WELCOME TO THE
CALLIDUS COMBUSTION SCHOOL 2O2O

YOU ARE AT THE RIGHT PLACE, PLEASE WAIT A MOMENT
AND THE PRESENTATION WILL BEGIN AT THE APPOINTED TIME

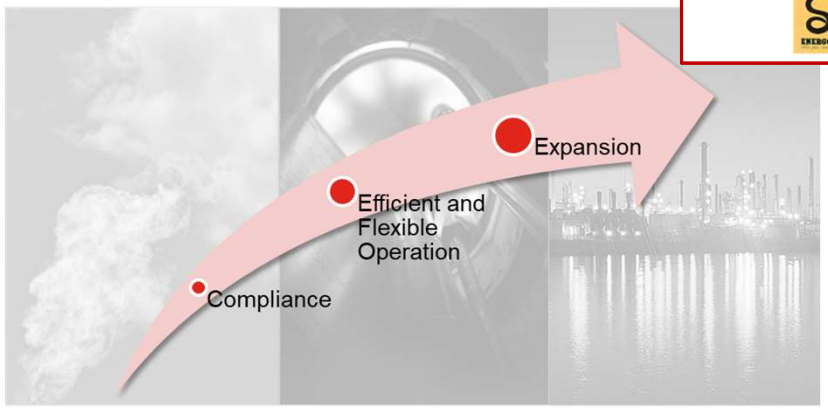
CallidusPartsInquiries@Honeywell.com

CALLIDUS
30 YEARS of INNOVATION
TECHNOLOGIES

Time	Monday, October 5, 2020	Tuesday, October 6, 2020	Wednesday, October 7, 2020	Thursday, October 8, 2020
10:00 AM CDT	Process Burner and Heater Combustion Fundamentals	Case Study: The CUBL-CF Compact Flame Burner	Process Flare Regulations and Fundamentals	Case Study: The nViro XSR Elevated Steam Flare
11:00 AM CDT	Process Burner Installation, Repair and Maintenance	Case Study: The AERO Radiant Wall Burner	Process Flare Inspection, Repair and Maintenance	Case Study: The Galaxy Multi-Point Ground Flare
3:00 PM CDT	Process Burner and Heater Combustion Fundamentals	Case Study: The CUBL-CF Compact Flame Burner	Process Flare Regulations and Fundamentals	Case Study: The nViro XSR Elevated Steam Flare
4:00 PM CDT	Process Burner Installation, Repair and Maintenance	Case Study: The AERO Radiant Wall Burner	Process Flare Inspection, Repair and Maintenance	Case Study: The Galaxy Multi-Point Ground Flare

Callidus Technologies – Leader in combustion solutions

- BURNERS
- FLARES
- FGRS
- TOs
- SCRs
- AFTERMARKET
- TURN KEY SOLUTIONS
- SOFTWARE



Callidus is the unique position to offer a complete solution for Environmental Compliance, Efficient Operation, Output Maximization

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30
YEARS of INNOVATION
TECHNOLOGIES





PROCESS FLARE REGULATIONS AND FUNDAMENTALS

DEE MCCLAIN
PRINCIPAL PROCESS ENGINEER

2020 CALLIDUS FLARE SCHOOL | VIRTUAL, ONLINE, EVERYWHERE

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WHAT IS A FLARE?

Flare: A device or system used to safely dispose of relief fluids in an environmentally compliant manner through the use of combustion (API 537)

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WHAT DOES A FLARE DO?

- The flare acts as the last point of disposal for waste gas
- It must operate with an extremely large turndown ratio
- It must be highly reliable in all climatic conditions
- Often operated outside the design envelope
- Without the flare, most facilities cannot be operated safely

TYPES OF FLARES

- Elevated Flares
- Enclosed Ground Flares
- Multipoint (Open) Ground Flares
- Horizontal and Pit Flares
- Offshore

ELEVATED FLARES

- Most common type of flare
- Elevated flare tips reduce radiation at grade
- Elevated flares have the best dispersion profiles of any flare type

ELEVATED FLARES—MAJOR TYPES

Guy Supported

ELEVATED FLARES—MAJOR TYPES

Self Supported

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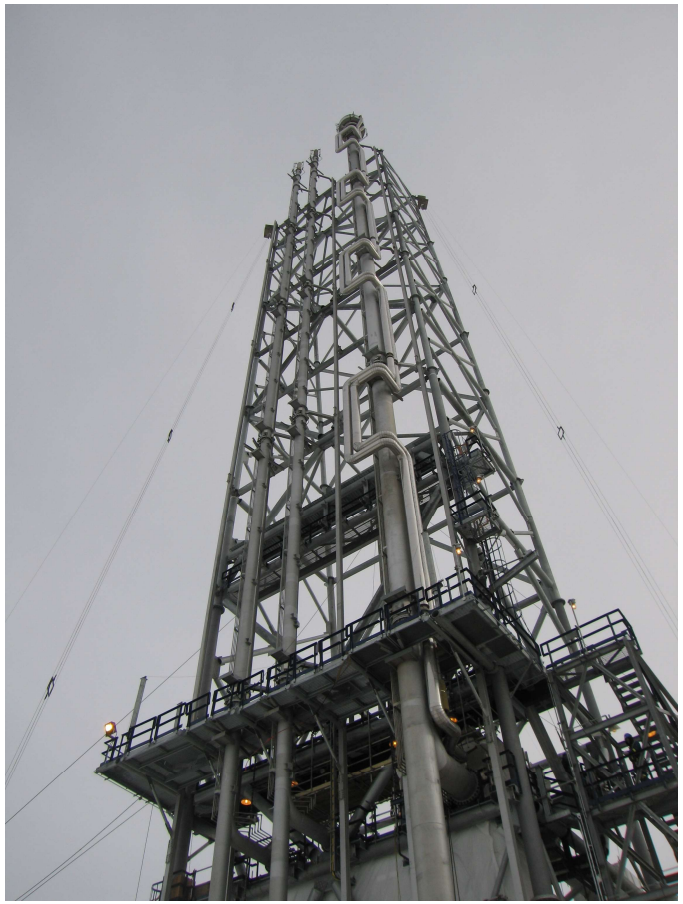
ELEVATED FLARES—MAJOR TYPES



