

THE H-J FAMILY[®]
OF COMPANIES
▪ SINCE 1969 ▪

34.5 kV PROTECTIVE LINK FUSES

The **H-J Family of Companies** is pleased to introduce our new **34.5 kV oil-immersed expulsion fuses** for **CSP** and large padmount-type transformers for renewable applications from **3 to 12 MVA**.

GENERALITIES:

WHAT ARE EXPULSION FUSES?

- Overloads
- Short circuits
- Power faults

Expulsion fuses, such as those shown in **Figure 1**, interrupt the current flow to the transformer when it exceeds the threshold defined by the fuse's time-current curve. These fuses operate quickly, following their time-current curves, causing the fuse to melt and open the circuit faster as the excessive current increases (**inverse curve**).

In addition to the commonly used bayonet and cut-out fuses, **our new line** will be referred to as **protective link fuses** to differentiate the developed line from them.

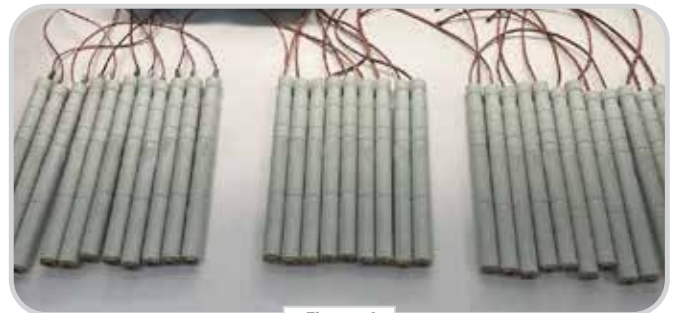


Figure 1

TOTAL CLEARING CURVES

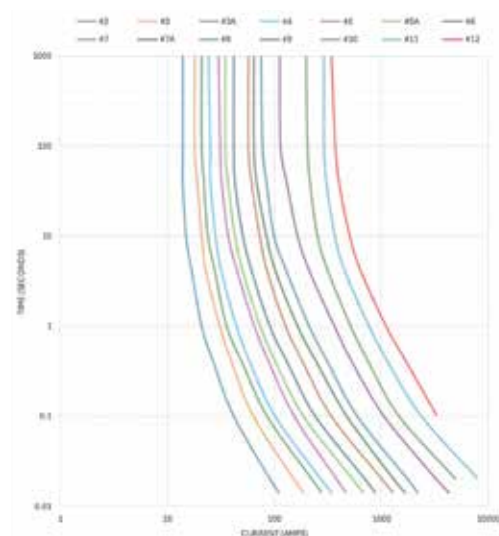
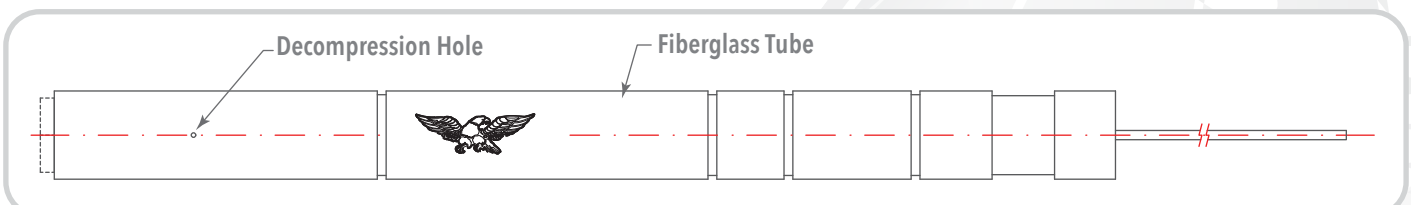


Figure 2

WHAT ARE THE EXPULSION FUSE COMPONENTS?



