



Linear description and breeding values for linear traits in the Swedish Warmblood



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About SWB

- ~ 4000 mares covered
2018
- ~ 250 stallions are
used for
breeding/year
- ~ 3500 members
- SWB-breeders have
1-3 mares in breeding.
Very few have more
than 6 mares





Overall breeding goal

A noble and durable warmblood horse, which by its good temperament, rideability, good movements and/or jumping ability is internationally competitive



35 %



75 %



7%



Events

Stallions

Advisory test (November)

Stallion performance test (February-March)

Young horses

Young Horse Tests tests for 3-4-year-olds (April-June)

Riding Horse Test (4 yo and older) (April-June)

Finals: Breeders Trophy (October)

Foals

Regional shows (July-August)

Elite foal auction (September)





SWB Young Horse Test



Young Horse Test

- Mainly 3-year-olds, but also open for 4-year-olds that have not been shown before
- Test **conformation, gaits at hand and in freedom, free jumping, rideability** test
- ~ 30 % of all born 3-year-olds are tested
- Qualification to finals

Riding Horse Test

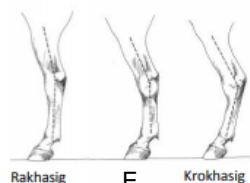
- Open for 4-year-olds, 5-year-old mares that had a foal, open class for older horses (not included in genetic evaluation)
- Tests **conformation, gaits under rider, jumping under rider or free** (optional)
- ~ 10 % of all born 4-year-olds are tested
- Qualification to finals

Both these test are included in the genetic evaluation



Evaluation & Description in SWB

- **Evaluation with numerical scores**
 - Evaluation of the horse relative the breeding goal
 - Using numerical scale 1-10 increments of 0,5
- **Linear description**
 - Description relative biological extremes and the population means
 - Using alphabetical scale A-I where E is in the middle
 - Scale A-E for foals, C in the middle
- **Tool for breeders, SWB and potential horse buyers**



Rakhasig E Krokhasig



Linear Description in SWB



- 2010 Literature study made by Master students
- 2010-11 PhD studying detailed underlying traits
- 2010 Theoretical intro of LD to judges and breeders
- 2011 Student thesis comparing SWB & KWPN system
- 2011-12 Training in LD for judges and discussions
- 2011 Decision to implement LD - complement existing evaluating system
- 2011-12 Work to create new protocols, extensive training of judges
- 2012 Test irl at young horse tests
- 2013 Full implementation 3-year-olds
- 2013 Manual for breeders available on SWB homepage
- 2014 Full implementation all tests