Derrick Supported

ENCLOSED GROUND FLARES

MULTIPOINT (OPEN) GROUND FLARES

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Horizontal and Pit Flares

Offshore Flares

Flare Design Parameters

Hydraulic Capacity

Radiation Control

Smokeless Capacity

Noise

Environmental Considerations

Hydraulic Capacity

- Flare system must flow the maximum volumetric relief case without exceeded maximum relief valve backpressure
- Typically multiple simultaneous relief sources
- Maximum flare tip exit velocity
  - Maximum velocity for a stable flame
  - Most important on elevated flare tips
  - Federal requirements
    - USA: 40 CFR 60.18, 40 CFR 60.670, 40 CFR 60 Subpart OOOO (Quad-O)
    - Other countries have similar requirements

Hydraulic Capacity

- Properly designed flares can maintain stable flame as high as 0.8 Mach in pipe-style flare tips
- HP tips routinely operate at sonic velocities
- Flame retention tabs help anchor the flame to the flare tip exit
- Unstable flame can result in combustion rumble

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Hydraulic Capacity – 40 CFR 60.18

- Sets maximum exit velocity based on either:
  - Hydrogen content (by volume)
    - 8% minimum hydrogen requirement
  - Waste gas lower heating value
    - 200 BTU/SCF minimum for unassisted flare
    - 300 BTU/SCF minimum for air or steam assisted flare
  - These requirements have been updated for refineries per 40 CFR 60.670

Hydraulic Capacity – 40 CFR 60.18

- Under hydrogen rules, unassisted flares are capped at 122ft/s exit velocity
- Under LHV rules, unassisted and steam assisted flares are capped at 400 ft/s
- Air flares have no velocity cap, but are limited by practical application

Hydraulic Capacity – 40 CFR 60.18

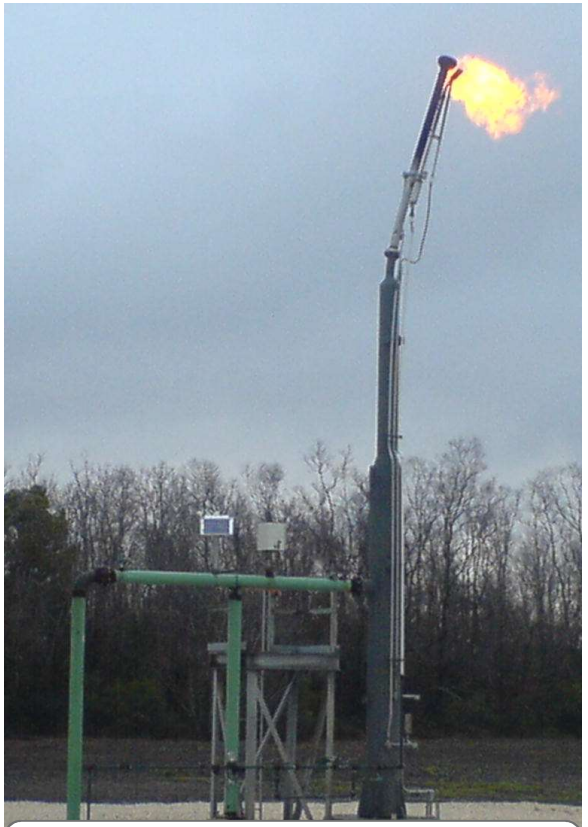
- 40 CFR 60.8(c) states:
  - "…nor shall emissions in excess of he level of the applicable emission limit during periods of startup, shutdown, and malfunction be considered a violation of the applicable emission limit unless otherwise specified in the applicable standard"
- Different states interpret this differently, so check your local permitting authority.

Hydraulic Capacity

- Design impact of the oversized flare tips:
  - Increased capital cost of tip
  - Higher radiation levels at grade
  - Increased wind loading and structural requirements
  - Shorter tip life

Hydraulic Capacity—Further Considerations

- Probability of simultaneous relief valve lifts at the maximum rate
- High integrity protection system (HIPS)
- Commercial software available for detailed relief system design.
- Commercial software available for detailed relief system design
  - Unisim
  - Hysis



Flare operated at roughly 10x the design capacity

Flare Radiation

- Two basic types of flame:
  1. Diffusion Flame
     - Buoyancy and wind have a large impact on flame shape
     - Typical operating condition for an elevated flare
  2. Aerated Flame
     - Momentum has a large impact on flame shape
     - Typically observed in high pressure flares

Flare Radiation

- Diffusion flames tend to be more radiant than aerated flames.
- The redder the flame is, the more it tends to emit radiation in the infrared end of the spectrum.

Flare Radiation

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Flare Radiation

- Aerated flames tend to look more clear or blue flames
- Typically less radiant than diffusion flames

Flare Radiation

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Flare Radiation

- Flare radiation is heat radiation emitted in the infrared portion of the spectrum
- Only 0.1% of flare energy is emitted as visible light
- The amount of radiant heat emitted is highly influenced by the composition of the waste gas
- By cooling the flame and reducing the amount of free carbon, steam or air assist methods tend to reduce the amount of infrared radiation emitted

Flare Radiation

- API 521 Maximum Exposure Times Summary

Radiation Level	Maximum Stay Time
9.46 kW/m^2 3,000 BTU/(hr·ft^2)	A few seconds with appropriate clothing
6.31 kW/m^2 2,000 BTU/(hr·ft^2)	Up to 30 seconds for emergency actions with appropriate clothing
4.73 kW/m^2 1,500 BTU/(hr·ft^2)	Emergency actions lasting from two to three minutes with appropriate clothing
1.58 kW/m^2 500 BTU/(hr·ft^2)	Continuous exposure with appropriate clothing
Appropriate clothing consist of a hard hat, long-sleeved shirts, gloves, pants, and shoes.	

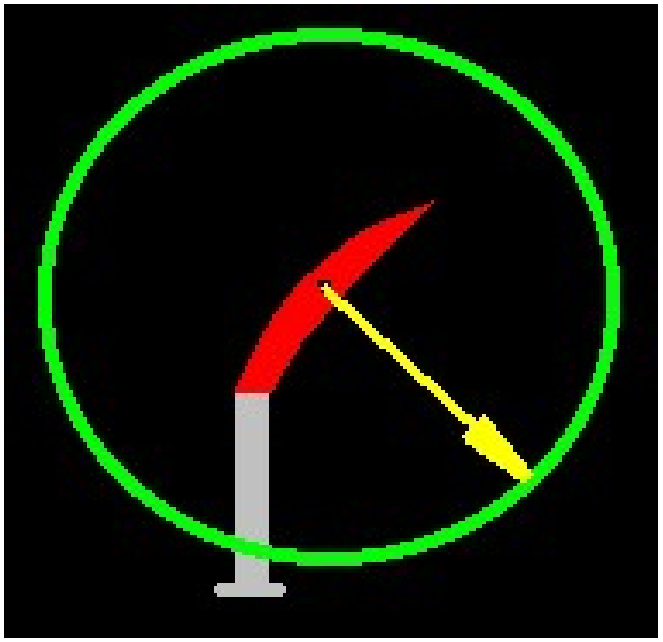
Flare Radiation

- The most common model for calculating flare radiation is the API 521 simple approach
- Assumptions:
  - Radiation emanates in a spherical manner from a single point near or within the flame
  - The point of interest is far enough from the flame that the flame can be considered a point source
  - Flame length is governed by heat release
  - Radiation is equal in all directions
  - Vertical velocity is zero at the end of the flame

