# **CAL** Manufacturing Company, Inc.

P.O. Box 180 5500 East 'V' Ave. Vicksburg, MI 49097 Phone - (269) 649-2942 Fax - (269) 649-2946

Toll Free - (888) 272-5446

### **Cables for Resistance Welding**

E-MAIL : CALCABLES@AOL.COM WEBSITE : CALMFGINC.COM



Air-Cooled Jumpers Dual Conductor Cables High Voltage cables Laminated Shunts Water-Cooled Jumpers

2007

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SERVICE AND SATISFACTION IS OUR MOTTO. NO ONE WILL TRY HARDER TO PLEASE OUR CUSTOMER THAN WE DO.

#### Some Reasons why <u>CAL</u> Cables should be your choice for cables.

#### FIRST: FLEXIBILITY

Exceptional flexibility results from careful selection of materials and from clearance tolerances designed to minimize rigidity. We also have a specially designed extra-flexible line of cables, built from copper wire stranded for <u>ultra</u> flexibility. Our "XL" line of cables are built from stranded wire rope that contains 4 times as many ultra fine wires. These are very flexible cables and under flexing conditions have been reported to last up to 5 times longer than conventional cables. However, under high heat applications these cables may have to be up-sized. The smaller diameter individual wires can burn faster under a high heat condition.

#### SECOND: MAXIMUM COOLING

Careful design of the <u>CAL</u> Dual Conductor water-cooled cable has provided for an effective cooling system which provides for adequate flow of water around all the conductor ropes. Particular attention to additional water flow within the rear portion of the terminal also increases the cooling characteristics. The flow of water through the conductors, together with the extra large water openings in the rear of the terminals, minimizes the blockage of water passages because of broken strands or other foreign materials. This process contributes to longer cable life.

#### THIRD: DUAL CONDUCTOR ALTERNATE POLARITY

Copper conductor ropes, with a special stranding, insulated from each other by our synthetic neoprene extrusion, are arranged in alternate polarity relationship to achieve an excellent balance of electrical forces. This reduces the pulsing vibration (KICK), reduces the AC voltage drop across the cable and also promotes longer cable life.

#### FOURTH: IMPROVED TERMINAL CONDUCTIVITY - MECHANICALLY STRONG TERMINALS

The <u>CAL</u> Dual Conductor Cable features a mechanically strong terminal of pure non-alloy copper rod giving 100% conductivity. The terminals are attached to the conductors by a **silver**-brazing process. **THERE ARE NO SOFT SOLDERED OR MECHANICALLY FASTENED** joints in a <u>CAL</u> Dual Conductor Cable with standard terminals. This excludes terminal "L" which is a cast, two part terminal, requiring some soft solder for assembly.

#### FIFTH: SERVICE AND SATISFACTION

The CAL line of cables for resistance welding is backed by design, development, and testing over a period of **45** years of operation and production.

#### SERVICE AND SATISFACTION IS OUR MOTTO. NO ONE WILL TRY HARDER TO PLEASE OUR CUSTOMER THAN WE DO.

### **CAL Air-Cooled Jumpers**

The **<u>CAL</u>** line of Air-Cooled Jumpers will meet your every welding requirement for this type of cable. Jumpers are available in circular mill sizes from 400 MCM to 2000 MCM as standards. Other circular mill sizes available upon request.

Terminals can be furnished with any desired angle. (SEE TERMINAL STANDARD CONFIGURATIONS BELOW)

#### As standard and unless otherwise ordered:

(1.) the 1-1/4" width will be supplied up to and including 1500 MCM size.

(2.) the 600 - 1500 MCM size can be furnished in the 1-3/8" width.

(3.) the 2000 MCM size will be furnished in the 1-1/2" width.

When so ordered, Automotive standards will automatically be met such as Ford-WKA series and GM-CBL series.

#### **TERMINAL LENGTH:**

The contact surface length of CAL Air-Cooled Jumpers is 1-9/16. Other lengths can be furnished if special ordered.

#### BOLT HOLE SIZE:

All CAL Air-Cooled Jumpers are drilled with 17/32" bolt holes, unless otherwise ordered.

When ordering please specify: ACJ/MCM Size and length bolt hole center to bolt hole center and the terminals required. If no terminals are specified the CFF will be furnished.