Number of traits scored at SWB tests

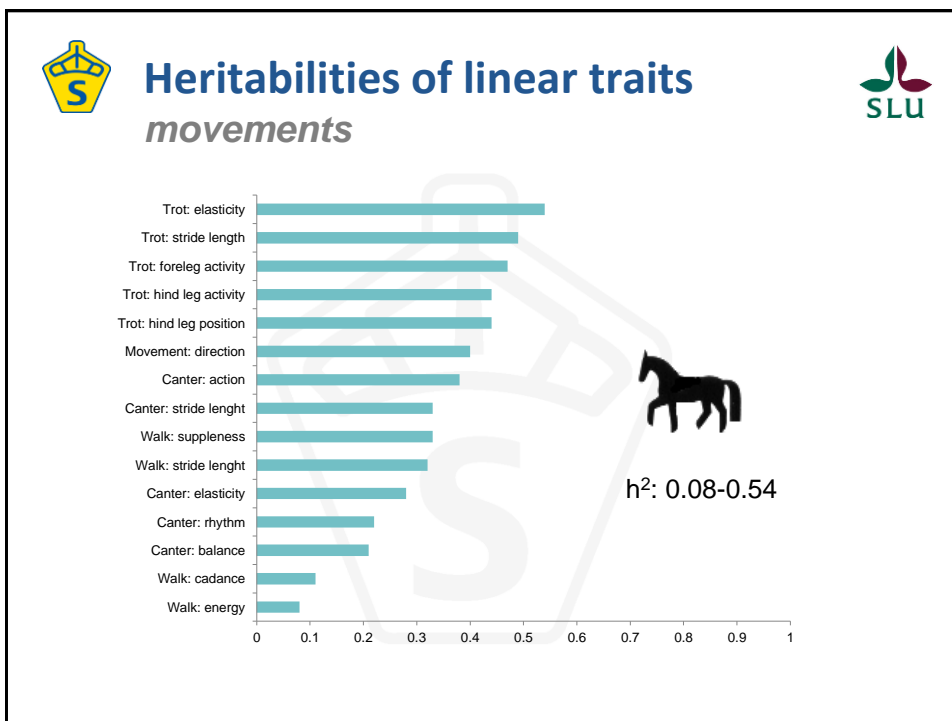
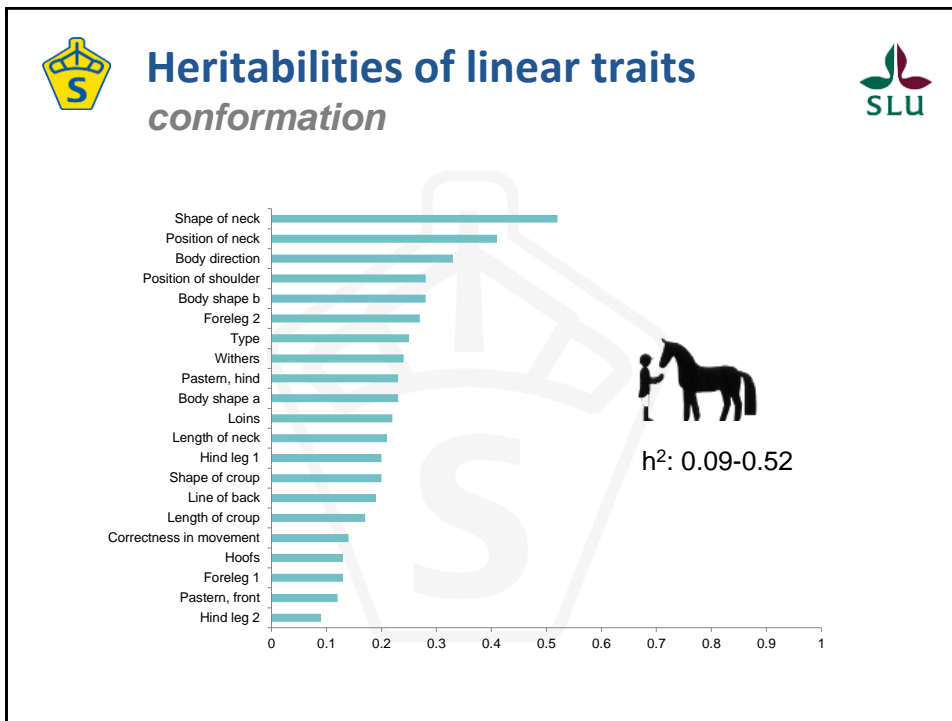
Evaluating scores

