possible to melt the steel; the solid metal might be able to conduct away the heat as fast as it is being introduced. Generally, it is found that heat source power densities of approximately 10^3 watts/cm^2 are necessary to melt most metals.

At the other end of the power density spectrum, it is found that heat intensities of 10^6 or 10^7 watts/cm^2 will cause vaporization of most metals within a few microseconds. Above these power densities, all of the solid interacting with the heat source is vaporized and no fusion welding can occur. Thus it is seen that the heat sources for all fusion welding processes lie between approximately 10^3 and 10^6 watts/cm^2 on the power density spectrum. The spectrum with the locations of several common joining processes is shown in Figure 4.

Inspection of Figure 1 shows that the power density is inversely related to the interaction time of the heat source on the material. Since this is a transient heat conduction problem, one can expect the heat to diffuse into the steel to a depth which increases as the square root of time, i.e. from the Einstein equation

$$x = \sqrt{at}$$

where: x is the distance that the heat diffuses into the solid, in cm
a is the thermal diffusivity of the solid, in cm^2/sec, and
t is the time in seconds

For the planar heat source on a steel surface as represented by Figure 3, one finds the time in seconds to produce melting on the surface, t_m, is given by:

$$t_m = \left[\frac{5000}{H.I.}\right]^2$$

where H.I. is the heat intensity in watts/cm^2. If we consider the time to melting to be equal to the necessary interaction time, t_I, of the heat source with the material, one can generate the graph shown in Figure 5. One can see that heat sources of the order of 10^3 W/cm^2, such as oxyacetylene flames or electroslag welding require interaction times of 25 seconds in steel while laser and electron beams at 10^6 W/cm^2 need interaction times on the order of 25 microseconds. If we divide this interaction time into the heat source diameter, d_H, we obtain a maximum travel speed, V_{max} for the welding process, as shown in Figure 6. From this, it is clear why welders begin their training with the oxyacetylene process as it is inherently slow and does not require rapid response time in order to control the size of the weld puddle. Greater skill is needed to control the more rapid fluctuations in arc processes, while no human can control the pool of the high heat intensity processes such as laser and electron beam. It is an inherent fact that these processes must be automated in order to control them. This need to automate leads to increased capital costs for these high heat intensity processes. One can approximately replace the number of watts/cm^2 of a process with the dollar cost of the capital equipment.

For constant total power, a decrease in the spot size will produce a squared increase in the heat intensity. This is one of the reasons why the spot size decreases with increasing heat intensity as shown in Figure 6. It is easier to make the spot smaller than to increase the power rating of the equipment. In addition, one generally wishes only to melt a small volume of material. If the spot size were kept constant and the input power were squared in order to

obtain higher power densities, the volume of fused metal would increase dramatically, with no beneficial effect. However, this decreasing spot size, coupled with a decreased interaction time at higher power densitites, compounds the problem of controlling the higher heat intensity process. A shorter interaction time means that the sensors and controllers for automation must operate at higher frequencies. The smaller spot size means that the positioning of the heat source must be even more precise. This positioning accuracy must be on the order of the heat source diameter, d_H, while the control frequency must be greater than the travel velocity divided by the diameter of the heat source. For processes operating near the maximum travel velocity, this is the inverse of the process interaction time, t_I (see Figure 5).

Thus we see that not only must the high heat intensity processes be automated due to an inherently high travel speed, but the fixturing requirements become greater and the control systems and sensors must have ever higher frequency response. Both of these factors lead to increased costs of high heat intensity processes, which is one reason that these processes, which are very productive, have not found wider utilization.

Another important welding process parameter that is related to the power density of the heat source is the width of the heat affected zone. Using the Einstein equation one can estimate a heat affected zone width from the process interaction time and the thermal diffusivity of the material. This is shown in Figure 7 with one slight modification. Above about 10^4 W/cm^2 the heat affected zone width becomes roughly constant. This is due to the fact that the HAZ grows during the heating stage at power densities below 10^4 W/cm^2 but it grows during the cooling cycle at higher power densities. Thus at low power densities, the HAZ width is controlled by the interaction time, while at high power densities it is independent of the heat source interaction time. In this latter case, the HAZ width is controlled by the cooling time necessary to remove the heat of fusion from the weld metal. In such a case the HAZ width is proportional to the fusion zone width.

The change of slope in Figure 7 also represents the heat intensity at which the heat utilization efficiency of the process changes. At high heat intensities, nearly all of the heat is used to melt the material and little is wasted in preheating the surroundings. As the heat intensity decreases, this efficiency is reduced. For arc welding, it may be only one-half of the heat entering the plate and for oxyacetylene it may be 10 percent or less.