"CFL" "CFF" "CFR"

"CFV" "CLV" "CLVO"

"CVV"

L

"CVVO" "CLL" "CLLO"

мсм	1-1/4" WIDE	1-3/8" WIDE	1-1/2" WIDE
400	3/8" Thick		
500	7/16"		
600	1/2"	7/16" Thick	
750	5/8"	9/16"	
1000	3/4"	1-1/16"	5/8" Thick
1200	7/8"	13/16"	3/4"
1500	1.00"	1-1/16"	1.00"
2000			1-7/16"

### **CAL XL Air-Cooled Jumpers**

The XL line of cables were first introduced in the US by <u>CAL</u> in the early 1980's for the more demanding flex of the newer machines. <u>CAL's</u> XL Cables are the same as the standard cable except for the special stranding of the rope. The MCM sizes available are from 400 MCM to 1200 MCM excluding 500 MCM. The XL Air-Cooled Jumpers were designed for flexibility. In a high flex job, these cables have been reported to last up to <u>5 times</u> longer than a standard jumper. Because of the special stranding, and the smaller diameter individual wires in the bunches, we recommend that in a <u>high heat</u> application you move up to a larger MCM size, if possible.

**<u>CAL</u>** also makes XL cables in Water-Cooled Jumpers and Dual Conductor Cables.

DUTY CYCLE	MULTIPLIER
100 %	1.00
90 %	.95
80 %	.90
70 %	.84
60 %	.78
50 %	.71
40 %	.63
30 %	.55
20 %	.45
10 %	.32
5 %	.22
3 %	.17
2 %	.14

#### Determining the MCM size required

To determine the required MCM rating, it is first necessary to know: (1) the duty cycle, (2) current to be used and (3) length of the cable to be used, measured bolt hole center to bolt hole center.

Once this has been determined, proceed as follows:

- 1. Find the closest duty cycle shown on the multiplier chart to the left. Take your current level and multiply it times the multiplier shown. This will give you the continuous duty current of the cable.
- Refer to the chart below. Looking up from the length of your required cable, find the angular line closest to the continuous current level you just established. Then follow the angular line to the right for the MCM rating.



#### **Air-Cooled Jumper Selection Chart**

### **CAL Laminated Shunts**

**<u>CAL Manufacturing</u>** has adopted a different process than other manufacturers for laminated Shunts. A <u>CAL</u> shunt is <u>wound and formed</u> without cutting the ends.

Because the laminations are not cut, but continue around the ends of the shunt without interruption, the current may also flow around the ends. This results in a greatly improved distribution of current and a more even distribution of heat throughout the entire shunt.

The standard <u>CAL</u> shunt is made from .005" copper laminations but .003" and .010" are available upon request.

Fill out the sheet on the next page or provide us with a drawing or print with the following information.

Length to the outside sheet (OL) Width (W) Thickness, excluding clip (T) Drill size or boll size Drill pattern (See next page) Laminations to be used .005" Etc. End treatment (Clip, Solder Etc.) Type of shunt ("C", "J", "L" "F" Etc.)

Examples of shunt configuration below:



### Example "F"(Flat) Shunt

### CAL Manufacturing Company Inc. Phone (269) 649-2942 • FAX (269) 649-2946

Laminated Shunt DATA Sheet

To order Fill out details below

All <u>**Cal</u>** Shunts are made from .005" Thick lamination with 1/16" Copper clips riveted in place UNLESS otherwise ordered.</u>

Type of shunt:



### **CAL Dual Conductor "Kickless" Cables**

The <u>CAL</u> line of Dual Conductor, water-cooled cables features a wide variety of terminals designed to meet all required applications. See the following pages for the industry standard terminals. CAL Manufacturing Company, Inc., has the capability to manufacture various terminals that you may require, per your specifications.

The use of <u>99.9% pure copper rod</u> for our terminals, along with <u>silver brazing</u> of the conductor rope to the terminal allows for 100% conductivity. The only exception is our "L" terminal, which is a cast terminal, and requires some soft solder for connection.

The <u>CAL</u> cable features copper conductor ropes, each separated by a synthetic neoprene separator first introduced to the market by <u>CAL</u>. The conductor ropes are arranged alternately in a positive negative relationship within the neoprene extrusion, thus giving alternated polarity to the electrical forces and reducing excessive vibration or "KICK".

