

เอกสารข้อมูลอัตราการแผ่รังสีความร้อนของโครงการ  
และ Procedure Start-Stop Flare Stack และสถิติการใช้หอเผาทิ้ง (Flare)

# ZEECO, INC

CLIENT: PTT Asahi Chemical Co. Limited  
(PITAC)  
PLANT: AN AND MMA Project  
PROJECT: 07X5772A  
CLIENT P.O. NO: LOI#08P100A-F0005  
PTTAC DOC NO: Z4-0801.01-FK7.010A-011-M

ZEECO DOCUMENT NUMBER: 17678- 1101

ZEECO S.O: 17678

## FLARE SYSTEM

## RADIATION CALCULATIONS

<input checked="checked" type="checkbox"/> E: Work May proceed.	
<input type="checkbox"/> F: Work May proceed, Submit final drawings.	
<input type="checkbox"/> G: Revise and Resubmit. Work may proceed subject to incorporation of changes indicated.	
<input type="checkbox"/> H: Revise and Resubmit, Work may not Proceed.	
<input type="checkbox"/> I: Review Not Required, Work May proceed. Submit / Resubmit with _____ Days	
THIS REVIEW DOES NOT RELIEVE THE CONTRACTOR OF HIS RESPONSIBILITY FOR ERRORS IN DESIGN	
By: <input type="text"/>	Date: 7/17 '09



REV	DATE	BY	APPROVED	DESCRIPTION
2	09-JUL-09	DLL	SLK	FOR APPROVAL
1	08-APR-09	DLL	KAN	FOR APPROVAL
0	31-MAR-09	DLL	KAN	FOR APPROVAL



**Zeeco, Inc.**

**Client:** CTCI  
**End User:** Asahi Chemical  
**Project Name:** AN and MMA Project  
**Client PO#:** LOI#08P100A-F0005

**Zeeco Document Number:** 17678-1101 rev 2  
**Zeeco Ref:** SO 17678  
**Date:** July 9, 2009  
**Location:** Thailand

## Flare Height Sizing / Radiation Calculations

Rev	Date	By	Approved	Description



# Zeeco, Inc.

**Client:** CTCI  
**End User:** AN-MMA  
**Project Name:** AN and MMA Project

**Zeeco Document Number:** T70439F-RAD-CALC  
**Zeeco Ref:** T70439F Rev. Final  
**Date:** July 9, 2009

**Client Ref:** AN-MMA

**Location:** Thailand

## Stack Height Calculations Per API RP-521 Fourth Edition, March 1997 Appendix 'C', Section C.3

### Design Basis

Maximum Cumulative Allowable Radiation: 1,500 Btu/hr-ft<sup>2</sup>  
Solar Radiation (Included in Maximum Cumulative Allowable Radiation above): 300 Btu/hr-ft<sup>2</sup>

NOTE: API RP-521 radiation calculation does not include solar radiation, therefore the design basis for radiation used in these calculations shall be:

*Max. Cumulative Allowable Radiation - Solar Radiation:* 1500 - 300 = **1,200 Btu/hr-ft<sup>2</sup>**

Wind Velocity: 30 ft/sec  
Flare Tip Diameter: 54 inches  
Flare Gas Flow: 220,460 lb/hr  
Flare Gas MW: 44.1  
Flare Gas Temperature: 122 Farenheit  
Relative Humidity: 60.8 %

Specified Radiation Point of Interest: 98.4ft (30) from base of flare stack

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**Zeeco Ref:** T70439F Rev. Final  
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**Location:** Thailand

## Basic Radiation Calculation Formula: $D^2 = \tau FQ / 4 \Pi K$ where:

D = distance from center of flare flame to point of interest for radiation in feet  
 $\tau$  = fraction of heat intensity transmitted. (cannot be greater than 1.0) Value decreases with increase in humidity.  
F = fraction of total heat release emitted as radiant heat. This value is typically set by the flare system supplier based on testing data.  
Q = total heat release based on lower heating value of the gases being flared. This is expressed in Btu/hr units.  
 $\Pi$  = constant with value of 3.14159  
K = allowable or resultant radiation value at the point of interest given in Btu/hr-ft<sup>2</sup>  
R = radius from stack base to point of interest

