LISUN GROUP

Goniophotometer for Automotive and Signal Lamps (LSG-1950)

Brochure

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Leader in Lighting & Electrical Test Instruments

Rev. 3/29/2026

1.System Configuration

A. LSG-1950 goniophotometer system::

- Angular measurement rotation console: using Japanese Mitsubishi Electric and German angle decoder system
- Photometer rotation controller: connected to computer and controlled by software.
- Class A Constant Temperature Photo Detector
- Laser alignment system for calibration
- Chinese and English software
- Laser System for Calibrating
- Two sets of multifunctional fixtures
- Two sets of luminaries Clamps: multi-functions
- SLS-150W DC light intensity standard light source

B. LS2050B digital electrical parameter measuring instrument: LCD display, used to measure AC and DC voltage, current, power, power factor, DF and harmonics.

C. DC6010 precision digital display DC voltage and current stabilized power supply: 60V/10A constant current and voltage source output (optional DC12010: output 120V/10A)

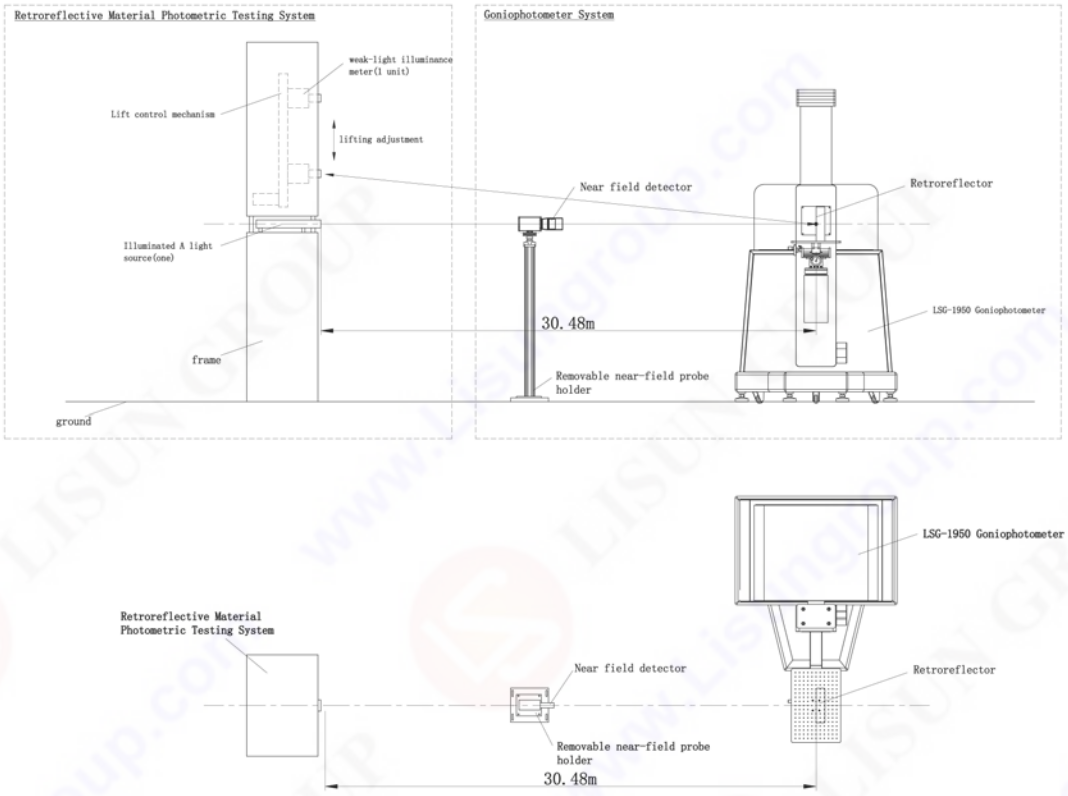
D. AC power supply: equipped with LSP-500VARC pure sine wave variable frequency voltage stabilized power supply, LCD display, maximum output power 500VA

E. CASE-19IN 19-inch cabinet: put AC/DC power supply and electrical parameter table, etc.

F. LMS-9000CG high-precision CCD spectroradiometer and CLAMP-9000 accessories and adjustable tripod (optional): used for spatial color distribution test of automotive lights

