

CeRam-Kote Coatings Incorporated

Flare Stack Division

CLIENT NAME

CLIENT PROJECT

**FLARE SYSTEM
4" x 25' OAH FLARE SYSTEM**

PROJECT NO. #####

Prepared By:

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FLARE SYSTEM STUDY
4" X 25' OAH

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1. INTRODUCTION

This document summarizes the specifications and results of flaring hydrocarbon gas stream per the process gas data specified in this document. The flare system used to generate this data is open pipe-type, 4-inch in diameter and 20-ft overall height.

2. GAS & CHEMICAL ANALYSIS

Process Design Conditions		
Site Location / Name:		
Elevation		ft
Gas Flow:		MMSCFD
		Others
Gas Composition (mole %): (Gas composition is not provided. We will assume natural gas with approximate MW of 18 with mostly C1 products and traces of C2).	Gas	Mole %
	CH ₄	
	C ₂ H ₆	
	C ₃ H ₈	
	C ₄ H ₁₀	
	C ₅ H ₁₂	
	C ₆ H ₁₄	
	C ₇ H ₁₆ +	
	N ₂	
	CO ₂	
H ₂ S		
Flare Gas Temperature	Assume 80 -100	° F
Flare Gas Pressure @ base of stack:	As specified below	PSIG
Smokeless Requirement:		%

MW	18.00		
S. H. Ratio	1.25	AT 15'C	
HHV	1081.0	BTU/SCF	
LHV	1008.0	BTU/SCF	
LEL	4.40	%	
UEL	14.79	%	

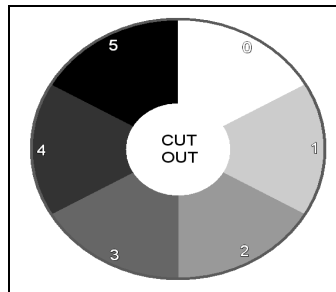
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3. COMBUSTION ANALYSIS

Preliminary Performance (RINGELMANN #): Based on gas composition specified

See chart below.

RINGELMANN & OPACITY CHART			
% Light Transmission		Plume % Opacity	
0		100	5
20		80	4
40		60	3.0
60		40	2
70		30	1.5
80		20	1
100		0	0



$0 \leq R \leq 2$ (with 80 - 90% CH₄ & 10 - 20 %C₂H₆ Gas)

Note: RINGELMANN number above is based on steady flow rates and calm to low winds.

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4. HYDRAULIC ANALYSIS

4" x 25' FLARE SYSTEM	
Flare Diameter (Overall)	4-inch
Max Flow Rate	2.95 MMSCFD
Approx. MW	18
Approx. NHV/GHV	1008/1081 Btu/SCF
Flare Gas Temperature	80-100 deg C
Flare Gas Inlet Pressure @ base	< 2 PSIG
Max Exit Velocity ft/sec	Per EPA 40 CFR, Section 60.18 403 ft/sec
MACH #	< 0.3
Purge Gas w/ velocity seal (min)	~ 20 SCFH (using nat.-gas) ~ 15 SCFH (using N2)

Flare Performance			
Pressure	Volume Flow	Mass Flow	Velocity
PSIG	MMSCFD	#/hr	ft/sec
0	0	0	0
0.01	0.2	395	27
0.04	0.4	790	55
0.08	0.6	1186	82
0.14	0.8	1581	108
0.21	1	1976	136
0.46	1.5	2964	203
0.80	2	3952	271
1.25	2.5	4940	338
1.80	3	5928	406

Note:

Per EPA 40-CFR, the exit velocity of a gas with this NHV and MW is 400 ft/sec.

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5. PRELIMINARY RADIATION ANALYSIS

DOWNWIND RADIATION ANALYSIS BASED ON 20-FT OAH

Max Flame Length @ 3 MMSCFD is approximately 45-ft.

