DESIGN OF THE HOISTING SYSTEM

FOR

D-ZERO COLLISION HALL PIT

D-ZERO ENGINEERING NOTE # 3823.000-EN-562

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Revised August 7, 2002

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PPD/MSD/D0 Operations

INTRODUCTION

A hoisting rail system has been designed for lifting loads from the north sidewalk of the D0 collision hall into the collision hall pit. This engineering note documents the design.

PURPOSE

The hoisting system was conceived primarily to aid in getting heavy loads into the pit during short (less than a few days) accesses. The typical use for the hoist will be to lift a BLS power supply (120 lbs) and carrier (16 lbs) from a roll around cart on the sidewalk and onto a similar cart in the collision hall pit. The hoist system will alleviate the need for two persons to carry this heavy load up and down a narrow (24") staircase.

DESIGN

The hoisting system has a designed lift rating of 150 lbs. All members and components are well within a conservative safety factor when subjected to this loading at it's worst possible configuration, that is with it's boom cantilevered out 8 feet from the base rail.

See the hoisting rail assembly sketch (in the hand calculations section) and the picture inserted below to get an orientation of the device. The hoisting system is designed using B-Line "unistrut" system components. The hoist consists of a "base" rail that is fastened to either the northeast or northwest air handler platforms. This fixed base rail has (2) two sided trolley assemblies inserted into it's lower unistrut member. One assembly is locked in place on the base rail. Another is locked in place on the lower "boom" rail. The trolley assemblies are free wheeling which allows boom movement in the north-south direction about 7 ½ feet within the fixed base rail. An electric hoist hangs from the "boom" rail on a single trolley.

The hoisting system meets Fermilab Environment and Safety Manual chapter 5021 entitled "Overhead cranes hoists and rigging". Inclusive in that requirement is that it meets the applicable Fermilab "work smart standards" of ANSI B30.11-1998 "Monorails and underhung cranes", and ANSI B30.16-1998 "Overhead hoists (underhung). The design criteria for the structural members per these standards is that static stresses shall not exceed 0.2 times the average ultimate material strength.

The unistrut members are fabricated from hot rolled carbon steel. The B-Line catalog states that the minimum yield strength of the virgin material is 33,000 psi and the cold worked average yield stress is 42,000 psi. The ultimate strength of the material is not given in the catalog, but based on the description of the material and values listed in the Ryerson steel catalog, I will use a value 58,000 psi for the ultimate strength. A minimum safety factor of 5 must be achieved based on ultimate strength.

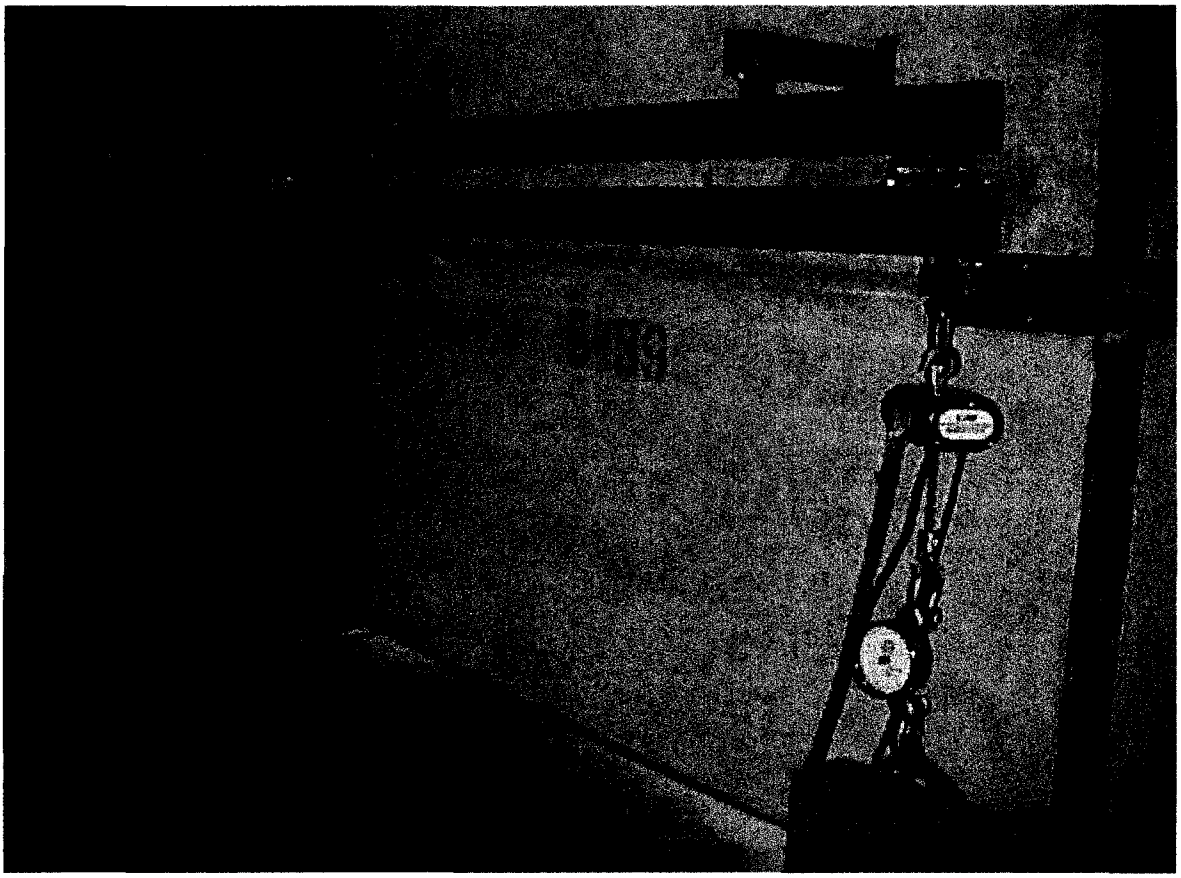


Figure 1. Assembled hoisting rail set up for load test

Another criteria that could be used for the design is that given for below the hook lifting devices (FESHM 5022 and ASME B30.20-1998) which limits static stresses to 1/3 of the material yield stress. Since the yield value is given by B-Line, a minimum safety factor of 3 based on yield can be checked with no interpretation necessary on the actual material property.

FACTORS OF SAFETY

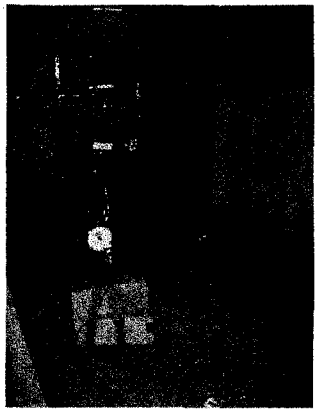
Given the design criteria, the minimum factor of safety based on yield strength must be 3 and the minimum factor of safety based on ultimate strength must be 5 or greater. The summary table below demonstrates that the calculated factors of safety meet the design criteria.

Table 1. Factors of Safety on members

COMPONENT	F.S. – varied criteria	F.S. BASED ON ULTIMATE
Boom rail – extended position	3.7 based on yield	5.1
Base rail – from extended boom	3.7 based on yield	5.1
Trolley assembly – on functional rating	3.1 – bearings	Not applicable
Trolley assembly – on failure	4.0 based on yield	7.6
Hoist trolley – on functional rating	8.1 - bearings	Not applicable
End stops on rails	8.1 -slip	Not applicable
Base rail mounting bolts – concentrated load	24 based on listed rating	Listed rating supersedes
Base rail mounting – ext boom	20 based on listed rating	Listed rating supersedes
Trolley assembly bolts	---	6.8

LOAD TEST

After each hoisting assembly was built, a load test of 125% of the rated load (Approx. 190 lbs) was performed. The hoist was exercised through it's entire travel motions with the load test weight. The system was inspected by the D-Zero project engineer and approved to be put installed in the collision hall.