The positive conductors are grouped at each end and stamped into a fitting which is silver brazed to the terminal. The negative conductors, by the same process, are brazed to the other half of the terminal.

The whole assembly is enclosed into a specially designed high quality rubber hose.

The terminals are assembled using high quality micarta for insulation between the two halves of the terminal. The single "O" ring principle, first introduced by <u>CAL</u> is used between the terminals to provide a positive water seal. A metal band over the hose at the "O" ring point completes the assembly.



### CAL MANUFACTURING PRESENTS THE "SWIVEL KING" KICKLESS CABLE



**<u>Cal's</u>** "Swivel-King" Dual Conductor Cable is one of the greatest innovations to hit the spot welding market in years. <u>**Cal**</u> invented and patented the "Swivel-King" in 1990 with the robots in mind. We found, however, that manual jobs received the greatest benefits. This cable will allow the welding head to twist 180 degrees, with as little as 15 lbs of pressure. The swivel feature relieves stress on the shoulders, arms, and wrists of the welders on the floor. It has made life a lot easier on people and robots alike.

The "Swivel-King" can be ordered in any length, MCM size, or terminal combination. The only extra information required is where do you want the swivel placed? Every machine is different so the placement of the swivel can vary with any operation. Simply look at the operation and find a place back from the welding head where there is very little bend in the cable. Measure back from the bolt hole center on the existing cable and give us that measurement.

Basically the "Swivel-King" feature breaks the hose and allows the cable to move freely inside.

### **TERMINALS For DUAL Conductor ("Kickless") Cables**



1

#### **TERMINALS For DUAL Conductor ("Kickless") Cables**



#### **TECHNICAL DATA**

**Dual Conductor (kickless) Cable** 

Based on: Water - 2 g.p.m. @ 100° temperature; Maximum Temperature of 167° F; OHM's per foot include BOTH LEADS

Cable Size MCM	<u>300MCM</u>	400MCM	<u>500MCM</u>	<u>600MCM</u>	<u>650MCM</u>	800MCM
Resistance per foot (D.C) OHMS X 10 <sup>-6</sup>	69.66/ft.	52.4/ft.	43.0/ft.	38.8/ft	33.1/ft	27.32/ft
Impedance OHMS X 10 <sup>-6</sup>	78.7	59.5	48.3	41.2	37.8	30.1

DUTY CYCLE	MULTIPLIER
100 %	1.00
90 %	.95
80 %	.90
70 %	.84
60 %	.78
50 %	.71
40 %	.63
30 %	.55
20 %	.45
10 %	.32
5 %	.22
3 %	.17
2 %	.14

#### Determining the MCM size required

To determine the required MCM rating, it is first necessary to know: (1) the duty cycle, (2) current to be used and (3) length of the cable to be used, measured bolt hole center to bolt hole center.

Once this has been determined, proceed as follows:

- Find the closest duty cycle shown on the multiplier chart to the left. Take your current level and multiply it times the multiplier shown. This will give you the continuous duty current of the cable.
- Refer to the chart below. Looking up from the length of your required cable, find the angular line closest to the continuous current level you just established. Then follow the angular line to the right for the MCM rating.

#### Dual Conductor ("Kickless") Cable Selection Chare



Based on 2 gallon per minute minimum water flow and 100°F temperature rise.

### CAL Single Conductor Water-Cooled Cables (WCJ)

The <u>CAL</u> line of single conductor, Water-Cooled Cable Jumpers feature a wide variety of terminals designed to meet all required applications. The terminals shown on the following two pages are only some of the terminals that <u>CAL</u> can provide. If you require a different terminal than is pictured, let us know, and we can provide you with a quote.

Water-Cooled Cable Jumpers are available as standard in 300MCM - 350MCM - 400MCM - 500MCM 600MCM - 750MCM and 1000MCM. Other circular mill sizes and or special terminals can be furnished upon request.

<u>CAL</u> cables feature both extruded copper and cast copper terminals depending on the terminal configuration. A phosphorous bronze spring is centered within the copper conductor rope:

- 1. To minimize the possibility of restricted water flow should the cable be subjected to acute bending during operation, and
- 2. To act as a filter for broken copper strands and other foreign material to prevent clogged water passages.