Flare Radiation

- The API 521 simple approach calculates the spherical radiation emanation from a single point using the following variables:
- τ = the amount of radiation transmitted through the atmosphere
- F = the fraction of the total heat release that is emitted as infrared radiation
- Q = total flare heat release
- K = the target radiant heat intensity

$$D = \sqrt{\frac{\tau \bullet F \bullet Q}{4\pi \bullet K}}$$

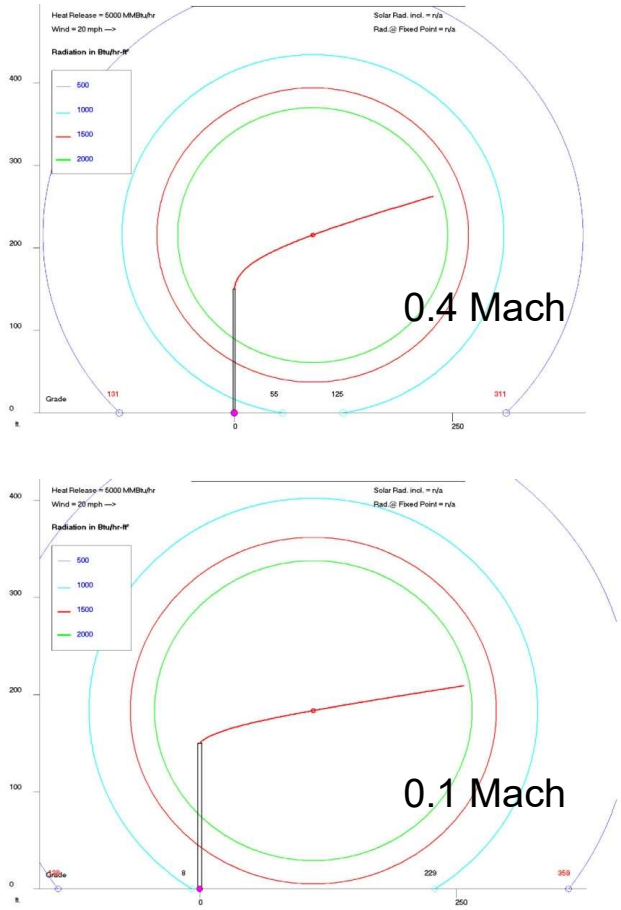


Radiant Fraction

- Not all heat released by the flare is emitted as infrared radiation
- The radiant fraction (F) represents the fraction emitted in the infrared spectrum
- Often referred to as “emissivity”, although this is not technically accurate
- Determined experimentally
- Varies with gas composition and tip design

API 521 Location of Emissive Point

- Uses flame length calculation based on heat release
- Uses flame lean calculation based on values of cross wind velocity and waste gas exit velocity
  - Higher waste gas velocity, less flame lean
  - Not validated at extremely high wind velocities



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Radiation Calculation Accuracy

- Point of interest should be two to three flame lengths from the flame in order for the point source approximation to be valid
- API 521 assumes flame length is only governed by heat release in low velocity diffusion flames. High velocity waste gas can change both the flame length and the flame shape
- Highly dependent on the radiation fraction selected

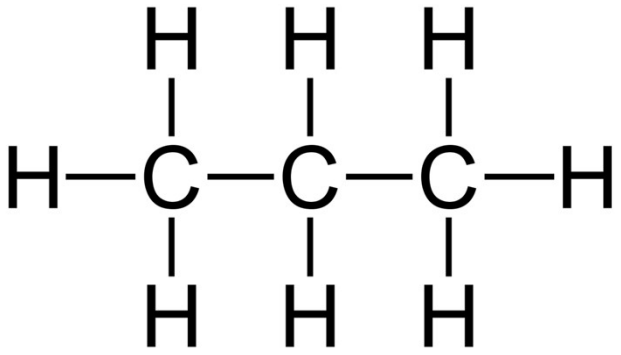
Other Radiation Models

- Brzustowski's and Sommer's method
  - Also found in API 521
  - Changes the method for calculating the emissive point
  - Very similar to the simple approach
- Shell-Thornton
- Gas Processors Suppliers Association
- Various multiple point of interest flame models
- Proprietary, unpublished vendor methods
- UOP Callidus typically uses the B&S method

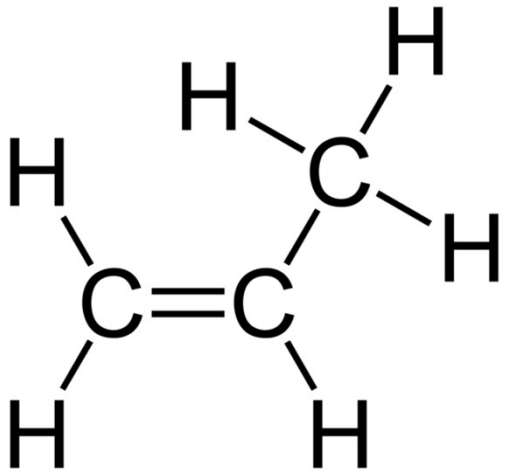
Smokeless Capacity

- Smoke is the release of cooled, unburned free carbon outside of the flame bundle
- Results from localized or bulk fuel-rich areas within the combustion zone
- Eliminated by ensuring sufficient oxygen and rapid mixing within the combustion zone
- The tendency of the waste gas to smoke varies based on composition