Figures 3 & 4. Load Test (190 lbs.) extended on boom

OTHER

The hoisting system will be mounted to the under side of the north east and north west air handler platforms. The additional loading to these platforms is parasitic and negligible compared to their design strength.

Figure 2. North East Air Handler Platform, will mount to lower diagonals

Use of the hoisting system will be limited to personnel in the Particle Physics Division, Mechanical Department, D-Zero operations group who are familiar with rigging practices. In addition a select few personnel from the PPD/EED group may be trained and approved for lifting BLS power supply loads. The method of limiting use to the aforementioned personnel is yet to be determined, but may include a configuration control lock or labeling of the controls.

FERMILAB

ENGINEERING NOTE

SUBJECT: HOISTING RAIL FOR DØ C.H. PIT

SECTION: PPD/MD DØ OPS

PROJECT:

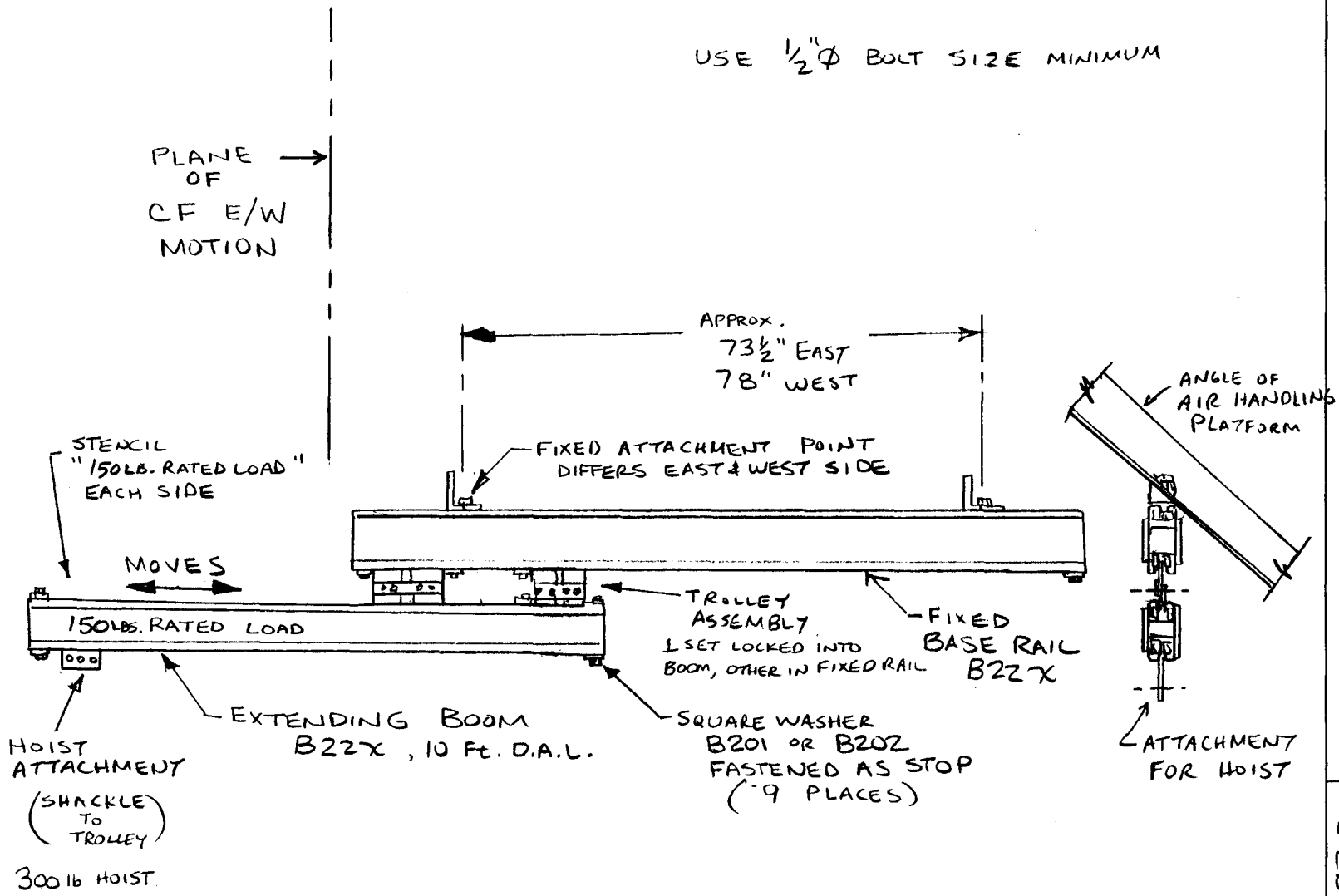
NAME: RUSS RUCINSKI

DATE: 2-26-02

REVISION DATE:

SERIAL-CATEGORY:

PAGE: 1



HOISTING RAIL ASSEMBLY

NOT TO SCALE

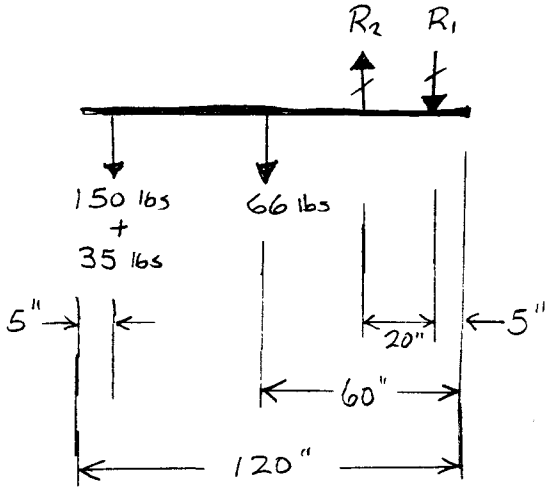
LOADS

LOAD WEIGHT = 150 LBS.
HOIST WEIGHT = 35 LBS
RAIL WEIGHT = 66 LBS
TROLLEY WEIGHT = 4 lbs.

CALCULATION OF FACTORS OF SAFETY ON COMPONENTS

BOOM

WORST CASE LOADING IS EXTENDED POSITION.



$\Sigma M_2 = 0$ @

$(185\ lbs)(90\ in.) + (66\ lbs)(40\ in.) = R_1(20\ in.)$

$R_1 = 964.5\ lbs$

$M_{MAX} = (964.5\ lbs)(20\ in)$

$= 19{,}290\ in\text{-}lbs$

$\sigma_b = \frac{M}{S} = \frac{19{,}290\ in\text{-}lbs}{1.7019\ in^3} = 11{,}334\ psi$

$S.F._{yield} = \frac{\sigma_{yield}}{\sigma_{ACTUAL}} = \frac{42{,}000\ psi}{11{,}334\ psi} = \boxed{3.71}$

$S.F._{ULT.} = \frac{\sigma_{ULT}}{\sigma_{ACTUAL}} = \frac{58{,}000\ psi}{11{,}334\ psi} = \boxed{5.12}$

BASE RAIL

BY INSPECTION WORST CASE LOADING IS MOMENT REACTION FROM BOOM. S.F. = BOOM S.F.'S.

FERMILAB ENGINEERING NOTE	SECTION PPD/MD DØ OPS	PROJECT	SERIAL-CATEGORY	PAGE 3
SUBJECT HOISTING RAIL FOR COLLISION HALL			NAME RUSS RUCINSKI	
			DATE 8-7-02	REVISION DATE

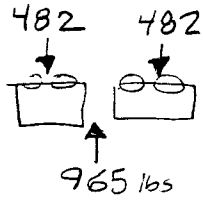
TROLLEY ASSEMBLY

FROM BOOM F.B.D. REACTION LOAD = 964.5 lbs

RATING = 600 lbs / TROLLEY. WITH S.F. = 2.5 *

THIS RATING IS ASSUMED TO BE BASED ON FUNCTIONALITY OF BEARINGS.