G. PM400F flash light source illuminance meter (optional): dedicated to testing flashing light sources

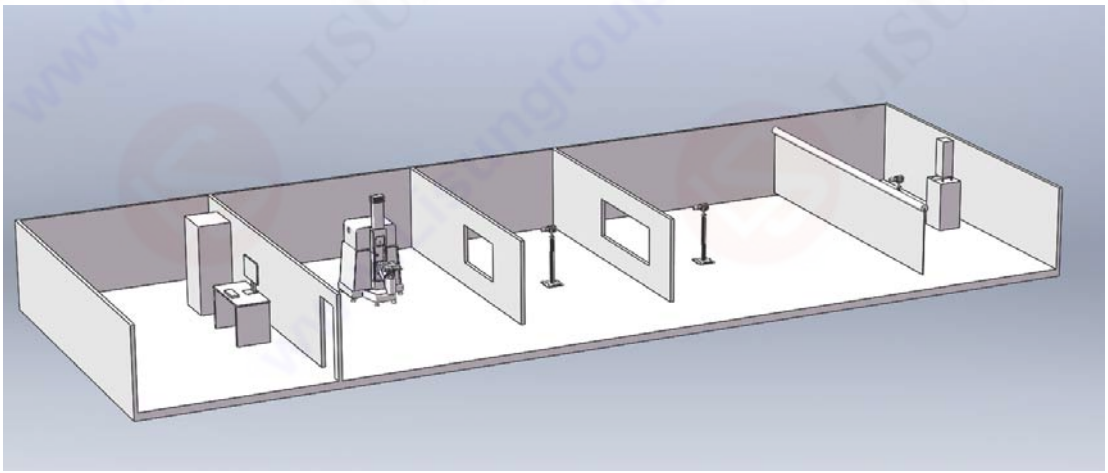
H. LS-RF200 Retroreflective material photometric test system (optional): test the photometric performance of various retroreflectors or materials such as raised road signs, faulty vehicle warning signs, road marking paint, contour markers, etc.



Note: The computer and printer must be prepared by the customer and must have at least one USB port.

2. Measurement Principle

LSG-1950 is a goniophotometer recommended by CIE A-α. When the test sample rotates around the horizontal and vertical axes, the photometer head remains stationary and faces the object to be tested, so as to test the light intensity and illumination value of the tested lamp.



3. Specifications

3.1 Goniophotometer LSG-1950:

- Adopting Mitsubishi Electric from Japan and angle encoder imported from Germany, angle accuracy: 0.01°;
- A-α axis rotation angle is -180~180°; turntable XY stroke is 100mm, Z stroke is 350mm;
- Class A Constant Temperature Photo Detector;
- Photometric linearity: 0.2%; Stray light: <0.1%;
- Photometric test range: illumination range 0.001lx~10000lx;
- Adopting precious metal steering gear to achieve uninterrupted continuous measurement, no need to worry about winding;
- The software has built-in traffic and automotive lamp test standard library, which is convenient for customers to call according to the test;

LISUN MODEL	Center Height (A)	Total Height (B)	Total Depth (C)	Total Width (D)	The max size for the Testing Lamp: Diameter(E)*Depth(F)	The max diameter of the mast rotating(G)	Max Testing Weight
LSG-1950	1100	1920	980	1500	⌀800x800	⌀1800	50kg
LSG-1950B	1300	2370	980	1980	⌀1600x1200	⌀2300	60kg

Table 1 The Diamensions of the Goniophotometer Master

Note: 1. The above table E is the max diameter of the testing lamp. Depeonds on the darkroom size, the max diameter of the light-emitting area will be about 200mm less and the thickness F will also be less accordingly; 2. A-type goniophotometer can be customized according to customer requirements to test larger lamps.