Finally, the heat intensity also controls the depth to width ratio of the molten pool. This can vary from 0.1 in low heat intensity processes to more than 10 in high heat intensity processes.

CONCLUSION

It is seen that there are fundamental chemical and physical limits to our selection of welding processes. The chemical stability of surface contamination influences our choice of shielding or surface removal during the process. A knowledge of the power density on the surface of the material produces quantifiable parameters which provide criteria for maximum travel speed, minimum frequency of process control systems, heat affected zone width and equipment cost. Although these criteria are only approximations and will not define any process precisely, they do provide guidelines from which to predict how a new process or a new material will behave. Intelligent application of such guidelines can often help in the selection or application of a wide range of welding processes on a variety of materials.

Acknowledgements

The author wishes to express his sincere appreciation to Dr. Bruce MacDonald of the Office of Naval Research and Dr. Robert Reynik of the National Science Foundation for a decade of support on the physics and chemistry of welding processes. This generalized approach to welding process could only have been developed through such a long term committment to the study of a number of different welding processes.

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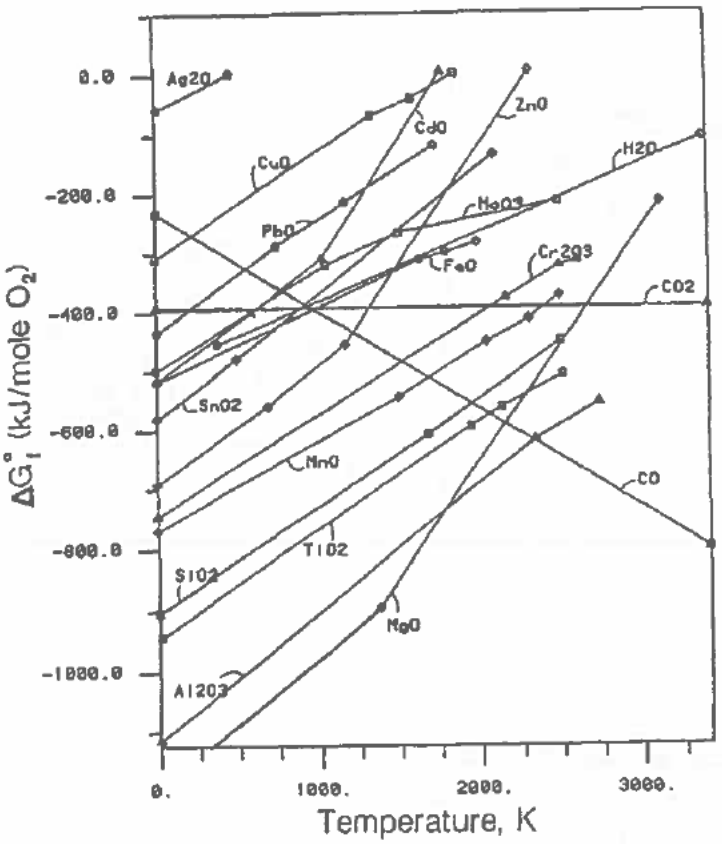


Figure 1

Ellingham diagram illustrating the relative thermodynamic stability of a number of metal oxides.