* LISTED IN TEXT OF CATALOG DESCRIPTION.



$$S.F. = \{2.5\} \frac{600 \text{ lb RATING}}{482 \text{ lb LOAD}} = \boxed{3.1}$$

HOIST TROLLEY

$$S.F. = \{2.5\} \frac{600 \text{ lbs}}{150 \text{ lb load} + 35 \text{ lb Hoist}} = \boxed{8.1}$$

FERMILAB ENGINEERING NOTE	SECTION PPD/MD DØ OPS	PROJECT	SERIAL-CATEGORY	PAGE 4

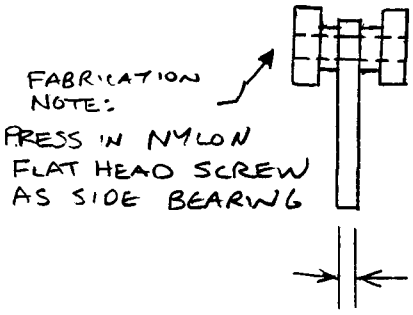
SUBJECT: HOISTING RAIL FOR DØ C.H. PIT

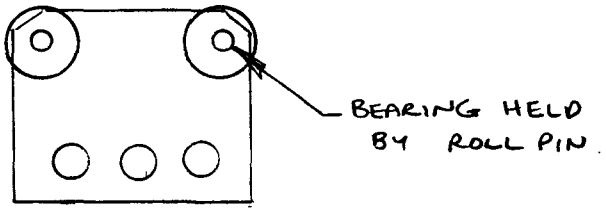
NAME: RUSS RUCINSKI

DATE: 2-27-02 | REVISION DATE:

TROLLEY SET

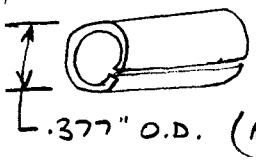
DO ANALYSIS ON PART IN HAND, B-LINE B376





BY INSPECTION, SHEAR OF ROLL PIN IS WEAK LINK.
(SAVE POSSIBLE BEARING FAILURE – FUNCTIONAL FAILURE ONLY)

ROLL PIN, .377" O.D., 0.22" I.D., .080" THICK MAT'L

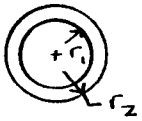


(MEASURED WHILE STILL PARTLY IN HOLE.)

ROLL PIN IS IN DOUBLE SHEAR

$$\text{SHEAR AREA} = \frac{\pi}{4}\left[D_o^2 - D_i^2\right] = \frac{\pi}{4}\left[(.377\,in)^2 - (.220\,in)^2\right] = .0736\,in^2$$

FROM MECHANICS OF MAT'LS 2ND EDITION, BERG & TIMOSHENKO p. 238



$$\tau_{MAX} = \frac{VQ}{Ib} = \frac{4V}{3A} \cdot \frac{r_2^2 + r_2 r_1 + r_1^2}{r_2^2 + r_1^2} \qquad (\text{EQN. } 5\text{-}33)$$

FOR OUR CASE LET TWO SETS OF ROLLERS TAKE THE 965 lb REACTION OF THE BOOM.

SINCE ROLL PIN IS IN DOUBLE SHEAR, $V = \frac{1}{4}(965) = 241$ ← SHEAR IN ONE PLANE

$$\tau_{MAX} = \frac{4\,(241\,lbs)}{3\,(.0736\,in^2)} \cdot \frac{.1885^2 + (.1885)(.110) + (.110)^2}{.1885^2 + .110^2}$$

$\tau_{MAX} = 6266$ psi

{ NOTE THAT THERE WILL BE 2 SETS OF TROLLEYS TAKING THE LOAD, NOT ONE }

FERMILAB ENGINEERING NOTE	SECTION PPD/MD DØ OPS	PROJECT	SERIAL-CATEGORY	PAGE 5
SUBJECT HOISTING RAIL FOR DØ C.H. PIT			NAME RUSS RUCINSKI	
			DATE 2-27-02	REVISION DATE

ROLL PIN IS ZINC PLATED STEEL, CONSERVATIVELY ASSUME TYPICAL YIELD STRESS = 50 ksi & ULTIMATE = 95 ksi

LET $\tau_{YIELD} = \frac{1}{2}\sigma_{YIELD} = 25$ ksi

$$S.F._{yield} = \frac{\tau_{YIELD}}{\tau_{CALC.}} = \frac{25 \text{ ksi}}{6.26 \text{ ksi}} = \boxed{4.0}$$

$$S.F._{ult.} = \boxed{7.6}$$

NOTE FOR COMPARISON.

McMASTER CARR CATALOG RATING ON

3/8" ROLL PIN = 17,600 lbs, TYPE 420 S.S. & PLAIN STEEL

NOTE 420 S.S. $\sigma_y = 50$ ksi

$\sigma_{ult} = 95$ ksi

DISCREPANCY COULD COME FROM NUMBER IN McMASTER CARR BEING BASED ON ULTIMATE STRENGTH AND AVERAGE SHEAR STRESS.

CONNECTIONS:

ROLLING LOAD, SAY $(185\text{lbs})(2) = 370\text{ lbs}$

$$S.F._{SLIP} = 3\left(\frac{1000\text{ lbs}}{370\text{ lbs}}\right) = \boxed{8.1}$$

↑ S.F. GIVEN IN CATALOG

{END STOPS}

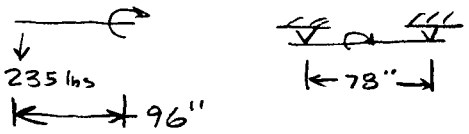
PULL OUT,

$$S.F._{PULL\ OUT} = 3\left(\frac{1500\text{lbs}}{185\text{lbs}}\right) = \boxed{24}$$

↑ S.F. GIVEN IN CATALOG

STRAIGHT TENSION ON MOUNTING OF BASE RAIL

PULL OUT - CANTILEVERED LOAD



$$S.F. = 3\left(\frac{1500}{185} \times \frac{78}{96\text{in}}\right) = \boxed{20}$$

↑ S.F. GIVEN IN CATALOG

FROM MOMENT REACTION ON BASE RAIL MOUNTING

SHEAR ON TROLLEY CONNECTION,

MAX LOADING = 965 lbs SHARED BY 4 ~ 1/2" Ø BOLTS

$F_v = 10\text{ ksi}$ (ALLOWABLE) FOR A307 BOLTS, TABLE 1-D AISC STEEL CONSTRUCTION MANUAL

$$\tau = V/A = \frac{965\text{lbs}}{\frac{\pi(.50\text{in})^2}{4}} = 4914\text{ psi}$$

FOR ONE BOLT TAKING TOTAL LOAD.

F_v — BASED ON $0.3F_u$ OR S.F. = 3.33

$$F.S. = 3.33\left[\frac{10\text{ ksi}}{4.9\text{ ksi}}\right] = \boxed{6.8}$$

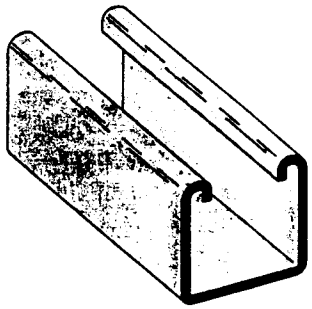
ASSUMING ONLY ONE BOLT!