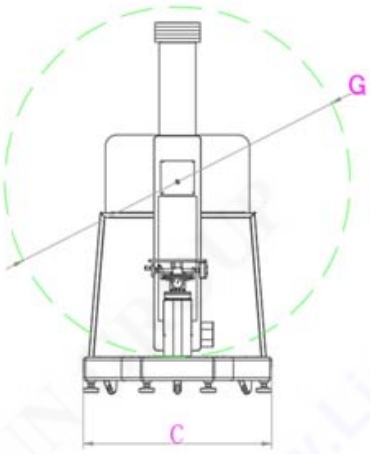


Figure 1 The Side View

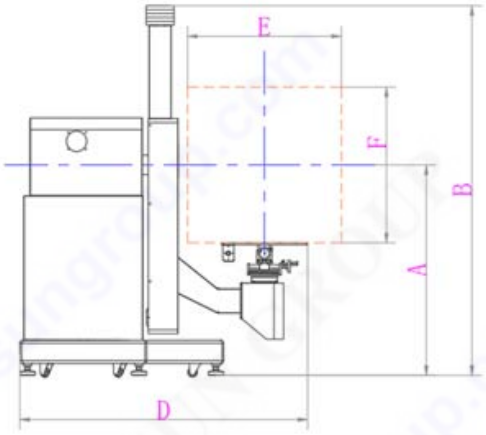


Figure 2 The Vertical View

3.2 LMS-9000CG High Precision CCD Spectroradiometer and CLAMP-9000 Accessories and Adjustable Tripod (Optional):

- Spectral range: 380-800nm, wavelength test accuracy: ±0.3nm, wavelength repeatability: ±0.1nm
- Sample scanning interval: ±0.1nm
- Chromaticity coordinate accuracy: ±0.002 (under standard A light source)
- Correlated color temperature test range: 1,500K~100,000K, accuracy: ±0.3%
- Color rendering index range: 0~100.0, accuracy: ±(0.3%rd±0.3)
- Luminous flux test range: 0.01-200,000lm; photometric linearity: ±0.5%
  Stray light: <0.015%(600nm) and <0.03%(435nm)
- Integration time: 0.1~10,000ms
- Temperature inside and outside the integrating sphere can be tested
- Luminous flux test method: spectroscopy, photometry, spectrophotometry
- Chinese and English software can run under Win7, Win8, Win10 and Win11

3.3 PM400F flash light source illuminance meter (optional): used with LSG-1950, it fully complies with the following standards:

MH/T 6012-1999 Aviation Obstruction Lights
HB6490-1991 General Specifications for Aircraft Navigation Lights and Anti-collision Lights
JTT 761—2022 General Technical Requirements for Navigation Lights
ECER65 Uniform Provisions Concerning The Approval of Special Warning Lamps for Motor Vehicles
JJF1330-2011 Calibration Specifications for Transient Effective Light Intensity Meters

3.4 LS-RF200 Retroreflective material photometric performance test system (optional):

3.4.1 Weak-light illuminance meter

- Measuring range: 0~1000.00 (mlx);
- Illuminance resolution: 0.01 (mlx);
- Matching accuracy: National Class I;

3.4.2 illuminated A light source

- Light source color temperature: Tc=（2856±50）K;
- Spot illumination unevenness Emax/Emin <1.05;
- Illumination of the irradiated surface can be provided: Emax≥8.0 lx (at a distance of 30m and an irradiated surface diameter φ≈600mm);

3.4.3 Lifting adjustment system

Adopting a stepper motor precision guide rail system, the detector is driven up and down at 30.48m, and the observation angle is automatically adjusted from 12′ to 2°. The observation angle adjustment speed is fast, and the adjustment time from 12′ to 2° does not exceed 30 seconds. The positioning accuracy of the lifting and adjustment mechanism is ±0.5mm.

- Total height: 2300mm;
- Base size: 500mm(L) *600mm(W) *1000mm(H);
- Collimated light source center height: 1300mm;
- Total weight: 120KG;