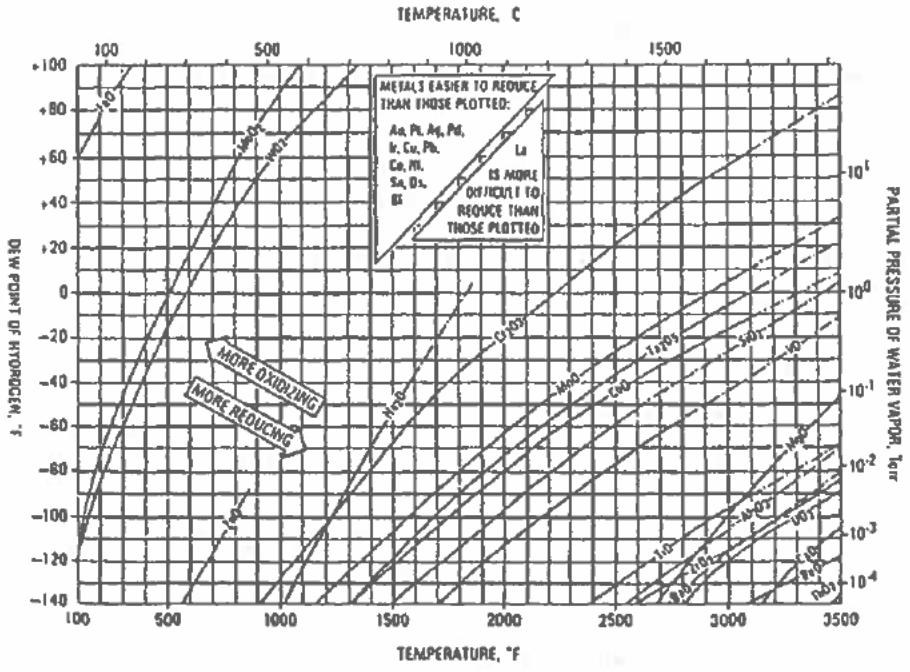


Figure 2

Metal-metal oxide equilibria in hydrogen atmospheres. From the AWS Brazing Manual, used by permission.

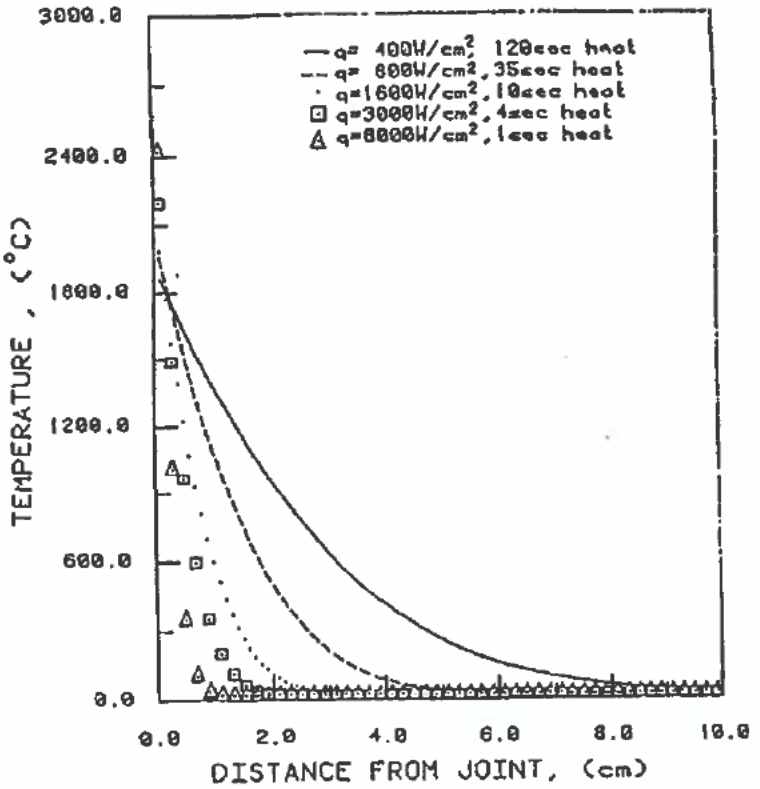
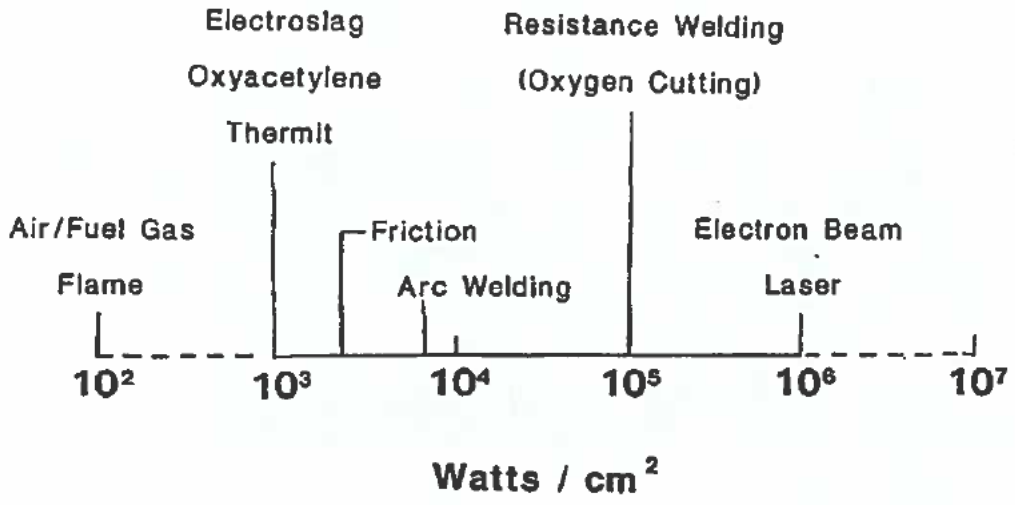


Figure 3

Temperature distribution after a specific heating time in a thick steel plate, heated uniformly on one surface as a function of applied heat intensity. The initial temperature of the plate is 25°C.