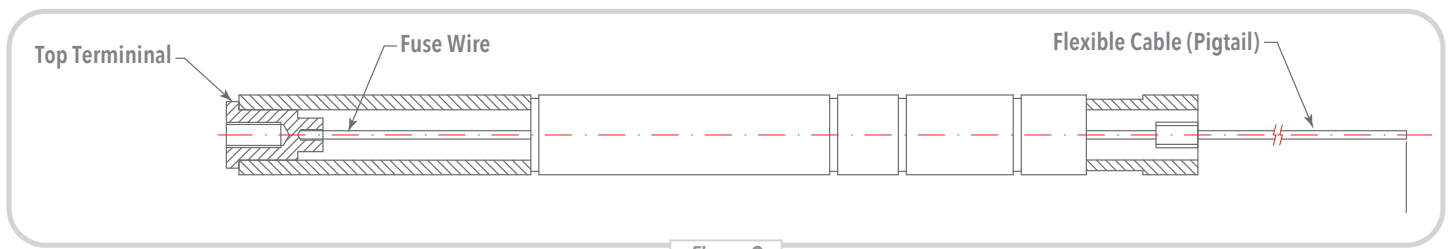


Figure 3

WHAT ARE THE OPERATING PRINCIPLES OF AN EXPULSION FUSE?

An expulsion fuse operates by melting its internal element when an overcurrent occurs, according to its minimum melting time (**MMT**) curve. Once the fuse element melts, an internal arc forms. This arc can only be extinguished when the fault current reaches a natural current zero. At that point, the arc is momentarily interrupted, and the pressure from the ionized gases within the fuse tube causes the expelled gases to be forced out, clearing the fault. For this reason, it is named “**expulsion fuse.**” The bottom terminal of the fuse is also expelled and if the pressure and the distance between the electrodes is large enough, the arc is not restarted, and the failure is cleared.

The introduction of the **34.5 kV protective link** expulsion fuse represents a significant advancement in transformer protection. As the demand for reliable and efficient solutions grows, especially in renewable energy systems, the need for fuses that provide enhanced protection against overloads, short circuits, and power faults has become critical. This new fuse offers a modern solution for ensuring the reliability of transformers by quickly and effectively interrupting current flow, minimizing downtime, and safeguarding equipment.

PRODUCT FEATURES:

34.5 kV oil-immersed expulsion type fuse designed to be mounted in series with the high-voltage winding of **34.5 kV class** delta connected, or **46 kV class** grounded wye-connected transformers.

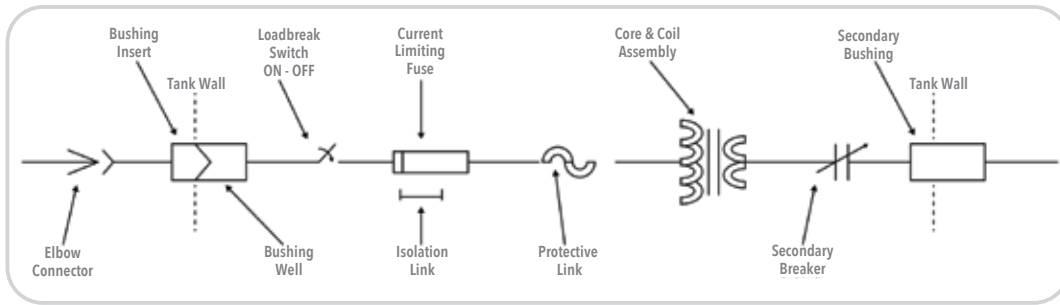
DESIGNED AND TESTED TO MEET THE FOLLOWING STANDARDS:

- **IEEE Std. C37.41-2016** for Design Tests
- **IEEE Std. C37.40-2003** for Service Conditions and Definitions
- **IEEE Std. C37.48-2005** Guide for Application, Operation, and Coordination

USED TO PROTECT:

- **CSP single-phase transformers** up to 167.5 kVA, 240 V, or 333 kVA, 480 V in coordination with an LV Breaker.
- **CSP three-phase transformers** up to 250 kVA, 208 V, or 630 kVA, 480 V in coordination with an LV Breaker.
- **Padmount three-phase transformers** up to 12 MVA in coordination with a backup-type current limiting fuse.