4. Laboratory Requirements

1) Room Requirements according to CIE

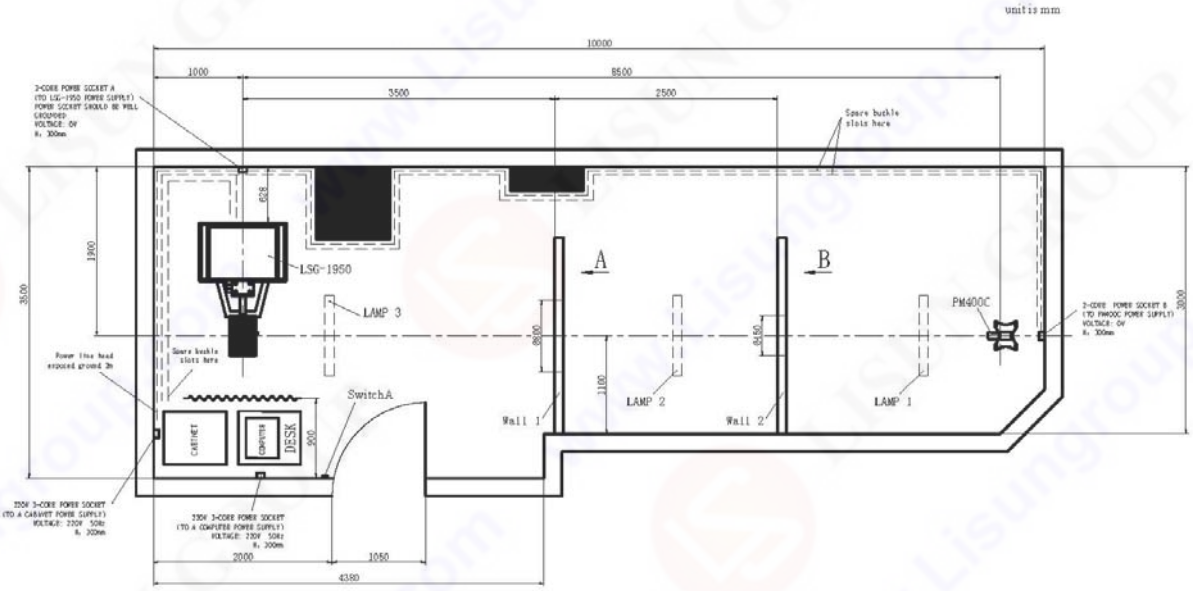
A. Dark Room: Place the goniophotometer

3*3*8~30m (W*H*L)

B. Operating Room:

3*3m (W*L)

LSG-1950 DARK ROOM VERTICAL VIEW



Technical requirement:

1. **The walls, floors and ceilings of dark room must painted matt black paint and the ground spreads black carpet .**
2. The power lines of 3-core power socket A and 2-core power socket B laying along the wall and into the operating room, **r**
equires power line head exposed ground 2 meter, the other slot laying along and enter into operating room for standby application.
3. SwitchA used to control lamp 1、lamp 2、lamp 3, Lamp installed in the ceiling.
4. **Three-core power socket A（Power to LSG-1950) must be well grounded, or separate ground terminal .**
5. The slot where is refering by dotted line should be detachable ,and the width of the slot should be not less than 50mm .
6. The windows are sealed off in the darkroom to make sure light cannot leak absolutely.
7. In the dark room where LSG-1950 main machine placed ,the air oulet of air set should not directly face to the tested lamp and the optical path.
8. All wire diameter $\geqslant 2mm^2$.
9. The width of dark room door above 1050mm, so that LSG-1950 could enter into dark room.

- The dark room wall, ceiling and floor should be all coated with dull black paint or be covered by black cloth and black carpet.
- Air-conditioner: be set in the dark room to control the temperature around lamps to the standard value upon the CIE requirements.

Note: The above lab design was only for reference. LISUN GROUP engineer dept will submit the Lab Design support documents according to the customer's real lab size after the formal purchase order was confirmed

2) Requirements of Eliminating the stray Light

Luminaires must be where the photo detector can only receive the light reflected by the rotating mirror in the LSG-1950 system. The light given off directly by the luminaries and reflected by the wall and floor is warded off by the light fence. Internal surface of the dark room and dark path together with the surface of the light fence should be painted unpolished black or be covered by black cloth and black carpet.

3) Temperature of the Environment

Temperature around the lamp or luminaries must be 25℃±1℃ during the test. Exceptions can be given according to relative lamps as following.

a. Tungsten Incandescent Lamp: 25℃±5℃
b. Double-caps Fluorescent Lamp: 25℃±1℃
c. High Pressure Mercury Lamp: 25℃±2℃
d. Metal Halogen Lamp: 25℃±2℃
e. High Pressure Sodium Lamp: 25℃±2℃
f. Low Pressure Sodium Lamp: 25℃±2

4) Airflow

Airflow may be induced by natural aeration, air conditioner or movement of the luminaries in the goniophotometer, but the speed of the airflow couldn't exceed 0.2m/s.

5) Vibration and shock

When the lamp is in lighting, the vibration couldn't exceed 10m/s2(4～3000Hz), or the moving scope of the lamp couldn't exceed 30mm (at most 4Hz)

6) Smoke, Dust and Moisture

The test environment must free from smoke, dust or moisture. At the same time, even not during the measurement, smoke, dust or moisture will also influence the reflectance of the reflecting mirror and induce more stray light. So, the test room must be kept clean, no smoke and dry. The humidity should be less than 60% RH.