Figure 4

Spectrum of practical heat intensities used for fusion welding.



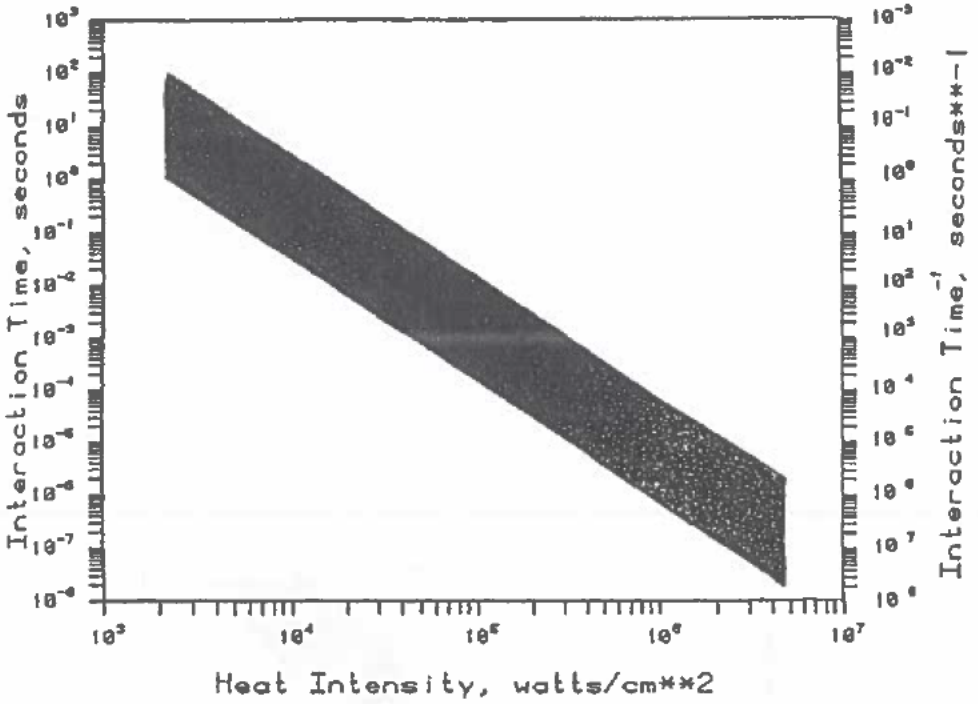


Figure 5

Typical weld pool-heat source interaction times as a function of source heat intensity. Materials with a high thermal diffusivity, such as copper or aluminum would lie near the top of this band, while steels, nickel alloys or titanium would lie in the middle, and uranium and ceramics, with very low thermal diffusivities, would lie near the bottom of the band.