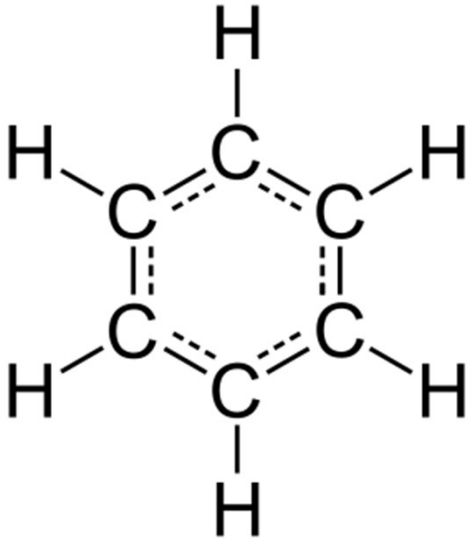
Smokeless Capacity



PROPANE: EASY



PROPYLENE: MORE DIFFICULT

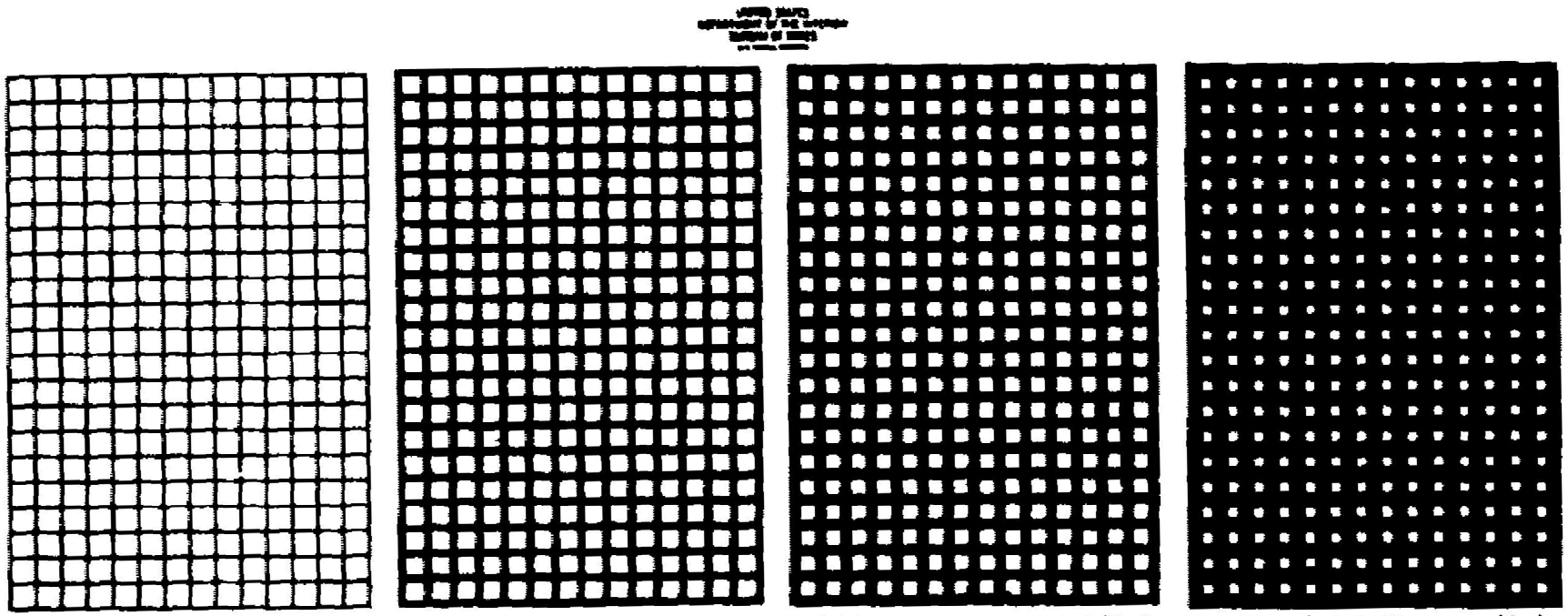


BENZENE: DIFFICULT

Smoke Suppression Methods

- Must combine oxygen with the waste gas
- Steam or gas injection
- LP or HP air injection
- Self-inspirating HP flares
- Assist method selected based on a variety of criteria

Ringelmann Scale



1. Equivalent to 20 percent black. 2. Equivalent to 40 percent black. 3. Equivalent to 60 percent black. 4. Equivalent to 80 percent black.

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Ringelmann Scale

- Commonly used to define the level of flare smoking
- Ranges from zero to five
- One is 20% opaque; five is 100% opaque
- Measured visually
- Ringelmann one and lower is normally considered smokeless
- UOP Callidus normally designs for Ringelmann zero

Ringelmann Scale—Ringelmann Five

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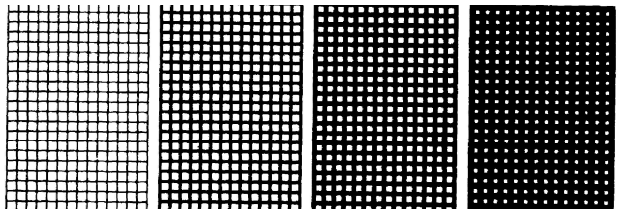
Ringelmann Scale—Best Judgment



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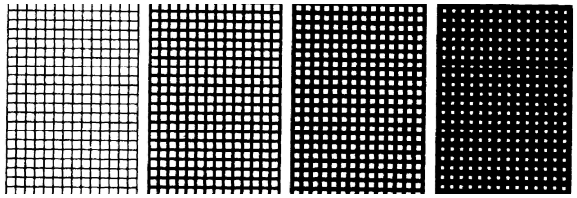
Ringelmann Scale—Best Judgment



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EPA Test Method 22

- US method of measuring smoke density
- Defines the procedure for measuring smoke emissions
- Condensed water vapor is not smoke
- Smoke within the flame is not considered a violation

Smoke Suppression Methods

- Must combine oxygen with the waste gas
- Steam or gas injection
- LP or HP air injection
- Self-inspirating HP flares
- Assist method selected based on a variety of criteria

Flare Noise Sources

- Combustion noise (often calculated using the thermo-acoustic efficiency factor)
- Combustion rumble due to flame instability
- Waste gas jet noise
- Steam injection noise
- Air assist blower noise

Noise Considerations

- Allowable noise often a function of the facility location
- Residential locations are extremely sensitive to nighttime noise emissions

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Flare Noise Control Methods Discussion

- Combustion Noise
- Combustion rumble due to flame instability
- Waste gas jet noise
- Steam injection noise
- Air assist blower noise

Environmental Concerns

- 40 CFR 60.18 originally written to improve destruction efficiency of flares
- Current research is ongoing to revise flare requirements
- Oversteaming and overuse of air assist currently a major concern
- EPA criteria are being revised

