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Page 1 of 1

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1	/	Design Authority GP Janicek	<i>[Signature]</i>	9/25/98	S7-12	1	/	Project Mgr. R.E. Hanson	<i>[Signature]</i>	10/1/98	S7-12
1	/	Design Agent BL Coverdell	<i>[Signature]</i>	9/25/98	S7-12						
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18. BL Coverdell Signature of EDT Originator		19. RN Dale Authorized Representative For Receiving Organization		20. JS Schofield Design Authority/Cognizant Manager		21. DOE APPROVAL (if required) Ctrl No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments	
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Date		Date		Date			

Stress Analysis of Down Force Calibration Stand

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U.S. Department of Energy Contract DE-AC06-96RL13200

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Abstract: This document presents the stress analysis of the Down Force Calibration Stand. All structural components were evaluated and found to be adequate to withstand the applicable design loads meeting all codes and standards requirements.

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Date

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STRESS ANALYSIS OF THE DOWN FORCE CALIBRATION STAND

B. L. Coverdell

COGEMA ENGINEERING CORPORATION

July 22, 1998

CHECKLIST FOR INDEPENDENT REVIEW

Document Reviewed: STRESS ANALYSIS OF DOWN FORCE CALIBRATION STAND

Author: B. L. CoverdellDocument No. HNF-3106, Rev. 0

Yes No N/A

☒	☐	☐	Problem completely defined.
☒	☐	☐	Necessary assumptions explicitly stated and supported.
☐	☐	☒	Computer codes and data files documented.
☒	☐	☐	Data used in calculations explicitly stated in document.
☒	☐	☐	Data checked for consistency with original source information as applicable.
☒	☐	☐	Mathematical derivations checked including dimensional consistency of results.
☒	☐	☐	Models appropriate and used within range of validity or use outside range of established validity justified.
☒	☐	☐	Hand calculations checked for errors.
☐	☐	☒	Code run streams correct and consistent with analysis documentation.
☐	☐	☒	Code output consistent with input and with results reported in analysis documentation.
☒	☐	☐	Acceptability limits on analytical results applicable and supported. Limits checked against sources.
☒	☐	☐	Safety margins consistent with good engineering practices.
☒	☐	☐	Conclusions consistent with analytical results and applicable limits.
☒	☐	☐	Results and conclusions address all points required in the problem statement.

Reviewer: _____

T. S. Hundal

Date: 9/25/98

DESIGN VERIFICATION METHOD

The need for design verification has been reviewed with the method selected as indicated below:
(Work Plan # NA / _____).

 x Independent Review
 Alternate Calculations
 Qualification Testing
 Formal Design Review

RN Dale Bde
9/25/98
GP Janicek / BL Coverdell / ~~DS Haring~~
Design Authority / Design Agent / Cog. Engr.

DOC #HNF-3106, Rev. 0

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APPENDIX A: CALCULATIONS A-1

1.0 INTRODUCTION

This analysis evaluates the structural adequacy of the Down Force Calibration Stand (DFCS). The DFCS will be used to safely calibrate the electronic and mechanical components used in determining the down force applied by a Core Sample Truck (CST) drill rig.

2.0 SUMMARY OF RESULTS

The calculations determined the overall weight of the DFCS (approx. 200 lb.) and that the DFCS is adequate to support the 5,700 lb. down force applied by a CST drill rig.

3.0 DISCUSSION

Currently, a steel spring type DFCS is used to calibrate the down force of a CST drill rig. This type of DFCS has been deemed unsatisfactory and unsafe for use. The new DFCS uses an air spring instead of four steel springs. The air spring is allowed to move in the vertical direction by the use of four hardened steel rods and ball bushing bearings. The drill string thrusts against an aluminum push block. This block then rests on a thrust bearing which allows the drill string to rotate.

The air spring in conjunction with the bushing bearings and rods will provide a more stable platform for down force and it will also provide a safer means of calibration.

4.0 RESULTS AND CONCLUSIONS

The calculations in Appendix A determined that the DFCS is adequate to support the 5,700 lb. down force applied by the hydraulic rams on a CST.

5.0 REQUIREMENTS

Following are the only requirements for use of the DFCS:

- 1) For the 0 lb. to 1000 lb. load test the air spring must be inflated just enough to support the upper pillow block plate and the parts attached to it.
- 2) For the 4000 lb. to 5700 lb. load test the air spring should be inflated to approximately 58 psi.
- 3) The DFCS must be placed on a solid surface such as concrete or plywood.
- 4) The solid surface must not be out of level by more than 5 degrees.
- 5) The DFCS must be leveled using the four swivel pads mounted on threaded rod.

