

Moly-D[®]

MOLYBDENUM DISILICIDE HEATING ELEMENTS

GENERAL DESCRIPTION

The Moly-D element is a dense cermet material consisting of MoSi₂ and an oxide, glassy phase component.

Moly-D elements have the ability to withstand oxidation at high temperatures by forming a protective layer of quartz on its surface. If this glassy phase should be exposed to contaminants, a lower melting phase forms. This material literally drips off the element exposing more molybdenum disilicide on which a new protective oxide layer forms.

Moly-D elements become somewhat ductile at approximately 1200°C (2190°F).

THE UNIQUE PROPERTIES

1. Moly-D elements may be used up to a surface temperature of 1800°C (3270°F) in oxidizing atmospheres.
2. Long service life and ease of replacement contribute to high furnace utilization and low maintenance costs.
3. New and old elements can be used together and in series.
4. Can dissipate high power loading.
5. Can be used continuously or intermittently.
6. Provide rapid furnace temperature ramping.

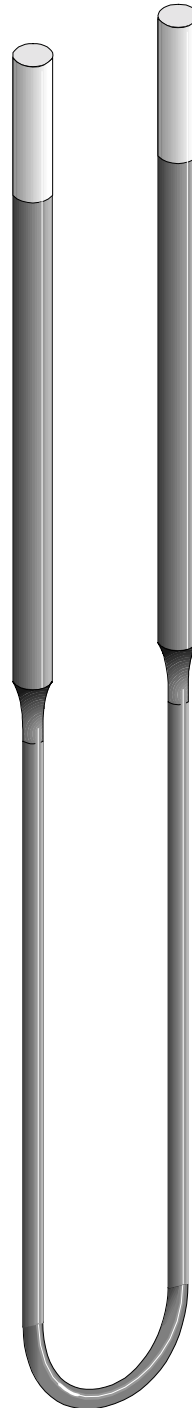
QUALITY AND PRODUCT SUMMARY

Type MD-31

- Maximum Element Temperature -- **1700°C (3090°F)**
- General Applications -- Most types of industrial furnaces for heat treating, forging, sintering, glass melting and refining, and for use in radiant tubes.

Type MD-33

- Maximum Element Temperature -- **1800°C (3270°F)**
- General Applications -- Laboratory furnaces, testing equipment, and high temperature sintering production furnaces.



 Moly-D[®]

Molybdenum
Disilicide
Heating Elements



I SQUARED R ELEMENT CO., INC.

PHYSICAL CHARACTERISTICS

Moly-D heating elements are manufactured by powder metallurgy. They consist of molybdenum disilicide with additives that prevent recrystallization. Since Moly-D is completely stable up to 1800°C (3270°F), it surpasses other heating element types for high temperature performance.

The resistance of Moly-D elements to oxidation lies in the formation of an impermeable quartz, or glass-like protective layer which re-forms when heated if damaged in operation.

The Moly-D element has a low specific electrical resistivity with a positive resistance-temperature characteristic as shown in figure 1. It can be used at a very high watt loading compared to metallic heating elements. Please refer to figure 2, page 3 for watt loading at various element temperatures. Because of its high temperature oxidation resistance, Moly-D electrical resistance remains constant at constant temperature over its useful life. This permits the use of old and new elements together in the same furnace, even if series-connected.

TEMPERATURE RANGE

Shown in Table A, below, maximum element temperature depends on the atmosphere within the furnace chamber. In air this is 1800°C (3270°F). Since element surface temperature exceeds furnace ambient in relation to the watt loading, careful attention must be given to these parameters for satisfactory element performance.

Moly-D heating elements normally operate between 1300 and 1750°C (2372-3182°F). Moly-D elements may be used below 1300°C (2372°F) particularly for furnace atmospheres harmful to silicon carbide heating elements (e.g., sulfur dioxide, water-steam, etc.). Moly-D should not be used between the temperature range of 400 and 700°C (752-1292°F), where a destructive low temperature oxidation may occur called pest.

PERMISSIBLE ATMOSPHERES

Moly-D heating elements are designed for use in oxidizing atmospheres. In addition, neutral atmospheres such as nitrogen, inert gases, CO and CO₂ are not harmful to Moly-D. Maximum element surface temperatures in various gaseous environments are given in Table A.

Reducing atmospheres attack the protective layer and therefore lower permissible maximum use temperature.