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BURNERS	PARTS	FLARES
Matt McSpadden	Debra Wenaas	Steve Freimuth
Jesse Chambers	Brian Yeates	Kurt Kraus
	Albert Septiano	





PROCESS FLARE INSPECTION, REPAIR AND MAINTENANCE

Todd Locke

- Flare Technology Manager
- 2020 Callidus Flare School | Virtual, online, everywhere

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SERVICE GROUP (ONSITE & Virtual)

- Service Group that specializes in all Combustion Technologies
- Domestic Service team / International Service Team
- Partners with UOP and Honeywell
- ISNetWorld, Browz, NCMS, PICS, TWIC Cards, Basic Plus Training, Site Specifics, All Major Safety Council Credentials

- Service Activities
- Jobsite Walks To Identify Layouts and Tie In points to help Customize the Flare Application to fit the Customers Needs
- Remote Flare Schools, Seminars, Lunch and Learns and New Product Introductions
- Problem Troubleshooting Trips
- Spare Parts / Maintenance Recommendations
- Installation Supervision
- Pre-Commissioning / Commissioning
- Start Up Support
- Training
- Performance Test Support
- Flare Inspections / Drone Surveys

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FLARE troubleshooting

	PROBLEM OR OBSERVATION	POTENTIAL CAUSES	ACTION
1	Flare tip will not light	Pilots are not burning.	Light the pilots per the operating instructions.
		Flare gas heating value is too low.	Inject assist gas and confirm composition.
		Excessive steam injection	Reduce the steam injection to cooling steam rate.
		Waste gas flow is too low	Increase flow to minimum purge rate.
2	Flare is smoking	Insufficient steam injection quantity.	Increase the steam rate to the flare tip.
		Steam equipment is damaged.	Inspect and repair the steam injection equipment.
		Insufficient steam pressure.	Increase the steam supply pressure.
		Flow rate exceeds smokeless capacity of tip.	Contact manufacturer for different flare tip.
		Flare gas composition has changed.	Confirm flare gas composition is per design.
3	Panel indicates pilots are not burning	Fuel gas supply has failed.	Confirm fuel gas is available at correct pressure.
		Pilots are damaged or mixers are plugged.	Inspect pilots for tip or mixer failure.
		Pilot fuel lines are plugged.	Inspect and blow out pilot fuel gas lines.
		Pilot ignition lines are plugged.	Inspect and blow out pilot ignition lines.
		Pilot thermocouple has failed.	Perform check on thermocouple at grade.
		Pilot thermocouple wiring has failed.	Perform check on TC wiring at grade and inspect.
		Pilot temperature switch has failed.	Perform check on temperature switch in panel.
		Panel pilot temperature settings not correct.	Correct temperature set points per manual.
4	Cannot light the pilots	Flame front from FFG not reaching pilots.	Confirm ignition lines are clear. Review operating instructions.
		Cannot establish flame front from FFG.	
		Spark plug is not sparking.	Remove and replace the spark plug. Inspect and clean HEI spark probe.
		HEI spark probe is not sparking.	
		HEI ignition wiring has failed.	Inspect and confirm integrity of HEI wiring.
		Pilot fuel gas has failed.	Confirm fuel gas is per specifications.
5	Flame at flare tip is pulsing	Density seal is full of liquid.	Check density seal drain line for obstruction.
		Liquid seal level is not correct.	Confirm liquid seal level is correct (6” is normal).
		Steam injection rate is excessive.	Reduce steam injection rate until yellow flame.

FLARE troubleshooting

	PROBLEM OR OBSERVATION	POTENTIAL CAUSES	ACTION
6	Flare tip body glows red at night	Air is leaking into the flare tip body. Purge gas has failed.	Inspect flare tip and header for air ingress leaks. Confirm continuous purge gas to flare line.
7	Ignition lines on FFG are very hot	Operator is holding down ignition button. Automatic ignition sequence is not correct. Fuel gas composition to FFG has changed. Ignition gas to air ratio not set correctly.	Review operating instructions for manual FFG. Check setting for regulators for automatic FFG. Confirm FFG is designed for available fuel gas. Adjust gas to air ratio per manual instructions.
8	Explosions heard inside flare stack	Continuous purge gas has failed. Air is leaking into flare header or stack. Gas from process contains oxygen.	Confirm continuous purge gas to flare line. Inspect flare stack and header for air leaks. Check process plant for correct operation.
9	Excessive corrosion in base of flare	Oxygen entering flare stack. Water is causing corrosion.	Check for leaks or oxygen in process gas. Confirm drain is open
10	Pilot tip windshield glows red at night.	Pilot is operating correctly.	No action necessary.
11	Flare is noisy	Flame is pulsing. Pilot gas has changed composition.	See section above on pulsing flame. Confirm pilots are designed for correct fuel. Confirm equipment is per original drawings.
12	Cannot regulate air or gas to FFG	Pressure regulators are not installed. Pressure regulators are not installed correctly. Air or gas or ignition lines are plugged. Air or gas supply pressure is too low.	Install pressure regulators in gas and air supplies. Inspect and correct regulator installation. Inspect and blow out lines. Confirm supply pressures are per specification.

FLARE PREVENTIVE MAINTENANCE

At Installation

- Insure Spare Parts are on site
- Record initial operating points, insure comm / startup is correct

Every Six Months

- Inspect Panel. Verify FFG / HEI systems work
- Drain water from piping between panel and stack
- Verify Temps on TC's, replace bad ones
- Verify pilot gas pressure and composition
- Rotate Spare motors / blades
- Verify Purge gas rate
- Verify steam flows
- Verify Gas Assist flows
- Inspect Retractable Systems

Yearly

- Flare Tip Inspection / Drone Inspection
- Inspect guy wires visually
- Verify Spare Parts are on site
- Verify oil in motors
- Insure all operators are trained
- Inspect refractory / insulation / hot spots
- Inspect Liquid Seals / KOP's
- Inspect Piping

Long Term

- Replace oil in motors
- Clean Density Seal Internals
- Replace TC's every 2-3 years
- Replace Pilots every 5-8 years
- Replace Tip every 10-15 years

GENERAL COMBUSTION COMM & START UP ACTIVITIES

Mechanical / Electrical Completion

- Verify installation of all items per the latest P&I,D's
- All critical punchlists should be completed
- All instruments should be calibrated
- Configure all controllers / switches
- All field piping should be tested to last block valve
- Make sure a shop test has been completed on our process rack, if not field test
- All utilities (especially nat. gas) should be supplied to the last block or electrical disconnect before the system
- All field wiring should be verified point to point
- Verify rating / operation of all circuit breakers / switches
- Verify proper grounding in panel
- Stroke all major valves
- Run all rotating equipment, run test, circulate fluids
- Hydrotest Boiler, Certify Boiler other buyout equipment

