Summary of Studies Supporting USDA Product Licensure

Establishment Name	Boehringer Ingelheim Animal Health USA Inc.
USDA Vet Biologics Establishment Number	124
Product Code	17H1.R2
True Name	Marek's Disease-Newcastle Disease Vaccine, Serotypes 2 & 3, Live Virus, Live Marek's Disease Vector
Tradename(s) / Distributor or Subsidiary (if different from manufacturer)	
Date of Compilation Summary	May 17, 2019

Disclaimer: Do not use the following studies to compare one product to another. Slight differences in study design and execution can render the comparisons meaningless.

Study Type	Efficacy
Pertaining to	Marek's disease virus
Study Purpose	Demonstrate efficacy against very virulent Marek's Disease virus
Product Administration	1 dose by in ovo route
Study Animals	18- to 19-day-old embryos were divided into 4 groups Group 1 vaccinated with test product and challenged Group 2 sham vaccinated and challenged (control) Group 3 sham vaccinated non-challenged (control) Group 4 vaccinated with HVT vaccine and challenged
Challenge Description	Serotype 1, RB1B very virulent Marek's disease virus
Interval observed after challenge	Birds observed daily for clinical signs for 45 days post challenge
Results	Vaccinates and controls were evaluated in terms of Marek's disease clinical signs and/or grossly observable lesions per the criteria in 9 CFR 113.330(c). Birds with clinical signs and/or observable lesions: Group 1: 5/28 Group 2: 34/34 Group 3: 0/25 Group 4: 18/34 Requirements of 9 CFR 113.330(c) were met. Raw data on attached page
USDA Approval Date	March 25, 2014

Group/Bird	Paralysis	Locomotive	Emaciation	De-pression	Liver	Spleen	Heart	Muscle	Gonads	Kidneys	Other Gross Lesions	Comments
1/1			X						X			
1/2									X	X		
1/3		X	X						X	X		
1/4									X			
1/5									X	X		
2/1				X		X			X			
2/2				X	X	X	X			X		
2/3		X							X	X		
2/4				X	X		X					
2/5				X	X	X				X		
2/6										X		
2/7				X	X	X	X					
2/8			X			X				X		
2/9				X					X	X		
2/10			X			X	X		X	X		
2/11				X	X				X	X		
2/12				X	X	X	X			X		
2/13		X		X	X	X						
2/14				X	X	X	X					
2/15										X		
2/16			X	X				X	X	X		
2/17				X		X				X		
2/18				X	X		X		X	X		
2/19			X	X		X			X	X		
2/20				X				X	X			
2/21					X	X				X		
2/22			X	X		X			X	X		
2/23				X		X				X		
2/24				X			X		X	X		
2/25				X		X			X	X		
2/26				X								
2/27				X						X		
2/28		X		X						X		
2/29				X		X	X			X		
2/30				X		X	X			X	X	Intestinal tract
2/31		X	X					X	X	X		
2/32				X	X	X				X		
2/33				X		X				X		
2/34				X	X	X				X		
4/1					X	X	X		X	X		

Group/Bird	Paralysis	Locomotive	Emaciation	De-pression	Liver	Spleen	Heart	Muscle	Gonads	Kidneys	Other Gross Lesions	Comments
4/2								X	X	X	X	Intestinal tract (other)
4/3									X			
4/4	X								X			
4/5			X	X			X			X	X	Intestinal tract
4/6				X		X		X	X		X	Intestinal tract
4/7											X	Intestinal tract
4/8									X		X	Intestinal tract
4/9			X	X		X			X	X		
4/10										X		
4/11		X							X			
4/12			X								X	Intestinal tract
4/13		X		X			X		X			
4/14		X		X			X	X		X		
4/15		X		X			X	X		X		
4/16		X							X	X		
4/17							X			X		
4/18					X	X	X			X		

No clinical signs or lesions were observed in remaining birds in study.

Study Type	Efficacy
Pertaining to	Marek's disease virus
Study Purpose	Demonstrate efficacy against very virulent Marek's Disease virus
Product Administration	1 dose by Subcutaneous route
Study Animals	Day-old chicks divided into 4 groups Group 1 vaccinated with test product and challenged Group 2 sham vaccinated and challenged (control) Group 3 sham vaccinated non-challenged (control) Group 4 vaccinated with HVT vaccine and challenged
Challenge Description	Serotype 1, RB1B very virulent Marek's disease virus
Interval observed after challenge	Birds observed daily for clinical signs for 45 days post challenge
Results	Vaccinates and controls were evaluated in terms of Marek's disease clinical signs and/or grossly observable lesions per the criteria in 9 CFR 113.330(c). Birds with clinical signs and/or observable lesions: Group 1: 5/35 Group 2: 35/35 Group 3: 0/25 Group 4: 9/34 Requirements of 9 CFR 113.330(c) were met. Raw data on attached page
USDA Approval Date	April 3, 2014

