Summary of Studies Supporting USDA Product Licensure

Establishment Name	Bimeda Biologicals, Inc.
USDA Vet Biologics Establishment Number	290
Product Code	4429.21
True Name	Bovine Rhinotracheitis-Virus Diarrhea Vaccine, Modified Live Virus, Mannheimia Haemolytica-Pasteurella Multocida Bacterin-Toxoid
Tradename(s) / Distributor or Subsidiary (if different from manufacturer)	Respivax 3 + PH-M - Huvepharma, Inc
Date of Compilation Summary	December 01, 2020

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	Bovine Viral Diarrhea Virus - Type 1a (BVDV 1a)
Study Purpose	Pivotal Efficacy against BVDV1a
Product Administration	Single Dose administered subcutaneously
Study Animals	30 mixed breed beef calves, 4 to 5 months of age randomly divided into 20 vaccinates and 10 controls
Challenge Description	BVDV Type 1a (field isolate) administered 21 days following vaccination
Interval observed after challenge	Observed daily for 14 days for rectal temperature and clinical signs (Nasal Lesions) daily and a nasal swab and a blood sample were collected from each animal daily. Nasal swabs were evaluated for BVDV by cell culture cytopathic effect (CPE) and PCR. Blood samples were utilized for determining antibody titer and buffy coat virus isolation analysis.
Results	Nineteen out of 20 (95%) vaccinates responded with BVDV type 1a serum neutralization (SN) antibody titer greater than or equal to 8 and all 10 (100%) control animals were sero-negative (SN titer <2) to BVDV type 1 and 2. BVDV type 1a was isolated in from 100% (10 of 10) in the nasal swabs and 70% (7 of 10) from the buffy coat samples on at least 1 day following challenge of the control animals. In the vaccinate group, the BVDV type 1a was isolated in nasal swab and buffy coat samples on at least 1 day following challenge from 25% (5 of 20) and 10% (2 of 20) of the animals, respectively.
USDA Approval Date	February 17, 2012

Virus-neutralizing Antibody Titer

		Pre-Vaccination Titers			Day of Challenge	Day 14 Post Challenge
Calf	grp	BVDV 1a	BVDV 1b	BVDV 2	BVDV 1a	BVDV 1a
2	V	<2	<2	<2	32	>256
5	V	<2	<2	<2	32	>256
6	V	<2	<2	<2	64	>256
8	V	<2	<2	<2	16	>256
10	V	<2	<2	<2	8	>256
11	V	<2	<2	<2	16	>256
13	V	<2	<2	<2	32	>256
15	V	<2	<2	<2	8	>256
18	V	<2	<2	<2	32	>256
20	V	<2	<2	<2	<2	>256
23	V	<2	<2	<2	16	>256
27	V	<2	<2	<2	32	>256
29	V	<2	<2	<2	8	>256
30	V	<2	<2	<2	16	>256
31	V	<2	<2	<2	32	>256
32	V	<2	<2	<2	8	>256
33	V	<2	<2	<2	8	>256
41	V	<2	<2	<2	8	128
49	V	<2	<2	<2	16	>256
82	V	<2	<2	<2	16	>256
1	C	<2	<2	<2	<2	8
4	C	<2	<2	<2	<2	64
9	C	<2	<2	<2	<2	32
19	C	<2	<2	<2	<2	>256
21	C	<2	<2	<2	<2	32
25	C	<2	<2	<2	<2	128
26	C	<2	<2	<2	<2	64
47	C	<2	<2	<2	<2	16
86	C	<2	<2	<2	<2	128
93	C	<2	<2	<2	<2	128

V = Vaccinate, C = Control

BVDV la Isolation from Nasal Swabs

Swab		Day															CPE	PCR
calf	grp	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Summ	Summ
2	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
5	V	-/-	-/-	-/-	-/-	-/-	+/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+	+
6	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
8	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
10	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
11	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
13	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
15	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
18	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
20	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
23	V	-/-	-/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	-/-	-/-	-/-	-/-	-/-	+	+
27	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
29	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
30	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
31	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/+	-/-	-	+
32	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	-/-	-/-	-/-	-/-	-/-	+	-
33	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
41	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
49	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
82	V	-/-	-/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	+
1	C	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	-/-	-/-	-/-	-/-	-/-	-/-	-/+	+	+
4	C	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	+/+	-/-	-/-	-/-	-/-	-/-	+	+
9	C	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	-/+	+/+	+/+	-/-	-/-	-/-	-/-	+	+
19	C	-/-	+/+	+/+	+/+	+/+	+/+	-/-	+/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+	+
21	C	-/-	-/+	-/-	-/-	-/-	+/+	-/-	-/-	-/-	+/+	-/-	-/-	-/-	-/-	-/-	+	+
25	C	-/-	-/-	-/-	+/+	+/+	+/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/+	+	+
26	C	-/-	+/+	-/-	-/-	-/-	+/+	-/-	-/-	-/-	+/+	-/-	-/-	-/-	-/-	-/-	+	+
47	C	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	-/-	+/+	-/-	-/-	-/-	-/+	-/-	+	+
86	C	-/-	-/-	-/-	+/+	-/-	-/-	-/-	-/-	-/-	+/+	-/-	-/-	-/-	-/-	-/-	+	+
93	C	-/-	+/+	-/-	-/-	+/+	-/-	+/+	+/+	-/-	+/+	-/-	-/-	-/-	-/-	-/-	+	+

V = Vaccinate, C = Control

-/- = Neg CPE / Neg PCR, -/+ = Neg CPE / Pos PCR, +/+ = Pos CPE / Pos PCR

BVDV Ia Isolation from Buffy Coats

Buffy Coat		Day															CPE	PCR
calf	grp	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Summ	Summ
2	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
5	V	-/-	-/-	-/-	-/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	+
6	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
8	V	-/-	-/-	-/-	-/-	-/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/+	-	+
10	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-I-	-	-
11	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-I-	-	-
13	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-I-	-	-
15	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
18	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	- /-	-	-
20	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	- /-	-	-
23	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	- /-	-	-
27	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	- /-	-	-
29	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	- /-	-	-
30	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	- /-	-	-
31	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	- /-	-	-
32	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	- /-	-	-
33	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	- /-	-	-
41	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	- /-	-	-
49	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	.7-	-	-
82	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	- /-	-	-
1	C	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	-/-	-/-	-/-	-/-	-/-	+	+
4	C	-/-	-/-	-/-	-/+	-/-	-/+	-/-	-/-	-/-	+/+	-/-	-/-	-/-	+/+	-/-	+	+
9	C	-/-	-/-	-/-	-/-	-/+	-/-	+/+	+/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+	+
19	C	-/-	-/-	-/-	-/+	-/-	+/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+	+
21	C	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
25	C	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
26	C	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	-/-	-/-	-/-	-/-	-/-	+	+
47	C	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	-
86	C	-/-	-/-	-/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-	+
93	C	-/-	-/-	-/-	-/+	-/-	+/+	+/+	+/+	+/+	-/-	-/-	-/-	-/+	-/-	-/-	+	+

V = Vaccinate, C = Control

-/- = Neg CPE / Neg PCR, -/+ = Neg CPE / Pos PCR, +/+ = Pos CPE / Pos PCR

Study Type	Comparative Serology
Pertaining to	Bovine Virus Diarrhea Virus Type 1a
Study Purpose	Comparative serology for Bovine Virus Diarrhea Virus Type 1a to show that combining fractions with satisfactory efficacy studies does not reduce the immune response. Refer to the summaries of the original efficacy studies under Product Code 1181.21 and in the Product Compilation Summary for this Product Code.
Product Administration	Subcutaneous injection twice, 21 days apart
Study Animals	Weaning age calves
Challenge Description	Serological response prior to vaccination and 35 days after first vaccination
Interval observed after challenge	
Results	Serological response to vaccination after 35 days showed a Geometric Mean Titer (GMT) for the Product Group, Reference Group, and Control group. Please see following pages for treatment groups, vaccination schedule and individual animal antibody titers.
USDA Approval Date	May 16, 2017