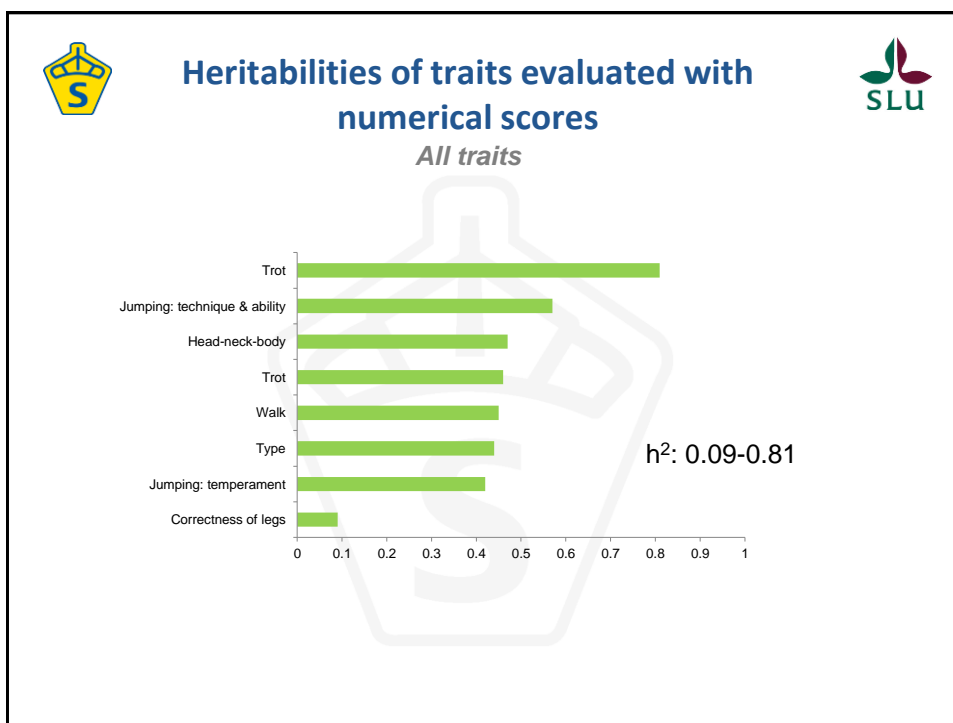
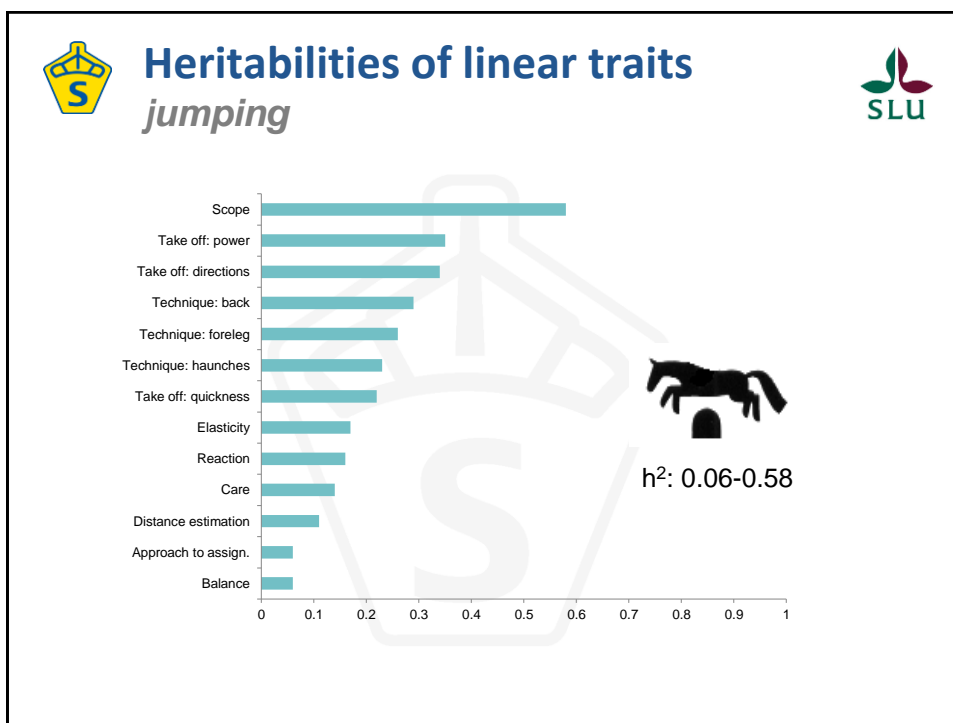
	Foals	Young horse test	Riding horse test	Stallions
Conformation	1	3	3	3
Gaits	1 (mean of 3)	3	4	7
Jumping	-	2	2	3

Linear description

	Foals	Young horse test	Riding horse test	Stallions
Conformation	8 (14)	21(39)	21 (39)	21 (39)
Gaits	7 (8)	15 (17)	21 (23)	21 (23)
Jumping	-	14 (16)	14/15 (16)	14/15 (16)

Including tick boxes for binary traits within brackets







Scientific results in short



Heritabilities

Conformation (21 traits)

0.10 hock joint from behind - 0.52 for shape of the neck

Movements (21 traits)

0.08 energy in walk - 0.54 el-

Jumping (14 traits)

Conclusion:

Linear information suitable for genetic evaluation and can be a useful tool for breeders

G

ver

responding traits



Breeding values for linear traits



- **2017**
 - Stallions - minimum 10 offspring with linear assessment at young horse test and minimum 15 offspring tested overall.
- **2018**
 - Stallions - minimum 10 offspring with linear assessment at Young Horse Test
 - Mares – with own linear assessment from Young Horse Test

BLUP Animal Model

$$Y_{ijk} = \text{sex}_i + \text{event}_j + \text{horse}_k + \text{residual}_{ijk}$$



Breeding values for linear traits



- Based on young horse test for 3-year-olds (4,000 horses)
- 50 traits (conformation, movements, jumping)
- **100** = average of all assessed horses
- Genetic standard deviation of 4 units
- Same direction of scale as protocol
- Accuracy – low, moderate and high
- 107 stallions & 2077 mares got linear profiles in 2018
- Everything published at www.blup.se



