

The Manitoba Live Steamers Inc.

The Mud Ring

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Notes From the Editor
Paul Winslow

Opinion regarding our newsletter and the adopted name, 'THE MUD RING' has been encouraging. If you missed it, copies of 'The Mud Ring', Volume 1, Issue 1, Issue Date May 2004 are available at the Clubhouse. To save postage costs, please register your name on the list when picking up your copy, as Members who have not signed this list will eventually have their copy mailed. 'The Mud Ring' is also available for downloading in an acceptable PDF format (in colour but some fonts replaced) at our newly formed website: <http://www.manitoba.livesteamers.net/>. Plans for the Mud Ring may include a PURCHASE, SELL AND SWAP section. Submit what you want, have for sale or willing to swap to Paul Winslow, 35 Watson Crescent, Winnipeg, Manitoba, R3R 1S5 or by Email at winslow1@mts.net.

Submitted Articles

John Westwood writes: With the completion date of Bob Railian's #2837 Royal Hudson drawing nearer and all the interest CPR 2816 has been generating, I found it quite interesting to discover that the chief designer of these beautiful semi-streamlined locomotives, along with the Jubilee and Selkirk Classes spent part of his career with the Canadian Pacific Railway at the Weston Shops in Winnipeg. Henry Blane Bowen, born in England in 1884, came to Canada in 1905 and went to work for the CPR in Montreal. Later, he was transferred to Weston Shops where he eventually became Superintendent of Motive Power, Western Lines. It was after he returned to Montreal in 1928, as Chief of Motive Power and Rolling Stock, that the new design work began. It is to be noted that these engines incorporated North American and English features, using the best of both types. Did you know that A. D. Baker, the inventor of the Baker Valve Gear, also invented the Baker Fan?

ON THE TECHNICAL SIDE

The first issue of 'The Mud Ring' included the design of leaf springs. This second issue continues with Part One of the design for a single load coil compression spring. More formulae exists for proper coil spring design than Carter has pills, but the following, shown with examples should provide all necessary data for the average live steam designer:

Step One: Decide if the coil spring will be used for light, average or severe service. Determine the end conditions that the coil spring is to have. The four end conditions are Plain ends - not squared, Ends squared by bending, Ends squared by grinding or Closed Ends Squared by grinding. Refer to Figure 1 for the explanation of the differences.

Step Two: Decide which material will be used for the coil spring. The most commonly used coil spring material is Chrome Vanadium wire, Hard drawn spring steel "MB" grade, Inconel, Music Wire, Oil Tempered "MB" wire, Phosphor Bronze, and Stainless Steel "18-8" 302. Properties for these metals are shown in Figures Two to Eight respectively.

Example: A steel coil spring is to be made from Music Wire. It will be designed so that it can support a load (P) of 10 pounds at a working length of 0.750 inches. The mean diameter (D) of the spring is to be .800 inches. The coil spring will be used for severe service. It is to be capable of deflection to solid length without permanent set. Ends of the spring are to be squared by grinding.

Step Three: Compute a trial wire diameter. To do this, use the following formula:

$$d = \sqrt[3]{\frac{PD}{0.3\sigma}}$$

where: d = the trial wire diameter (inches), P = load (pounds),
 D = mean spring diameter (inches), σ = a trial torsional stress (psi).

With a load of 10 pounds and using a value of say 80,000 psi for torsional stress (See Figure 5), a trial wire diameter 0.0693 inch is calculated.

Step Four: The trial diameter (0.0693") is not commercially available. Select a near size commercially available gauge wire and use this to compute the torsional stress. The nearest commercial size for Music Wire is 0.0685" (Gauge 28). The torsional stress is computed from the following formula:

$$\sigma = \frac{8 K_a D P}{\pi d^3}$$

where: σ = torsional stress (psi),
 K_a is the Wahl factor that corrects for stress at the inside fibres due to the curvature of the spring and takes into account the direct shearing stress by the axial load,
 D = mean spring diameter, P = load (lbs),
 π = 3.141592654 and etcetera, d = wire diameter (ins.),

$$K_a = \frac{4C - 1}{4C - 4} + \frac{0.615}{C}$$

where: K_a is the Wahl factor, C = the spring index

and: $C = \frac{D}{d}$

where: C = the spring index, D = mean spring diameter (ins),
 d = wire diameter (ins).