Allocation BVDV1a naïve calves to Treatment Group

Group	Number of Calves (n)	Product	Animal ID
A	20	Reference Product Establishment 290, Product Code 1181.22 Bovine Rhinotracheitis-Virus Diarrhea-Parainfluenza 3-Respiratory Syncytial Virus Vaccine, Modified Live Virus	2,5,8,12,15,19,23,24,31,32,43,55,57,59,61, 64,67,68,72,74
B	21	Product	3,6,7,9,10,11,14,17,21,22,25,26,27,28,34,38, 41,42,53,56,76
D	6	Sterile H20 Diluent	1,4,16,20,54,60

Individual Antibody titers to BVD Type 1a

Tag #	Group	Day 0	Day 35
2	A	<2	64
5	A	<2	256
8	A	<2	512
12	A	<2	128
15	A	<2	2048
19	A	<2	256
23	A	<2	2048
24	A	<2	512
31	A	<2	1024
32	A	<2	1024
43	A	<2	1024
55	A	<2	1024
57	A	<2	512
59	A	<2	256
61	A	<2	1024
64	A	<2	1024
67	A	<2	2048
68	A	<2	1024
72	A	<2	2048
74	A	<2	1024
3	B	<2	1024
6	B	<2	2048
7	B	<2	128
9	B	<2	1024
10	B	<2	2048
11	B	<2	512
14	B	<2	2048
17	B	<2	1024
21	B	<2	256
22	B	<2	512
25	B	<2	1024
26	B	<2	1024
27	B	<2	1024
28	B	<2	256
34	B	<2	2048
38	B	<2	2048
41	B	<2	1024
42	B	<2	2048
53	B	<2	1024
56	B	<2	2048
76	B	<2	2048
1	D	<2	<2
4	D	<2	<2
16	D	<2	<2
20	D	<2	<2
54	D	<2	<2
60	D	<2	<2

Study Type	Efficacy
Pertaining to	Bovine Viral Diarrhea Virus - Type 2 (BVD 2)
Study Purpose	Pivotal Efficacy against BVD 2
Product Administration	Single Dose administered subcutaneously
Study Animals	30 mixed breed beef calves, 4 to 5 months of age randomly divided into 20 vaccinates and 10 controls
Challenge Description	BVDV Type 2a strain 1373 administered intranasally 21 days following vaccination
Interval observed after challenge	Observed daily for 17 days for rectal temperature and clinical signs daily and a nasal swab and a blood sample were collected from each animal daily
Results	Twenty out of 20 (100%) vaccinates responded with BVDV type 2 SN antibody titer greater than or equal to 8 and all 10 (100%) control animals were sero-negative (SN titer <2) to BVDV type 2. BVDV type 2 was isolated in nasal swab and buffy coat samples on at least 1 day following challenge from 100% (10 of 10) of the control animals. In the vaccinate group, the BVDV type 2 was isolated in nasal swab and buffy coat samples on at least 1 day following challenge from 60% (12 of 20) and 30% (6 of 20) of the animals, respectively. Ten of 10 (100%) animals in the control group, and 9 of 20 (45%) animals in the vaccinate group, had leukopenia (at least 40% decrease in white cells from the baseline) for at least a day following challenge. Ten of 10 control animals had pyrexia (at least 2 °F above the baseline temperature) and 1 of 20 (5%) animals in the vaccinate group had pyrexia on at least 1 day following challenge. Ten of 10 calves in the control group had clinical signs (respiration, coughing, nasal discharge, nasal lesions, ocular lesions, oral lesions, attitude and/or diarrhea) with 70% (7 of 10) mortality rate. Some of the animals in the vaccinate group had mild clinical disease (nasal discharges and lesions, ocular lesions and/or oral lesions) following challenge. None of the calves in the vaccinate group died (0% mortality) during the challenge phase due to BVDV type 2 challenge. The results are compliant with 9 CFR 113.311.
USDA Approval Date	February 17, 2012

Virus-neutralizing Antibody Titer

		Prevaccination			Day of Challenge	Day 14 Post-Challenge
Calf	Grp	BVDV2	BVDV1a	BVDV1b	BVDV2	BVDV2
2521	V	<2	<2	<2	16	>256
2543	V	<2	<2	<2	32	>256
2560	V	<2	<2	<2	8	>256
2561	V	<2	<2	<2	32	>256
2562	V	<2	<2	<2	16	128
2566	V	<2	<2	<2	16	>256
2569	V	<2	<2	<2	32	>256
2571	V	<2	<2	<2	32	>256
2574	V	<2	<2	<2	16	>256
2576	V	<2	<2	<2	32	>256
2588	V	<2	<2	<2	64	>256
2590	V	<2	<2	<2	16	>256
2591	V	<2	<2	<2	16	>256
2592	V	<2	<2	<2	32	>256
2599	V	<2	<2	<2	16	>256
2601	V	<2	<2	<2	16	>256
2602	V	<2	<2	<2	32	>256
2603	V	<2	<2	<2	16	>256
2615	V	<2	<2	<2	8	>256
2616	V	<2	<2	<2	32	>256
2523	C	<2	<2	<2	<2	Dead
2544	C	<2	<2	<2	<2	>256
2565	C	<2	<2	<2	<2	Dead
2570	C	<2	<2	<2	<2	Dead
2589	C	<2	<2	<2	<2	Dead
2598	C	<2	<2	<2	<2	16
2600	C	<2	<2	<2	<2	>256
2606	C	<2	<2	<2	<2	32
2609	C	<2	<2	<2	<2	Dead
2614	C	<2	<2	<2	<2	Dead

BVDV2 Isolation from Nasal Swabs

swabs		-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Calf	grp																				
2521	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2543	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2560	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2561	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/+	-/-	-/+	-/+	-/-
2562	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/+	-/-	-/-	-/-	-/-	-/-	-/-	-/+	-/-	-/-	-/-	-/-
2566	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/+	-/-	-/-	-/-	-/-
2569	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2571	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/+	-/-	-/-	-/-	-/-
2574	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/+	-/-	-/-	-/-	-/-
2576	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2588	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2590	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/+
2591	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	-/-	+/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2592	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2599	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2601	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2602	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2603	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2615	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2616	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2523	C	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	+/+	+/+	+/+	+/+	+/+	+/+	Dead	Dead	Dead	Dead	Dead	Dead
2544	C	-/-	-/-	-/-	-/-	-/-	-/-	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	-/-	-/-	-/-	-/-	+/+
2565	C	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	+/+	+/+	+/+	+/+	+/+	Dead	Dead	Dead	Dead	Dead	Dead
2570	C	-/-	-/-	-/-	-/-	+	-/-	-/-	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	Dead	Dead
2589	C	-/-	-/-	-/-	-/-	-/-	-/-	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	Dead	Dead	Dead	Dead	Dead	Dead
2598	C	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	-/-
2600	C	-/-	-/-	-/-	-/-	+	-/-	-/-	-/-	+/+	+/+	+/+	+/+	+/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2606	C	-/-	-/-	-/-	-/-	+	-/-	-/-	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+
2609	C	-/-	-/-	-/-	-/-	+	-/-	-/-	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	Dead	Dead	Dead	Dead
2614	C	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	Dead	Dead	Dead	Dead