On-going activities




Add information on ridden horses in breeding value estimations


- Young horse test for 4- and 5-year-old horses
- Performance test for stallions



Photos by Roland Thunholm

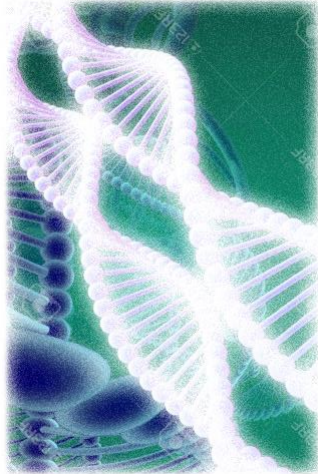



Genome-wide Association Study (GWAS) of Young Horse Test Traits in SWB Horses



Aim

To find genomic regions associated with conformation and performance traits in Swedish Warmblood (SWB)





Thanks to



- Swedish University of Agricultural Sciences
- Swedish-Norwegian Foundation for Equine Research



STIFTELSEN
HÄSTFORSKNING



Bedömningsprotokoll 3-årstest

Strömsholm 2011-05-07

Linjärbeskrivning

EXTERIÖR	Extremvariant							Extremvariant	Kommentar
	A	B	C	D	E	F	G		
1 Typ	del							grov	vill proportionerlig
2 Kroppform a	lång							kort	
3 Kroppform b	högtålad							lågtaålad	
4 Kroppens riktning	uppförbacke							framvikt	
5 Halsens längd	lång							kort	brett ansen
6 Halsens position	vertikal							horisontell	låg ansen
7 Halsens form	våvad							rak	grov översjög huvud-hals
8 Manke	hög							låg	
9 Bogens position	liggande							brant	djup häla
10 Rygg	rak							svark	
11 Ländrygg	lång							kort	karp
12 Korsets lutning	stapande							rakt	
13 Korsets längd	långt							kort	
14 Framben	bockhent							sabelhent	knippt parallellfötkj, rikligt iaktsett
15 Framben	intålad							utålad	gracil framtak
16 Framkotar	upprättade							veka	långa korta
17 Bakben	krakning							rakning	knippt under has
18 Bakben	hastning							hög	
19 Bakkotar	upprättade							veka	långa korta
20 Röttersans hornstärkt	sl. nystad							biljardar	
21 Hovar	små							små	öjarna starkt understäckta trakter

GÅNGARTER

GÅNGARTER	Extremvariant							Extremvariant	Kommentar
	A	B	C	D	E	F	G		
22 tak	takmässig							oregelbunden	
23 steglängd	lång							kort	
24 energi	överlad							ömggerad	
25 rörlighet	rörlig							lät	
26 steglängd	lång							kort	otakmässig
27 elasticitet	elastisk							oelastisk	markbunden
28 framaktivitet	bogfri							kortfärd	
29 bakbensens pos.	vill underkast							bakom sig	
30 bakaktivitet	aktiv							inaktiv	
31 takrytm	takmässig							oregelbunden	
32 spridningslängd	lång							kort	
33 aktion	rand							flack	
34 elasticitet	elastisk							oelastisk	
35 balans	balanserad							obalanserad	
36 Gång: rörelserikt. uppförbacke								framvikt	

Bedömningsprotokoll 3-årstest

FORS, katar 24 Aerodynamics (SWB)

HOPPNING	Extremvariant							Extremvariant	Kommentar
	A	B	C	D	E	F	G		
37 Avstamp	knäfullt							svagt	
38 Avspr. snabbhet	snabbt							långsamt	
39 Avspr. riktning	uppl							framf	
40 Teknik: framben	böjda							hängande	under kroppen
41 Teknik: rygg	rundad							släkt	
42 Teknik: bakben	öppnar upp							kniper	
43 Scope	stort							långt	
44 Elasticitet	stark, elastisk							svak	
45 Förskinghet	överförsiktig							öförsiktig	
46 Tävningförmåga	säker							osäker	
47 Balans	balanserad							obalanserad	
48 Reaktionsförmåga	snabb							långsam	
49 Utvärdering	fokuserad							obalanserad	
50 Betende	svoplad							spålad	