- **All items above must be completed prior to Callidus coming out for Precomm / Comm / Start Up !!!!!!**

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GENERAL COMBUSTION COMM & START UP ACTIVITIES

Pre-Commissioning

- Apply power to the system and function check each end devise via PLC or DCS
- Ensure all field device inputs are on line and reading within design
- Verify loop action on all loops
- Simulate all alarms and shutdowns
- Make sure all timers are set properly
- Verify all limit switches
- Verify all ESD's
- Verify all Thermocouple's
- Align / certify ID Fans, major equipment
- Bring all utilities online for the system
- Verify all shutdowns and permissives

Commissioning / Start Up

- Commission all liquid systems
- Commission all combustion and quench air processes
- Light the pilot
- Ramp up temp to Boiler boil out temp
- After boil out, shut down if req'd and clean out (see Boiler manufacturer recommendations)
- Light the main burner, Start dry out if required
- With all controls in manual run the dry out up
- After completion of dry out set the fuel gas minimum flow on control valve
- Bring control loops on line and tune as required
- Verify all permissive and shutdowns under operating conditions
- With system at normal operation introduce waste to the system
- Optimize and tune the system as required
- Verify waste shutdowns if required

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FLARE START UP checklists

VISUAL INSPECTION

1) Panel appearance (color, arrangement, mounting, door seals intact, handling damage, etc).
2) Check conduit arrangement and size.
3) Check Callidus nameplate for proper information.

INSTRUMENTS

1) Verify installation of all instruments per P&ID and instrument location plan.
2) Check instruments for proper installation and connections.
3) Check height and spacing for accessibility.
4) Check instrument tags for proper identification per job requirements.

SKIDS / PIPING /CONDUIT AND WIRING

1) Check for bracing, structural integrity and shipping damage.
2) Check conduit installation per Area Classification.
3) Check conduit runs for horizontal / vertical alignment, verify correct supports, check arrangement of drains, seals, etc.
4) Verify flex conduit is installed to allow movement without low points.
5) Check ground lug(s) for proper installation.
6) Operate manual valves to ensure they open and close properly.
7) Verify piping is installed per project pipe specifications, sloped per project drawings, and have been blown clean of debris.

MECHANICAL

1) Check piping supports are installed with anchors and piping guides located as per drawings.
2) Verify vessels are installed on foundations properly and are plumb.
3) Check ladders and platforms are properly installed.
4) Check structural steel is installed per drawings, verify items specified as finger tight to allow thermal growth.
5) Check guy wire tension is per project drawings.

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FLARE START UP checklists, cont'd

SYSTEM OPERATIONAL CHECK

PLC

1) Verify PLC communications if applicable.
2) Check PLC configuration.
3) Verify PLC program is loaded.

VERIFY LOGIC

1) Functional check per electrical schematics.
2) Verify all digital I/O. Simulate as required with switch box with indicating lamps)
3) Verify proper operation of analog loops. Simulate as required with signal calibrator.
4) Confirm calibration of all trip points.
5) Check all annunciator points.
6) Check valve operation and failure position.
7) Verify damper operation (if possible).

FUNCTIONAL CHECK

1) Simulate actual start-up, operation and shutdown.
a) All alarm & shutdown limits function as designed.
b) All timers properly set.
c) Limit switches properly adjusted and functional.
d) ESD functions properly.
e) Thermocouple "burnout" protection correct.
f) All limits function in "fail - safe" mode.

STARTUP CHECKLIST

PRELIMINARY SETTINGS

1) Verify power switch is in the OFF position.
2) Verify power cable is connected to panel.
3) Place Pilot(s) selector switch(es) in the off position.
4) Place Power Switch in the ON position.
5) Verify Power on light is illuminated, and Pilot(s) indicate pilot OFF or LOW alarm.
6) Verify flare system has been appropriately purged.

HEI IGNITOR OPERATION

1) Verify pilot gas pressure control valve is set per PID.
2) Place pilot 1 switch in the MANUAL position.
3) Press and hold MANUAL pilot ignition switch,
(HEI ignitor will attempt to light/spark 1 per second)
4) Confirm pilot is lit by observing the pilot OFF illuminator goes out and/or pilot ON indicator turns on.
5) Once pilot has been confirmed to be lit, place pilot switch in AUTO.
6) Repeat steps 1-5 for each pilot.

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FLARE START UP CHECKLISTS, cont'd

FFG IGNITOR OPERATION

1) Turn off pilots by placing the HEI ignition switch in the OFF position.
2) Verify ignition gas/air isolation ball valves are open.
3) Verify ignition gas/air pressure control valves are set per project PID.
4) Place FFG selector switch in manual.
5) Open FFG ignition valves allowing fuel/air mixture to flow to the pilot tip.
6) Wait the proscribed amount of time, and press the FFG ignition swtich, repeat as necessary.
7) Confirm pilot is lit by observing the pilot OFF illuminator
8) Repeat steps 1-5 for each pilot.

FUNCTIONAL TEST

FLARING

1) Ensure power is on control panel as per section III above.
2) Verify flare system has been appropriately purged.
3) Verify all flare gas manual block valves are in the closed position.
4) Open manual block valves for all stages
5) Introduce flare gas.
6) Verify flare gas staging valves open and close as per the set pressures if applicable.
6) Verify assist medium operation if applicable.
7) Verify cross lighting between burners if applicable.
8) Verify smokeless operation per contractual guarantees.
9) Verify noise tests as per contractual guarantees.