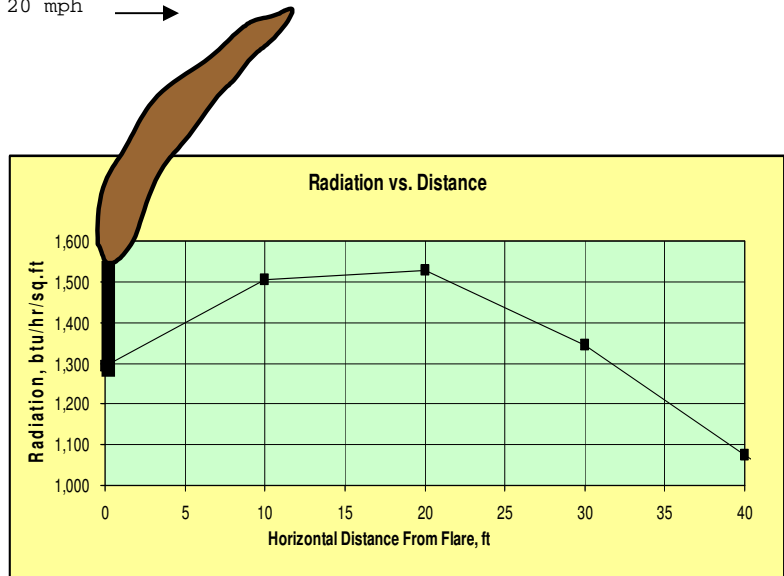
Flame coordinates @ 20 MPH winds:

X Coordinate: 32-ft

Y Coordinate: 22-ft

20 mph →

Distance, ft	Btu/hr/ft ²	Notes
-	1294	Personnel with appropriate clothing can be continuously exposed to the flare under maximum flaring conditions at APPROX. 55-ft downwind. See API Guidelines below for further details
10.0	1505	
20.0	1528	
30.0	1345	
40.0	1074	
50.0	822	
60.0	624	
70.0	480	
80.0	375	
90.0	299	
100.0	242	
110.0	200	
120.0	167	
130.0	142	
140.0	122	



Excluding Solar Radiation

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6. PRELIMINARY NOISE ANALYSIS

Noise calculations								
Hz	63	125	250	500	1KHz	2K	4K	8K
Jet	85.2	86.2	84.4	80.6	76.0	71.3	67.6	65.9
Shock	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Combustion	135.7	130.0	123.7	116.8	109.5	101.6	93.1	84.1
Distance =	18.3	M					Directivity	90.0
SPL dB(A) =	83.7							

7. DISPERSION/PLUME ANALYSIS

Not required for this analysis.

8. SCOPE OF SUPPLY

- Scope of Supply to include:
 1. Utility Flare, 4" x 6' 316L SS with 4" 150# ANSI, A-105 inlet flange.
 2. One (1) **Model # pilot** with thermocouple.
 3. Flare Stack- **As Specified Below**. Overall height: 25-ft (including the tip). Material: SA-516-70 or equal.
 4. One (1) **Model #** ignition control panel in NEMA 4X electrical enclosure.
 5. One (1) Ignition control panel free standing rack. Panel will be located @ radiation safe location downwind the flare-stack.
 6. Purge seal not applicable with 4-inch flare tip.
 7. One lot of utility piping & cables from flare tip to grade.
 8. Ladders and platforms are not required with 20-ft flare stack.
 9. Engineering flare reports, design and drawings.
 10. Coating and painting per manufacturer standard

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9. CONCLUSION

- Based on the models presented in this report, personnel may have continuous exposure outside the 500 Btu/hr/ft² zone limits shown above, under continuous flaring without protective shielding but with appropriate clothing. See API-521 Guideline below.
- Predominant wind direction as shown above.
- Estimated Surface Temperatures:

Temperature Profile		
Radiation Btu/hr.ft ²	Temperature @ 0 MPH wind (° F)	Temperature @ 20 MPH wind (° F)
2,500	141 Attained in approx. 10 min	134 Attained in approx. 10 min
1,500	123 Attained in approx. 20 min	112 Attained in approx. 20 min
1,000	112 Attained in approx. 20 min	103 Attained in approx. 20 min

• **API-521 Guideline for Radiation Intensities:**

INTENSITY BTU/HR/FT ² (W/M ²)	GUIDELINE FOR USAGE OF HEAT INTENSITIES (Ref: API Std. 521, 2008)
3000 (9465)	<ul style="list-style-type: none"> ☐ Required urgent emergency action. Radiation shielding and/or special protective apparel (e.g. a fire approach suit) required ☐ Exposure must be limited to a few (approx. six) seconds, sufficient for escape only. May consider tower or structure provide some degree of shielding. ☐ Radiation shielding and/or special protective apparel such as fire approach suite should be considered.
2000 (6310)	☐ Personnel may be exposed up to 30 seconds without shielding but with appropriate clothing ^{note 1} ,
1500 (4730)	☐ Emergency actions lasting 2 min to 3 min without shielding but with appropriate clothing.
500 (1580)	☐ personnel with appropriate clothing can be continuously exposed
Notes	
1)	Appropriate clothing consists of hard-hat, long-sleeved shirts with cuffs buttoned, work gloves, long-legged pants and work shoes.
2)	Appropriate clothing minimizes direct skin exposure to thermal radiation.