5. Service

1) Installation and Training

LISUN GROUP engineers will take responsibility for installation and Training of the system at the customer's

2) Period of Guarantee: 24 months

The service is for free except technician's travel payment if the service provided by LISUN GROUP implement at the customer's.

3) Upgrading the applications software for free

6. Design Standard of Device

The construction, technical parameter, test & operate steps as well as data processing software of LSG-1950 Goniophotometer for Automotive and Signal Lamps meet the following requirements: GB, ECE, SAE, JIS, KS and FMVSS108

7. Typical oversea market customers:

There are many world famous company and lab institute choose Lisun Goniophtometer, Please get the reference customers' information from Lisun Group Oversea Sales Dept.

The next pages are some Test Reports from the LSG-1950.

Lisun Electronics Inc.
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Report No.	:	LS171124
Program	:	Special Warning Lights
Standard	:	ECE Addendum 64 Regulation No.65 Revision
Function	:	Category X Blue Day
Trade name or mark	:	LISUN
Type	:	lilp
Light source	:	led
Rated voltage	:	12v
Manufactureri¯s name	:	lisun
Manufactureri¯s address	:	shanghai
Light source module	:	no
Light source module specific identification code	:	12lo
Operator	:	oprt
Voltage	:	12.140 V
Test Instrument	:	LSG-1950
Test Distance	:	3.580 m
Test Time	:	2017-10-19 18:19

H V	-90°	-45°	-30°	-20°	-10°	0°	10°	20°	30°	45°	90°
min 8° max					100 **92.5** 1500		100 **96.5** 1500				
min 6° max				100 **115.1** 1500		150 **140.4** 1500		100 **176.6** 1500			
min 4° max	40 **62.0** 1000	40 **45.2** 1000	40 **115.7** 1000		200 **165.6** 3000		200 **206.0** 3000		40 **236.6** 1000	40 **218.8** 1000	40 **113.8** 1000
min 0° max	100 **197.3** 1000	100 **128.8** 1000	100 **181.5** 1000	150 **243.6** 1500		200 **426.7** 3000		150 **515.7** 1500	100 **463.7** 1000	100 **431.6** 100	100 **276.9** 1000
min -4° max	40 **349.6** 1000	40 **426.3** 1000	40 **420.9** 1000		200 **687.7** 3000		200 **720.7** 3000		40 **620.2** 1000	40 **476.8** 1000	40 **275.9** 1000
min -6° max				100 **552.9** 1500		150 **617.1** 1500		100 **492.3** 1500			
min -8° max					100 **337.1** 1500		100 **257.3** 1500				

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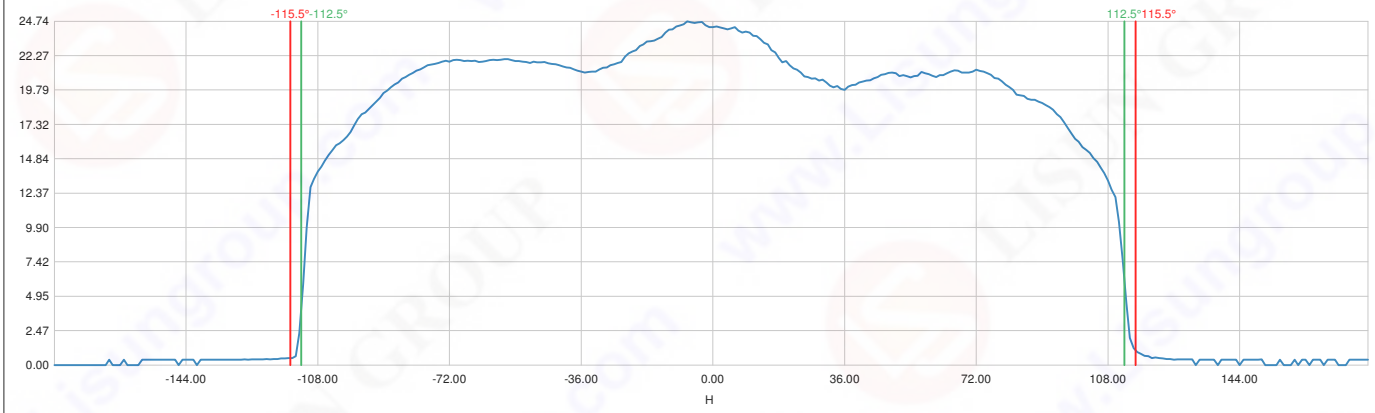
3nm Masthead Light (White) Photometric Test Report