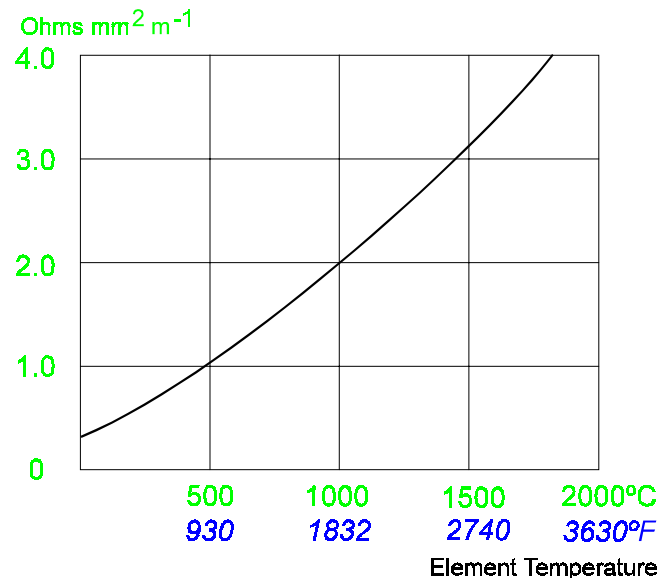


Figure 1, Resistivity of Moly-D elements MD-31 and MD-33

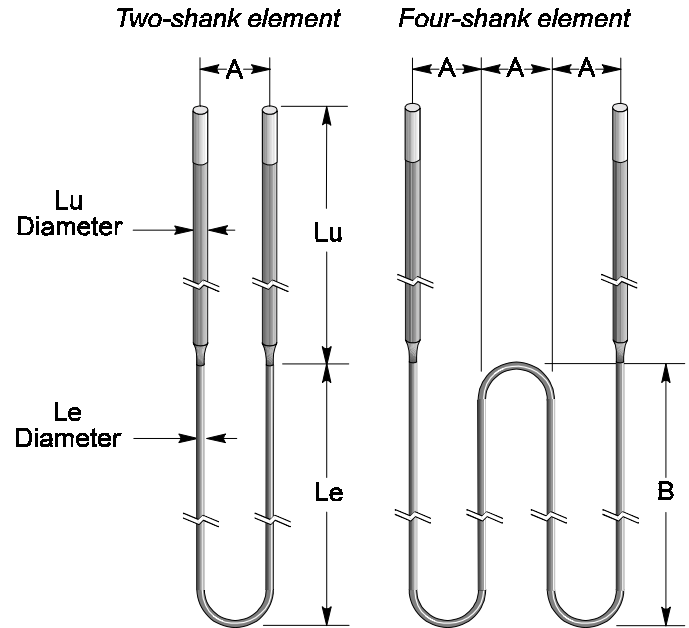
TABLE A				
MAXIMUM RECOMMENDED ELEMENT TEMPERATURES IN ATMOSPHERES				
Atmosphere	MD-31		MD-33	
	°C	°F	°C	°F
Air	1700	3090	1800	3270
Nitrogen	1600	2910	1700	3090
Argon, helium	1600	2910	1700	3090
Dry Hydrogen, dewpoint -80°C (-112°F)	1150	2100	1150	2100
Moist hydrogen, dewpoint 20°C (68°F)	1450	2640	1450	2640
Exogas (e.g. 10% CO ₂ , 5% CO, 15% H ₂)	1600	2910	1700	3090
Endogas (e.g. 40% H ₂ , 20% CO)	1400	2550	1450	2640
Cracked and partially converted ammonia (~8% H ₂)	1400	2550	1400	2550

ELEMENT TYPE AND DIMENSIONS

Moly-D heating elements may be made in a variety of configurations. Most common is a two shank (U-shaped) element having terminal ends twice the diameter of the heating section. Please refer to Table B for sizes currently available. Since the cross sectional area of the terminal ends is four times that of the heating section, the exposed terminal ends operate at a low enough temperature to require no supplemental cooling if proper design criteria are used.

Maximum heating lengths at various element temperatures are shown in figure 3, page 4.

Four-shank-elements in the 6/12, 9/18 and 12/24 diameters are also available. They are normally used in furnaces with a low chamber height where the elements would be mounted horizontally.