The air spring inflation pressure requirements ensures that the air spring will resist down force of the CST hydraulic rams and allow the maximum stroke. The solid surface requirement ensures that the DFCS will remain in a stable upright position. The 5 degree level requirement ensures that the four swivel pads will be used to keep the DFCS level. Keeping the DFCS level ensures that no horizontal loads will be applied and failure due to bending or buckling of the rods will not occur.

6.0 REFERENCES

AISC, 1989, *Manual of Steel Construction*, ninth Edition, American Institute of Steel Construction, Chicago, Illinois.

Kleinlogel, A, 1956, *Rigid Frame Formulas*, Fredrick Ungar Publishing Co., New York.

Oberg, E. and Jones, F.D., *Machinery's Handbook*, 25th Edition, Industrial Press Inc., New York.

Appendix A

Calculations

1 CALIBRATION STAND ASSY
SCALE: NONE

COGEMA Engineering Corp.

Calc. No. _____
Revision 0
Page No. _____

DESIGN ANALYSIS

Client: Characterization Equipment
Subject: Down Force Calibration Stand
Location: _____

WO/Job No. _____
Date: 4/15/98
Checked: 9/29/98
Revised: _____
By: B. L. Coverdell
By: [Signature]
By: _____

1.0 OBJECTIVE

Determine the structural adequacy of the Down Force Calibration Stand.

2.0 DESIGN INPUTS

2.1 Drawing (H-2-690124).

3.0 ASSUMPTIONS

3.1 None

4.0 METHODS OF ANALYSIS Hand Calculations

5.0 REFERENCES

- 5.1 AISC, 1989, *Manual of Steel Construction*, 9th Edition, American Institute of Steel Construction, Chicago Illinois.
- 5.3 Oberg, E. and Jones, F.D., *Machinery's Handbook*, 25th Edition, Industrial Press Inc., New York.
- 5.4 AAI, *Aluminum Design Manual*, Sixth Edition, The Aluminum Association Inc.

6.0 FINDINGS AND CONCLUSIONS

The down force calibrations stand is structurally adequate to support a design load of 5700 lb.

7.0 CALCULATIONS

7.1 Determine the weight of the Down Force Calibration Stand.

$$V_0 := 12\text{-in} \cdot 28.5\text{-in} \cdot 1\text{-in} - 1\text{-in} \cdot \frac{\pi}{4} \cdot (4.5\text{-in})^2 \quad V_0 = 326.096 \cdot \text{in}^3 \quad \text{Material volume of upper 1" plate (7).}$$

$$V_1 := 4\text{-in} \cdot 4\text{-in} \cdot 2.25\text{-in} - 1.75\text{-in} \cdot \frac{\pi}{4} \cdot (2.75\text{-in})^2 \quad V_1 = 25.606 \cdot \text{in}^3 \quad \text{Material volume of Push Block (9).}$$

$$V_2 := 6\text{-in} \cdot 6\text{-in} \cdot 2\text{-in} - 1\text{-in} \cdot \frac{\pi}{4} \cdot (4.33\text{-in})^2 - 1\text{-in} \cdot \left[\frac{\pi \cdot (3\text{-in})^2}{4} \right] \quad V_2 = 50.206 \cdot \text{in}^3 \quad \text{Material volume of Thrust Bearing Block (10).}$$

$$V_3 := 12\text{-in} \cdot 28.5\text{-in} \cdot .75\text{-in} - 4\text{-in} \cdot \frac{\pi}{4} \cdot (2.31\text{-in})^2 \quad V_3 = 248.118 \cdot \text{in}^3 \quad \text{Material volume of upper Pillow Block plate (5).}$$

$$V_4 := 10\text{-in} \cdot 3\text{-in} \cdot 2\text{-in} \quad V_4 = 60 \cdot \text{in}^3 \quad \text{Material volume of air spring block (11).}$$

$$V_5 := 28.4\text{-in} \cdot \frac{\pi}{4} \cdot (1\text{-in})^2 \quad V_5 = 22.305 \cdot \text{in}^3 \quad \text{Material volume of Thompson rods (13).}$$

$$V_6 := 24\text{-in} \cdot 3\text{-in} \cdot 2\text{-in}$$

$$V_6 = 144 \cdot \text{in}^3 \quad \text{Material volume of Thompson rod supports (8).}$$