FLARE INSPECTIONS USING DRONES

ADVANTAGES:

- *CALLIDUS DOES NOT OFFER DRONE SURVEYS, WE OFFER FLARE INSPECTIONS*
- Flare SME on site for each inspction
- Full understanding of Flares, where to inspect, what to look for
- Access to home office for consulting
- Inspect at Grade: Panels, KOP's, LS's, Piping
- Verify retractable systems, pilot gas conditions, tip integrity
- FAA certified pilots
- Multiple drones / cameras
- Full report hightlighting issues, troubleshooting causes, providing solutions
- Fully trained to all site requirements / adhere to stringent safety protocols
- Spare Parts Recommendations
- Can offer training, commissioning, startup

Aircraft description:

- Multiple Drones (DJI M-600 and many others)
- Multiple controllers/screens, for dual operator capability
- Multiple sets of batteries plus additional chargers
- Fail safe / return to home
- Lose of power / over temp alarms

Payload Description:

- Thermal Imaging to determine hotspots
- Video to analyze flame patterns, record smoking
- Multiple cameras with multiple zooms for all conditions

Aircraft Performance Specifications:

- Max Flight Time / set of batteries: 25 minutes
- Max wind: 30mph
- Number of motors: up to 6

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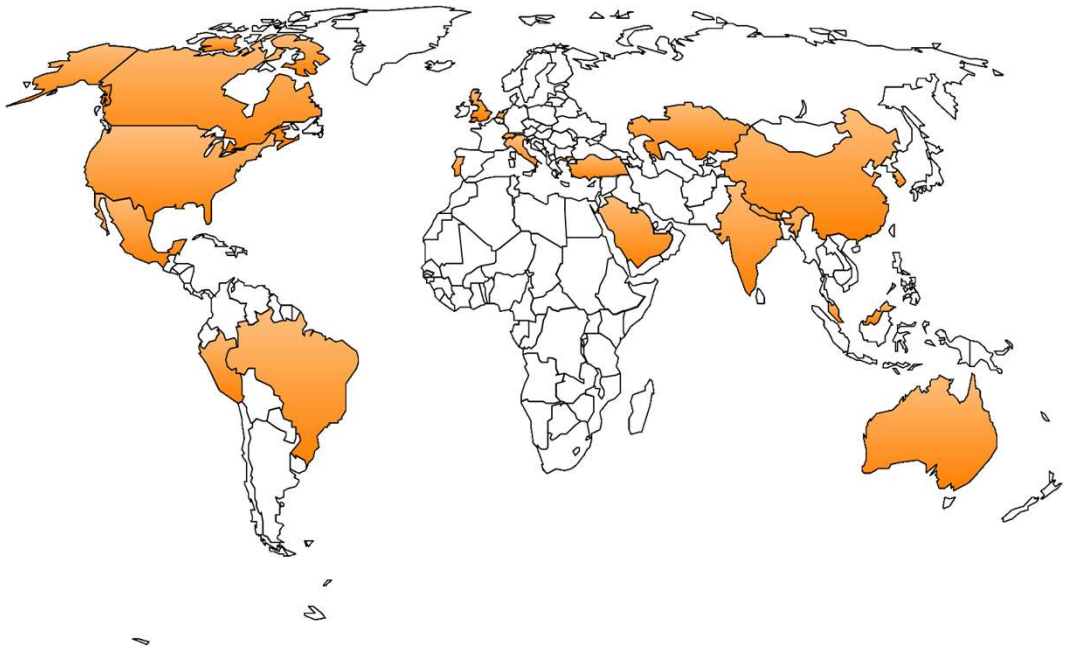
INSTALLATIONS / SUPERVISIONS

Callidus has had a stand alone “installation” group since the mid 90’s and over that time we have developed relationships with installers around the world. This experience and product feedback puts us in a position to better understand and design our systems for the best overall turnkey approach. Our in-house installation group will live with the project from the proposal stage all the way thru the installation.

BENEFITS

- In house team will Manage Project, do Planning and Scheduling
- Some customers have limited resources or expertise to manage installation
- Some jobsites have limited resources to install the product
- Work with repeat Installers
- Have Supervisors based around the world (USA, Singapore, Italy, Australia, China)
- Experts will be on site
- Direct Line of communication to home office
- Instantly able to Troubleshoot and correct problems
- Shipping Coordination
- Direct Customer Interface

Locations of installations



Partial List

- Belgium
- Brazil
- Canada
- China
- France
- Greece
- India
- Indonesia
- Korea
- Kuwait
- Mexico
- Netherlands
- Puerto Rico
- Qatar
- Saudi Arabia
- Taiwan
- United Arab Emirates
- United Kingdom
- United States
- Algeria
- Nigeria
- South Africa
- Turkey
- Norway
- Russia
- Kahzakstan
- Peru
- Singapore
- Venezuela
- Trinidad
- Kuwait
- Spain
- Taiwan
- Thailand
- Pakistan
- Egypt

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175’ SELF SUPPORTED FLARE
500’ GUYED FLARE

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REWORK MPGF

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TEGF NEXT TO MPGF

WINDE FENCE COLUMNS

WINDFENCE PANELS

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TEGF

350’ TALL ONE PIECE LIFT

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UPPER PIECE LIFT

THERMAL OXIDIZER

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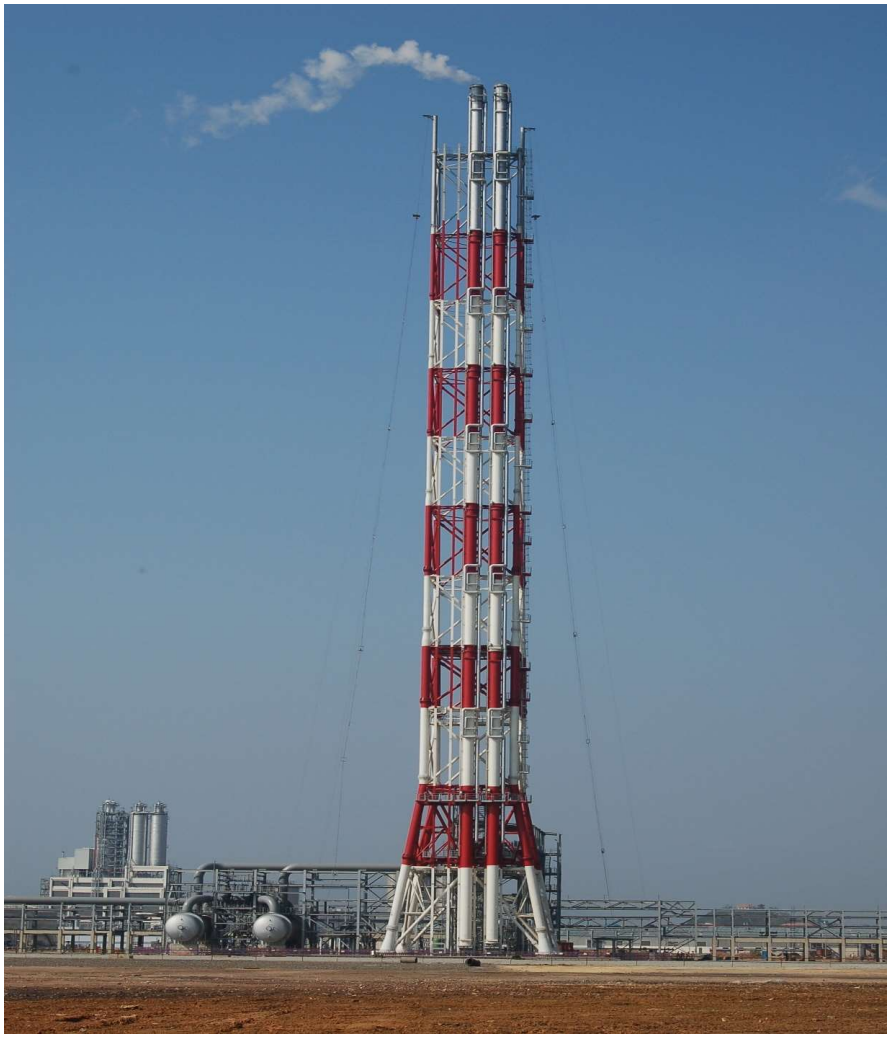