Day 0 is Day of Challenge

- / - = Neg CPE / Neg PCR, - / + = Neg CPE / Pos PCR, + /+ = Pos CPE / Pos PCR

BVDV2 Isolation from Buffy Coats

Calf #	grp	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
2521	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2543	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2560	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2561	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2562	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2566	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/+
2569	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/+
2571	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2574	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2576	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2588	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2590	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2591	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2592	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2599	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2601	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2602	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2603	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2615	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	+/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2616	V	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/+	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-	-/-
2523	C	-/-	-/-	-/-	-/-	-/-	-/-	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	Dead	Dead	Dead	Dead	Dead	Dead
2544	C	-/-	-/-	-/-	-/-	-/-	-/-	-/-	+/+	+/+	+/+	+/+	+/+	+/+	+/+	-/-	-/-	-/-	-/-	-/-	-/-
2565	C	-/-	-/-	-/-	-/-	-/-	-/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	Dead	Dead	Dead	Dead	Dead	Dead
2570	C	-/-	-/-	-/-	-/-	-/-	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	Dead	Dead
2589	C	-/-	-/-	-/-	-/-	+/+	-/-	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	Dead	Dead	Dead	Dead	Dead	Dead
2598	C	-/-	-/-	-/-	-/+	-/-	-/+	+/+	+/+	+/+	+/+	-/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+
2600	C	-/-	-/-	-/-	-/+	-/-	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	-/-	-/-	-/+	-/-	-/-	-/-	-/-
2606	C	-/-	-/-	-/-	-/+	-/-	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+
2609	C	-/-	-/-	-/-	-/-	-/-	-/-	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	Dead	Dead	Dead	Dead
2614	C	-/-	-/-	-/-	-/+	-/-	-/-	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	+/+	Dead	Dead	Dead	Dead

Day 0 is Day of Challenge / - = Neg CPE / Neg PCR, - / + = Neg CPE / Pos PCR, + /+ = Pos CPE / Pos PCR

Leukocyte Counts

Calf	grp	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
2521	V	7.8	7.2	7.7	7.6	8.2	7.7	7.3	6.7	6.3	6.6	7.8	6.8	6.1	5.9	7.1	6.9	7.2	6.7	7.7	6.4
2543	V	7	7.7	7	7.5	7.5	7.1	6	8.2	8.9	8.6	8.5	8.1	7.9	7.7	8.6	7.2	7.3	8.3	7.5	8.5
2560	V	8.8	7.7	8.7	9.2	9.4	7.8	9.4	7.9	6.9	6.1	6.8	5.2	6.6	5.7	6.7	7.6	5.5	6.9	5.9	7
2561	V	6.2	7.7	9	9.3	10.2	9.1	9.1	8.9	7.7	5.4	4.5	6.1	6.7	7.3	8.1	7.2	8.3	9	8.6	9.5
2562	V	10	11.3	10	9.1	9.5	9	8.5	8.9	6.5	6	6.9	8.4	7.4	5.8	7.9	7.2	8.6	9.1	9.9	9.8
2566	V	11.1	11.6	9.1	10	7	6.2	7.5	8.2	8.8	8.8	5.6	8.3	8.3	10.9	11.5	10.4	10.6	9.9	9.5	10.7
2569	V	7.2	7.5	6.7	10.2	8.6	8	8.1	6.4	6.6	4.9	6.6	5.7	5.5	5.3	8.4	8	8.9	8.5	9	8.4
2571	V	9.3	7.3	10.4	10	10.9	8.4	7.6	7.9	8.1	7.9	7.6	7.5	5.5	7	5.1	7	7.4	7.7	8.1	7.3
2574	V	9.4	6.8	10	10.4	11.2	11.8	9.7	9.9	7.8	5.4	5.2	6.8	8.2	7.3	8	8.6	9	8.2	7.3	9.2
2576	V	10.8	10	10.2	11.4	10.3	10.5	10.3	9.6	10.4	9.5	9.7	10.3	10.7	9.9	11	10.9	10.6	12	7.3	8.3
2588	V	7.6	7.7	6.8	6.8	6.7	7.5	8.9	9.1	11.8	14.5	10.2	8.1	5.6	5.9	7.1	6.7	7.7	8.4	8.2	11.4
2590	V	8.8	10.1	10	4.3	8.6	8.2	8.3	7.2	8	8.1	8.9	7.7	7.7	6.6	9.4	8.4	6.9	8.1	8.5	8.4
2591	V	4.4	9	10	10.8	9.4	7.9	7.2	8.5	8.7	8.8	8.4	7.9	5.4	2.6	5	5.6	6.1	7.4	6.9	5.7
2592	V	7.6	9	9.1	11.3	10.4	9.9	8.2	8.4	8.4	8.8	7.9	8.5	7.4	5.9	6.7	8.9	7.4	7.7	7.8	7.5
2599	V	12	12.5	11.2	10.3	11	10.9	9.7	9	7.1	7.3	7.6	7.9	7.2	6.2	7.9	7.5	6.6	7	5.8	8.1
2601	V	12.9	8.8	8.9	9.7	8.5	7.7	7.9	7.2	6.3	6.9	6.6	8.1	6.6	5.7	5.9	6.7	7.7	4.8	4.8	6.3
2602	V	7	8.4	9.8	11.7	12	13.9	14.2	12.2	13.8	11.9	11.2	12.7	10.6	10.8	10.6	10.4	9.7	9.7	10	11.3
2603	V	7.5	7.9	7.7	7.9	6.8	7.5	7.2	9	7.2	6.6	7.5	7.8	7.4	8.7	8	6.3	6.5	7.6	7.6	8.2
2615	V	7.5	8.2	11.8	10.6	9.7	8.5	6.2	7.8	8.5	11.3	12.5	14	12.5	11.7	12	11.2	11.5	11.3	10.9	9.8
2616	V	11.6	11.5	11.4	13.6	12.1	8	8.3	8.6	9.4	9.2	10.6	12.5	12.9	12.4	11	6.5	7.6	7.8	6.8	7.6
2523	C	11.9	13.1	13.8	12.9	11.5	7.6	6.1	6.1	5	5.3	4.9	4.2	6.1	7.5	Dead	Dead	Dead	Dead	Dead	Dead
2544	C	9.4	9.9	10.8	10.6	9.1	6	6.2	5.2	5.7	4.2	6.7	5.7	5.2	6	3.9	2.7	4.3	5.1	5.2	7
2565	C	7.6	7.4	7.6	9.8	9.7	5.8	4	3.6	3.6	3.7	2.5	1.7	2	2.3	Dead	Dead	Dead	Dead	Dead	Dead
2570	C	11.6	13.6	13.9	12.9	7.9	5.7	6.8	7.4	6.4	7	4.3	2.2	2.5	3	4.2	3.3	3.5	4.5	Dead	Dead
2589	C	8.7	9.2	8	7.4	5.8	3.7	3.7	5	5.3	3.5	3.5	3.8	4.5	2.6	Dead	Dead	Dead	Dead	Dead	Dead
2598	C	9	10.2	10.6	12.1	9.7	4.6	4	3.7	4.9	7.2	4.7	3.2	2.6	1.1	1.3	1.4	1.9	1.5	1.8	2.6
2600	C	13.5	10.1	13.9	12.4	11.6	7.2	7.1	6.3	5.8	5.4	4.1	4.6	5.4	3.9	4.5	5.4	5.7	7	8.6	8.8
2606	C	8.5	4.7	6.2	7.1	5.8	7.2	5.1	4	3.1	2.6	1.7	1.5	1.4	1.7	2.3	2.2	2.1	3	3.4	5.5
2609	C	12.4	11.4	11.5	11.7	10.5	6.9	5	4.7	4.7	5.2	4.3	3	1.4	2	1.9	1.8	Dead	Dead	Dead	Dead
2614	C	11.4	11.1	11.4	10.2	10.4	5.2	6	4.4	4.2	4.2	3.2	2.6	1.7	0.4	0.9	1.9	Dead	Dead	Dead	Dead