$$V_7 := 12\text{-in} \cdot 28.5\text{-in} \cdot .75\text{-in} - 4 \cdot .5\text{-in} \cdot \frac{\pi}{4} \cdot (1.5\text{-in})^2$$

$$V_7 = 252.966 \cdot \text{in}^3 \quad \text{Material volume of Lower Pillow Block Plate (6)}$$

$$V_8 := 2\text{-in} \cdot .75\text{-in} \cdot 4\text{-in}$$

$$V_8 = 6 \cdot \text{in}^3 \quad \text{Material volume of Axle Block Bar (14).}$$

$$V_9 := \frac{\pi \cdot (1\text{-in})^2}{4} \cdot 25.5\text{-in}$$

$$V_9 = 20.028 \cdot \text{in}^3 \quad \text{Material volume of Axle (17).}$$

$$V_{10} := \frac{\pi \cdot (1.5\text{-in})^2}{4} - (1.26\text{-in})^2 \cdot 40\text{-in}$$

$$V_{10} = 54.81 \cdot \text{in}^3 \quad \text{Material volume of Handle (15 and 16)}$$

$$V_{11} := \frac{\pi \cdot (.75\text{-in})^2}{4} \cdot 11\text{-in}$$

$$V_{11} = 4.86 \cdot \text{in}^3 \quad \text{Material volume of Threaded Rod (45).}$$

$$\rho := \begin{bmatrix} .098 \\ .098 \\ .098 \\ .098 \\ .098 \\ .290 \\ .098 \\ .098 \\ .284 \\ .290 \\ .284 \\ .284 \end{bmatrix} \frac{\text{lb}}{\text{in}^3}$$

Density of various components

$$i := 0..11$$

$$W_i := \rho_i \cdot V_i$$

$$W =$$

$$\begin{bmatrix} 31.957 \\ 2.509 \\ 4.92 \\ 24.316 \\ 5.88 \\ 6.469 \\ 14.112 \\ 24.791 \\ 1.704 \\ 5.808 \\ 15.566 \\ 1.38 \end{bmatrix} \cdot \text{lb}$$

Individual weights of the various components.

Components with known weights.

$$W_{12} := 1 \cdot \text{lb}$$

Weight of thrust bearing (23).

$$W_{13} := 1 \cdot \text{lb}$$

Weight of upper bearings (22).

$$W_{14} := 1 \cdot \text{lb}$$

Weight of lower bearings (21).

$$W_{15} := 16 \cdot \text{lb}$$

Weight of triple bellows air spring (28)

$$W_{16} := 40\text{-in} \cdot 8.27 \cdot \frac{\text{lb}}{\text{ft}}$$

$$W_{16} = 27.567 \cdot \text{lb} \quad \text{Weight of aluminum channel (12).}$$

$$W_{17} := 16 \cdot \text{lb}$$

Weight of calibration scale (25).

$$W_{18} := 1 \cdot \text{lb}$$

Weight of swivel mount (27).

$$W_{19} := 2 \cdot \text{lb}$$

Weight of pneumatic wheels (24).

N :=	1	Quantity of various components.	i := 0..19	$W_i := N_i \cdot W_i$	W =	31.957
	1					2.509
	1					4.92
	1					24.316
	1					5.88
	4					25.874
	2					28.224
	1					24.791
	1					1.704
	2					5.808
	4					31.132
	1					5.521
	4					1
	1					4
	1					4
	1					16
	4					27.567
	2					16

$\Sigma W = 269.203 \cdot \text{lbf}$ Total weight of components.

7.2 Determine the structural adequacy of the Down Force Calibration Stand given a maximum down force of 5700 lb.

P := 5700 · lbf

7.2.1 Allowable stresses for material used in fabrication of Down Force Calibration Stand.

$\sigma_{y_ss} := 30000 \cdot \text{psi}$	Yield stress for 316L stainless steel, Machinery's Handbook 25, Page 440.
$\sigma_{b_ss} := .6 \cdot \sigma_{y_ss}$	$\sigma_{b_ss} = 18000 \cdot \text{psi}$ Allowable bending stress per AISC 1989.
$\tau_{ss} := .4 \cdot \sigma_{y_ss}$	$\tau_{ss} = 12000 \cdot \text{psi}$ Allowable shear stress per AISC 1989.
$\sigma_{b_al} := 28000 \cdot \text{psi}$	Allowable bending stress for 6061-T6 aluminum (AAI).
$\tau_{alum} := 12000 \cdot \text{psi}$	Allowable shear stress for 6061-T6 aluminum (AAI).
$\sigma_{y_cs} := 36000 \cdot \text{psi}$	Yield stress for plain carbon steel.
$\sigma_{b_cs} := .6 \cdot \sigma_{y_cs}$	$\sigma_{b_cs} = 21600 \cdot \text{psi}$ Allowable bending stress per AISC 1989.
$\tau_{cs} := .4 \cdot \sigma_{y_cs}$	$\tau_{cs} = 14400 \cdot \text{psi}$ Allowable shear stress per AISC 1989.