Selecting a standard wire diameter, 0.0685 inches Gauge 28, a torsional stress (71,170 psi) is computed which is low for a spring of that wire size subjected to severe service. (See Figure 5). A smaller diameter, 0.0640 inches Gauge 27 is tried, achieving an acceptable calculated value for the torsional stress of 86,604 psi.

Step Five: Compute the deflection per coil. This is calculated by the following formula:

$$\frac{\delta}{N} = \frac{8 D^3 P}{G d^4}$$

where: δ = linear deflection (ins.), N = number of active coils in the spring,
 D = mean spring diameter (ins.), P = load (lbs.),
 G = the torsional modulus, d = wire diameter (ins.)

The torsional modulus (G) for Music Wire is 12,000,000 psi (See Table 1). The deflection per coil (δ/N) is calculated to be 0.2035 inches.

Step Six: Compute pitch at the unloaded condition. This is calculated by the following formula:

$$L = c + \frac{\delta}{N} + d$$

where: L = pitch at the unloaded condition (ins.), c = clearance between coils (ins.),
 δ/N = linear deflection per coil (ins.), d = wire diameter (ins.)

A clearance (distance) between coils is set at 0.094 inches. The unloaded pitch (L) is calculated to be 0.3615 inches.

Step Seven: Compute coils per inch. This value is computed using the formula:

$$n = \frac{1}{L}$$

where: n = coils per inch, L = pitch at the unloaded condition (ins.)

Coils per inch ($1/L$) is therefore 2.7666. If the lathe is to be used for winding the spring, the corresponding number of coils should match the lathe gearing (Threads Per Inch). In this example, a lathe gearing 3 will be used (See Next Issue of the Mud Ring for details winding of coil springs in the lathe).

Step Eight: Compute the final value for pitch. This is calculated by the following formula:

$$L = 1 \text{ divided by the lathe gearing}$$

where: L = pitch at the unloaded condition (ins.)
and the lathe gearing depends upon the Lathe capability.

Using a lathe gearing of 3, the value (L) is 0.3333 inches.

Step Nine: Compute pitch in the loaded condition. This is calculated by the formula:

$$l = L - \frac{\delta}{N}$$

where: l = pitch at loaded condition (ins.), L = pitch at the unloaded condition (ins.),
 δ/N = the deflection per coil.

Pitch in the loaded condition (l) is 0.3333 minus 2.7663 which equals 0.1299 inches.

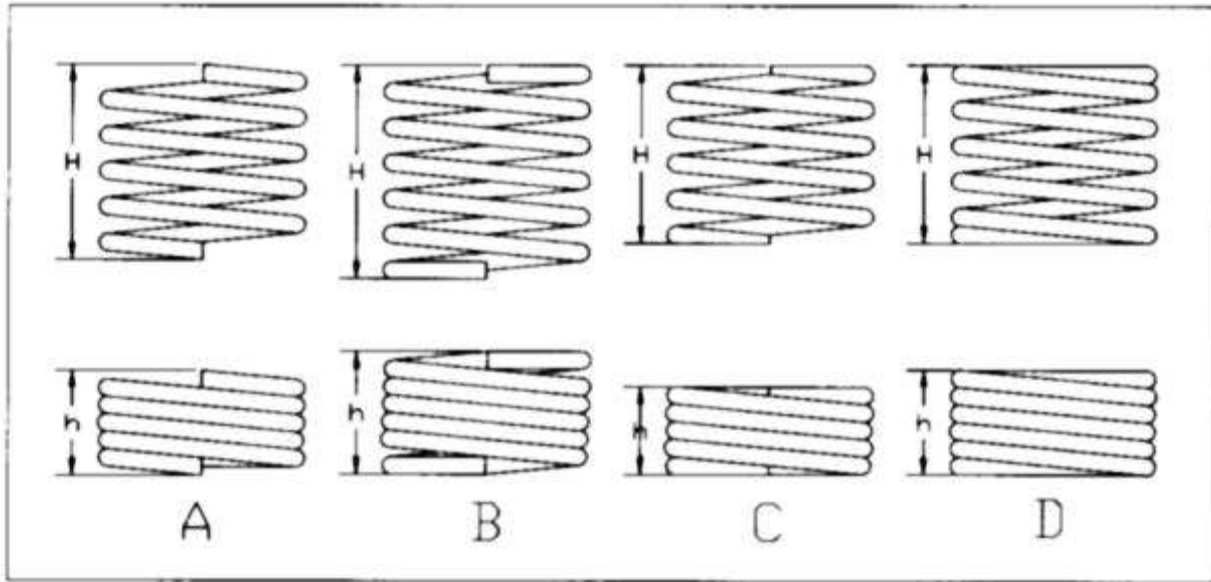
Step Ten: Compute the number of active coils. This is found by the following formula:

$$N = \frac{H_w}{l} *$$

where: N = number of active coils, H_w = working length of spring (ins.),
 l = pitch at the loaded condition (ins.).

* the calculated value N may be rounded.

Since the given working length for the coil spring was 0.750 inches, the number of coils (N) is calculated to be 5.7744. Rounding this value, the number of active coils (N) becomes 6.



A:	Plain Ends - Not Squared	$H = NL + d$	$H_w = Nl + d$	$h = Nd + d$
B:	Ends Squared by Bending	$H = NL + 3d$	$H_w = Nl + 3d$	$h = Nd + 3d$
C:	Ends Squared by Grinding	$H = NL$	$H_w = Nl$	$h = Nd$
D:	Closed Ends Squared by Grinding	$H = NL + 2d$	$H_w = Nl + 2d$	$h = Nd + 2d$

Where: d = wire diameter, h = solid length, H = free length, H_w = working length, l = pitch at working length. L = pitch at free length, N = number of active coils.

<u>Ferrous Materials</u>		<u>Non-Ferrous Materials</u>	
Material Commercial Name	Modulus of Elasticity in Torsion, G	Material Commercial Name	Modulus of Elasticity in Torsion, G
Hard Drawn MB Spring Steel	11,400,000	Spring Brass, Type 70-30	5,000,000
Music Wire Spring Steel	12,000,000	Phosphor-Bronze, 5 % tin	6,000,000
Oil-Tempered MB Spring Steel	11,200,000	Beryllium-Copper, Type 2 1/4 %	7,250,000
Alloy Steel, Chrome- Vanadium	11,200,000	Inconel	10,500,000
Silicone-Manganese	10,750,000	Inconel X	10,500,000
Silicone- Chromium	11,200,000	Monel	9,500,000
Stainless Steel, Type 302, 304, 316	10,000,000	K-Monel	9,500,000
Type 17-7 PH	11,000,000	Duranickel	11,000,000
Type 414	10,500,000	Permanickel	11,000,000
Type 420	11,000,000	Ni-Span C	10,000,000
		Elgiloy	12,000,000
		Iso-Elastic	9,200,000