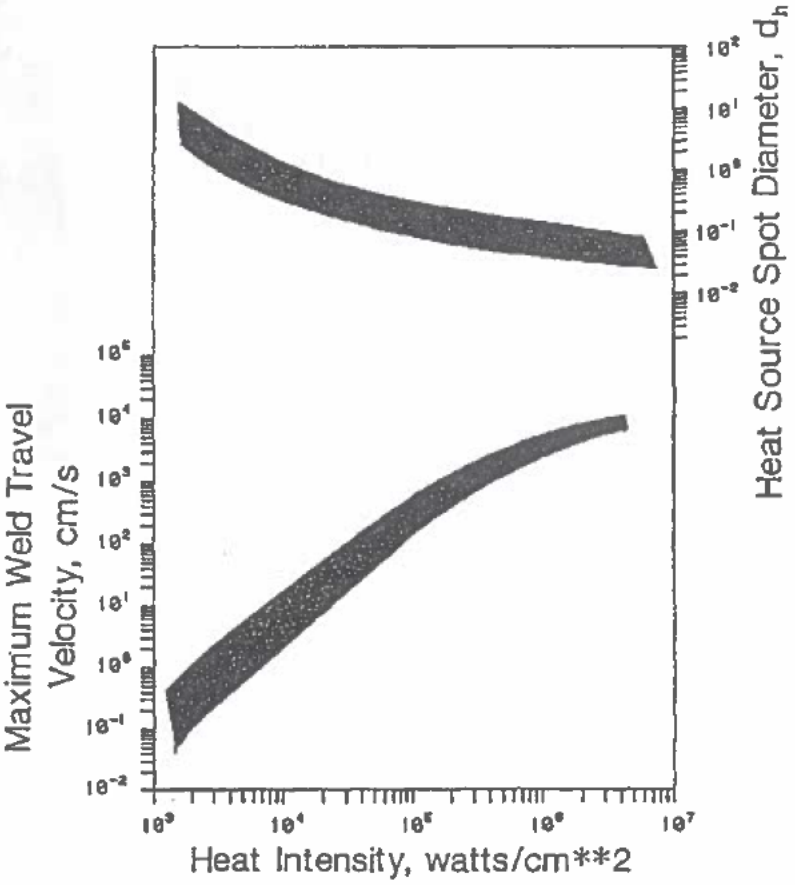


Figure 6

Maximum weld travel velocity as a function of source heat intensity based upon typical heat source spot diameters.

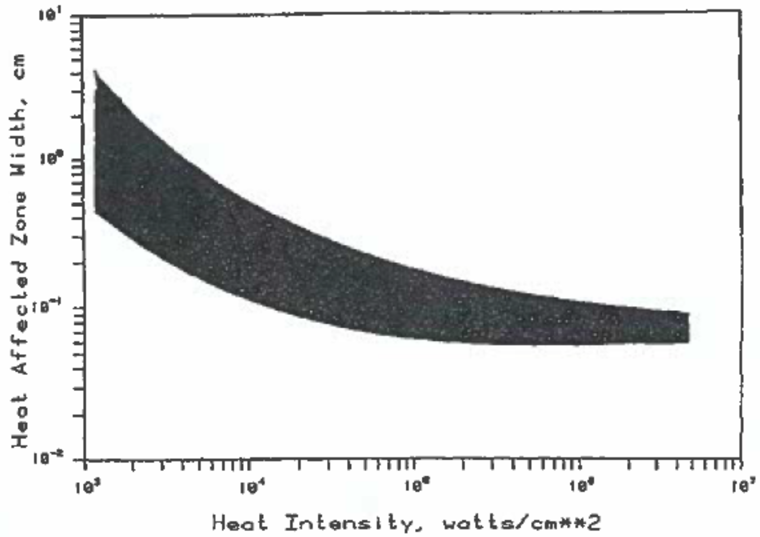


Figure 7

Range of weld heat affected zone widths as a function of source heat intensity.

CHAPTER 2

PHYSICS OF WELDING AND CUTTING

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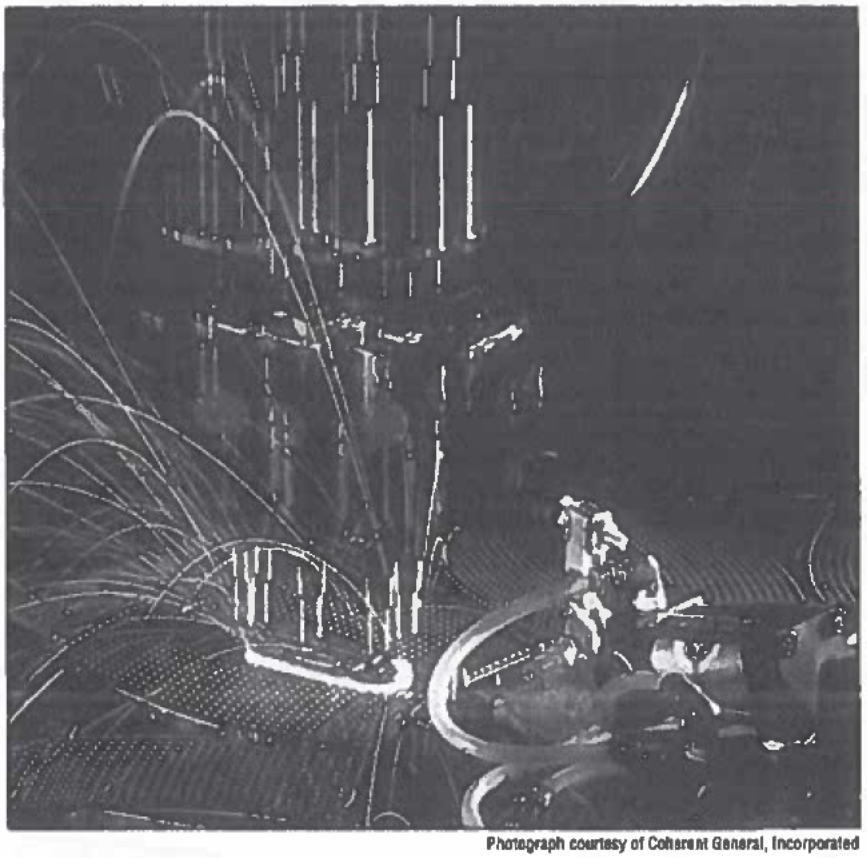

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CHAPTER 2

PHYSICS OF WELDING AND CUTTING

INTRODUCTION

The physics of welding deals with the phenomena associated with welding processes and the formation of weld bonds. This chapter discusses two types of welds, fusion welds and solid-state welds. These are commonly differentiated by the physics of the metallic bonding mechanism.