Day 0 is Day of Challenge

Rectal Temperatures

Calf	Group	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
2521	V	102.1	102.3	102	101.8	101.7	101.9	102.1	101.4	102.1	101.8	101.4	101.7	101.7	101.8	101.7	101.1	101.8	100.4	100.4	102.1
2543	V	101.2	101	100.6	101.6	101.9	101.7	101.6	101.5	101.1	100.9	101.1	101.1	100.6	101.1	101.3	101.3	101.4	100.8	101.3	101.3
2560	V	100.3	102.1	101.7	101	101.9	101.5	101.4	101.4	101.2	101.3	101.1	100.8	101	101.4	101.4	101.1	101.1	100.6	100.5	101.2
2561	V	101.6	101.5	101.5	100.6	101.5	102.1	101.7	101.8	101.5	101.4	101.7	101.5	101.6	101.4	100.6	100.7	101.2	101.2	100.2	101.6
2562	V	102.0	101.5	101.4	102.1	102.6	102.2	102.1	102.4	102.1	101.2	102	101.8	101.7	101.3	101.4	101.2	101	100.7	100.8	101.4
2566	V	101.6	101.3	100.3	101.4	103.7	101.7	101.4	101.1	100.9	100.7	100.8	100.6	100.7	101.4	101.4	100.5	101.3	100.7	101.2	101.5
2569	V	102.1	100.4	100.8	100.6	101.7	101.4	101.7	101.5	102.1	101.6	100.2	101.1	100.4	100.6	100.9	100.6	101.3	100.5	101.1	101.6
2571	V	102.2	101.9	101.6	101	102.1	101.8	101.4	101.7	101.2	100.8	101.3	101.3	101.2	100.5	101.2	101	101.3	101.1	100.7	101.5
2574	V	101.5	102.1	100.6	100.3	101.2	101.6	101.9	101.4	101.2	102.1	101.8	101.2	100.6	100.8	101.2	101.2	101.3	101.1	100.3	101.1
2576	V	102.4	101.5	102.3	100.3	101.7	102.4	101.1	101.2	101.3	100.8	101.4	101.1	101.5	101.3	101.6	101.4	100.8	101.6	103	102
2588	V	101.3	100.9	101.1	101.7	101.9	102.2	102	102.9	102	101.8	101.4	102.4	101.4	101.3	101.3	100.7	100.9	101.2	101	101.8
2590	V	101.7	100.2	100.4	101.1	101.9	101.9	101.6	102.1	101.4	101.6	101.3	101.2	101.4	101.7	101.5	101.3	101.6	101.2	101.7	101.2
2591	V	101.4	101.9	101.1	101.4	101.3	101.4	102	101.8	101.4	101.3	102	101.4	101.7	102	101.6	101.3	101.4	100.5	101.3	102.5
2592	V	102.8	102.5	101.4	102.2	102.7	102.1	102.5	102.3	101.9	101.3	101.9	101.8	102.1	102.2	101.8	NA	102.2	101.6	101.8	103.1
2599	V	102.2	102.4	102	101.6	102.5	102.3	101.9	102	100.5	101.3	101.6	101.3	100.7	101.3	100.7	100.9	101.7	100.5	100.3	101.9
2601	V	101.6	100.6	101.9	101.2	101.5	101.4	101.7	101.5	100.6	100.3	101.5	101.1	101.1	101	100.7	100.7	101.1	101.7	99.4	101.3
2602	V	100.6	100.7	101.9	100.7	102.1	101.6	102	102	101.3	101.3	101.8	101.8	101.4	101.1	101.5	101.2	101.4	100.2	100.2	101.7
2603	V	101.9	101.4	101.5	101.6	102.1	102	101.7	101.1	101.2	101.3	100.7	101.8	101.7	100.5	101.5	101	101.5	100.2	100.8	101
2615	V	102.3	100.8	101.7	100.6	100.7	101.8	102.3	101.2	100.2	100.2	100.2	101.3	101.1	101.6	100.7	101	100.6	100.5	100.3	101.2
2616	V	102.5	100.9	102.3	102	102.2	101.6	102.8	102	101.8	101.5	102.1	101.9	102.1	101.9	101.8	103.7	102.1	101.8	101.2	101.7
2523	C	101.9	101	102.5	100.5	103.1	102.4	102.8	102.8	102.4	105.1	105	103.7	104.1	102.3	Dead	Dead	Dead	Dead	Dead	Dead
2544	C	101.5	101.6	101.9	101.1	102.3	101.9	102.4	102.1	101.7	104.4	104.6	105	103.1	101.6	101.6	101	101.4	100.9	101.2	101.4
2565	C	100.8	101.1	102.4	100.6	101.4	103.4	102.5	102.8	103.3	104.3	106.4	106.2	105.8	101.8	Dead	Dead	Dead	Dead	Dead	Dead
2570	C	102.3	101.5	101.3	101.4	102.9	103.1	102.5	102.7	102.7	105.1	105.2	104.5	105.9	104.6	104.5	104.7	103.5	102.5	Dead	Dead
2589	C	102.5	100.2	101.2	100.3	101.5	101.7	102.7	102.4	103.7	104.2	104.6	104.9	104.5	100.4	Dead	Dead	Dead	Dead	Dead	Dead
2598	C	102.3	100.6	101.9	101.9	102.6	102.4	102.8	102.9	102.2	104.3	105.2	104.6	106	105.1	103.1	102	101.7	102.1	102.4	102.7
2600	C	101.5	101.2	101.3	102.3	102.6	103.5	103	103.1	104.7	105.1	105.8	105.3	104.6	104.2	103.1	102.2	101.4	102.2	101.3	102.1
2606	C	102.5	101.6	101.9	100.5	103.6	103.7	104.1	104.2	104.9	104.7	105.1	105.4	105.6	105.6	105.4	105.7	104.8	104.6	104.5	104.4
2609	C	101.7	101	101.8	100.2	102.6	102	102.9	102.6	102.5	103.3	105.3	105.7	106	106.1	105.3	104.5	Dead	Dead	Dead	Dead
2614	C	101.4	100.6	101.9	101.6	102.3	102.8	101.4	102.9	103.5	104.4	106	105.5	106.2	107.1	105.7	104.7	Dead	Dead	Dead	Dead

Day 0 is Day of Challenge

Post Challenge Observations - Respiratory

Respiratory		-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Calf	Group																				
2521	V	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
2543	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2560	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2561	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2562	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2566	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2569	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2571	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2574	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2576	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2588	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2590	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2591	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2592	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2599	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2601	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2602	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2603	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2615	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2616	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2523	C	0	0	0	0	0	0	0	0	0	0	0	1	1	1	Dead	Dead	Dead	Dead	Dead	Dead
2544	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2565	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Dead	Dead	Dead	Dead	Dead	Dead
2570	C	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2	0	Dead	Dead
2589	C	0	0	0	0	0	0	0	0	0	0	0	0	1	2	Dead	Dead	Dead	Dead	Dead	Dead
2598	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
2600	C	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	1	0	0	0	0
2606	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2
2609	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	Dead	Dead	Dead	Dead
2614	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	Dead	Dead	Dead	Dead