Table 1: Modulus of Elasticity in Torsion of Spring Materials

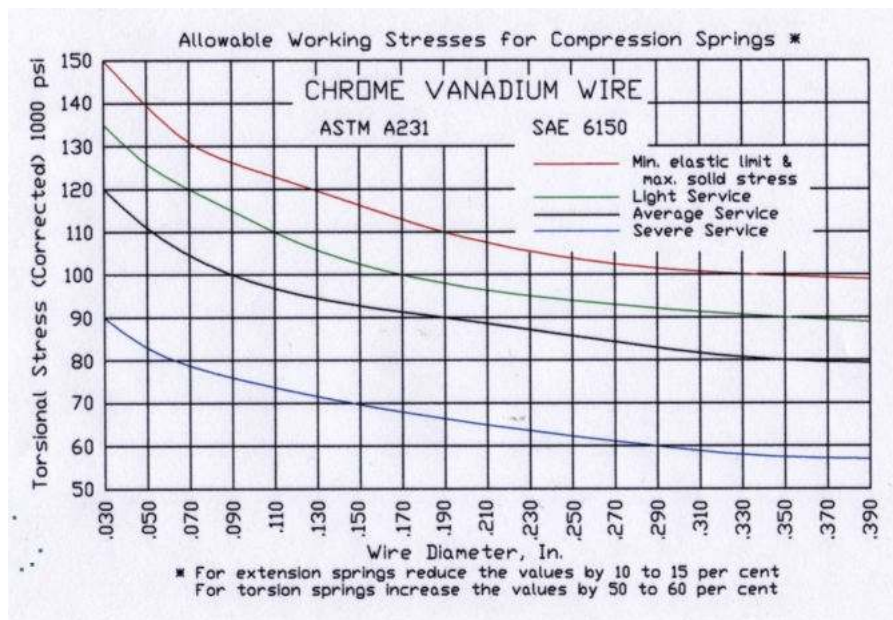


Figure 2

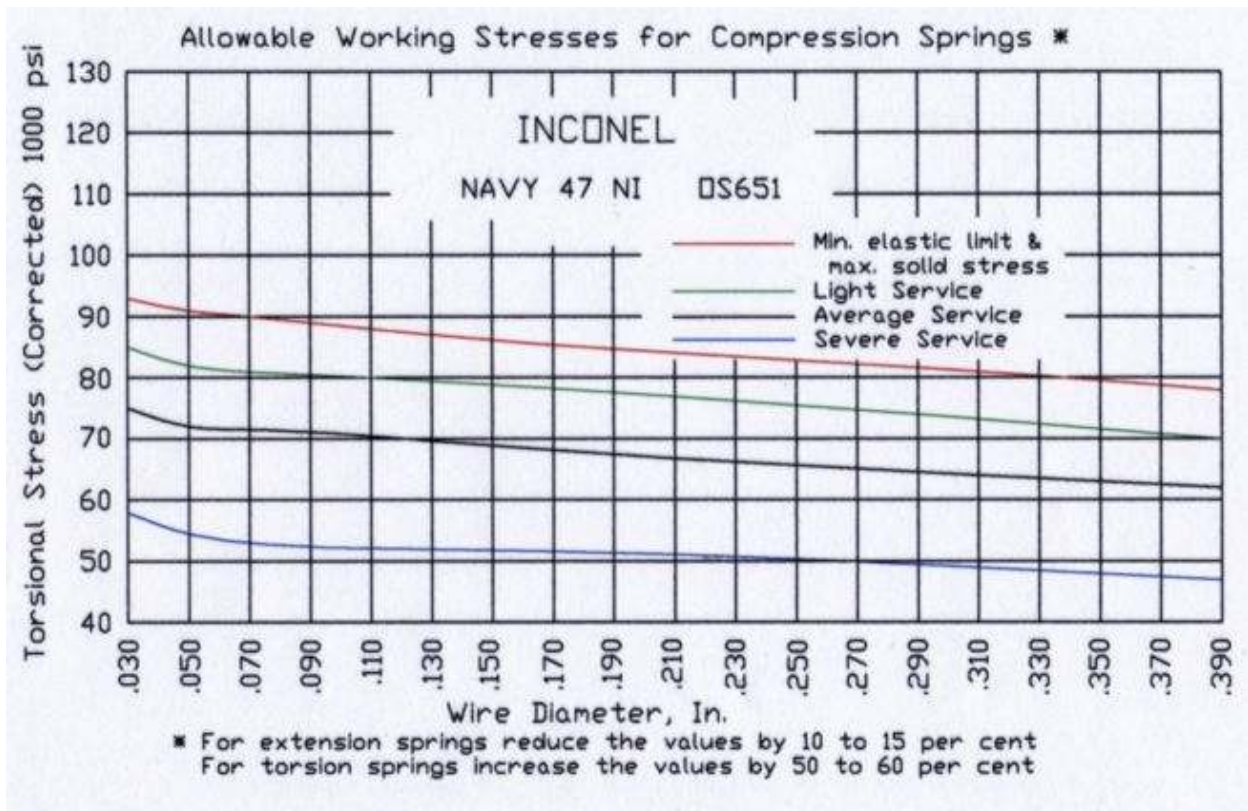


Figure 4

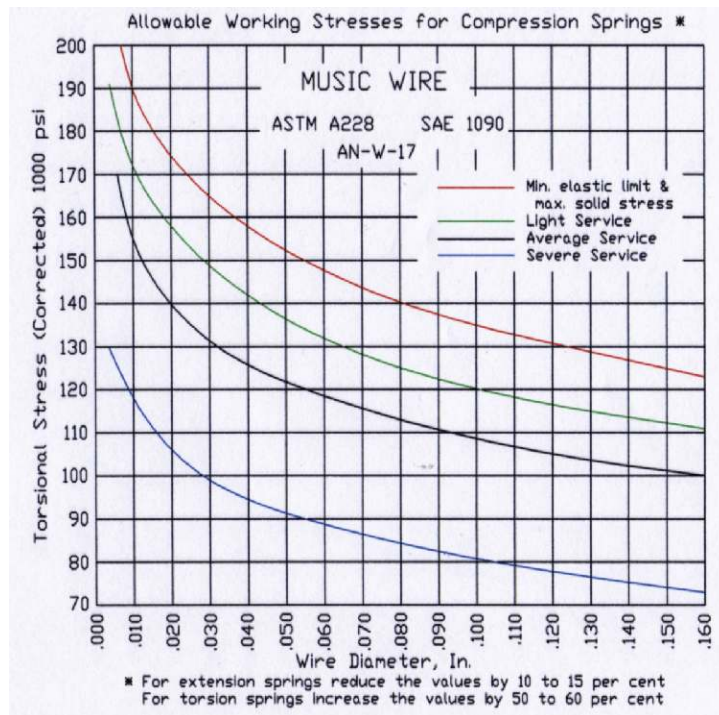


Figure 5

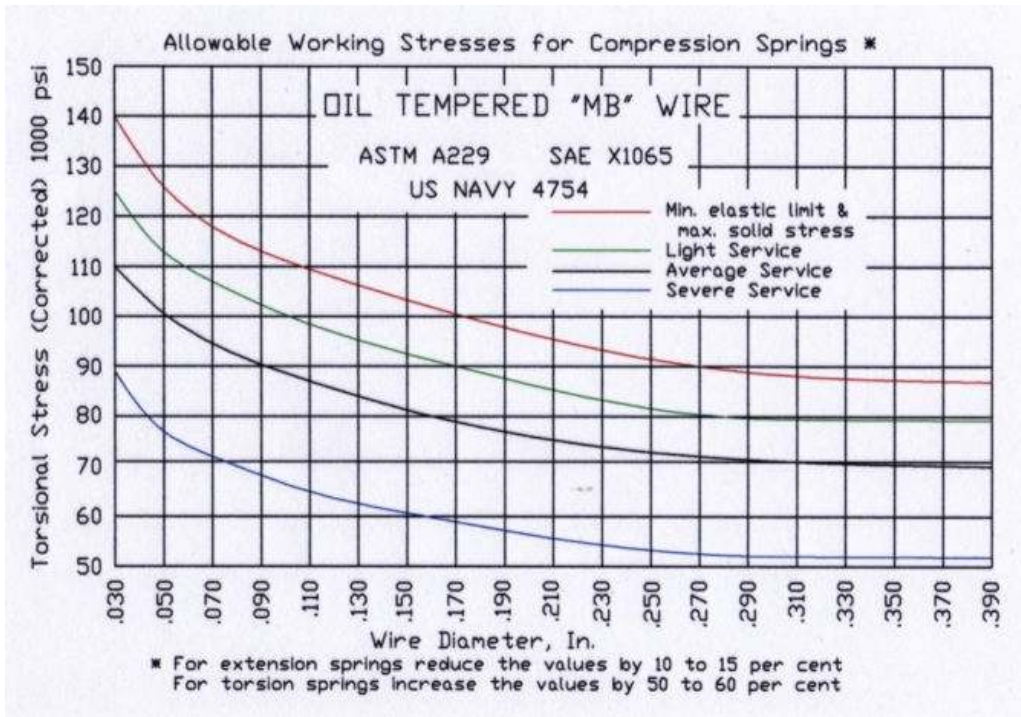


Figure 6

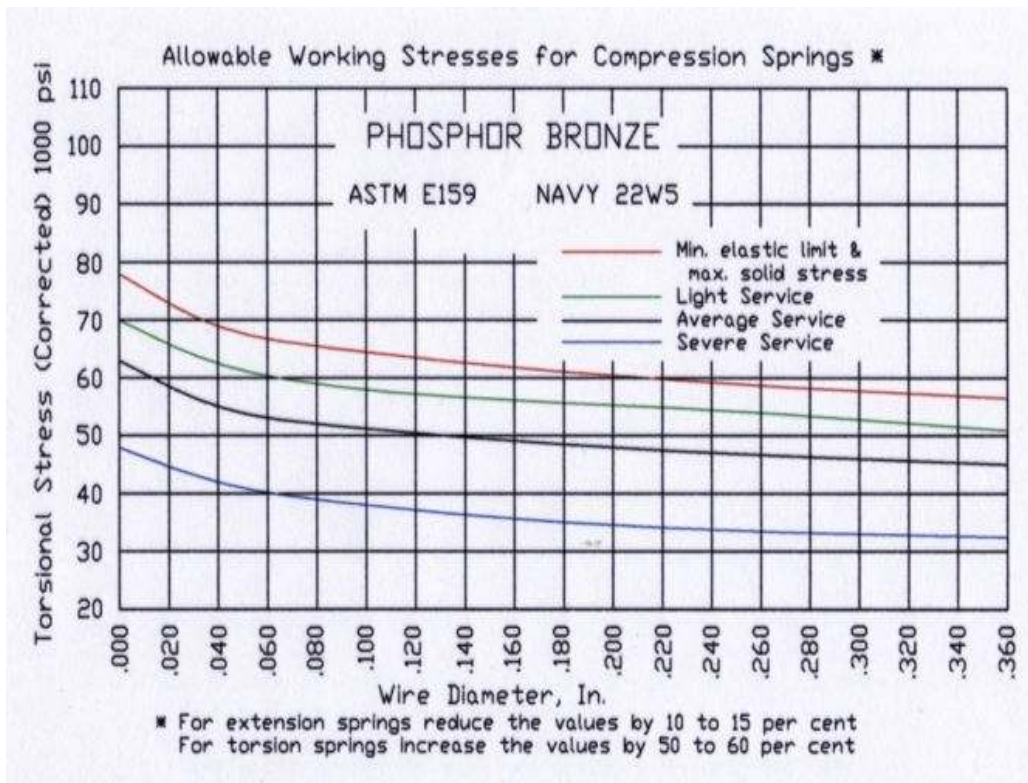


Figure 7

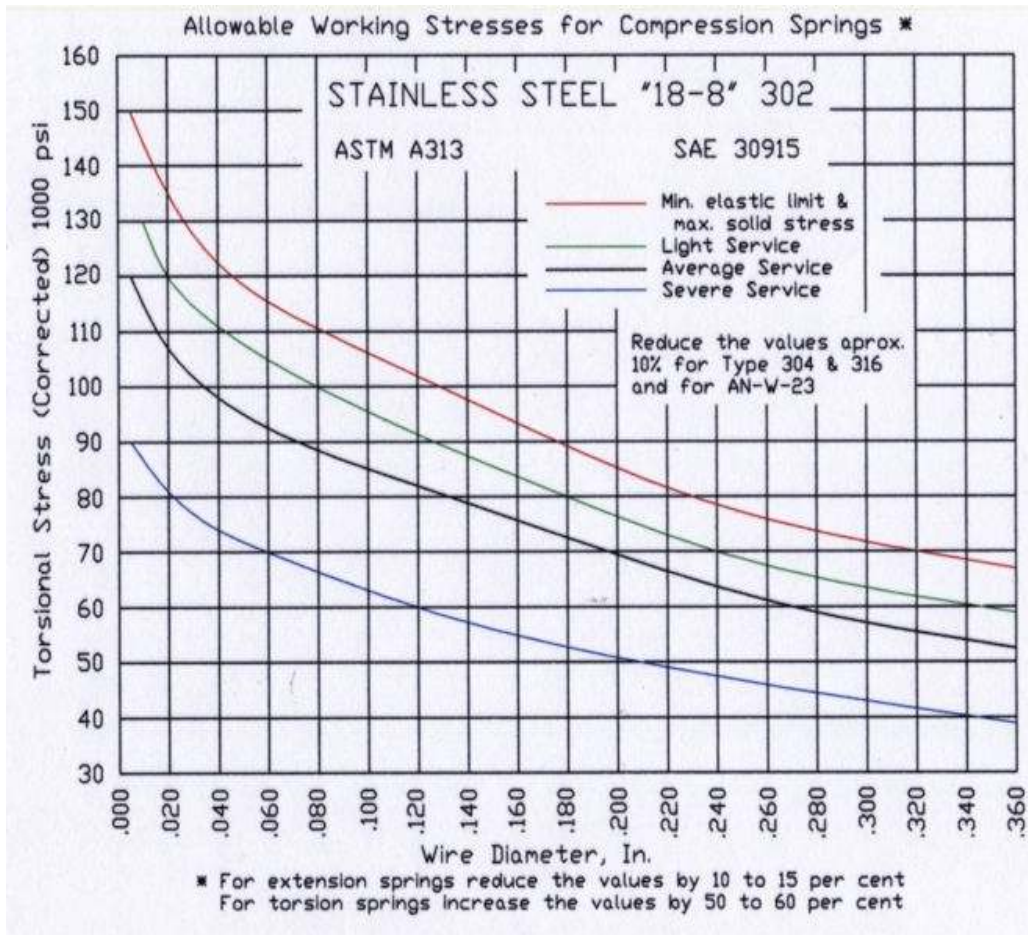


Figure 8: Allowable Working Stresses for Compression Springs.

PAST AND UPCOMING EVENTS FOR THE MLSI

In spite of this years' lousy summer weather, somehow we managed to escape Mother Nature's wrath to have an extremely successful Live Steam Meet held August 28 and 29. Some photos taken at the Meet are up on the Manitoba Live Steamers Web Site. Right now, labour has resumed at our meetings. Plans in the works may include the construction of a pedestrian footbridge over the elevated track to permit easy access to the inner field.

FROM GRANNIES KITCHEN

To Clean Windshields: Use equal parts of denatured alcohol and ether. Apply this mixture to the glass with a clean woolen cloth. Rub briskly, then sprinkle a little of jewellers' rouge upon a piece of chamois skin and polish. The result will be that the glass will shine like crystal.

Hard Metal Drilling Lubricant: For drilling in hard metal, it is recommended to use carbolic acid instead of another fatty substance as a lubricant, since the latter, by decreasing the friction, diminishes the "biting" of the drill, whereas the carbolic acid has an etching action.

Callous Spots on Feet: To remove – Soak feet for half an hour morning and night in a gallon of water in which has been dissolved a handful of sal soda.

Two Members' names have been drawn. Tony Doerksen and Charlie Sparrow have been assigned the duty of submitting an article for our next newsletter.