Determine the allowable compressive stress for the Thomson rods.

$$E := 28 \cdot 10^6 \text{ psi}$$

Modulus of elasticity for stainless steel.

$$h := 26.5 \text{ in}$$

Height of frame.

$$r := .5 \text{ in}$$

Radius of Thomson rod.

$$A_c := \pi \cdot (.5 \text{ in})^2$$

$$A_c = 0.785 \text{ in}^2$$

Cross sectional area of Thomson rod.

$$k := .65$$

$$C_c := \sqrt{\frac{2 \cdot \pi^2 \cdot E}{\sigma_{y_{ss}}}}$$

$$C_c = 135.732$$

$$\sigma_c := \text{if} \left[\frac{k \cdot h}{r} > C_c, \frac{12 \cdot \pi^2 \cdot E}{23 \cdot \left(\frac{k \cdot h}{r} \right)^2}, \frac{1 - \left(\frac{k \cdot h}{r} \right)^2}{2 \cdot C_c^2} \sigma_{y_{ss}} \right]$$

$$\frac{5}{3} + \frac{3 \cdot \frac{k \cdot h}{r}}{8 \cdot C_c} - \frac{\left(\frac{k \cdot h}{r} \right)^3}{8 \cdot C_c^3}$$

$$\sigma_c = 16498.296 \text{ psi}$$

Determine the maximum compressive stress on each column.

$$\sigma_{c_actual} := \frac{P}{4 \cdot A_c}$$

$$\sigma_{c_actual} = 1814.364 \text{ psi}$$

Actual maximum compressive force on the columns.

$$\text{Answer} := \text{if}(\sigma_{c_actual} \leq \sigma_c, \text{"OK"}, \text{"No Good!"})$$

Answer = "OK"

Determine the adequacy of the bar fixing the base of each Thomson rod.

$$h := 2 \text{ in}$$

$$w := 3 \text{ in}$$

Height and width of aluminum bar (PN 8).

$$b := 9 \text{ in}$$

$$L := 17.5 \text{ in}$$

Loaded width and effective length of aluminum bar, respectively.

$$A_c := w \cdot h$$

Cross-sectional area of aluminum bar.

$$a := \frac{L - b}{2}$$

$$a = 4.25 \text{ in}$$

Distance from adjustable leg to Thomson rod (Note: a=c).

$$P_v := \frac{P}{2}$$

$$P_v = 2850 \cdot \text{lbf}$$

Maximum down force on a single bar.

Determine the maximum bending stress on the aluminum bar (PN 8).

$$M_{\max} := \left(\frac{P_v}{2} \right) \cdot a$$

$$M_{\max} = 6056.25 \cdot \text{in} \cdot \text{lbf}$$

Maximum moment in the bar.

$$S_{\text{bar}} := \frac{w \cdot h^2}{6}$$

$$S_{\text{bar}} = 2 \cdot \text{in}^3$$

Section modulus of the bar.

$$\sigma_{\text{bar}} := \frac{M_{\max}}{S_{\text{bar}}}$$

$$\sigma_{\text{bar}} = 3028.12 \cdot \text{psi}$$

Maximum bending stress on the bar.

Answer := if($\sigma_{\text{bar}} < \sigma_{b_{al}}$, "OK", "No Good!")

Answer = "OK"

Determine the maximum shear stress on the bar.

$$\tau_{\text{bar}} := \frac{P_v}{A_c}$$

$$\tau_{\text{bar}} = 237.5 \cdot \text{psi}$$

Maximum shear stress on the bar.

$$\tau_{\text{alum}} := 12000 \cdot \text{psi}$$

Allowable shear stress for 6061-T6 aluminium (AAI).