Day 0 is Day of Challenge

0 = Normal, 1 = Short/rapid, 2 = Mild dyspnea, 3 = Severe dyspnea

Post Challenge Observations – Coughing

Coughing		-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Calf	Group																				
2521	V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2543	V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2560	V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2561	V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2562	V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2566	V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2569	V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2571	V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2574	V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2576	V	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
2588	V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2590	V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2591	V	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
2592	V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2599	V	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
2601	V	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
2602	V	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
2603	V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2615	V	-	+	-	+	+	+	+	-	+	+	-	-	+	-	+	-	+	-	-	+
2616	V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-
2523	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Dead	Dead	Dead	Dead	Dead	Dead
2544	C	-	-	-	-	-	-	-	-	-	+	+	+	-	+	-	+	-	-	+	-
2565	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Dead	Dead	Dead	Dead	Dead	Dead
2570	C	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	+	-	-	Dead	Dead
2589	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Dead	Dead	Dead	Dead	Dead	Dead
2598	C	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-
2600	C	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	-	-	-	-
2606	C	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	-	+
2609	C	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	Dead	Dead	Dead	Dead
2614	C	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	+	Dead	Dead	Dead	Dead

+ = Coughing, - = No Coughing

Day 0 is Day of Challenge

Post Challenge Observations – Nasal Discharge

Nasal Discharge		-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Calf	Group																				
2521	V	0	1	0	0	1	1	0	0	0	0	1	1	0	0	1	0	0	0	1	0
2543	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2560	V	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2561	V	0	1	0	0	1	0	1	0	0	1	2	1	0	0	0	0	0	0	0	0
2562	V	2	0	0	2	1	0	1	0	2	2	0	0	0	0	0	1	0	0	0	0
2566	V	0	0	0	1	1	1	0	0	0	0	2	1	0	1	1	0	0	0	0	0
2569	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2571	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2574	V	0	0	0	0	0	2	0	0	0	0	1	1	0	0	0	0	0	0	0	0
2576	V	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	1	1
2588	V	0	2	0	0	2	1	0	2	1	2	1	0	2	1	1	0	0	0	0	1
2590	V	0	0	0	0	0	0	0	0	1	1	0	2	0	0	1	0	0	1	0	1
2591	V	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
2592	V	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
2599	V	0	1	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1
2601	V	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0
2602	V	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
2603	V	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
2615	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2616	V	0	0	0	0	0	0	0	0	0	1	0	0	0	2	0	3	2	2	1	0
2523	C	0	0	0	0	0	0	1	0	1	2	2	1	2	2	Dead	Dead	Dead	Dead	Dead	Dead
2544	C	0	0	0	0	0	0	2	0	0	2	2	2	3	3	3	3	0	0	0	0
2565	C	0	0	0	0	0	0	0	0	0	0	0	2	2	1	Dead	Dead	Dead	Dead	Dead	Dead
2570	C	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	Dead	Dead
2589	C	1	0	0	0	0	0	0	0	0	0	0	0	2	3	Dead	Dead	Dead	Dead	Dead	Dead
2598	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0
2600	C	0	0	0	0	0	0	0	0	0	0	1	2	3	3	3	2	0	2	0	0
2606	C	0	0	0	0	0	0	0	0	0	0	0	1	0	2	3	2	1	2	1	1
2609	C	0	0	0	0	0	0	0	1	0	2	0	0	2	2	2	2	Dead	Dead	Dead	Dead
2614	C	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	Dead	Dead	Dead	Dead

Day 0 is Day of Challenge

0 = No/slight, 1 = Mucous, 2 = Mucopurulent, 3 = Purulent, 1 = Blood-tinged

Post Challenge Observations – Oral Lesions

Oral Lesions		-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Calf	Group																				
2521	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2543	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2560	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2561	V	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
2562	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2566	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
2569	V	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
2571	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2574	V	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2576	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2588	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2590	V	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
2591	V	0	0	0	0	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0
2592	V	0	0	0	0	0	0	0	0	2	2	0	0	1	2	0	0	1	0	0	0
2599	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2601	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2602	V	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0
2608	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2615	V	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
2616	V	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
2523	C	0	0	0	0	0	0	0	0	0	1	2	0	2	2	Dead	Dead	Dead	Dead	Dead	Dead
2544	C	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	1	0	0	0
2565	C	0	0	0	0	0	0	0	0	0	1	0	2	1	0	Dead	Dead	Dead	Dead	Dead	Dead
2570	C	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	Dead	Dead
2589	C	0	0	0	0	0	0	0	0	0	1	0	1	2	2	Dead	Dead	Dead	Dead	Dead	Dead
2598	C	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2	0	2	2	0	0
2600	C	0	0	0	0	0	0	0	0	0	1	0	1	0	2	2	2	0	0	0	0
2606	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2609	C	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	Dead	Dead	Dead	Dead
2614	C	0	0	0	0	0	0	0	0	1	0	1	0	0	0	2	2	Dead	Dead	Dead	Dead

Day 0 is Day of Challenge

0 = Normal, 1 = 1-3 Lesions, 2 = >3 Lesions

Post Challenge Observations – Ocular Lesions

Ocular Lesions		-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Calf	Group																				
2521	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2545	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2560	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2561	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2562	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2566	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2569	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2571	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2574	V	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2576	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2588	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2590	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2591	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2592	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2599	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2601	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2602	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2603	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2615	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2616	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2533	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Dead	Dead	Dead	Dead	Dead	Dead
2544	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2565	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Dead	Dead	Dead	Dead	Dead	Dead
2570	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	Dead	Dead
2589	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Dead	Dead	Dead	Dead	Dead	Dead
2598	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
2600	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2606	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2609	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Dead	Dead	Dead	Dead
2614	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Dead	Dead	Dead	Dead

Day 0 is Day of Challenge

0 = Normal/slightly watery, 1 = Moderate watery, 2 = Conjunctivitis, 1 = Purulent

Post Challenge Observations – Attitude

Attitude		-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Calf	Group																				
2521	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2543	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2560	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2561	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2562	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2566	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2569	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2571	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2574	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2576	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2588	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2590	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2591	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2592	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2599	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2601	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2602	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2603	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2615	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2616	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
2523	C	0	0	0	0	0	0	0	0	0	1	0	1	2	3	50	Dead	Dead	Dead	Dead	Dead
2544	C	0	0	0	0	0	0	0	0	0	0	0	1	2	2	2	2	1	0	0	0
2565	C	0	0	0	0	0	0	0	0	0	0	0	1	2	2	50	Dead	Dead	Dead	Dead	Dead
2570	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	3	50	Dead	Dead
2589	C	0	0	0	0	0	0	0	0	0	0	0	0	1	3	50	Dead	Dead	Dead	Dead	Dead
2598	C	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	2	1	1	1
2600	C	0	0	0	0	0	0	0	0	0	0	0	2	2	2	1	2	1	1	0	0
2606	C	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	2	2	2	2
2609	C	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	3	50	Dead	Dead	Dead
2614	C	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	3	50	Dead	Dead	Dead

0 = Normal, 1 = Mild depression, 2 = Moderate depression, 3 = Severe depression, 50 = Comatose / Dead