The chapter includes a discussion of the physics of energy sources—electrical, chemical, focused-beam, mechanical, and solid-state—and energy transfer as they relate to the various welding processes. Also discussed are the physical phenomena of the electric arc, metal transfer, melting rates, the properties of metals and shielding gases, and the manner in which these and myriad associated phenomena contribute to successful (or unsuccessful) welds.

The information in this chapter is applicable to many thermal cutting and spraying processes, as they are closely allied with welding processes and involve the same phenomena for the purposes of cutting or removing material, cladding, and surfacing. Considering that the International System of Units (SI) is customarily employed in this discipline, this chapter uses SI units exclusively.

FUSION AND SOLID-STATE WELDING

The physics of weld bonds and the associated welding processes differ markedly with respect to fusion welds and solid-state welds and are best considered separately. Fusion welds are created by the coalescence of molten base metals mixed with molten filler metals (if a filler metal is used). Metals must be heated to the melting point for fusion welds to be produced. Solid-state welds are produced at temperatures below the melting temperature and are created by either the macroscopic or microscopic coalescence of the materials in the solid state.

FUSION WELDS

Fusion welding processes must produce sufficient heat to achieve melting. Heat for melting is either developed at the intended weld joint or applied to the intended joint from an external source. In some processes, pressure is applied to force the materials into close contact. An example of a means of developing heat at the weld joint is the passing of current through the electrical contact resistance between the contacting surfaces of the materials to be welded (resistance welding). Electrical discharges between surfaces can also be utilized to develop heat for joining (flash welding). A common characteristic of these welding processes is that the entire weld is usually produced at one time, either at a spot or along an entire joint.

Most fusion welding processes apply heat from an external source to the weld joint to produce the weld bond. Heat is transported from the heat source to the joint by conduction, convection, and radiation. Almost every imaginable high energy density heat source has been adapted at one time or another for fusion welding.

Sources of externally developed heat include electron beams, laser beams, exothermic chemical reactions (used in oxyfuel gas welding and thermite welding), and electric arcs. Fusion welding processes that apply heat from external sources are usually identified according to the type of heat source employed. Electric arcs, the most widely used heat source, are the basis for the various arc welding processes. The following are the most

What is Welding?

February 2, 2021

People tend to use the word "welding" commonly without really understanding what it means. Yes, the word's basic meaning refers to joining metallic parts together, but it is so much more than that.

So, what is welding?

Welding is a critical construction-related activity that is generally used for binding materials together through the application of heat. It is a fabrication process that involves the usage of heat, pressure, or both to fuse two parts.

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The Fundamentals of Welding

Apply for a degree in welding at NEIT!

While the definition mentioned above might make it sound simple, welding is far from easy. Take a look at some of the fundamental principles of welding:

- ✔ Welding involves a high skill level and practical knowledge of subjects like physics, chemistry, and metallurgy.
- ✔ Welding is generally done on metals but is also used for fusing wood or thermoplastic parts.
- ✔ A completed joint is a weld joint or weldment.
- ✔ The parts fused are the parent material, while the material used to help form this weld joint is the filler material.
- ✔ Welding involves bonding the same type of material (metal and metal, or wood and wood) using heat welding, pressure welding, or both.
- ✔ Welders add metal to the welded joint to strengthen the weldment, while a shielding gas like carbon dioxide protects the joint from contamination through natural elements.
- ✔ Different metals react in different ways, depending on their physical, mechanical, and chemical properties.

- ✔ Heat can alter the strength, ductility, and malleability of metal. Welding can straighten out a warped piece of metal by applying adequate heat.
- ✔ Welding involves the heating and cooling of the metal – there is no other chemical reaction involved. However, the weld becomes weak if oxygen reacts with the molten metal. Using protective gases around the weld pool prevents oxygen and other contaminants from damaging the weld.
- ✔ Extreme heat can alter the crystalline structure and weaken any metal.