7.3

Determine the adequacy of the 4 legs used to level the stand.

$$K := 2$$

Effective length factor.

$$D := .627 \cdot \text{in}$$

Min. root diameter for 3/4 in all thread.

$$L := 7 \cdot \text{in}$$

Length of all thread Item No 45.

$$r := \frac{D}{2}$$

$$r = 0.314 \cdot \text{in}$$

$$E := 29 \cdot 10^6 \cdot \text{psi}$$

Modulus of elasticity for carbon steel.

$$\sigma_{y_{cs}} := 36 \cdot 10^3 \cdot \text{psi}$$

Yield stress of carbon steel.

Determine the allowable compressive stress for the 3/4 in. all thread per AISC 1989.

$$\frac{K \cdot L}{r} = 44.657$$

Slenderness Ratio.

$$C_c := \sqrt{\frac{2 \pi^2 \cdot E}{\sigma_{y_{cs}}}}$$

$$C_c = 126.099$$

$$\sigma_c := \text{if} \left[\frac{K \cdot L}{r} > C_c, \frac{12 \pi^2 \cdot E}{23 \cdot \left(\frac{K \cdot L}{r} \right)^2}, \left[1 - \frac{\left(\frac{K \cdot L}{r} \right)^2}{2 \cdot C_c^2} \right] \cdot \sigma_{y_{cs}} \right]$$

$$\sigma_c = 18809.385 \cdot \text{psi}$$

Determine the actual compressive stress.

$$A_c := .334 \cdot \text{in}^2$$

Cross sectional area of 3/4 in all thread (AISC 1989).

$$\sigma_a := \frac{P + 200 \cdot \text{lbf}}{A_c}$$

$$\sigma_a = 4416.161 \cdot \text{psi}$$

Actual compressive stress.

Answer := if($\sigma_a < \sigma_c$, "OK", "No Good!")

Answer = "OK"

7.5

Determine the adequacy of Hex HD Screws (PN 39 & 40) connecting a Thomson rod (PN13) to either the Upper Rod Plate (PN 7) or Lower Rod Position Bar (PN 8) and Base Channel (PN 12).

$$\sigma_{y_grade5} := 92 \cdot 10^3 \cdot \text{psi}$$

Yield stress of SAE grade 5 screws (ref. Oberg, E.)

$$\sigma_{t_allow} := .6 \cdot \sigma_{y_grade5}$$

Allowable tensile stress per AISC 1989.

$$A_k := .126 \cdot \text{in}^2$$

Min root area for a 1/2 in screw (AISC 1989).

$$d := .5 \cdot \text{in}$$

Distance from center of bolt to edge of rod.

$$\sigma_t := \frac{P}{A_k}$$

$$\sigma_t = 11309.507 \cdot \text{psi}$$

Maximum tensile stress on a single screw due to prying and downforce.

Answer := if($\sigma_t < \sigma_{t_allow}$, "OK", "No Good!")

Answer = "OK"

7.6

Determine the adequacy of the Handles (PN 15 & 16).

7.6.1 Force on Handle.

CALIBRATION STAND ASSY

$$d_1 := 60.5 \cdot \text{in}$$

$$d_2 := 60.5 \text{ in} - 40.22 \cdot \text{in}$$

$$F_{\text{handle}} := \frac{\frac{\Sigma W}{2} \cdot d_2}{d_1}$$

$$F_{\text{handle}} = 45.119 \cdot \text{lbf}$$

Actual force on a single handle.

Determine the stresses on the handle.

$$T := F_{\text{handle}} \cdot 7 \cdot \text{in}$$

$$T = 315.835 \cdot \text{in} \cdot \text{lbf}$$

Maximum torque on handle.

$$A := \frac{\pi \cdot (1.5 \cdot \text{in} - .12 \cdot \text{in})^2}{4}$$

$$A = 1.496 \cdot \text{in}^2$$

Area bounded by centerline of tubing.

$$t := .12 \cdot \text{in}$$

Thickness of tubing.

$$\tau_T := \frac{T}{2 \cdot t \cdot A}$$

$$\tau_T = 879.832 \cdot \text{psi}$$

Maximum torsional shear stress on a handle.

$$A_c := \frac{\pi \cdot [(1.5 \cdot \text{in})^2 - (1.5 \cdot \text{in} - .24 \cdot \text{in})^2]}{4}$$

$$A_c = 0.52 \cdot \text{in}^2$$

Cross sectional area of 1.5" tubing.