Day 0 is Day of Challenge

Post Challenge Observations – Gastrointestinal

GI		-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Calf	Group																				
2521	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2543	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2560	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2561	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2562	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2566	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2569	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2571	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2574	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2576	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2588	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2590	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2591	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2592	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2599	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2601	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2602	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2608	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2615	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2616	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2523	C	0	0	0	0	0	0	0	0	0	0	0	0	0	3	Dead	Dead	Dead	Dead	Dead	Dead
2544	C	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
2565	C	0	0	0	0	0	0	0	0	0	0	0	0	0	3	Dead	Dead	Dead	Dead	Dead	Dead
2570	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	0	Dead	Dead
2589	C	0	0	0	0	0	0	0	0	0	0	0	0	3	0	Dead	Dead	Dead	Dead	Dead	Dead
2598	C	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	0	2
2600	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
2606	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2609	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	Dead	Dead	Dead	Dead
2614	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	Dead	Dead	Dead	Dead

Day 0 is Day of Challenge

0 = Normal, 1 = Pasty, 2 = Loose, 3 = Watery, 4 = Bloody

Study Type	Comparative Serology
Pertaining to	Bovine Virus Diarrhea Virus Type 2
Study Purpose	Comparative serology for Bovine Virus Diarrhea Virus Type 2 to show that combining fractions with satisfactory efficacy studies does not reduce the immune response. Refer to the summaries of the original efficacy studies under Product Code 1181.21 and in the Product Compilation Summary for this Product Code.
Product Administration	Subcutaneous injection twice, 21 days apart
Study Animals	Weaning age calves
Challenge Description	Serological response prior to vaccination and 35 days after first vaccination
Interval observed after challenge	
Results	Serological response to vaccination after 35 days showed a Geometric Mean Titer (GMT) for the Product Group, Reference Group, and Control group. Please see following pages for treatment groups, vaccination schedule and individual animal antibody titers.
USDA Approval Date	May 16, 2017

Allocation BVDV 2 naïve calves to Treatment Group

Group	Number of Calves (n)	Product	Animal ID
A	20	Reference Product Establishment 290, Product Code 1181.22 Bovine Rhinotracheitis-Virus Diarrhea-Parainfluenza 3-Respiratory Syncytial Virus Vaccine, Modified Live Virus	2,5,8,12,15,19,23,24,31,32,43,55,57,59,61, 64,67,68,72,74
B	21	Product	3,6,7,9,10,11,14,17,21,22,25,26,27,28,34,38, 41,42,53,56,76
D	6	Sterile H20 Diluent	1,4,16,20,54,60

Individual Antibody titers to BVD Type 2

Tag #	Group	Day 0	Day 35
2	A	<2	256
5	A	<2	256
8	A	<2	128
12	A	<2	32
15	A	<2	256
19	A	<2	128
23	A	<2	2048
24	A	<2	512
31	A	<2	512
32	A	<2	1024
43	A	<2	512
55	A	<2	128
57	A	<2	128
59	A	<2	64
61	A	<2	512
64	A	<2	256
67	A	<2	2048
68	A	<2	1024
72	A	<2	1024
74	A	<2	64
3	B	<2	256
6	B	<2	1024
7	B	<2	512
9	B	<2	512
10	B	<2	2048
11	B	<2	128
14	B	<2	256
17	B	<2	512
21	B	<2	1024
22	B	<2	512
25	B	<2	512
26	B	<2	512
27	B	<2	512
28	B	<2	64
34	B	<2	1024
38	B	<2	256
41	B	<2	256
42	B	<2	256
53	B	<2	512
56	B	<2	512
76	B	<2	1024
1	D	<2	<2
4	D	<2	<2
16	D	<2	<2
20	D	<2	<2
54	D	<2	<2
60	D	<2	<2

Study Type	Efficacy
Pertaining to	Bovine Rhinotracheitis (IBR)
Study Purpose	Demonstrate efficacy against respiratory disease
Product Administration	Single dose administered subcutaneously
Study Animals	33 mixed-breed beef calves, 4 to 5 months of age, randomly divided into 22 vaccinates and 11 controls
Challenge Description	IBR virus administered 28 days following vaccination
Interval observed after challenge	Observed daily for 14 days. Vaccinates and controls were monitored daily for nasal lesions) daily, and a nasal swab was collected from each animal daily as well. Swabs were evaluated for IBR virus by cell culture and polymerase chain reaction (PCR).
Results	Presence of nasal lesions: 11/11 Controls 4/22 Vaccinates Severity of nasal lesions: Controls All 11 calves had with lesions affecting more than 50% of the visible nasal mucus membrane Vaccinates The 4 affected calves had nasal lesions that did not exceed 10% of the visible nasal mucus membrane Duration of nasal lesions Controls 10/11 controls had unresolved nasal lesions at the end of the observation period Vaccinates No lesions evident by the end of the study. Duration of nasal shedding of virus, in days:

	Min	1st Quartile	Median	3rd Quartile	Max
Control (CPE*)	9	10	11	12	13
Vaccinate (CPE)	6	8	9	10	14
Control (PCR)	10	10	11	12	13
Vaccinate (PCR)	6	8	9	10	14

*CPE= cytopathic effect in cell culture

See Next Page for Raw Data.

USDA Approval Date	September 25, 2012

Bovine Nasal Lesion Scores

		Observation Day (Challenge administered on Day 0)																
Calf ID	Group	Day -2	Day -1	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14
2	Vaccinate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Vaccinate	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0
11	Vaccinate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Vaccinate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Vaccinate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	Vaccinate	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0
15	Vaccinate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	Vaccinate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	Vaccinate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	Vaccinate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	Vaccinate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	Vaccinate	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0
28	Vaccinate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	Vaccinate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	Vaccinate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
101	Vaccinate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
103	Vaccinate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
108	Vaccinate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
111	Vaccinate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
112	Vaccinate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
115	Vaccinate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
117	Vaccinate	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0
1	Control	0	0	0	0	0	0	1	4	4	4	4	4	4	4	4	4	4
4	Control	0	0	0	0	0	1	2	4	4	4	4	4	4	4	4	4	3
9	Control	0	0	0	0	0	0	1	1	3	4	3	3	2	1	0	0	0
17	Control	0	0	0	0	0	1	2	3	4	4	4	4	4	4	4	2	1
21	Control	0	0	0	0	0	1	1	3	4	4	4	4	4	4	3	3	3
22	Control	0	0	0	0	0	0	1	3	4	4	4	4	3	3	3	2	2
23	Control	0	0	0	0	0	0	1	3	4	4	4	4	4	4	4	3	3
30	Control	0	0	0	0	0	1	1	2	3	4	4	4	4	4	4	3	2
116	Control	0	0	0	0	0	1	3	4	4	4	4	4	3	3	3	3	2
118	Control	0	0	0	0	0	0	1	3	4	4	4	4	4	3	2	2	2
124	Control	0	0	0	0	0	0	1	2	3	4	4	4	4	4	3	2	1

Score	Description
0	Absence of definitive lesions of IBR virus disease.
1	The presence of lesions characteristic of IBR disease not to exceed 10% of the visible nasal mucous membrane.
2	The presence of lesions characteristic of IBR disease affecting 11-25% of the visible nasal mucous membrane.
3	The presence of lesions characteristic of IBR disease affecting 26-50% of the visible nasal mucous membrane.
4	The presence of lesions characteristic of IBR disease affecting greater than 50% of the visible nasal mucous membrane.