CONNECTING DIAGRAM FOR A PADMOUNTED TRANSFORMER IN A RADIAL CIRCUIT



PROTECTIVE LINK IN LARGE PADMOUNT APPLICATIONS

- **Available** in a wide range of current ratings (**4.5 to 160 Amp**) and with a complete family of 14 fuses covering this range.
- Complete interchangeability with other oil-immersed **34.5 kV protective links** that are available in the market.
- **Fuses** can be connected in parallel for higher ratings. Please consult our sales representative for the test report.
- **Test reports are also available** for single barrel operation of the family of fuses from curve #2 to curve #12.
- A **fuse holder** is available for all fuses offered.

ELECTRICAL RATINGS (Under oil):

- **34.5 kV** class for delta-connected transformers
- **46 kV** class for grounded wye connected transformers
- **1200 Amp** interrupting capacity tested in a horizontal position at **34.5 kV** line to ground in **Powertech Lab, Canada**
- Current ratings from **4.5 to 160 Amp** in a family of 14 fuses covering this amp range

Item	Curve Number	Current Rating (A)	Part Number
1	2	4.5	HJ345C02
2	3	6.2	HJ345C03
3	3A	7.0	HJ345C03A
4	4	8.2	HJ345C04
5	5	11.0	HJ345C05
6	5A	13.0	HJ345C05A
7	6	16.0	HJ345C06
8	7	21.0	HJ345C07
9	7A	24.0	HJ345C07A
10	8	30.0	HJ345C08
11	9	49.0	HJ345C09
12	10	71.0	HJ345C10
13	11	102.0	HJ345C11
14	12	160.0	HJ345C12

TIME-CURRENT CURVES:

THE FOLLOWING MMT AND TCT CURVES REPRESENT THE TIME-CURRENT OPERATION FOR THE COMPLETE FAMILY OF OUR FUSES.



Figure 2

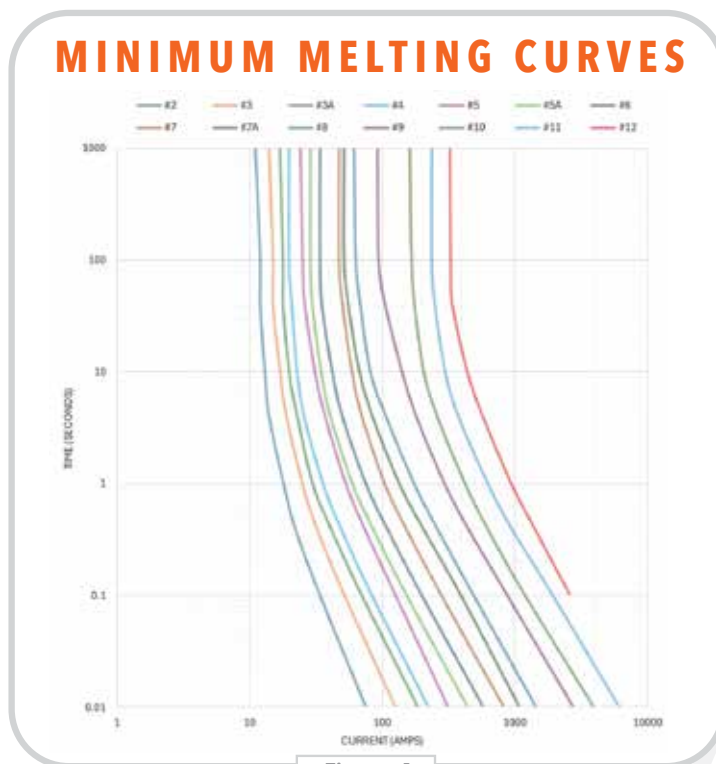


Figure 6

TIME-CURRENT CURVES:

These **fuse curves** have been introduced to our fuse coordination program to select the right current-limiting fuses and secondary breakers to mate with the expulsion

fuse to obtain full-range protection for **padmount or CSP transformers**.

The data points used for the above graphics are displayed in these tables below.