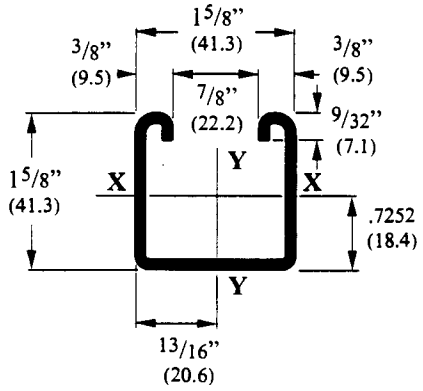
B22 CHANNEL

B-Line

B22

- Thickness: 12 Gauge (2.6 mm)
- Standard lengths: 10' (3.05 m) & 20' (6.09 m)
- Standard finishes: Plain, Dura-Green, Pre-Galvanized, Hot-Dipped Galvanized, Stainless Steel Type 304 or 316, Aluminum
- Weight: 1.90 Lbs./Ft. (2.83 kg/m)

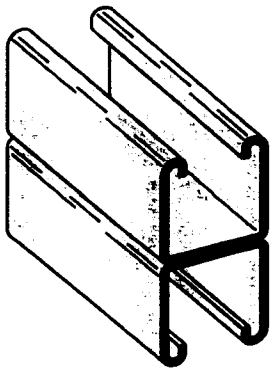




SECTION PROPERTIES

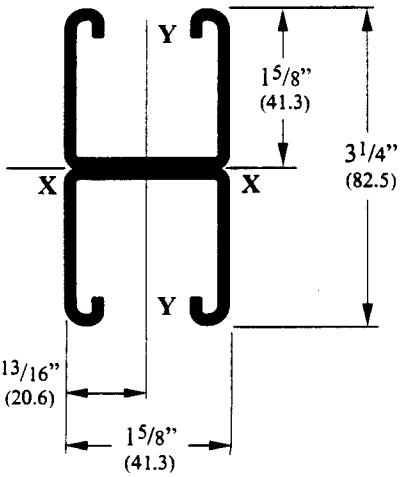
Channel	Weight		Areas of Section		X - X Axis: Moment of Inertia (I)		X - X Axis: Section Modulus (S)		X - X Axis: Radius of Gyration (r)		Y - Y Axis: Moment of Inertia (I)		Y - Y Axis: Section Modulus (S)		Y - Y Axis: Radius of Gyration (r	
	lbs./ft.	kg/m	sq. in.	cm^2	$in.^4$	cm^4	$in.^3$	cm^3	in.	cm	$in.^4$	cm^4	$in.^3$	cm^3	in.	cm
B22	1.910	(2.84)	.562	(3.62)	.1912	(7.96)	.2125	(3.48)	.583	(1.48)	.2399	(9.99)	.2953	(4.84)	.653	(1.66
B22A	3.820	(5.69)	1.124	(7.25)	.9732	(40.51)	.5989	(9.81)	.931	(2.36)	.4798	(19.97)	.5905	(9.68)	.653	(1.66
B22X	6.649	(9.89)	1.956	(12.62)	4.1484	(172.67)	1.7019	(27.89)	1.456	(3.70)	1.1023	(45.88)	1.2027	(19.71)	.751	(1.91

Calculations of section properties are based on metal thicknesses as determined by the AISI Cold-Formed Steel Design Manual.



B22A

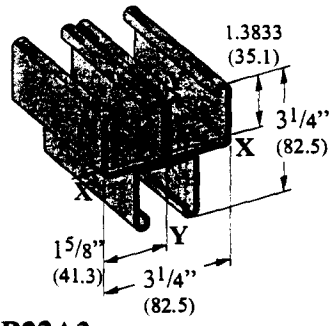
Wt. 3.80 Lbs./Ft. (5.65 kg/m)



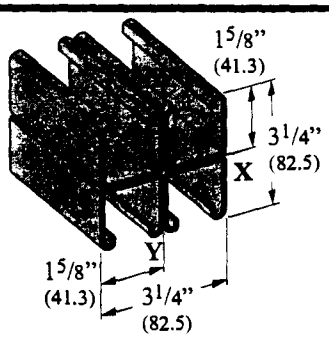
Reference page 14 for general fitting and standard finish specifications.

B22 COMBINATIONS

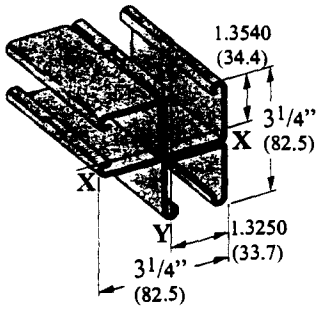
B-Line



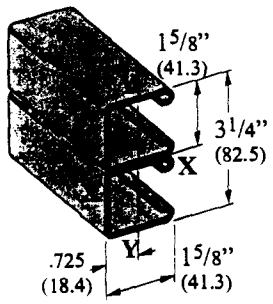
B22A3
Wt. 5.70 Lbs./Ft. (8.48 kg/m)



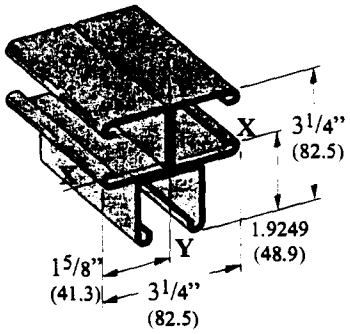
B22A4
Wt. 7.60 Lbs./Ft. (11.31 kg/m)



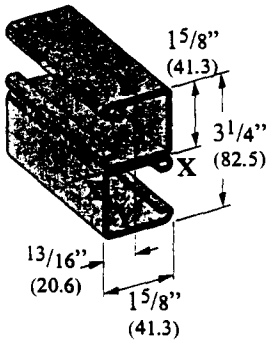
B22AD3
Wt. 5.70 Lbs./Ft. (8.48 kg/m)



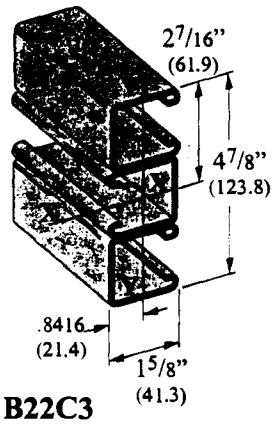
B22B
Wt. 3.80 Lbs./Ft. (5.65 kg/m)



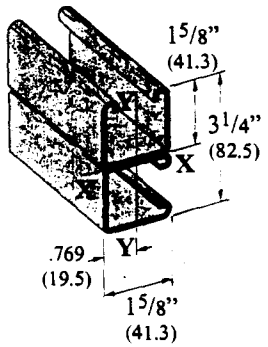
B22B3
Wt. 5.70 Lbs./Ft. (8.48 kg/m)



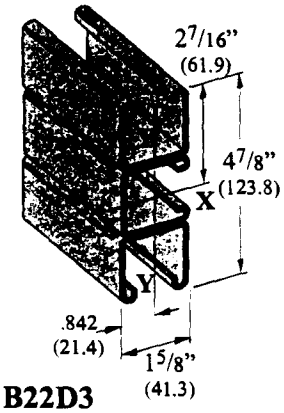
B22C
Wt. 3.80 Lbs./Ft. (5.65 kg/m)



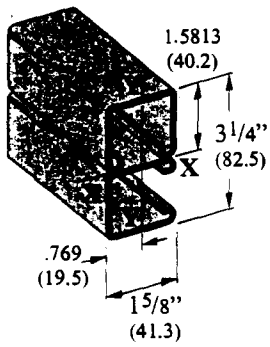
B22C3
Wt. 5.70 Lbs./Ft. (8.48 kg/m)



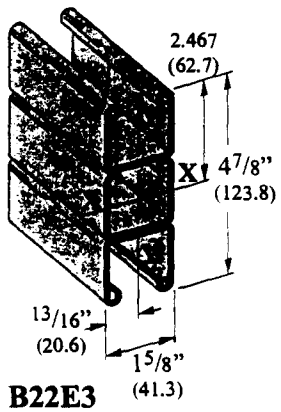
B22D
Wt. 3.80 Lbs./Ft. (5.65 kg/m)



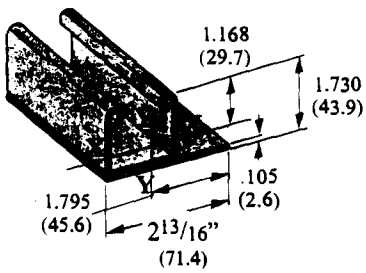
B22D3
Wt. 5.70 Lbs./Ft. (8.48 kg/m)



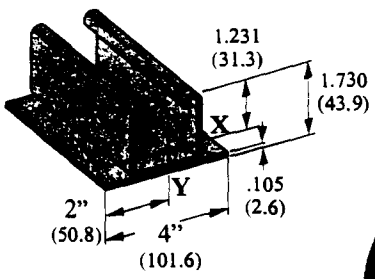
B22E
Wt. 3.80 Lbs./Ft. (5.65 kg/



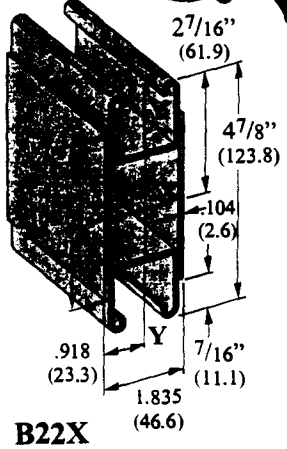
B22E3
5.70 Lbs./Ft. (8.48 kg/m)



B22LPL
Wt. 2.90 Lbs./Ft. (4.31 kg/m)



B22PL
Wt. 3.35 Lbs./Ft. (4.98 kg/m)



B22X
Wt. 6.70 Lbs./Ft. (9.97 kg/m)

Reference page 14 for general fitting and standard finish specifications.