$$\tau_V := \frac{F_{\text{handle}}}{A_c}$$

$$\tau_V = 86.726 \cdot \text{psi}$$

$$\tau := \tau_T + \tau_V$$

$$\tau = 966.558 \cdot \text{psi}$$

$$\text{Answer} := \text{if}(\tau < \tau_{cs}, \text{"OK"}, \text{"No Good!"})$$

Answer = "OK"

$$M := 30 \cdot \text{in} \cdot F_{\text{handle}}$$

$$M = 1353.577 \cdot \text{in} \cdot \text{lbf}$$

Maximum moment on handle.

$$S := \frac{\pi \cdot [(1.5 \cdot \text{in})^4 - (1.25 \cdot \text{in})^4]}{32 \cdot 1.5 \cdot \text{in}}$$

$$S = 0.172 \cdot \text{in}^3$$

$$\sigma_b := \frac{M}{S}$$

$$\sigma_b = 7890.257 \cdot \text{psi}$$

$$\text{Answer} := \text{if}(\sigma_b < \sigma_{b_{cs}}, \text{"OK"}, \text{"No Good!"})$$

Answer = "OK"

Determine the stress on the CS 12 x 8.27

$$l := 25.5 \cdot \text{in}$$

$$a := 2.5 \cdot \text{in}$$

$$b := 20.5 \cdot \text{in}$$

Channel dimensions.

$$w := \frac{P}{b}$$

$$w = 278 \frac{\text{lbf}}{\text{in}}$$

Load on channel.

$$x := a + \left(\frac{P}{2} \right)$$

$$x = 12.75 \cdot \text{in}$$

Location of maximum moment.

$$M_{\max} := \frac{P}{2} \cdot \left(a + \frac{x}{2} \right)$$

$$M_{\max} = 21731.25 \cdot \text{in} \cdot \text{lbf}$$

Maximum moment in channel.

$A_{fl} := .47 \cdot \text{in} \cdot (4 \cdot \text{in} - .29 \cdot \text{in})$	$A_{fl} = 1.744 \cdot \text{in}^2$	Area of flange.
$A_w := .29 \cdot \text{in} \cdot 12 \cdot \text{in}$	$A_w = 3.48 \cdot \text{in}^2$	Area of web.
$A_{total} := 2 \cdot A_{fl} + A_w$	$A_{total} = 6.967 \cdot \text{in}^2$	Total Area.
$Ybar_{fl} := \frac{(4 \cdot \text{in} - .29 \cdot \text{in})}{2}$	$Ybar_{fl} = 1.855 \cdot \text{in}$	Distance from X-X to CG of flange.
$Ybar_w := 4 \cdot \text{in} - \frac{.29 \cdot \text{in}}{2}$	$Ybar_w = 3.855 \cdot \text{in}$	Distance from X-X to CG of web.
$y_{bar} := \frac{(2 \cdot A_{fl} \cdot Ybar_{fl}) + A_w \cdot Ybar_w}{A_{total}}$	$y_{bar} = 2.854 \cdot \text{in}$	Distance to CG of channel from X-X.
$d_{fl} := y_{bar} - \left(\frac{4 \cdot \text{in} - .29 \cdot \text{in}}{2} \right)$	$d_{fl} = 0.999 \cdot \text{in}$	Distance from CG of flange to CG of channel.
$d_w := \left(4 \cdot \text{in} - \frac{.29 \cdot \text{in}}{2} \right) - y_{bar}$	$d_w = 1.001 \cdot \text{in}$	Distance from CG of web to CG of channel.
$I_w := \frac{12 \cdot \text{in} \cdot (.29 \cdot \text{in})^3}{12}$	$I_w = 0.024 \cdot \text{in}^4$	Moment of inertia of web.
$I_{fl} := \frac{.47 \cdot \text{in} \cdot (4 \cdot \text{in} - .29 \cdot \text{in})^3}{12}$	$I_{fl} = 2 \cdot \text{in}^4$	Moment of inertia of flange.
$I_{channel} := 2 \cdot (I_{fl} + A_{fl} \cdot d_{fl}^2) + (I_w + A_w \cdot d_w^2)$	$I_{channel} = 10.992 \cdot \text{in}^4$	Moment of inertia of channel.
$\sigma_{channel} := \frac{M_{max} \cdot \frac{y_{bar}}{2}}{I_{channel}}$	$\sigma_{channel} = 2821.158 \cdot \text{psi}$	Maximum bending stress in the channel.
Answer := if($\sigma_{channel} < \sigma_{b_al}$, "OK", "No Good!")		
Answer = "OK"		