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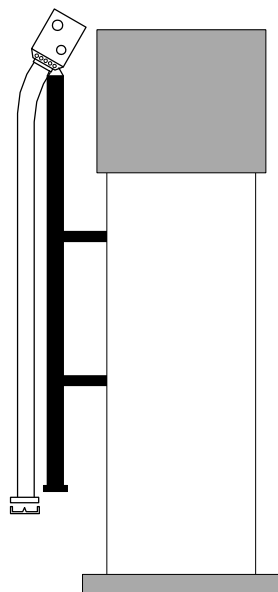
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10. APPENDICES

APPENDIX A: FLARE DATA SHEET

4 Inch-UTILITY FLARE SPECIFICATIONS		REF NO: Nov 2013
PROCESS DATA		
GAS STREAM		
FLOW MAXIMUM	3 MMSCFD	
FLOW MINIMUM	PURGE	
MOLECULAR WEIGHT	18	
TEMPERATURE	80 °F	
PRESSURE DROP	< 2.0 psig	
UTILITIES		
PILOT FUEL GAS	50-100 SCFH (per pilot)	
PURGE GAS (Nat Gas)	15 SCFH min, Nat-Gas	
PILOTS		
QUANTITY	One	TYPE FFG or Electronic
THERMOCOUPLES	TBD	TYPE TBD
DIMENSIONS (approx.)		
HEIGHT	10' - 0"	WIDTH approx. 10"
WEIGHT	(TBD) LBS	
MATERIALS		
BODY 316L SS		
ECCENTRIC REDUCER N/A		
PILOT (6-ft) 316L SS		
PILOT NOZZLE CAST INCOLOY 800H		
INSPIRATOR PLATE 316L SS		
IGNITION 316L SS		
SURFACE FINISH / PAINT (carbon steel)		
SANDBLAST SP-6		
PRIMER CZ-11 2-3 mil		
TOP COAT Client's specs		
NDE		
RADIOGRAPHY 10 % of butt welds		
OTHER RADIOGRAPHY none		
TERMINAL POINTS		
GAS INLET	4"	Class 150 RFWN A-105
PILOT INLET	1"	Class 150 RFWN A-105
IGNITION INLET	1"	Class 150 RFWN A-105
REMARKS		



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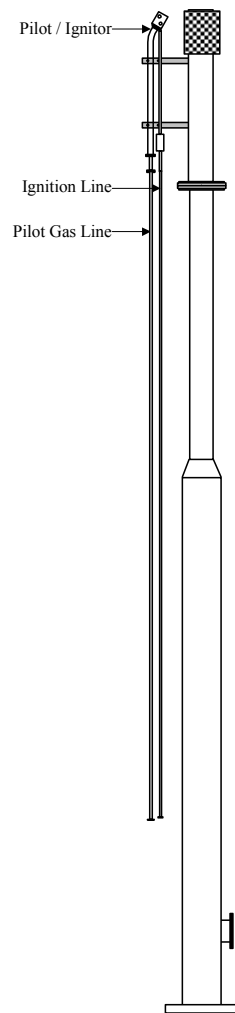
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APPENDIX A: GA DRAWING

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This drawing is preliminary and may not reflect the final design



Stack Design Specifications

STRUCTURAL Design Code: TBD
Overall Height: 25-ft
Support Structure Type: Self Supported
Max. Wind Speed: (TBD) MPH
Exposure: "C"
Importance Factor: 1.0
Earthquake Zone: (TBD)
Deflection Criteria: Not Applicable
External Nozzle Loads: Assumed Zero
Corrosion Allowance CS: 1/16"

Material Specifications

Utility Piping: A-106 Gr B
Flanges: Class 150 A-105
Stack Riser: A-106 Gr B or Equal

Ladders & Platforms (N/A FOR THIS HEIGHT)

Surface Preparation Specifications

Per Specifications

Inspection & Testing Specifications

Radiography: 10% Random X-ray
Other Weld Exam: Not Applicable
Pressure Test: Not Applicable
Alignment Check: Trial Fit up of Riser & Attachments at Shop
Coat Film Thickness: Nordson Dry Film Gage