#### This spring can be eliminated for special requirements.

The copper conductor ropes are stranded to our specifications for flexibility and long life. XL Stranding is now available for Water-Cooled jumpers. The outer cover is a one braid high quality rubber hose specifically sized for flexibility and terminal diameter. The special stranding plus the special sizing put together a combination resulting in a quality Cable Jumper.

<u>CAL</u> is well known for putting together special cables for your special needs. Send us a CAD drawing or a sample and let us show you what we can do for you.

#### SERVICE AND SATISFACTION IS OUR MOTTO. NO ONE WILL TRY HARDER TO PLEASE OUR CUSTOMER THAN WE DO.

### **Terminals for Water-Cooled Jumpers (WCJ)**





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DUTY CYCLE	MULTIPLIER
100 %	1.00
90 %	.95
80 %	.90
70 %	.84
60 %	.78
50 %	.71
40 %	.63
30 %	.55
20 %	.45
10 %	.32
5 %	.22
3 %	.17
2 %	.14

#### Determining the MCM size required

To determine the required MCM rating, it is first necessary to know: (1) the duty cycle, (2) current to be used and (3) length of the cable to be used, measured bolt hole center to bolt hole center.

Once this has been determined, proceed as follows:

- 1. Find the closest duty cycle shown on the multiplier chart to the left. Take your current level and multiply it times the multiplier shown. This will give you the continuous duty current of the cable.
- Refer to the chart below. Looking up from the length of your required cable, find the angular line closest to the continuous current level you just established. Then follow the angular line to the right for the MCM rating.

### Water-Cooled Jumper Selection Chart



### WATER-COOLED FURNACE CABLES AND

### **HIGH VOLTAGE INDUCTION**



CABLE SIZE	МСМ	TERM. NUT "A" DIM.	HOSE I.D.
C-8	71	.84	.50
C-10	97	.90	.62
C-12	133	1.02	.75
C-16	266	1.12	1.00
C-20	532	1.22	1.23
C-24	796	1.41	1.50
C-32	1064	1.74	2.00

Note : Thermal glass covering is optional. EMERGENCY ORDERS : CAL. MFG. can ship the same day.

Phone: (269) 649-2942 Fax: (269) 649-2946 Toll Free: (888) 272-5446 CAL Manufacturing Company Inc. P.O. Box 180 5500 East 'V' Avenue Vicksburg, MI 49097

### COMMON WATER-COOLED CABLE COVER FOR RESISTANCE WELDING JUMPERS

SIZE	CONDUCTOR SIZE IN MCM	LOW VOLT TYPE 1501	LOW VOLT TVPF 9500
1.12.		0.D.	0.D.
3/4''	50 TO 250	1-1/8''	N/A
1''	200 TO 400	1-3/8''	1-1/2''
1-1/8''	300 TO 400	1-1/2''	1-5/8''
1-1/4''	450 TO 600	N/A	1-3/4''
1-1/2''	750 TO 1000 DUAL CONDUCTOR 200 TO 300	N/A	2''
1-13/16''	1200 DUAL CONDUCTOR 400 TO 500	N/A	2-3/8''
2-1/8"	1500 DUAL CONDUCTOR 650	N/A	2-5/8''
2-1/4''	2000 DUAL CONDUCTOR 800	N/A	2-7/8''

#### OTHER TYPES OF HOSE ARE AVALIBLE UPON REQUEST CAL MANUFACTURING CO. INC TOLL FREE (888) 276-5446

### COMMON WATER-COOLED CABLE COVER FOR HIGH VOLTAGE AND HIGH TEMPERATURE

SIZE I.D.	CONDUCTOR SIZE IN MCM	HIGH VOLT O.D.	HIGH TEMP TURBO HOSE O.D.
1/2"	50 TO 100	1-1/16"	1-1/16"
5/8"	100 TO 150	1-1/8"	1-3/16"
3/4"	150 TO 200	1-3/8"	1-5/16"
1"	200 TO 400	1-1/2"	1-3/16"
1-1/8"	300 TO 400	1-3/4"	1-5/16"
1-1/4"	450 TO 600	1-7/8"	1-7/16"
1-1/2"	650 TO 1000	2-1/8"	1-11/16"
2"	1000 TO 1500	2-5/8"	2-3/16"

#### OTHER TYPES OF HOSE ARE AVALIBLE UPON REQUEST CAL MANUFACTURING CO. INC TOLL FREE (888) 276-5446

### CAL Cable Repair and Rebuilding Service

The <u>CAL Manufacturing Company</u> offers a fine, complete repair service of cables or for outer cover replacement where this is the only work necessary.