B22 BEAM LOADING DATA

B-Line

9

Beam Span In.	Beam Span mm	Channel Style	Uniform Load and Deflection Lbs.	N	In.	mm	Uniform Load @ Deflection = 1/240 Span Lbs.	N	1/360 Span Lbs.	N
12	(305)	**B22**	2610	(11610)	.014	(.35)	2610	(11610)	2610	(11610)
		B22A	2610*	(11610)	.002	(.05)	2610*	(11610)	2610*	(11610)
		B22X	5790*	(25755)	.001	(.02)	5790*	(25755)	5790*	(25755)
18	(457)	**B22**	2269	(10093)	.031	(.79)	2269	(10093)	2269	(10093)
		B22A	2610*	(11610)	.007	(.18)	2610*	(11610)	2610*	(11610)
		B22X	5790*	(25755)	.003	(.07)	5790*	(25755)	5790*	(25755)
24	(609)	**B22**	1702	(7571)	.056	(1.42)	1702	(7571)	1702	(7571)
		B22A	2610*	(11610)	.017	(.43)	2610*	(11610)	2610*	(11610)
		B22X	5790*	(25755)	.008	(.20)	5790*	(25755)	5790*	(25755)
30	(762)	**B22**	1361	(6054)	.087	(2.21)	1361	(6054)	1294	(5756)
		B22A	2610*	(11610)	.033	(.84)	2610*	(11610)	2610*	(11610)
		B22X	5790*	(25755)	.017	(.73)	5790*	(25755)	5790*	(25755)
36	(914)	**B22**	1135	(5049)	.126	(3.20)	1135	(5049)	899	(3999)
		B22A	2610*	(11610)	.057	(1.45)	2610*	(11610)	2610*	(11610)
		B22X	5790*	(25755)	.029	(.73)	5790*	(25755)	5790*	(25755)
42	(1067)	**B22**	972	(4323)	.172	(4.37)	972	(4323)	660	(2936)
		B22A	2610*	(11610)	.091	(2.31)	2610*	(11610)	2610*	(11610)
		B22X	5790*	(25755)	.046	(1.17)	5790*	(25755)	5790*	(25755)
48	(1219)	**B22**	851	(3785)	.224	(5.69)	758	(3372)	505	(2246)
		B22A	2405	(10698)	.125	(3.17)	2405	(10698)	2405	(10698)
		B22X	5790*	(25755)	.068	(1.73)	5790*	(25755)	5790*	(25755)
54	(1371)	**B22**	756	(3363)	.284	(7.21)	599	(2664)	399	(1775)
		B22A	2138	(9510)	.158	(4.01)	2138	(9510)	2024	(9003)
		B22X	5790*	(25755)	.097	(2.46)	5790*	(25755)	5790*	(25755)
60	(1524)	**B22**	681	(3029)	.351	(8.91)	485	(2157)	323	(1437)
		B22A	1924	(8558)	.195	(4.95)	1924	(8558)	1640	(7295)
		B22X	5645	(25110)	.130	(3.30)	5645	(25110)	5645	(25110)
66	(1676)	**B22**	619	(2753)	.424	(10.77)	401	(1784)	267	(1187)
		B22A	1749	(7780)	.236	(5.99)	1749	(7780)	1355	(6027)
		B22X	5132	(22828)	.158	(4.01)	5132	(22828)	5132	(22828)
72	(1829)	**B22**	567	(2522)	.505	(12.83)	337	(1499)	225	(1001)
		B22A	1603	(7130)	.281	(7.14)	1603	(7130)	1139	(5066)
		B22X	4704	(20924)	.188	(4.77)	4704	(20924)	4704	(20924)
78	(1981)	**B22**	524	(2331)	.593	(15.06)	287	(1276)	191	(849)
		B22A	1480	(6583)	.330	(8.38)	1455	(6472)	970	(4315)
		B22X	4342	(19314)	.220	(5.59)	4342	(19314)	4270	(18994)
84	(2133)	**B22**	486	(2162)	.687	(17.45)	248	(1103)	165	(734)
		B22A	1374	(6112)	.383	(9.73)	1255	(5582)	837	(3723)
		B22X	4032	(17935)	.255	(6.48)	4032	(17935)	3682	(16378)
90	(2286)	**B22**	454	(2019)	.789	(20.04)	216	(961)	144	(640)
		B22A	1283	(5707)	.440	(11.17)	1093	(4862)	729	(3243)
		B22X	3763	(16738)	.293	(7.44)	3763	(16738)	3207	(14265)
96	(2438)	**B22**	425	(1890)	.898	(22.81)	190	(845)	126	(560)
		B22A	1202	(5347)	.500	(12.70)	961	(4275)	640	(2847)
		B22X	3528	(15693)	.334	(8.48)	3528	(15693)	2819	(12539)
102	(2591)	**B22**	400	(1779)	1.013	(25.73)	168	(747)	112	(498)
		B22A	1132	(5035)	.565	(14.35)	851	(3785)	567	(2522)
		B22X	3320	(14768)	.377	(9.57)	3320	(14768)	2497	(11107)
108	(2743)	**B22**	378	(1681)	1.136	(28.85)	150	(667)	100	(445)
		B22A	1069	(4755)	.633	(16.08)	759	(3376)	506	(2251)
		B22X	3136	(13949)	.422	(10.72)	3136	(13949)	2227	(9906)
114	(2895)	**B22**	358	(1592)	1.266	(32.15)	134	(596)	90	(400)
		B22A	1013	(4506)	.706	(17.93)	681	(3029)	454	(2019)
		B22X	2971	(13215)	.471	(11.96)	2971	(13215)	1999	(8892)
120	(3048)	**B22**	340	(1512)	1.403	(35.63)	121	(538)	81	(360)
		B22A	962	(4279)	.782	(19.86)	615	(2735)	410	(1824)
		B22X	2822	(12553)	.521	(13.23)	2706	(12037)	1804	(8024)

Based on simple beam condition using an allowable design stress of 25000 psi (172 MPa) in accordance with MFMA, with adequate lateral bracing (see page 11 for further explanation). Actual yield point of cold rolled steel is 42,000 psi. To determine concentrated load capacity at mid span, multiply uniform load by 0.5 and corresponding deflection by 0.8. *Failure determined by weld shear.

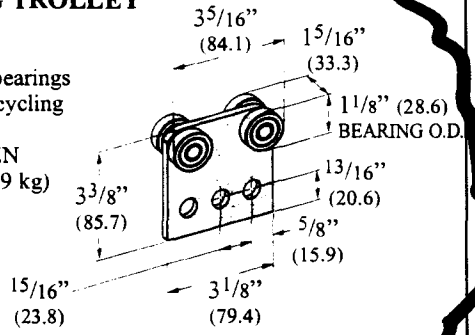
MAT'L INFORMATION

Reference page 14 for general fitting and standard finish specifications.