Voltage (V)	AC 24.21
Current (A)	0.057
Power	1.39
Power Factor	1.000
Frequency (Hz)	0.00
Test Time	2026-03-06 11:00:07
Goniophotometer	LSG-1950 [E912016A]
Digital Power Meter	LS2050B [F413296M]
Illuminometer	PM400C [D313336A], Test Distance (m): 8.761

0 Horizontal Distribution[0 Horizontal]						
H [°]	V [°]	Min. limit	Max. limit	Test Value	Unit	Test Result
-180~180:1	0.0			[0.000, 24.739]	cd	Passed



V \H	180.00	-179.00	-178.00	-177.00	-176.00	-175.00	-174.00	-173.00	-172.00	-171.00
0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
V \H	-170.00	-169.00	-168.00	-167.00	-166.00	-165.00	-164.00	-163.00	-162.00	-161.00
0.00	0.000	0.000	0.000	0.000	0.000	0.393	0.000	0.000	0.000	0.393
V \H	-160.00	-159.00	-158.00	-157.00	-156.00	-155.00	-154.00	-153.00	-152.00	-151.00
0.00	0.000	0.000	0.000	0.000	0.393	0.393	0.393	0.393	0.393	0.393
V \H	-150.00	-149.00	-148.00	-147.00	-146.00	-145.00	-144.00	-143.00	-142.00	-141.00
0.00	0.393	0.393	0.393	0.393	0.000	0.393	0.393	0.393	0.393	0.000
V \H	-140.00	-139.00	-138.00	-137.00	-136.00	-135.00	-134.00	-133.00	-132.00	-131.00
0.00	0.393	0.393	0.393	0.393	0.393	0.393	0.393	0.393	0.393	0.393
V \H	-130.00	-129.00	-128.00	-127.00	-126.00	-125.00	-124.00	-123.00	-122.00	-121.00
0.00	0.393	0.393	0.426	0.393	0.426	0.426	0.426	0.426	0.458	0.426
V \H	-120.00	-119.00	-118.00	-117.00	-116.00	-115.00	-114.00	-113.00	-112.00	-111.00
0.00	0.458	0.458	0.491	0.491	0.524	0.524	0.655	2.324	5.825	9.883
V \H	-110.00	-109.00	-108.00	-107.00	-106.00	-105.00	-104.00	-103.00	-102.00	-101.00
0.00	12.828	13.417	13.941	14.301	14.726	15.151	15.479	15.839	15.970	16.199
V \H	-100.00	-99.00	-98.00	-97.00	-96.00	-95.00	-94.00	-93.00	-92.00	-91.00
0.00	16.460	16.788	17.278	17.737	18.064	18.195	18.457	18.718	18.980	19.242
V \H	-90.00	-89.00	-88.00	-87.00	-86.00	-85.00	-84.00	-83.00	-82.00	-81.00
0.00	19.602	19.765	19.995	20.224	20.354	20.616	20.747	20.911	21.042	21.205
V \H	-80.00	-79.00	-78.00	-77.00	-76.00	-75.00	-74.00	-73.00	-72.00	-71.00
0.00	21.303	21.434	21.598	21.631	21.696	21.762	21.860	21.925	21.860	21.958
V \H	-70.00	-69.00	-68.00	-67.00	-66.00	-65.00	-64.00	-63.00	-62.00	-61.00
0.00	21.991	21.958	21.892	21.925	21.892	21.925	21.827	21.860	21.892	21.958
V \H	-60.00	-59.00	-58.00	-57.00	-56.00	-55.00	-54.00	-53.00	-52.00	-51.00
0.00	21.991	21.958	21.991	22.023	22.023	21.958	21.892	21.892	21.860	21.827