Isolation of IBR virus from nasal swabs

		4/11/2012	4/12/2012	4/13/2012	4/14/2012	4/15/2012	4/16/2012	4/17/2012	4/18/2012	4/19/2012	4/20/2012	4/21/2012	4/22/2012	4/23/2012	4/24/2012	4/25/2012
Calf	Group	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14
2	Vaccinate	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	+ / +	- / -	- / -
7	Vaccinate	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -	- / -	- / -	+ / +
11	Vaccinate	- / -	+ / +	+ / +	- / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -
12	Vaccinate	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -	- / -	+ / +	- / -
13	Vaccinate	- / -	+ / +	+ / +	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -	- / -
14	Vaccinate	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -	- / -	- / -
15	Vaccinate	- / -	+ / +	+ / +	+ / +	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -	- / -
16	Vaccinate	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -	- / -	- / -	- / -
19	Vaccinate	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -	- / -
20	Vaccinate	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -	- / -	- / -
25	Vaccinate	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -
27	Vaccinate	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / +	- / -	- / -	- / -	- / -	- / -
28	Vaccinate	- / -	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -	- / -	- / -
29	Vaccinate	- / -	- / -	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -	- / -	- / -
31	Vaccinate	- / -	+ / +	+ / +	+ / +	- / -	+ / +	- / -	+ / +	- / -	- / -	- / -	- / -	- / -	- / -	- / -
101	Vaccinate	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -	- / -
103	Vaccinate	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -	- / -	- / -
108	Vaccinate	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	- / +	- / -	+ / +	- / -	- / -	- / -	- / -	- / -	- / -
111	Vaccinate	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -	- / -
112	Vaccinate	- / -	+ / +	- / -	- / -	- / -	+ / +	+ / +	+ / +	- / -	+ / +	+ / +	- / +	- / -	- / -	- / -
115	Vaccinate	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	+ / +	- / +	- / -	- / -	- / -
117	Vaccinate	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -	- / -	- / -	- / -
1	Control	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -
4	Control	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -
9	Control	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -
17	Control	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -
21	Control	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -
22	Control	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -
23	Control	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -
30	Control	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -
116	Control	- / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -	- / -
118	Control	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	- / -	- / -	- / -
124	Control	- / -	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	+ / +	- / -	+ / +	+ / +	- / -

- / - = Neg CPE/Neg PCR, - / + = Neg CPE / Pos PCR, + / + = Pos CPE / Pos PCR

Study Type	Comparative Serology
Pertaining to	Infectious Bovine Rhinotracheitis
Study Purpose	Comparative serology for Infectious Bovine Rhinotracheitis to show that combining fractions with satisfactory efficacy studies does not reduce the immune response. Refer to the summaries of the original efficacy studies under Product Code 1181.21 and in the Product Compilation Summary for this Product Code.
Product Administration	Subcutaneous injection twice, 21 days apart – See Table 2
Study Animals	28 Day old calves – See Table 1
Challenge Description	Serological response prior to vaccination and 35 days after first vaccination
Interval observed after challenge	
Results	Serological response to vaccination after 35 days showed a Geometric Mean Titer (GMT) for the Product Group, Reference Group, and Control group. Please see following pages for treatment groups, vaccination schedule and individual animal antibody titers.
USDA Approval Date	May 16, 2017

Table 1: Allocation of Animal ID Numbers By Treatment Group.

Group	Number of Animals	Product	Animal IDs
A	16	Product	302, 306, 308, 324, 334, 338, 340, 365, 366, 372, 375, 377, 390, 397, 404, 405
B	16	Reference Product Establishment 290, Product Code 1181.22 Bovine Rhinotracheitis-Virus Diarrhea-Parainfluenza 3-Respiratory Syncytial Virus Vaccine, Modified Live Virus	304, 313, 322, 326, 330, 357, 368, 370, 371, 374, 385, 387, 388, 391, 400, 403
C	15	Reference Product Establishment 315 Product Code 7935.04 Mannheimia Haemolytica-Pasteurella Multocida Bacterin-Toxoid	310, 315, 325, 328, 341, 351, 364, 373, 376, 379, 380, 384, 389, 393, 401
D	5	Sterile H_2O Diluent	320, 343, 360, 361, 402

Table 2: Vaccination Schedule.

Group	Day 0	Day 21
A	Product	Reference Product Code 7935.04
B	Reference Product Code 1181.22	Sterile H_2O Diluent
C	Reference Product Code 7935.04	Reference Product Code 7935.04
D	Sterile H_2O Diluent	Sterile H_2O Diluent

Individual Calf Antibody Titer for Infectious Bovine Rhinotracheitis

Tag #	Group	Day 0	Day 35
302	A	<2	64
306	A	<2	32
308	A	<2	64
324	A	<2	128
334	A	<2	16
338	A	<2	128
340	A	<2	128
365	A	<2	32
366	A	<2	32
372	A	<2	64
375	A	<2	64
377	A	<2	128
390	A	<2	8
397	A	<2	32
404	A	<2	128
405	A	<2	128
304	B	<2	128
313	B	<2	32
322	B	<2	64
326	B	<2	128
330	B	<2	8
357	B	<2	128
368	B	<2	64
370	B	<2	16
371	B	<2	128
374	B	<2	16
385	B	<2	64
387	B	<2	128
388	B	<2	32
391	B	<2	8
400	B	<2	16
403	B	<2	32

Tag #	Group	Day 0	Day 35
310	C	<2	<2
315	C	<2	<2
325	C	<2	<2
328	C	<2	<2
341	C	<2	<2
351	C	<2	<2
364	C	<2	<2
373	C	<2	<2
376	C	<2	<2
379	C	<2	<2
380	C	<2	<2
384	C	<2	<2
389	C	<2	<2
393	C	<2	<2
401	C	<2	<2
320	D	<2	<2
343	D	<2	<2
360	D	<2	<2
361	D	<2	<2
402	D	<2	<2

Study Type	Efficacy
Pertaining to	*Mannheimia haemolytica*
Study Purpose	Efficacy against respiratory disease caused by *M. haemolytica*
Product Administration	Two doses, given subcutaneously, three weeks apart
Study Animals	Calves, 2.5 months of age, 20 vaccinates and 10 placebo controls and 4 environmental controls (non-vaccinated, non-challenged)
Challenge Description	*M. haemolytica* given 14 days after second vaccination
Interval observed after challenge	Observed daily for 4 days for clinical signs
Results	A calf was considered positive if mortality was due to *M. haemolytica.* Mortality after Challenge Vaccinates 7/20 (35%) Controls 10/10 (100%) Raw data in following table.
USDA Approval Date	January 9, 2012

Animal ID	Treatment	Clinical Observation	Organism Isolated
P10	V		MH
P18	P	Died 1 dpc	MH
P26	P	Died 1 dpc	MH
P27	V		
P28	P	Died 1 dpc	MH
P35	V		MH
P39	P	Died 1 dpc	MH
P42	V		MH
P45	V		MH
B46	V	Died 2 dpc	MH
G54	V		MH
G55	P	Died 4 dpc	MH
G59	V	Died 2 dpc	MH
Y61	V	Died 2 dpc	MH
Y63	V		MH
P5	EC		
P41	EC		
351	P	Died 1 dpc	MH
352	V		
353	EC		
354	V		
355	V	Died 1 dpc	MH
357	P	Died 1 dpc	MH
358	V	Died 1 dpc	MH
359	P	Died 1 dpc	MH
361	V		
362	V	Died 1 dpc	MH
363	V		
364	V		
366	EC		
367	P	Died 1 dpc	MH
368	V		
369	V	Died 1 dpc	MH
371	P	Died 1 dpc	MH