MISCELLANEOUS FITTINGS

B376
FOUR BEARING TROLLEY ASSEMBLY

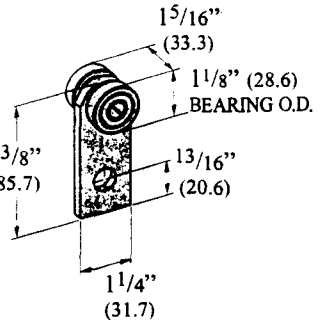
- Safety Factor of 2.5
- Stainless steel ball bearings
- Not for continuous cycling applications
- Standard finishes: ZN
- Wt./C 110 Lbs. (49.9 kg)



Design Load in B22		
Lbs.	kN	RPM
300	(1.33)	@600
450	**(2.00)**	**@300**
600	(2.67)	@100

B377
TWO BEARING TROLLEY ASSEMBLY

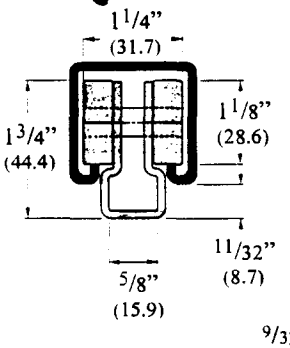
- Safety Factor of 2.5
- Stainless steel ball bearings
- Not for continuous cycling applications
- Standard finishes: ZN
- Wt./C 48 Lbs. (21.8 kg)

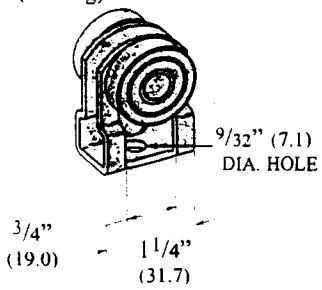


Design Load in B22		
Lbs.	kN	RPM
150	(.67)	@600
225	**(1.00)**	**@300**
437	(1.94)	@100

B477
TWO BEARING LIGHT DUTY TROLLEY ASSEMBLY

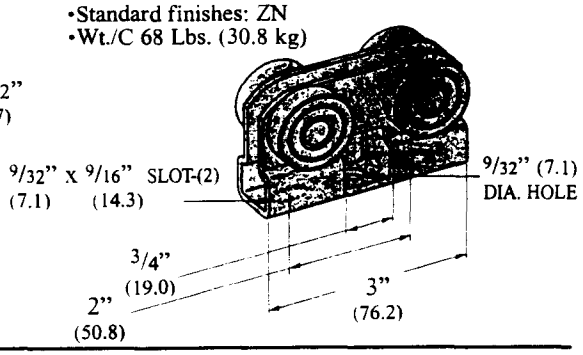
- Design Load 50 Lbs. (.22 kN)
- Safety Factor of 2.5
- Stainless steel ball bearings
- Not for continuous cycling applications
- Material: 12 Gauge (2.6) ASTM A570 Gr. 33
- Standard finishes: ZN
- Wt./C 30 Lbs. (13.6 kg)





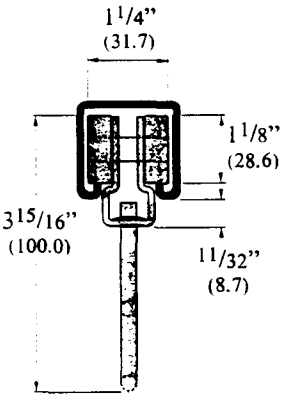
B478
FOUR BEARING LIGHT DUTY TROLLEY ASSEMBLY

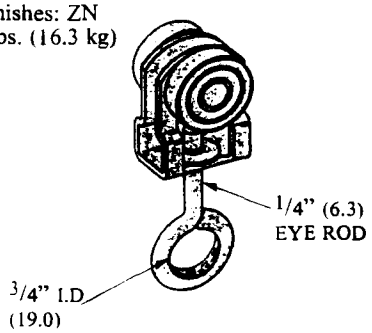
- Design Load 100 Lbs. (.44 kN)
- Safety Factor of 2.5
- Stainless steel ball bearings
- Not for continuous cycling applications
- Material: 12 Gauge (2.6) ASTM A570 Gr. 33
- Standard finishes: ZN
- Wt./C 68 Lbs. (30.8 kg)



B477H
TWO BEARING LIGHT DUTY TROLLEY ASSEMBLY WITH EYE HOOK

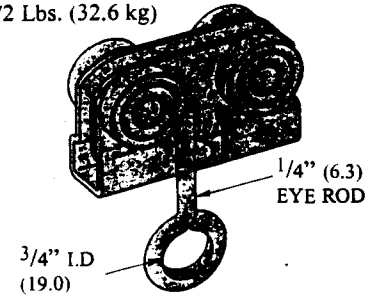
- Design Load 50 Lbs. (.22 kN)
- Safety Factor of 2.5
- Stainless steel ball bearings
- Not for continuous cycling applications
- Material: 12 Gauge (2.6) ASTM A570 Gr. 33
- Standard finishes: ZN
- Wt./C 36 Lbs. (16.3 kg)





B478H
FOUR BEARING LIGHT DUTY TROLLEY ASSEMBLY WITH EYE HOOK

- Design Load 100 Lbs. (.44 kN)
- Safety Factor of 2.5
- Stainless steel ball bearings
- Not for continuous cycling applications
- Material: 12 Gauge (2.6) ASTM A570 Gr. 33
- Standard finishes: ZN
- Wt./C 72 Lbs. (32.6 kg)

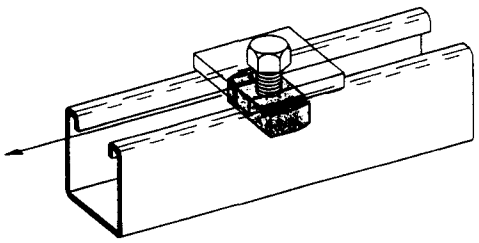


Reference page 58 for general fitting and standard finish specifications.

RESISTANCE TO SLIP

- With Safety Factor of 3
- Maximum slip strength for 12 gauge channels is limited to 1550 lbs. (6670 N)

Thread Size	Nut Part Numbers	Resistance to Slip					
		12 ga. Channel		14 ga. Channel		16 ga. Channel	
		Lbs.	N	Lbs.	N	Lbs.	N
#8-32	N221, N221WO,N521 N721,TN221	50	220	50	220	50	220
#10-24	**N222, N222WO, N522 N722, TN222**	**100**	**440**	**100**	**440**	**100**	**440**
#10-32	N227, N227WO, N527 N727, TN227	100	440	100	440	100	440
1/4"-20	**FN224, N224,N224WO, N524 N724, TN224**	**300**	**1330**	**300**	**1330**	**300**	**1330**
5/16"-18	N223, N223WO, N523 N723, TN223	450	2000	450	2000	450	2000
3/8"-16	**FN228, N228, N228WO, N528 N728, TN228**	**800**	**3560**	**600**	**2670**	**600**	**2670**
7/16"-14	N226, N226WO, N526 N726, TN226	1000	4450	800	3560	800	3560
1/2"-13	**N225, N225WO, N725, TN525**	**1500**	**6670**	**1000**	**4450**	**1000**	**4450**
	N525, N525WO, TN525	**1500**	**6670**	**1000**	**4450**	**1000**	**4450**
5/8"-11	N255, N255WO, N755	1500	6670	1000	4450	1000	4450
	N555, N555WO	1500	6670	1000	4450	1000	4450
3/4"-10	**N275, N275WO, N775**	**1500**	**6670**	**1000**	**4450**	**1000**	**4450**
	N575, N575WO	**1500**	**6670**	**1000**	**4450**	**1000**	**4450**
7/8"-9	N278, N278WO, N778	1500	6670	1000	4450	1000	4450



Resistance to Slip of Channel Nut

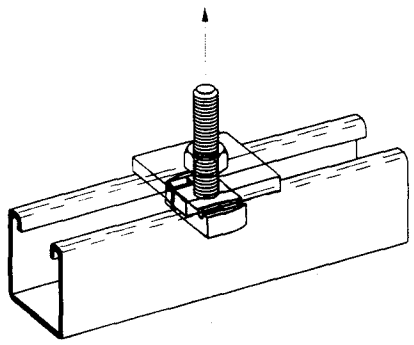
Reference page 44 for general fitting and standard finish specifications.