Benefits of Welding

Welding offers a variety of advantages, including the following:

- ✔ The technique creates a permanent weld and is excellent for the fusion of two materials.
- ✔ Using the right filler metal ensures strength and durability, producing long-lasting weld joints.
- ✔ In terms of costs, this method is quite economical in terms of materials, fabrication, and equipment.
- ✔ The process is versatile and flexible – used indoors as well as outdoors.
- ✔ Welded joints look good, smooth, and polished in terms of appearance.
- ✔ One of the fastest methods in terms of the speed of fabrication.

How does welding work?

A welding gun or torch melts a specific part of the parent metal. This process, conducted using high heat (typically with the addition of filler material), creates a molten metal pool so that it is easy to join a new metal part to it. Instead of heat, pressure is also used to weld metals together (pressure welding) depending on the type and thickness of the material.

- ✔ Metal welding: In most cases, using pressure and heat together over the base material enables quick and efficient metal welding. As mentioned above, a shielding gas safeguards the molten metal or weld pool from getting contaminated or oxidized.
- ✔ Plastic welding: In plastic welding, the surfaces are first prepared, followed by heat and pressure application. After this, the materials are cooled.

- ✔ Wood welding: Welding wood involves subjecting the materials to pressure before using the same heat that the linear friction movement creates

Welding Types and Processes

About

The welding process depends on what the material is. In case you want to become a professional welder, you must understand all the different processes well.

The most popular types of welding processes (https://www.neit.edu/blog/types-of-welding-processes) include:

Stick Welding (SMAW)

Shielded Metal Arc Welding (SMAW), more commonly referred to as stick welding, involves using welding rods or sticks. The stick consists of the filler material and flux (which enable the welding process and protect the weld). Used across construction, shipbuilding, field repair, mining, manufacturing, and aerospace, this type of welding is affordable.

Gas Metal Arc Welding (GMAW)

Also called Metal Inert Gas (MIG) welding, the gas metal arc welding process uses a welding gun through which an electrode wire passes. The result is an electric arc that produces the heat required for welding. also creates a shielding gas that protects the weld.

Used for manufacturing, automotive, industrial, and construction processes, this technique is easy and efficient.

Flux-Cored Arc Welding (FCAW)

Just like MIG welding, FCAW is great for outdoor welding work and general repairs. This technique finds its application in industrial welding, manufacturing, pipeline repairs, shipbuilding, and manufacturing. The difference between MIG and FCAW is that the latter uses a tubular filler wire that contains the flux.

Tungsten Inert Gas Welding (TIG Welding)

This particular type of welding uses a non-consumable electrode that consists of tungsten to produce the arc. Among the most popular types of welding, TIG welding creates a clean, smooth, and superior quality weld. Industries like art, automotive, and aerospace use gas tungsten arc welding.

Submerged Arc Welding (SAW)

SAW is a welding method that uses flux but is different from FCAW because the process happens under a blanket of granular flux. This is one of the safest types of welding because it creates lesser welding fumes and ultraviolet light. SAW is the preferred welding technique in vessel construction, industrial manufacturing, and structural construction.

Hyperbaric Welding

This is a process that welders use underwater. The wet welding technique utilizes stick welding, where the flux produces bubbles that act as a shield to prevent the welder from being electrocuted.

Some other important and often-used welding processes and techniques include:

- ✔ gas welding
- ✔ plasma arc welding
- ✔ electroslag welding
- ✔ electrogas welding
- ✔ oxyacetylene welding (gas welding)
- ✔ atomic hydrogen welding (AHW)
- ✔ carbon arc welding (CAW)
- ✔ energy beam welding (EBW)
- ✔ electron beam welding
- ✔ spot welding
- ✔ seam welding
- ✔ braze welding
- ✔ solvent welding
- ✔ resistance welding

Apart from these, laser beam welding, explosions, and vibrations are some of the other (rather extreme) processes used for fusing metals.

Welding Equipment

Welding is a specialized job that requires you to have a variety of essential tools, including (but not restricted to) the following equipment:

- ✔ Welding gun
- ✔ Welding torch
- ✔ Wire brush
- ✔ Chipping slag hammer
- ✔ Angle grinder
- ✔ Tape measure
- ✔ Welding magnets
- ✔ Soapstone marker
- ✔ Pliers
- ✔ C-clamps
- ✔ Electrode tip cleaners
- ✔ Flint strikers
- ✔ Cold chisels
- ✔ Screwdrivers
- ✔ Charged electrode
- ✔ Wire and electrode feed

Welding can be a high-risk job if you don't use protective gear. Welders must use the following safety equipment at the job site:

- ✔ Safety glasses
- ✔ Welding helmet
- ✔ Welding gloves
- ✔ Heat-resistant jacket
- ✔ Leatherwork shoes
- ✔ Earplugs

Welding Joints Explained

Depending on what kind of joint configuration welders are aiming for, there are various types of welding joints:

Butt joint

A versatile and common welding joint, where you place two metal pieces together in the same plane, welding the side of each piece.