Total Clearing Curve Number															
Time (s)		#2	#3	#3A	#4	#5	#5A	#6	#7	#7A	#8	#9	#10	#11	#12
	0.014	112	190	280	350	475	680	880	1300	1700	2200	4400			
	0.02	92	154	226	275	385	539	704	1012	1320	1760	3300	5000	8000	
	0.1	42	64	86	102	154	187	242	341	479	594	1067	1463	2365	3300
	0.4	27	40	50	59	89	103	132	184	248	314	535	759	1155	1700
	1	21	31	36	44	65	74	91	127	165	211	365	517	770	1100
	4	17	23	28	32	45	51	62	86	103	130	215	319	462	645
	10	15	21	24	28	37	43	51	73	84	99	165	253	369	505
	40	14	19	22	25	32	37	43	61	68	84	130	215	308	400
	100	14	18	21	25	31	35	42	57	64	77	114	204	292	370
	1000	14	18	21	24	30	35	42	57	64	75	112	198	292	340

Minimum Melting Curve Number															
Time (s)		#2	#3	#3A	#4	#5	#5A	#6	#7	#7A	#8	#9	#10	#11	#12
	0.01	76	126	185	225	315	441	576	828	1080	1440	2745	3960	6120	
	0.1	34	52	70	84	126	153	198	279	392	486	873	1197	1935	2600
	0.4	22	32	41	49	73	85	108	150	203	257	440	621	945	1400
	1	18	25	30	36	53	60	75	104	135	173	294	423	630	940
	4	14	19	23	26	37	41	50	70	85	106	180	261	378	575
	10	13	17	20	23	31	35	42	59	68	81	141	207	302	440
	40	12	15	18	21	26	30	35	50	56	68	105	176	252	340
	100	12	15	18	20	25	29	34	47	52	63	94	167	239	330
	1000	11	14	17	20	24	29	34	47	52	61	92	162	239	325

FUSE COORDINATION SOFTWARE:

THE H-J FAMILY OF COMPANIES

is pleased to offer a **fuse coordination tool** at www.h-j.com/fuse-coordination for customers

to find **full-range protection fuses** that match their needs depending on their **CSP or padmount transformer** characteristics up to **12 MVA**.

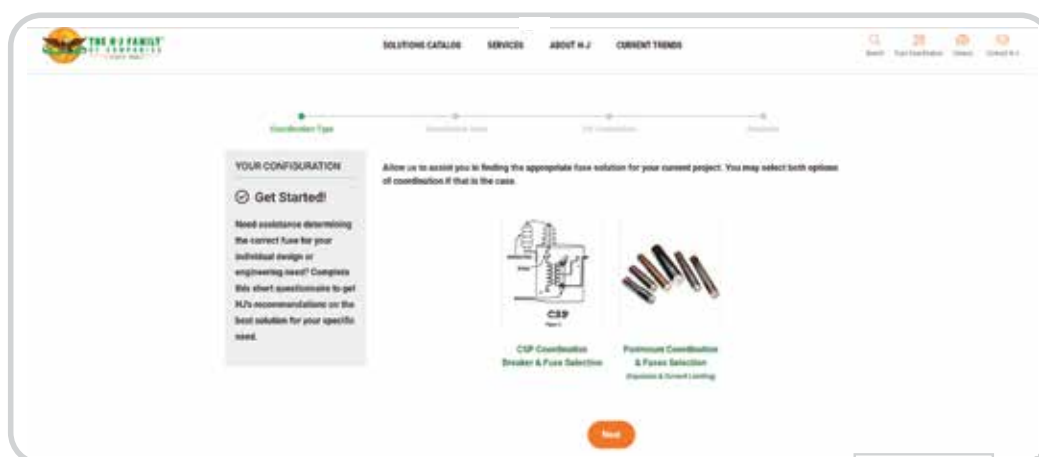
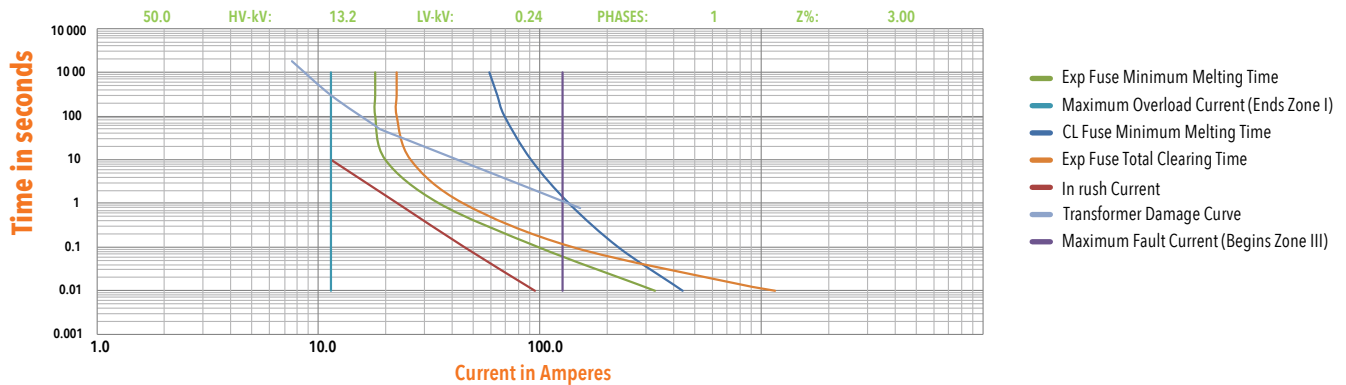