Group/ Bird	Paralysis	Locomotive	Emaciation	Depression	Other Clinical Signs	Liver	Spleen	Heart	Muscle	Gonads	Kidneys	Other Gross Lesions	Comments
1/1												X	Intestinal tract
1/2						X	X	X		X	X		
1/3								X		X			
1/4										X			
1/5		X		X		X				X	X		
2/1				X			X				X		
2/2		X		X		X		X			X		
2/3				X			X			X			
2/4				X			X						
2/5		X		X						X			
2/6				X			X	X					
2/7				X		X	X	X					
2/8											X		
2/9				X	X								Torticollis
2/10							X				X		
2/11			X	X							X		
2/12				X						X	X		
2/13				X									
2/14				X			X				X		
2/15				X									
2/16		X		X			X	X					
2/17				X			X						
2/18			X	X			X	X	X		X		
2/19		X		X									
2/20				X		X	X				X		
2/21				X		X	X				X		
2/22								X		X		X	Intestinal tract
2/23				X			X		X		X		
2/24		X				X	X	X		X	X		
2/25				X							X		
2/26				X									Large retained yolk
2/27				X			X				X		
2/28	X												
2/29				X			X				X		
2/30				X				X	X	X	X		
2/31				X			X				X		
2/32				X				X			X		
2/33				X		X	X		X				
2/34				X			X			X			
2/35				X	X								Torticollis
4/1												X	Intestinal tract
4/2		X											

Group/ Bird	Paralysis	Locomotive	Emaciation	Depression	Other Clinical Signs	Liver	Spleen	Heart	Muscle	Gonads	Kidneys	Other Gross Lesions	Comments
4/3										X			
4/4											X		
4/5							X	X		X	X		
4/6				X					X	X	X		
4/7		X	X	X				X	X		X		
4/8										X	X		
4/9		X		X		X			X	X	X		

No clinical signs or lesions were observed in remaining birds in the study.

Study Type	Efficacy
Pertaining to	Newcastle disease virus (NDV)
Study Purpose	Demonstrate efficacy against virulent Newcastle disease
Product Administration	1 dose by subcutaneous route
Study Animals	Day old chicks were divided into 2 groups Group 1 vaccinated and challenged Group 2 sham vaccinated and challenged (control)
Challenge Description	NDV Texas GB
Interval observed after challenge	Birds observed daily for clinical signs for 14 days post challenge
Results	Vaccinates and controls were evaluated in terms of Newcastle disease clinical signs per the criteria in 9 CFR 113.329(c)(4). Birds with clinical signs: Group 1: 0/30 Group 2: 30/30 Requirements of 9 CFR 113.329(c)(4) were met. Raw data on attached page
USDA Approval Date	March 10, 2014

Group/Bird	NDV Result based on clinical signs
2/1	Positive
2/2	Positive
2/3	Positive
2/4	Positive
2/5	Positive
2/6	Positive
2/7	Positive
2/8	Positive
2/9	Positive
2/10	Positive
2/11	Positive
2/12	Positive
2/13	Positive
2/14	Positive
2/15	Positive
2/16	Positive
2/17	Positive
2/18	Positive
2/19	Positive
2/20	Positive
2/21	Positive
2/22	Positive
2/23	Positive
2/24	Positive
2/25	Positive
2/26	Positive
2/27	Positive
2/28	Positive
2/29	Positive
2/30	Positive

Study Type	Efficacy
Pertaining to	Newcastle disease virus (NDV)
Study Purpose	Demonstrate efficacy against virulent Newcastle disease
Product Administration	1 dose by *in ovo* route
Study Animals	18 to 19 day old embryos were divided into 2 groups Group 3 vaccinated and challenged Group 4 sham vaccinated and challenged (control)
Challenge Description	NDV Texas GB
Interval observed after challenge	Birds observed daily for clinical signs for 14 days post challenge
Results	Vaccinates and controls were evaluated in terms of Newcastle disease clinical signs per the criteria in 9 CFR 113.329(c)(4). Birds with clinical signs: Group 3: 2/39 Group 4: 40/40 Requirements of 9 CFR 113.329(c)(4) were met. Raw data on attached page
USDA Approval Date	March 27, 2014