TWO-SHANK ELEMENTS

Two-shank elements with straight terminals are defined by:

- Heating zone diameter, mm
- Terminal diameter, mm
- Terminal length, Lu, mm (in.)
- Heating zone length, Le, mm (in.)
- Center distance between shanks, A, mm (in.)
- The grade (MD-31 or MD-33)

Example in metric: MD 6/12 Lu=254, Le=560, A=50, Grade MD-33

Example in inches: MD 6/12 Lu=10, Le=22, A=1.97, Grade MD-33

TABLE B SIZES AVAILABLE						
Size	Heating Zone Le Ø		Terminal End Lu Ø		Standard "A" Distance	
	mm	in	mm	in	mm	in
3/6	3	.12	6	.24	25	.98
4/9	4	.16	9	.35	25	.98
6/12	6	.24	12	.47	50	1.97
9/18	9	.35	18	.71	60	2.36
12/24	12	.47	24	.94	80	3.15

All diameters are available in the following grades:
 -Grade MD-31 - maximum element temperature 1700°C (3090°F)
 -Grade MD-33 - maximum element temperature 1800°C (3270°F)

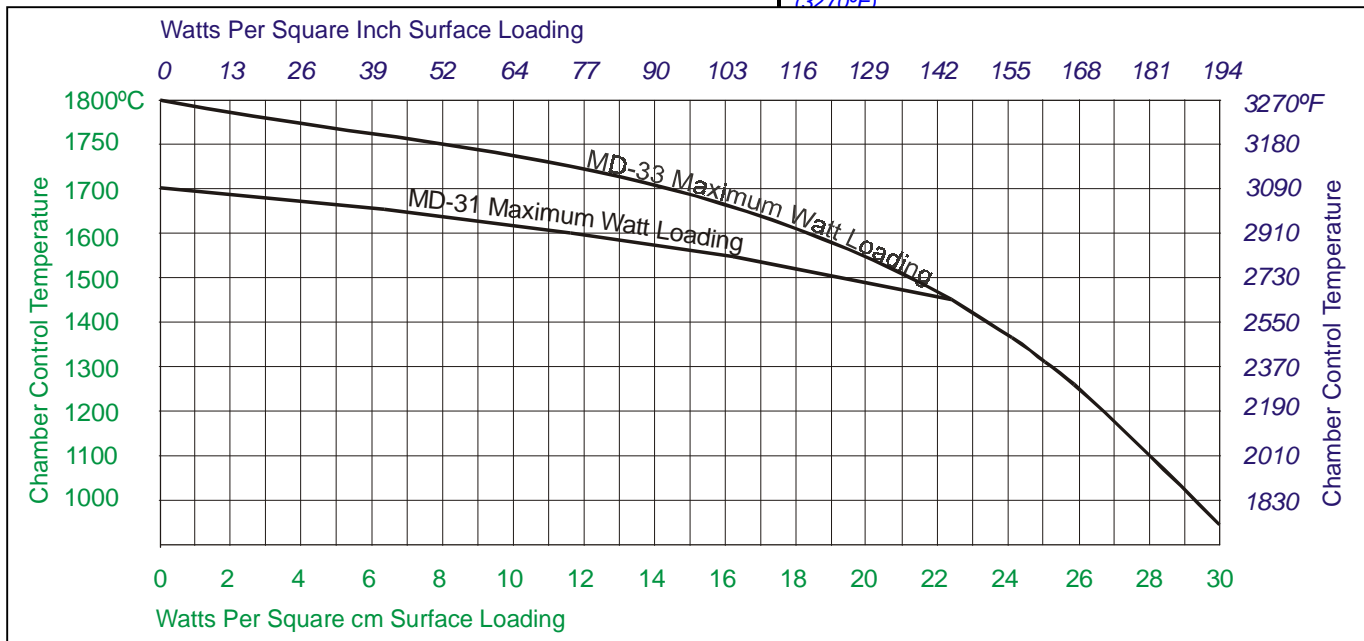


Figure 2, Maximum surface loads for Moly-D elements, Grade MD-31 and MD-33

Maximum Length of Hot Zone (Le)