Figure 7

COORDINATION CURVES - CURRENT LIMITING AND EXPULSION FUSE



As a part of **H-J's fuse coordination program**, we recommend secondary breakers and current limiting fuses from our partners **ERMCO and Mersen**, along

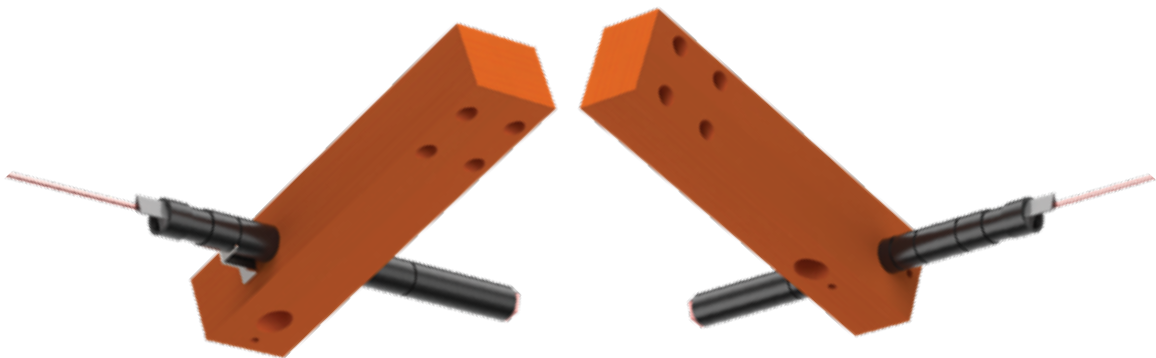
with our **H-J expulsion fuses for 34.5 kV** or **ERMCO** expulsion fuses for kV class lower than **34.5 kV**.

INSTALLATION INSTRUCTIONS:

Our new **34.5 kV protective link fuse** can be installed horizontally or vertically and mounted using

an **insulating block** like in the sketch below, ensuring the minimum distances to ground are kept.

MOUNTING BLOCK



Part #: **HJ345-FH**

Figure 9

The H-J Family of Companies is pleased to offer a mounting block designed for 34.5 kV expulsion fuses, compatible with any brand, with the caveat that clearances to ground must be kept. In regards to distances from the fuse to ground, it is necessary to explain the concept of "gases relief cone," which means during the operation, the volume occupied by the ionized gases are expelled by the fuse.

"Gases relief cone" describes the safe distance between the transformer ground points and its internally installed, oil-immersed expulsion fuse. This cone is also applied to establish the safety distance between parallel expulsion fuses.