PULL-OUT STRENGTH

•With Safety Factor of 3
•Maximum pullout strength for B11 & B12 channels is limited to 1550 lbs. (6670 N).

Thread Size	Nut Part Numbers	Pull-Out Strength					
		12 ga. Channel		14 ga. Channel		16 ga. Channel	
		Lbs.	N	Lbs.	N	Lbs.	N
#8-32	N221, N221WO,N521 N721,TN221	200	890	200	890	200	890
#10-24	N222, N222WO, N522 N722, TN222	250	1110	250	1110	250	1110
#10-32	N227, N227WO, N527 N727, TN227	250	1110	250	1110	250	1110
1/4"-20	FN224, N224, N224WO, N524 N724, TN224	450	2000	450	2000	450	2000
5/16"-18	N223, N223WO, N523 N723, TN223	750	3330	750	3330	750	3330
3/8"-16	FN228, N228, N228WO, N528 N728, TN228	1100	4890	1000	4450	1000	4450
7/16"-14	N226, N226WO, N526 N726, TN226	1500	6670	1200	5340	1000	4450
1/2"-13	N225, N225WO, N725, TN525	2000	8900	1400	6230	1000	4450
	N525, N525WO, TN525	1500	6670	1400	6230	1000	4450
5/8"-11	N255, N255WO, N755	2000	8900	1400	6230	1000	4450
	N555, N555WO	1500	6670	1400	6230	1000	4450
3/4"-10	N275, N275WO, N775	2000	8900	1400	6230	1000	4450
	N575, N575WO	1500	6670	1400	6230	1000	4450
7/8"-9	N278, N278WO, N778	2000	8900	1400	6230	1000	4450

Pull-Out Strength of Channel Nut



For spring pin assortments, see page 3031. For spring pin insertion tools, see page 3033.

13

Spring Pins

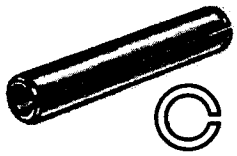
Spring pins are also called spring dowel, roll, tension, split, expansion, and C-pins. Ends are chamfered (beveled) for easy insertion. Pins meet ASME B18.8.2. Length tolerance is ±.015" for lengths up to 1", ±.020" for 1⅛" to 2" lengths, ±.025" for 2¼" to 3" lengths, and ±.030" for lengths 3¼" and over.

Shear strength is the amount of force that the side of a pin can withstand before breaking. *Double shear strength* (listed in chart) applies force against a fastener in two places causing it to break into three pieces.

Type 420 Stainless Steel—Our strongest stainless steel spring pin. Magnetic and mildly corrosion resistant. Rockwell hardness is C43-C52.

18-8 Stainless Steel—Offers more corrosion resistance, yet less shear strength than Type 420 stainless steel. Slightly magnetic. Rockwell hardness is B85.

Zinc-Plated Steel and ***Plain Steel***—Equal in shear strength to Type 420 stainless steel. Diameters up to ½" are C1070-C1095 heat-treated steel with a Rockwell hardness of C46-C53. Diameters larger than ½" are C6150 heat-treated steel with a Rockwell hardness of C43-C51. *Zinc-plated steel* offers rust resistance.



Nominal Diameter		1/16"	5/64"	3/32"	1/8"	5/32"	3/16"	7/32"	1/4"	5/16"	3/8"	7/16"	1/2"	5/8"
Actual Dia.	Min.	.066"	.083"	.099"	.131"	.162"	.194"	.226"	.258"	.321"	.385"	.448"	.513"	.640"
	Max.	.069"	.086"	.103"	.135"	.167"	.199"	.232"	.264"	.330"	.395"	.459"	.524"	.653"
Double Shear Strength, lbs.	Type 420 SS and Steel	425	650	1000	2100	3000	4400	5700	7700	11,500	17,600	20,000	25,800	46,000
	18-8 SS	250	460	670	1090	1600	2425	3400	4100	6300	9500	11,500	15,800	18,800

Type 420 Stainless Steel

Lg.	Pkg. Qty.		Per Pkg.
1/16" Dia.			
3/16"	100	92383A100	$1.86
1/4"	100	92383A102	1.89
5/16"	100	92383A103	1.93
3/8"	100	92383A104	2.00
7/16"	100	92383A105	2.04
1/2"	100	92383A106	2.14
9/16"	100	92383A107	2.03
5/8"	100	92383A108	2.36
11/16"	100	92383A109	2.27
3/4"	100	92383A110	2.61
7/8"	100	92383A112	2.89
1"	100	92383A114	3.21
5/64" Dia.			
3/16"	100	92383A149	1.67
1/4"	100	92383A151	1.89
5/16"	100	92383A152	1.93
3/8"	100	92383A153	2.04
7/16"	100	92383A154	2.11
1/2"	100	92383A155	2.18
9/16"	100	92383A156	2.13
5/8"	100	92383A157	2.39
11/16"	100	92383A161	2.33
3/4"	100	92383A159	2.68
13/16"	100	92383A162	2.60
1"	100	92383A163	3.68
1 1/2"	100	92383A167	5.14
3/32" Dia.			
3/16"	100	92383A198	1.80
1/4"	100	92383A200	2.00
5/16"	100	92383A201	2.11
3/8"	100	92383A202	2.25
7/16"	100	92383A203	2.39
1/2"	100	92383A204	2.50
9/16"	100	92383A205	2.68
5/8"	100	92383A206	2.82
11/16"	100	92383A207	2.73
3/4"	100	92383A208	3.07
13/16"	100	92383A209	3.00
7/8"	100	92383A210	3.39
1"	100	92383A212	4.07
1 1/8"	100	92383A213	4.46
1 1/4"	100	92383A214	4.86
1 3/8"	100	92383A215	4.67
1 1/2"	100	92383A216	5.64
1/8" Dia.			
1/4"	100	92383A249	2.29
5/16"	100	92383A269	4.14
3/8"	100	92383A250	2.43
7/16"	100	92383A251	2.59
1/2"	100	92383A252	2.75
9/16"	100	92383A253	2.89
5/8"	100	92383A254	3.11
11/16"	100	92383A255	3.36
3/4"	100	92383A256	3.57
13/16"	100	92383A257	3.67
7/8"	100	92383A258	4.14
1"	100	92383A260	5.55
1 1/8"	100	92383A261	6.09
1/8" Dia. (Cont.)			
1 1/4"	100	92383A262	$6.52
1 3/8"	100	92383A263	7.08
1 1/2"	100	92383A264	7.50
1 3/4"	100	92383A266	8.53
2"	100	92383A268	9.58
2 1/4"	100	92383A271	8.00
2 1/2"	100	92383A273	9.67
5/32" Dia.			
3/8"	100	92383A299	5.57
1/2"	100	92383A301	3.87
5/8"	100	92383A303	4.47
3/4"	100	92383A305	5.09
7/8"	100	92383A307	5.71
1"	100	92383A309	6.35
1 1/8"	100	92383A310	6.94
1 1/4"	100	92383A311	7.52
1 3/8"	100	92383A312	7.00
1 1/2"	100	92383A313	8.70
1 3/4"	100	92383A315	9.93
2"	100	92383A317	11.21
2 1/2"	100	92383A319	13.85
3/16" Dia.			
3/8"	100	92383A369	6.64
1/2"	100	92383A350	4.89
9/16"	100	92383A349	4.67
5/8"	100	92383A352	5.75
11/16"	100	92383A353	6.25
3/4"	100	92383A354	6.61
13/16"	100	92383A355	5.83
7/8"	100	92383A356	7.49
1"	100	92383A358	8.38
1 1/8"	100	92383A359	7.33
1 1/4"	100	92383A360	10.06
1 3/8"	100	92383A361	10.90
1 1/2"	100	92383A362	11.76
1 5/8"	50	92383A363	5.50
1 3/4"	50	92383A371	6.74
1 7/8"	50	92383A374	6.67
2"	50	92383A372	7.63
2 1/4"	50	92383A373	8.53
2 1/2"	50	92383A376	9.47
3"	50	92383A378	10.67
7/32" Dia.			
1/2"	100	92383A399	10.20
5/8"	100	92383A401	7.16
3/4"	100	92383A403	8.31
1"	100	92383A407	10.65
1 1/4"	100	92383A409	12.97
1 1/2"	100	92383A411	14.68
1 3/4"	50	92383A414	8.68
2"	50	92383A416	9.88
2 1/2"	50	92383A418	12.31
1/4" Dia.			
1/2"	100	92383A448	9.02
5/8"	100	92383A450	8.29
3/4"	100	92383A452	9.65
7/8"	100	92383A454	11.04
1"	100	92383A456	12.45
1 1/8"	100	92383A457	13.79
1/4" Dia. (Cont.)			
1 1/4"	100	92383A458	$14.65
1 3/8"	50	92383A472	8.20
1 1/2"	50	92383A474	8.93
1 5/8"	50	92383A476	12.29
1 3/4"	50	92383A478	13.43
2"	50	92383A480	11.69
2 1/4"	50	92383A482	13.02
2 1/2"	50	92383A484	14.39
2 3/4"	25	92383A485	7.92
3"	25	92383A486	8.66
3 1/4"	25	92383A487	10.00
3 1/2"	25	92383A488	10.25
5/16" Dia.			
3/4"	50	92383A500	6.83
1"	50	92383A504	8.65
1 1/4"	50	92383A509	11.11
1 1/2"	50	92383A508	12.56
1 3/4"	25	92383A511	7.49
2"	25	92383A522	8.26
2 1/4"	25	92383A526	9.28
2 1/2"	25	92383A530	10.30
3"	25	92383A534	12.43
3 1/2"	25	92383A538	14.75
4"	10	92383A542	14.09
3/8" Dia.			
3/4"	25	92383A550	$7.10
1"	25	92383A551	6.94
1 1/4"	25	92383A552	8.50
1 1/2"	25	92383A553	10.18
1 3/4"	25	92383A554	10.44
2"	25	92383A555	13.38
2 1/4"	10	92383A560	6.53
2 1/2"	10	92383A565	6.72
2 3/4"	10	92383A566	7.42
3"	10	92383A570	7.94
3 1/2"	10	92383A574	9.52
4"	10	92383A578	14.26
7/16" Dia.			
2"	10	92383A605	5.88
2 1/2"	10	92383A607	7.30
3"	10	92383A609	8.48
4"	10	92383A611	12.93
1/2" Dia.			
1 1/4"	10	92383A670	8.65
1 1/2"	10	92383A672	5.62
2"	10	92383A674	7.24
2 1/2"	10	92383A676	10.73
3"	10	92383A678	10.82
3 1/2"	5	92383A680	7.67
4"	5	92383A682	9.63