D = unknown  
 $\tau$  = unknown  
F = 0.33  
Q = 4094569960 Btu/hr  
 $\Pi$  = 3.14159  
K = 1,200 Btu/hr-ft<sup>2</sup>  
R = 98.4ft (30m)

## Calculation of Flame Center

### Gas Discharge Velocity = $U_j$

For the Zeeco flare tip, the exit velocity for this case is:  $U_j = 42$  ft/sec  
The design wind speed is:  $U_a = 30$  ft/sec

Therefore:  $U_j / U_a = 1.4$

We also know that:  $M_j = \text{Flare Gas MW} = 44.1$   
And that:  $M_a = \text{Ambient Air MW} = 29$

Therefore:  $M_j / M_a = 1.521$

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## Calculation of Flame Center (Continued)

Reference: API RP-521, Appendix C.3, Location of Flame Center C.3.3.

$$CL = C_{L1} (U_j/U_a) \times (M_j/M_a)$$

$C_{L1} = 0.021$  (for the 44.1MW flare gas on this project) = L.E.L. (As Required by NCRA)

$$CL = 0.021 (42 / 30) \times (44.1 / 29)$$

$$CL = 0.045$$

$$djR = dj(U_j/U_a) \times (Ta/Tj \times Mj)^{1/2}$$

$$djR = (54/12) (42/30) \times (520/582 \times 44.1)^{0.5}$$

$$djR = 40$$

From Figure C-2a:  $X_c = 179.7$  ft

From Figure C-3a:  $Y_c = 36.7$  ft

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## Calculation of Flare Stack Height

$$D = [(\tau \times F \times Q) / (4 \times 3.14159 \times K)]^{1/2}$$

$$\tau = 0.79 \times (100/r)^{1/16} \times (100/D)^{1/16}$$

Solving for D using tau is an iterative process, typically started at tau = 1.0.

For: r = 61 % and D = 271 ft

tau = 0.766

Checking D, using calculated tau:  $D = [(0.766 \times 0.33 \times 4094569960 \text{ Btu/hr}) / (4 \times 3.14159 \times 1200)]^{0.5}$

D = 262 ft

## Determination of Flare Stack Height

Referencing API RP-521, Appendix 'C', C.3.5

Stack Height is defined as "H".

$$H = D - Y_c$$

$$H = 262 - 36.7 = \underline{\underline{225.3 \text{ feet tall}}} \quad \underline{\underline{68.7m}}$$

The above height (H), is the height of the flare stack required to meet the required radiation at any grade level location.

If there is a specific point of interest for radiation on this project, proceed to the next section.

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## Determination of Flare Stack Height Using a Specific Point of Interest

From Figure C.1 of the API RP-521, we know the following:

$$D^2 = R'^2 + H'^2$$

$$H' = H + Y_c$$

$$R' = R - X_c$$

Solving for R', we get:  $R' = 98.4 - 179.7 = -81.3$  feet

Now, solving for H':  $H' = (D^2 - R'^2)^{1/2} = (271.3^2 - (-81.3)^2)^{0.5}$

$$H' = 249 \text{ feet (75.9m)}$$

Therefore, the stack height required is:

$$H = H' - Y_c$$

$$H = 249 - 36.7$$

$$\underline{H = 212.3 \text{ feet tall (64.7m)}}$$

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## PTT Asahi Chemical Company Limited

Title: Start-Stop Flare stack (VR-220)

Document No: WI-AN-8063

Revision No: 1

Effective date: 16-Jul-18

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สถิติการใช้งานอุปกรณ์ห่อเผา (Flare) ในกรณีฉุกเฉิน ระหว่างปีพ.ศ. 2563 – 2566  
บริษัท พีทีที อาซาฮี เคมิคอล จำกัด

ปีพ.ศ.	สถิติการใช้งานอุปกรณ์ห่อเผา (Flare) ในกรณีฉุกเฉิน (ครั้ง)	ระยะเวลา	สาเหตุ
2563	0	-	-
2564	0	-	-
2565	0	-	-
2566	0	-	-