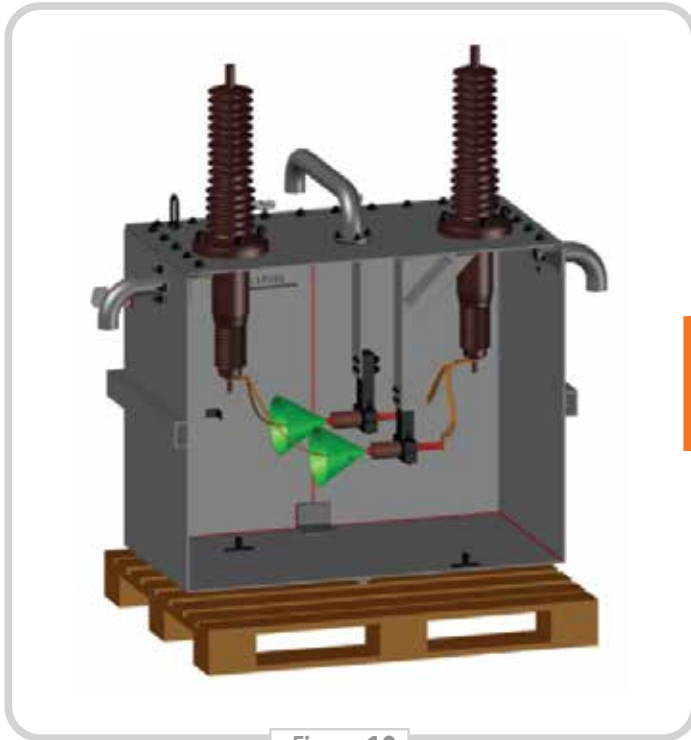


Figure 10

***Gases relief cone, in green
(Schematic, this is not a transformer)***

The "clearance cone" refers to the space directly in the terminal where ionized gases are expelled. The axle of the cone follows the direction of the expelled gases. No metallic part or ground plane can exist inside this cone; otherwise, a direct line-to-ground fault can occur. The

cone's final height and diameter depend on the voltage level, being 5.75" (146.1mm) and 7.0" (177.8) for 34.5 kV. This information is only a guide and can be replaced by user experience.

TEST REPORTS

H-J expulsion fuses were successfully tested in single barrel and in parallel applications at Powertech labs in Canada. General test reports and detailed test reports

are available upon request. Please see below for further information.

REPORT OF PERFORMANCE

34.5 kV liquid-submerged class A expulsion fuses interrupting tests

IEEE C37.41-2016,A.2.4.2 and client's
specifications.

TEST OBJECTS	Liquid-submerged Class A expulsion fuses	
	Rate Maximum Voltage:	34.5 kVrms
	Rated Current:	1200 Arms symmetrical interrupting
	Fuse Model 1:	PLINK #2, 4.5 A
	Fuse Model 2:	PLINK #12, 160 A
TESTED BY	Powertech Labs Inc. 12388-88th Ave, Surrey, BC Canada V3W 7R7 www.powertechlabs.com	
DATE RECEIVED	2024-08	
TEST DATES	2024-08-13	
TEST SPECIFICATION	IEEE C37.41-2016, A.2.4.2 and Client's Specifications	
TEST RESULT	Pass(see Section 4 for Details)	

PARALLEL APPLICATION:

Due to the larger size of padmount type transformers used in renewable energy applications (mainly solar and windfarm) the use of parallel fuses, both expulse and current limiting, is widely spread.

The **H-J expulsion fuses** used in parallel for these applications were successfully tested at Powertech Labs in Canada. See below for more information.

Powertech

Table 1: Results of Series 1 and 2 Interrupting Tests

Test series	Fuse Link Type	Sample # ¹⁾	Test # ²⁾	Closing Angle [°]	Prospective Current			Peak Arc Voltage [kV]	Results
					Symmetrical [A], rms	Duration [ms]	Melting time [ms]		
1	PLINK 11	3&4	5-2	11	2038	476	287	56.5	Pass
		5&6	5-3	97	2030	324	309	66.4	Pass
		7&8	5-4	140	2025	322	314	69.1	Pass
2	PLINK 11	9&10	6-1	Random	969	1764	1746	43.2	Pass
		11&12	6-2	Random	967	1808	1769	46.5	Pass

Note: 1) Fuse link sample numbers were marked by the lab.
2) Test are listed in chronological order.

34.5 kV liquid-submerged class A expulsion fuses interrupting tests two fuses in parallel configuration

Client's Specifications, using IEEE
C37.41-2016, A.2.4.2 as a guide