in. mm
 55 1400
 50 1250
 47 1200
 40 1000
 32 800
 24 600
 16 400
 8 200

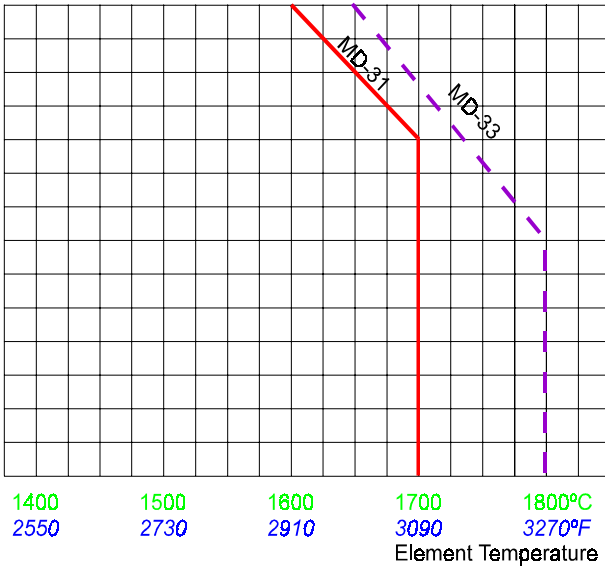
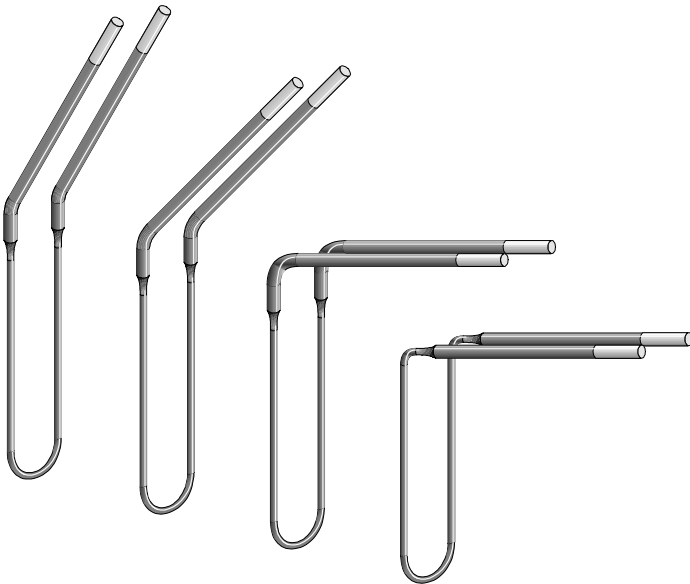


Figure 3, Maximum recommended heating zone lengths at element temperatures for vertically suspended 6/12, 9/18 & 12/24 elements. Note: 3/6 and 4/9mm MD-33 elements are not normally manufactured with a Hot Zone (Le) longer than 400mm (15.8 in.).

TWO-SHANK BENT ELEMENTS

Elements with a bend are available in the 3/6, 6/12 and 9/18 diameters. Bends can be made in the Le or Lu at 30°, 45° or 90° angles.



MADE TO INDUSTRY STANDARDS

Moly -D heating elements are manufactured to industry established resistance values. The same spacing, power ratings and voltages, used with other molybdenum disilicide elements can be used.

DELIVERY

Most sizes and types can be shipped 2 to 3 weeks after receipt of an order. Emergency shipments for 3/6 and 6/12 can usually be made in 2 to 3 days.

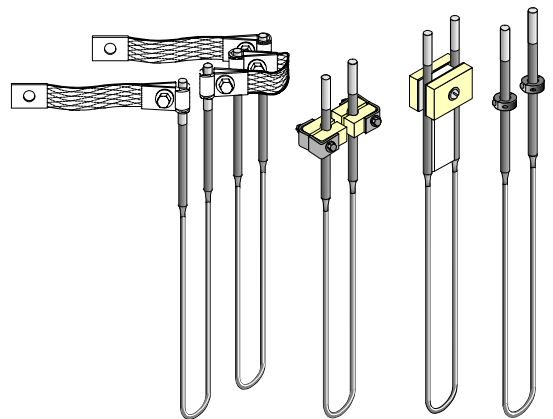
TECHNICAL ASSISTANCE

We can assist you in choosing the most suitable element material and element type for your application. We also offer free engineering service for a new furnace design or a conversion from gas or oil fired to electric heating.

MOLY-D ACCESSORIES

Straps and holders are available for all sizes. Please refer to our Moly-D accessory brochure for additional information.

Pictured below are aluminum strap assemblies, ceramic holders, plate type holder, and metallic holders.



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