V=vaccinate
P=placebo control
EC=environmental control
dpc = day post challenge

Study Type	Efficacy
Pertaining to	Mannheimia Haemolytica (*M. haemolytica)*
Study Purpose	Efficacy against Mannheimia Haemolytica
Product Administration	Subcutaneous Injection repeated in 21 days – See Table 1
Study Animals	Calves 2.5 to 4 months of age 11 calves in Product Group 11 calves in Placebo Group
Challenge Description	Challenge with Mannheimia Haemolytica 14 days after second vaccination
Interval observed after challenge	Calves were monitored daily for 5 days then lung tissues were examined
Results	The primary outcome was lung lesions as described in 9 CFR 113.68. Placebo Group Calf #23 died post-challenge due to *M. haemolytica.* Please next pages for animal grouping and lesion scores.
USDA Approval Date	December 7, 2018

Animal grouping and vaccination scheme

Group	Purpose	# of Animals	1st vaccination	2nd vaccination
1	Product Group	11	Product	Reference Product Establishment 315 Product Code 7935.04 Mannheimia Haemolytica-Pasteurella Multocida Bacterin-Toxoid
2	Placebo Group	11	Placebo matched to Product vaccine without *M. haemolytica* and *Pasteurella multocida* antigenic fractions	Placebo matched to Reference Product without *M. haemolytica* and *Pasteurella multocida* antigenic fractions

Percentages of Affected Pneumonic Tissue of Individual Lobes
Calculated amount each lobe contributes to total lung lesion (percentage × weight)

Animal ID	Left Cranial (5%)	Left Posterior Cranial (6%)	Left Caudal (32%)	Inter-mediate (4%)	Right Cranial (6%)	Right Posterior Cranial (5%)	Right Middle (7%)	Right Caudal (35%)
1	0	0	5	5	0	0	5	5
2	0	0	35	0	0	0	0	30
3	0	0	10	0	0	0	15	15
6	100	100	50	0	100	0	80	20
7	0	0	5	0	0	0	0	10
10	0	0	5	0	50	0	5	5
11	5	10	20	30	80	5	100	20
12	0	0	10	0	0	0	5	15
16	0	0	20	0	0	0	20	10
19	5	0	70	30	90	40	30	50
20	0	0	5	0	0	0	0	5
22	5	0	15	5	100	0	5	15
23	NA	NA	NA	NA	NA	NA	NA	NA
25	0	0	20	0	0	0	0	15
26	90	100	20	30	15	0	90	15
28	0	40	25	80	30	0	100	30
29	5	30	30	0	10	0	50	40
30	5	100	40	20	100	0	90	50
31	0	0	5	0	0	0	0	1
33	70	100	15	100	100	0	10	5
34	0	5	5	0	0	0	0	5
36	0	0	30	80	100	20	5	40

Lung lesion scores of calves 5 days after *M. haemolytica* challenge

Group	Animal ID	Lung Lesion Score
Vaccinated	31	1.95
	20	3.35
	34	3.65
	1	3.9
	7	5.1
	10	6.7
	12	8.8
	3	9.5
	16	11.3
	25	11.65
	22	16.85
Placebo	2	21.7
	33	26.75
	11	27.5
	29	29.75
	26	30.55
	28	32.9
	36	34.15
	6	45.6
	30	49.65
	19	50.85
	23	51

<table>
<tr><td>Study Type</td><td>Efficacy</td></tr>
<tr><td>Pertaining to</td><td>Pasteurella multocida</td></tr>
<tr><td>Study Purpose</td><td>Demonstration of efficacy against Pasteurella multocida</td></tr>
<tr><td>Product Administration</td><td>Two doses, administered intraperitoneally, 14 days apart</td></tr>
<tr><td>Study Animals</td><td>Mice</td></tr>
<tr><td>Challenge Description</td><td>0.2 ml containing 100-10000 mouse LD_{50} of P. multocida P1062, administered intraperitoneally 10-12 days after second vaccination.</td></tr>
<tr><td>Interval observed after challenge</td><td>Observe daily for 10 days to record motalities.</td></tr>
<tr><td>Results</td><td>Vaccines were evaluated using the standard reference Pasteurella Multocida P1062 Bacterin (PMSRB2) supplied by APHIS per the criteria in 9 CFR 113.121(c) and the results were satisfactory (S).
<table>
<tr><td rowspan="2">Serials/Ref</td><td colspan="4">Protection at Different Dilutions</td><td>PD_{50}</td><td>Results</td></tr>
<tr><td>1</td><td>5</td><td>25</td><td>125</td><td></td><td></td></tr>
<tr><td>#28001</td><td>15/20*</td><td>13/20</td><td>15/20</td><td>12/20</td><td>NA</td><td>S</td></tr>
<tr><td>#28002</td><td>15/20</td><td>14/20</td><td>13/20</td><td>2/20</td><td>$5^{1.83}$</td><td>S</td></tr>
<tr><td>#28003</td><td>14/20</td><td>14/20</td><td>6/20</td><td>8/20</td><td>$5^{1.57}$</td><td>S</td></tr>
<tr><td>PMSRB2</td><td>18/20</td><td>9/20</td><td>1/20</td><td>0/20</td><td>$5^{0.87}$</td><td></td></tr>
</table>
* live/total mice number
Challenge dose: 120 mouse LD_{50} of P. multocida P1062.</td></tr>
<tr><td>USDA Approval Date</td><td>January 29, 2013</td></tr>
</table>

Study Type	Efficacy
Pertaining to	Pasteurella Multocida
Study Purpose	Efficacy of Pasteurella Multocida
Product Administration	Mouse Potency Test
Study Animals	Mice
Challenge Description	Test conducted according to 9 CFR 113.121
Interval observed after challenge	
Results	The potency test was conducted in triplicate (three sets of mice for each vaccine). Each test was initiated on a different day and fresh preparations of the vaccines were used in each test. See next page for test results
USDA Approval Date	May 16, 2017

Pasteurella multocida mouse potency PD_{50} values

			Number Live / Dead				
Observation	Test	Treatment	Undilute	1:5	1:25	1:125	PD_{50}
1	1	Product	11 / 20	8 / 20	5 / 20	1 / 20	3.09
2	1	Reference Product Establishment 315 Product Code 7935.04 Mannheimia Haemolytica-Pasteurella Multocida Bacterin-Toxoid	12 / 20	6 / 20	2 / 20	0 / 20	2.16
3	2	Product	11 / 20	8 / 20	2 / 20	1 / 20	2.51
4	2	Reference Product Establishment 315 Product Code 7935.04 Mannheimia Haemolytica-Pasteurella Multocida Bacterin-Toxoid	12 / 20	9 / 20	3 / 20	2 / 20	3.49
5	3	Product	12 / 20	8 / 20	3 / 20	1 / 20	2.92
6	3	Reference Product Establishment 315 Product Code 7935.04 Mannheimia Haemolytica-Pasteurella Multocida Bacterin-Toxoid	11 / 20	8 / 20	3 / 20	0 / 20	2.51

Study Type	Safety
Pertaining to	All
Study Purpose	Demonstrate safety in cattle 5 months of age or older
Product Administration	One dose subcutaneously
Study Animals	638 head of cattle ranging in age of 4 to 12 months with 69% at or below the minimum age of 5 months.
Challenge Description	NA
Interval observed after challenge	Observed daily for 24 days after vaccination
Results	The only recorded adverse events were 43 head of cattle that were treated for and recovered from pneumonia. These events were not associated with the use of the product by the attending veterinarians.
USDA Approval Date	June 5, 2019

Summary of Field Safety Test

Group	No. Head	Adverse Events	Adverse Events Attributed to Product	Mortality
1	87	0	0	0
2	86	1	0	0
3	79	3	0	0
4	95	12	0	0
5	95	9	0	0
6	98	6	0	0
7	98	12	0	0
Total	638	43	0	0

*Calves treated for pneumonia and recovered without event. Cause of pneumonia was undetermined.