DEMOUNTABLE FLARE

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DEMOUNTABLE FLARE

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BURNERS WITH JACKSHAFT

BURNERS

MODULARIZATION

The single biggest mistake that customers can make is purchasing the equipment without considering the installation costs. When the equipment arrives on site, it is too late to customize it to provide the cheapest overall installed price. "Modularization" transfers the workload from the field to the shop and will provide a better quality product at a cheaper cost:

BENEFITS

- Better QUALITY in a shop
- Cheaper shop rates vs field rates
- Less Troubleshooting Problems
- Less chasing missing parts
- Shorten the field Schedule, delays
- Consolidate shipping, fewer shipments
- Eliminate crane / equipment durations
- Don't have to use already Limited field resources
- Eliminate Cust. Overhead costs, weather delays

MODULARIZATION EXAMPLES

- Increase Shipping Lengths: ship up to 100' plus lengths
- Add trunnions for one piece lifts, Limit "in air" welds
- Shop fab < 2" piping and ship in place
- Shop install L&P's in place
- Shop mount Control Panels to base of Flare
- Flat Packs for TEGF's: Can ship Ceramic Fiber Modules preinstalled on panels
- MPGF Runner Modules: Can weld Tips / Risers to Runners, Dress out Runners
- Thermal Oxidizers: Shop Install Refractory / Rain, Heat Shields
- Skid Mound Products to eliminate field piping
- Tripod Flares: To eliminate foundations

TEGF

ONE PIECE LIFT

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RENTAL SYSTEMS

Whether you are in a full turnaround, just doing temporary maintenance or have a special need, Callidus can provide a wide variety of rentals, custom fit for most applications. We have units ready and waiting or we can make one especially for your needs.

RENTAL UNITS AVAILABLE

- Pipe Flares
- Steam Assist Flares
- Air Assist Flares
- Pipeline Flares
- Thermal Oxidizers
- Trailer Mounted Flares
- Tripod Flares
- Cold Flares

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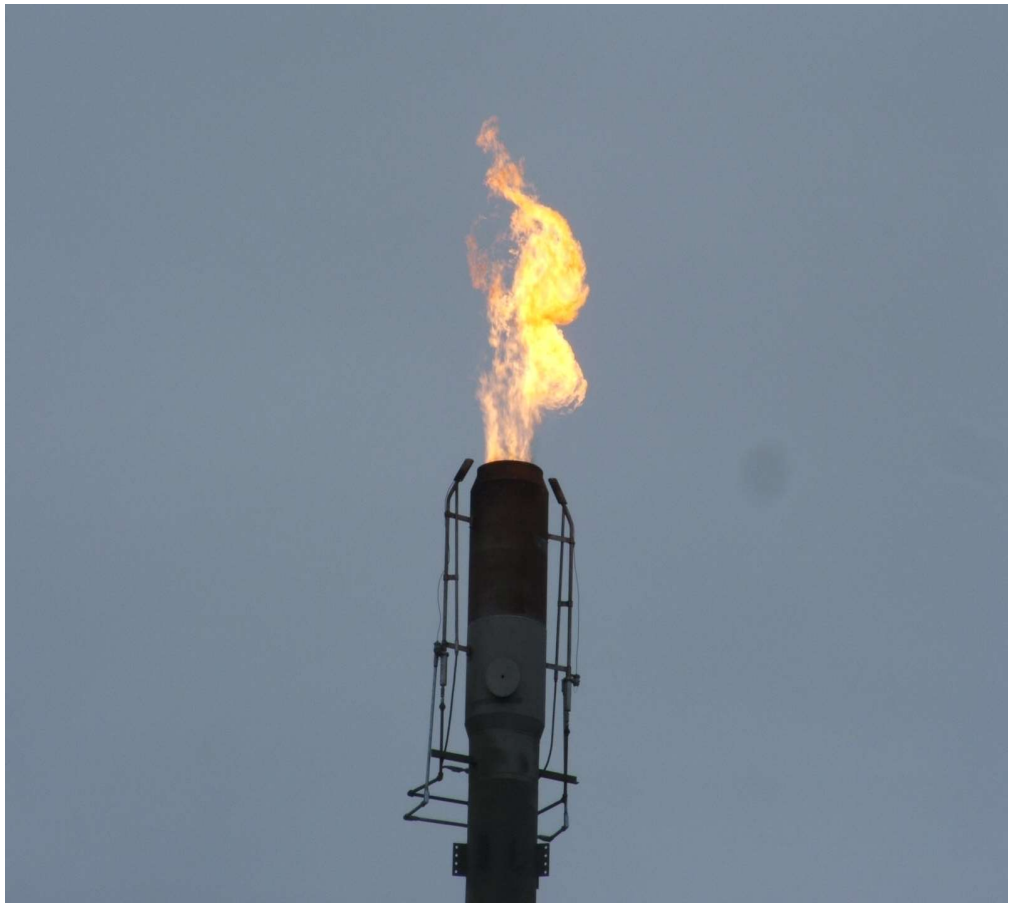

70’ RENTAL

GUYED RENTAL

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TANK RELIEF TRAILER MOUNTED

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SS: COLD TEMP FLARE

TRIPOD

THERMAL OXIDIZER

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Email: CallidusPartsInquiries@Honeywell.com

BURNERS	PARTS	FLARES
Matt McSpadden	Debra Wenaas	Steve Freimuth
Jesse Chambers	Brian Yeates	Kurt Kraus
	Albert Septiano	