Group/Bird	Paralysis	Muscular Tremors	NDV Result
3/1		X	Positive
3/2			Positive
4/1			Positive
4/2		X	Positive
4/3			Positive
4/4			Positive
4/5		X	Positive
4/6		X	Positive
4/7		X	Positive
4/8			Positive
4/9			Positive
4/10			Positive
4/11		X	Positive
4/12			Positive
4/13		X	Positive
4/14			Positive
4/15		X	Positive
4/16		X	Positive
4/17		X	Positive
4/18			Positive
4/19		X	Positive
4/20			Positive
4/21		X	Positive
4/22		X	Positive
4/23			Positive
4/24		X	Positive
4/25		X	Positive
4/26			Positive
4/27		X	Positive
4/28			Positive
4/29			Positive
4/30			Positive
4/31			Positive
4/32			Positive
4/33			Positive
4/34		X	Positive
4/35			Positive
4/36		X	Positive
4/37			Positive
4/38			Positive
4/39			Positive
4/40			Positive

<table>
<tr><td>Study Type</td><td>Safety</td></tr>
<tr><td>Pertaining to</td><td>All</td></tr>
<tr><td>Study Purpose</td><td>Demonstrate safety of product under typical use conditions</td></tr>
<tr><td>Product Administration</td><td>1 dose by either the in ovo or subcutaneous route</td></tr>
<tr><td>Study Animals</td><td>Poultry, 18 to 19 day-old embryos or day-old chicks.
75,600 were vaccinated by in ovo route, 48,029 were vaccinated by subcutaneous route and 181,400 were kept as controls treated by the typical site vaccination program. Animals were observed daily for mortality through 21 days after vaccination.</td></tr>
<tr><td>Challenge Description</td><td>Not applicable</td></tr>
<tr><td>Interval observed after challenge</td><td>Not applicable</td></tr>
<tr><td>Results</td><td>No adverse reactions attributable to the vaccine were noted.
<table>
<tr><th>Location</th><th>Treatment</th><th>Total Placed</th><th>21 Day Mortality</th><th>% Mortality</th><th>% Hatchability</th></tr>
<tr><td>1</td><td>In ovo</td><td>22,600</td><td>794</td><td>3.5</td><td>74.7</td></tr>
<tr><td rowspan="2">1</td><td>Control</td><td rowspan="2">24,700</td><td rowspan="2">721</td><td rowspan="2">2.9</td><td rowspan="6">87.4</td></tr>
<tr><td>In ovo</td></tr>
<tr><td rowspan="2">1</td><td>Control</td><td rowspan="2">24,700</td><td rowspan="2">815</td><td rowspan="2">3.3</td></tr>
<tr><td>In ovo</td></tr>
<tr><td rowspan="2">1</td><td>Control</td><td rowspan="2">24,700</td><td rowspan="2">679</td><td rowspan="2">2.7</td></tr>
<tr><td>In ovo</td></tr>
<tr><td>2</td><td>In ovo</td><td>20,200</td><td>398</td><td>2</td><td rowspan="2">89.3</td></tr>
<tr><td>2</td><td>In ovo</td><td>20,300</td><td>369</td><td>1.8</td></tr>
<tr><td rowspan="2">2</td><td>Control</td><td rowspan="2">19,100</td><td rowspan="2">410</td><td rowspan="2">2.1</td><td rowspan="2">86.6</td></tr>
<tr><td>In ovo</td></tr>
<tr><td rowspan="2">2</td><td>Control</td><td rowspan="2">19,100</td><td rowspan="2">678</td><td rowspan="2">3.5</td><td rowspan="2">N/A</td></tr>
<tr><td>SQ</td></tr>
<tr><td rowspan="2">2</td><td>Control</td><td rowspan="2">19,100</td><td rowspan="2">791</td><td rowspan="2">4.1</td><td rowspan="2">N/A</td></tr>
<tr><td>SQ</td></tr>
<tr><td>3</td><td>SQ</td><td>24,000</td><td>542</td><td>2.3</td><td>N/A</td></tr>
<tr><td>3</td><td>SQ</td><td>24,029</td><td>267</td><td>1.1</td><td>N/A</td></tr>
<tr><td rowspan="2">3</td><td>Control</td><td rowspan="2">25,000</td><td rowspan="2">332</td><td rowspan="2">1.3</td><td rowspan="2">N/A</td></tr>
<tr><td>SQ</td></tr>
<tr><td rowspan="2">3</td><td>Control</td><td rowspan="2">25,000</td><td rowspan="2">325</td><td rowspan="2">1.3</td><td rowspan="2">N/A</td></tr>
<tr><td>SQ</td></tr>
</table>
N/A is not applicable</td></tr>
</table>

USDA Approval Date	October 19, 2017

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<tr><td>Study Type</td><td>Safety</td></tr>
<tr><td>Pertaining to</td><td>All</td></tr>
<tr><td>Study Purpose</td><td>Demonstrate safety of product under typical use conditions</td></tr>
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<tr><td>Challenge Description</td><td>Not applicable</td></tr>
<tr><td>Interval observed after challenge</td><td>Not applicable</td></tr>
<tr><td>Results</td><td>No adverse reactions attributable to the vaccine were noted.
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