Tee joint

This joint features two pieces intersecting at a 90-degree angle, which forms a T shape. You can also create the joint by welding a tube or pipe onto the base metal.

Corner joint

As the name suggests, a corner joint meets in the corner, forming an L shape.

Lap joint

About

Used for sheet metal, this joint features two pieces of the metal placed on top of each other to create the lap joint.

Edge joint

Known to withstand force and pressure better than any other joint, the edge joint involves placing metal surfaces together to ensure even edges.

How to Become a Welder

A full-fledged program in welding engineering technology (https://www.neit.edu/academics/associate-degrees/welding-engineering-technology-as) can enable you to become a professional welder with all the right skills and qualifications.

New England Tech offers an Associate in Science in Welding Engineering Technology program that delivers the perfect blend of academic and laboratory environments. The program helps you understand the theoretical and practical aspects of welding technology.

Check our Welding Engineering Technology

With an emphasis on welding techniques like oxyacetylene and air carbon arc cutting, brazing, SMAW, GMAW, FCAW, GTAW, and pipefitting, this welding technology program helps aspiring welders gain real-world, hands-on training. Apart from these subjects, you will also take courses in:

- ✔ Industrial OSHA safety procedures and policy
- ✔ Metallurgy
- ✔ Structural design
- ✔ Blueprint reading
- ✔ Computer-aided design and drafting (CADD)
- ✔ Destructive and non-destructive testing
- ✔ Precision measurement

Upon the successful completion of this program (which you can complete in as little as 18 months), you can kick-start your career and assume varied work positions like:

- ✔ Welding engineering technician
- ✔ Production welder
- ✔ Industrial engineering technician
- ✔ Quality control engineering technician
- ✔ CADD designer/technician
- ✔ Welding industry salesman
- ✔ Materials testing technician
- ✔ Underwater welder
- ✔ Aluminum welder
- ✔ Fabrication welder
- ✔ Maintenance welder
- ✔ Sub arc operator
- ✔ Ship fitter
- ✔ Structural Steel Fitter

Fast-track your welding career and get the edge with one of the best welding schools (https://www.neit.edu/blog/best-welding-schools-in-usa) in the United States- sign up for our Associate Degree Program in Welding Engineering Technology (https://www.neit.edu/academics/associate-degrees/welding-engineering-technology-as) now!

Thinking about a career in welding? Fill this simple form to get more information about how you can achieve your career goals with the New England Institute of Technology. Alternatively, you can also call us at 401-467-7744 or 800-736-7744 to speak to our academic counselors.

FAQs

Why do we weld?

Welding is a convenient way of binding metals together without adhesives, nails, or other fusing material. Not only is welding a quicker and more efficient technique of joining materials together, but it is also quite cost-effective and reliable (compared to other methods).

For heavy metal fusing work in industries or applications such as aerospace, defense, shipbuilding, mining, automotive, oil and gas, and industrial manufacturing, welding is the preferred technique.

How much does a welder make an hour?

According to the United States Bureau of Labor Statistics (https://www.bls.gov/ooh/production/welders-cutters-solderers-and-brazers.htm), the median salary for welders (welding, brazing, and soldering specialists) is $42,490 per year or $20.43 per hour (https://www.neit.edu/blog/best-welding-schools-in-usa).

What welding jobs pay over 100k per year?

A nuclear welder, military support welder, or an underwater welder may earn over 100k per year. But, as is the case with any career, the more you gain experience in the field, the more you earn. While entry-level welders might not earn over 100k annually, with the right exposure, experience, and skills, you can expect to climb up the professional ladder and see a corresponding rise in your salary, too.

Which gas is used in welding?

The most common gases that welders use in welding and cutting processes include:

- ✔ Carbon dioxide, argon, and helium (shielding gases)
- ✔ Acetylene, propane, and butane (fuel gases)

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D50420 - Welding Technology - Diploma

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Program Title
Welding Technology - Diploma

Program Code
D50420

Degree Designation
Diploma

Department
Welding Programs

Fully online option available?
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Minimum Required Credit Hours
38