Poängbedömning

BEDÖMNING

Typ: _____

Kommentar: _____

Gångarter: _____

Hoppning: _____

Temperatur: _____

TOTALPÖÄNG

KLASS GÅNGARTER Diplom Klass 1 KLASS HOPPNING Diplom Klass 1

Övrigt: _____

RIDPROV (se särskilt protokoll) Godkänt Ej godkänt Ej utfört

Domarens underskrift _____ Datumets underskrift _____

ASVH 2014

Conformation

Kvalitetsbedömning: Conformation

Place/Date: _____

Nr. Name: _____ Sex: _____ Rtg nr: _____

Breed: _____ Color: _____ Pär: _____

Height: _____ cm

Linear scoring		Extrem									Comment	
EXTERIOR	Extrem	A	B	C	D	E	F	G	H	I	Extrem	Comment
1 Type	Noble										Heavy	Good proportions
2 Body slope a	long										Short	
3 Body slope b	long legend										Short legged	
4 Body direction	uphill										Forehill	
5 Length of neck	long										Short	Wide connection
6 Position of neck	vertical										Horizontal	Low connection
7 Shape of neck	arched										Angular	Heavy throatlatch contact
8 Withers	high										Low	
9 Shoulder	steep										Angular	Deep chest
10 Low of back	straight										Low	
11 Loin	long										Short	Reached back
12 Shape of croup	arched										Angular	
13 Length of croup	long										Short	
14 Pasterns	over or knee										Back or knee	Not in direct step or supported intermediate
15 Pasterns	good to										Bad set	Outward rotated hocks
16 Forelimb	upright										Weak	Slant
17 Hindlimb	upright										Weight	Slant
18 Hindlimb	good to										Fore hocked	Slant
19 Pastern, hind	upright										Weak	Slant
20 Connection of pastern	steep										Perching	
21 Hoof	long										Short	Not square or firm back

Points

CONFIRMATION	Comment	Score
Type:		
Head, neck, body:		
Legs:		
OTHER:		
Signature		

Gaits under rider



Kvalitetsbedömning - Gaits under rider

Place/Date:

No. Name: Sec. Page nr:
Breeder: Owner: Rider:
Sex: Mare:

Linear scoring

GAITS	Extremes	A	B	C	D	E	F	O	H	I	Extremes	Comments
22	cadence	even	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	harsh	
23	pitch of stride	long	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	short	
24	flexibility	elastic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	stagnant	if doesn't fit off the ground
25	driving activity	brisk/active flow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	slow	
26	handing position	balance body	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	balance body	
27	holding activity	active	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	passive	
28	cadence	even	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	harsh	
29	pitch height	long	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	short	
30	flexibility	elastic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	stagnant	
31	flexion	elastic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	stagnant	
32	pitch	even	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	harsh	
33	length of stride	long	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	short	
34	pitch	round	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	flat	
35	flexibility	elastic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	stagnant	

Ride ability

General impression	Extremes	A	B	C	D	E	F	O	H	I	Extremes	Comments
36	Impulsion	snatch	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	stale	<input type="checkbox"/> uneven
37	Pushoutness	cooperative	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	non cooperative	
38	Balance	balanced	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	unbalanced	
39	Self-carriage	good carriage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	weak carriage	
40	Suppleness	well supple	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	stiff	
41	Flexion	light	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	harsh/dull	
42	Balance, over all	round	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	stale	

Polished/finishing

GAITS	Comments	Score
WALK:		
Trot:		
Canter:		
Ride Ability and General Impression:		
OTHER:		
Signature:		

English version 2016/04/02 8/12s

Jumping under rider



Kvalitetsbedömning - Jumping under rider

Place/Date:

No. Name: Sec. Page nr:
Breeder: Owner: Rider:
Sex: Mare:

Linear scoring

JUMPING	Extremes	A	B	C	D	E	F	O	H	I	Extremes	Comments
43	Take off	powerful	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	weak	
44	Take off	quick	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	slow	
45	Take off	smooth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	harsh/dull	
46	Technique	flexible	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	rigid	if under body or stretched out
47	Technique	rounded	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	hollow	
48	Technique	light	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	heavy	
49	Scope	reach	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	short	
50	Flexibility	elastic	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	stiff	

Ride ability

General impression	Extremes	A	B	C	D	E	F	O	H	I	Extremes	Comments
51	Care	to careful	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	careless	
52	Impulsion	snatch	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	stale	<input type="checkbox"/> uneven
53	Pushoutness	cooperative	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	non cooperative	
54	Balance	balanced	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	unbalanced	
55	Flexion	light	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	harsh	
56	Approach to jump	forward	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	not of focus	
57	Balance	round	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	stale	

Polished/finishing

JUMPING	Comments	Score
Technique and capacity:		
Ride ability and General Impression:		
OTHER:		
Signature:		

English version 2016/04/02 8/12s