18-8 Stainless Steel

Lg.	Pkg. Qty.		Per Pkg.
1/16" Dia.			
3/16"	100	92373A103	2.04
1/4"	100	92373A105	2.07
5/16"	100	92373A106	2.09
3/8"	100	92373A107	2.18
7/16"	100	92373A108	2.23
1/2"	100	92373A109	2.36
5/8"	100	92373A111	2.61
3/4"	100	92373A113	2.86
7/8"	100	92373A114	3.21
1"	100	92373A115	3.54
5/64" Dia.			
1/4"	100	92373A118	2.61
5/16"	100	92373A120	2.64
3/8"	100	92373A122	2.79
7/16"	100	92373A124	2.86
1/2"	100	92373A126	3.00
5/8"	100	92373A128	3.25
3/4"	100	92373A130	3.68
1"	100	92373A132	5.00
1 1/2"	100	92373A134	7.14
3/32" Dia.			
1/4"	100	92373A139	2.32
5/16"	100	92373A140	2.43
3/8"	100	92373A141	2.61
7/16"	100	92373A142	2.79
1/2"	100	92373A143	2.93
9/16"	100	92373A144	3.11
5/8"	100	92373A145	3.25
3/4"	100	92373A147	3.57
7/8"	100	92373A148	3.93
1"	100	92373A149	4.71
1 1/8"	100	92373A151	5.18
1 1/4"	100	92373A152	5.64
1 1/2"	100	92373A153	6.57
1/8" Dia.			
1/4"	100	92373A173	3.25
5/16"	100	92373A174	3.36
3/8"	100	92373A175	3.43
7/16"	100	92373A176	3.68
1/2"	100	92373A177	3.89
9/16"	100	92373A178	4.11
5/8"	100	92373A179	4.39
11/16"	100	92373A180	4.75
3/4"	100	92373A181	5.07
7/8"	100	92373A182	5.89
1"	100	92373A183	6.64
1 1/8"	100	92373A184	7.14
1 1/4"	100	92373A185	7.93
1 3/8"	100	92373A186	8.68
1 1/2"	100	92373A187	9.57
1 3/4"	100	92373A189	11.39
2"	100	92373A191	13.21
5/32" Dia.			
3/8"	100	92373A212	5.61
1/2"	100	92373A211	6.00
5/8"	100	92373A213	6.79
3/4"	100	92373A215	7.62
7/8"	100	92373A216	8.32
1"	100	92373A217	9.32
1 1/8"	100	92373A225	10.11
1 1/4"	100	92373A218	10.93
1 1/2"	100	92373A219	13.18
1 3/4"	50	92373A221	7.57
2"	50	92373A223	9.14
2 1/2"	50	92373A229	11.07

(Continued on following page)

Michael Sarychev

From: Michael Sarychev [sarychev@fnal.gov]
Sent: Friday, February 26, 2010 10:22 AM
To: George Ginther
Cc: Russ Rucinski
Subject: New hoisting assembly built

George,

A new hoisting assembly for BLS power supplies was built and load tested. The load weight (200 lbs, 133% of rated 150 lbs load capacity) was exercised trough the entire travel. I witnessed the test and inspected the assembly. No distortions or deformations were found. As a reminder, this assembly was designed with safety factors greater than required factor of 3 based on yield strength and 5 based on ultimate strength (D0 engineering note # 3823.000-EN-562. This assembly will be labeled "150 lbs rated capacity" and will be stored next to the collision hall entrance, ready to be installed in collision hall during access (once ready, I will put a request on the white board).

Mike

Michael Sarychev

From: Michael Sarychev [sarychev@fnal.gov]
Sent: Thursday, March 18, 2010 11:49 AM
To: George Ginther; Robert Kubinski
Cc: Russell Rucinski; Jim Fagan; billl@fnal.gov
Subject: RE: BLS power supply hoist

Hi George,

This systems design already has a reviewed and approved D0 engineering note. I documented the load test. It will be kept with this engineering note as an amendment. The load capacity is clearly marked on this system. I think it's sufficient for safe operation.

Mike

-----Original Message-----
From: George Ginther [mailto:ginther@fnal.gov]
Sent: Thursday, March 18, 2010 11:13 AM
To: Robert Kubinski
Cc: Russell Rucinski; Jim Fagan; billl@fnal.gov
Subject: Re: BLS power supply hoist

Hi Bob:
Thanks for tacking care of this.

Russ and Mike:
Anything else we need to do to certify this system for use?

GG

---- Original Message -----
From: Robert Kubinski <kubinski@fnal.gov>
Date: Thursday, March 18, 2010 10:15 am
Subject: BLS power supply hoist
To: Russell Rucinski <rucinski@fnal.gov>, Jim Fagan <jefagan@fnal.gov>, ginther@fnal.gov, billl@fnal.gov

> Gentlmen
>
> This morning Tim Martin and I re-installed the BLS power supply
> hoist, a power supply was lowered to the East side of the platform.
>
> Robert Kubinski
>
>