Cables returned for repair can be accepted only when transportation charges are **PRE-PAID**. Returned cables will be partially dis-assembled for inspection. Cal Manufacturing performs an inspection report on all returned cables. The customer is then notified as to the repair or replacement charges and work to be done. If the customer decides not to continue with the work, the cable(s) will **not be re-assembled or returned**.

We do not repair Air-Cooled jumper cables or Laminated Shunts.

#### <u>Repair service</u>: Dual or single conductor, water-cooled cables.

If, after removal of the outer cover and thorough inspection, the cable is found to be repairable, the repairing process consists of the following as a minimum. (Unless recovering is all that is found necessary.)

- 1. Clean out the water passages to ensure adequate water flow.
- 2. Renew pipe threads, or install reducing bushings, if threads cannot be renewed.
- 3. Install new water seals (Dual Conductor only).
- 4. Replace insulation between terminals (Dual Conductor only).
- 5. Recondition terminal surface, or replace not more than one terminal where necessary.
- 6. Install outer covering, using new bands.
- 7. Test for water flow and leaks. Short test Dual Conductor Cables.

#### **Rebuilding or Replacement:**

If our inspection indicates returned cables are not suitable for repair, the rebuilding or replacement of the cable is priced as a new cable price, less 10% for usable parts and scrap salvage.

When terminal ends only are returned, an allowance of \$8.00 minimum per set (Both ends) is given on Dual Conductor Cables, and a minimum of \$6.00 per set for single conductor Water-Cooled Jumpers. These terminals **must be returned PRE-PAID**.

Reconditioned parts are used for rebuilding or replacement; however, all cables rebuilt or replaced by <u>CAL</u> always contain new conductor ropes, new inner separator and new outer coverings. Salvage credit cannot be given for cables or terminals shipped to us in excess of the number ordered.

#### SERVICE AND SATISFACTION IS OUR MOTTO. NO ONE WILL TRY HARDER TO PLEASE OUR CUSTOMER THAN WE DO.

### WARRANTY:

All statements, technical information and recommendations are based on tests, we believe to be reliable, but the accuracy or completeness thereof is not guaranteed, and the following is made in lieu of warranties, express or implied.

Seller's and manufacturer's only obligation shall be to replace such of the products proved to be defective. Neither seller or manufacturer shall be liable for any injury, loss or damage, direct or consequential, arising out of the use or the inability to use the product. Before using, user shall determine the suitability of the product for their intended use, and the user assumes all risk and liability whatsoever in connection therewith.

No statement of recommendation not contained herein shall have any force or effect unless there is an agreement signed by officers of the seller and manufacturer.

### **POLICY:**

Special length cables or shunts are priced at the next longer length listed in our price sheets.

Credit is allowed for cables or cable terminals returned to us *pre-paid* when applied on an equal number of cables ordered, or when the customer requests replacement or rebuilding of an un-repairable cable, which has been sent in for repairs. See page marked *CAL Cable Repair and Rebuilding Service*.

# ALL NEW OR REBUILT CABLES ARE WARRANTED AGAINST DEFECTIVE MATERIALS OR WORKMANSHIP.

All prices are F.O.B. Vicksburg, Michigan, unless otherwise quoted, and are subject to change without notice.

#### SERVICE AND SATISFACTION IS OUR MOTTO. NO ONE WILL TRY HARDER TO PLEASE THE CUSTOMER THAN WE DO.

## **CAL** Manufacturing Company Inc.

Phone (269) 649-2942 • FAX (269) 649-2946 2007 Laminated Shunt DATA Sheet

#### To order Fill out details below

All <u>**Cal</u>** Shunts are made from .005" Thick lamination with 1/16" Copper clips riveted in place UNLESS otherwise ordered.</u>

Type of shunt:



# CAL

# **Manufacturing Company Inc**

Phone (269) 649-2942 • FAX (269) 649-2946 E-MAIL:CALCABLES@AOL.COM WEBSITE: CALMFGINC.COM TOLL FREE (888) 272-5446

## **Cables for Resistance Welding**

**Dual Conductor ("Kickless") Cables** 