V \H	-50.00	-49.00	-48.00	-47.00	-46.00	-45.00	-44.00	-43.00	-42.00	-41.00
0.00	21.762	21.860	21.794	21.794	21.827	21.729	21.696	21.663	21.598	21.500
V \H	-40.00	-39.00	-38.00	-37.00	-36.00	-35.00	-34.00	-33.00	-32.00	-31.00
0.00	21.434	21.402	21.303	21.205	21.140	21.074	21.107	21.140	21.140	21.303
V \H	-30.00	-29.00	-28.00	-27.00	-26.00	-25.00	-24.00	-23.00	-22.00	-21.00
0.00	21.402	21.434	21.598	21.663	21.762	21.827	22.220	22.449	22.580	22.678
V \H	-20.00	-19.00	-18.00	-17.00	-16.00	-15.00	-14.00	-13.00	-12.00	-11.00
0.00	22.972	23.103	23.300	23.332	23.365	23.496	23.627	23.954	24.150	24.183
V \H	-10.00	-9.00	-8.00	-7.00	-6.00	-5.00	-4.00	-3.00	-2.00	-1.00
0.00	24.379	24.445	24.543	24.739	24.674	24.641	24.674	24.707	24.478	24.347
V \H	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00
0.00	24.347	24.379	24.314	24.249	24.183	24.249	24.347	24.085	23.954	24.020
V \H	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00
0.00	23.954	23.725	23.692	23.463	23.201	23.103	22.678	22.514	22.122	21.794
V \H	20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00
0.00	21.892	21.598	21.369	21.271	21.074	20.780	20.747	20.616	20.649	20.485
V \H	30.00	31.00	32.00	33.00	34.00	35.00	36.00	37.00	38.00	39.00
0.00	20.551	20.354	20.125	19.995	20.093	19.896	19.831	20.060	20.158	20.191
V \H	40.00	41.00	42.00	43.00	44.00	45.00	46.00	47.00	48.00	49.00
0.00	20.354	20.420	20.485	20.518	20.649	20.747	20.911	20.944	21.042	21.074
V \H	50.00	51.00	52.00	53.00	54.00	55.00	56.00	57.00	58.00	59.00
0.00	21.009	20.813	20.878	20.813	20.714	20.813	20.845	21.107	21.009	20.944
V \H	60.00	61.00	62.00	63.00	64.00	65.00	66.00	67.00	68.00	69.00
0.00	20.845	20.747	20.878	20.878	21.009	21.140	21.238	21.205	21.074	21.074
V \H	70.00	71.00	72.00	73.00	74.00	75.00	76.00	77.00	78.00	79.00
0.00	21.074	21.140	21.271	21.173	21.140	21.009	20.911	20.682	20.616	20.453
V \H	80.00	81.00	82.00	83.00	84.00	85.00	86.00	87.00	88.00	89.00
0.00	20.191	20.027	19.831	19.471	19.438	19.373	19.176	19.111	19.111	18.980
V \H	90.00	91.00	92.00	93.00	94.00	95.00	96.00	97.00	98.00	99.00
0.00	18.882	18.718	18.587	18.391	18.064	17.867	17.475	17.082	16.657	16.297
V \H	100.00	101.00	102.00	103.00	104.00	105.00	106.00	107.00	108.00	109.00
0.00	16.100	15.708	15.511	15.282	14.922	14.628	14.235	13.842	13.286	12.632
V \H	110.00	111.00	112.00	113.00	114.00	115.00	116.00	117.00	118.00	119.00
0.00	12.108	10.308	7.494	4.516	1.964	1.244	0.949	0.818	0.688	0.655
V \H	120.00	121.00	122.00	123.00	124.00	125.00	126.00	127.00	128.00	129.00
0.00	0.524	0.557	0.524	0.491	0.458	0.458	0.393	0.426	0.426	0.426
V \H	130.00	131.00	132.00	133.00	134.00	135.00	136.00	137.00	138.00	139.00
0.00	0.426	0.426	0.000	0.393	0.393	0.393	0.393	0.393	0.000	0.393
V \H	140.00	141.00	142.00	143.00	144.00	145.00	146.00	147.00	148.00	149.00
0.00	0.393	0.393	0.393	0.393	0.000	0.393	0.393	0.393	0.393	0.393
V \H	150.00	151.00	152.00	153.00	154.00	155.00	156.00	157.00	158.00	159.00
0.00	0.426	0.000	0.000	0.000	0.000	0.393	0.000	0.000	0.000	0.393
V \H	160.00	161.00	162.00	163.00	164.00	165.00	166.00	167.00	168.00	169.00
0.00	0.000	0.393	0.393	0.000	0.393	0.393	0.393	0.000	0.393	0.393
V \H	170.00	171.00	172.00	173.00	174.00	175.00	176.00	177.00	178.00	179.00
0.00	0.393	0.000	0.000	0.000	0.393	0.393	0.393	0.393	0.393	0.393

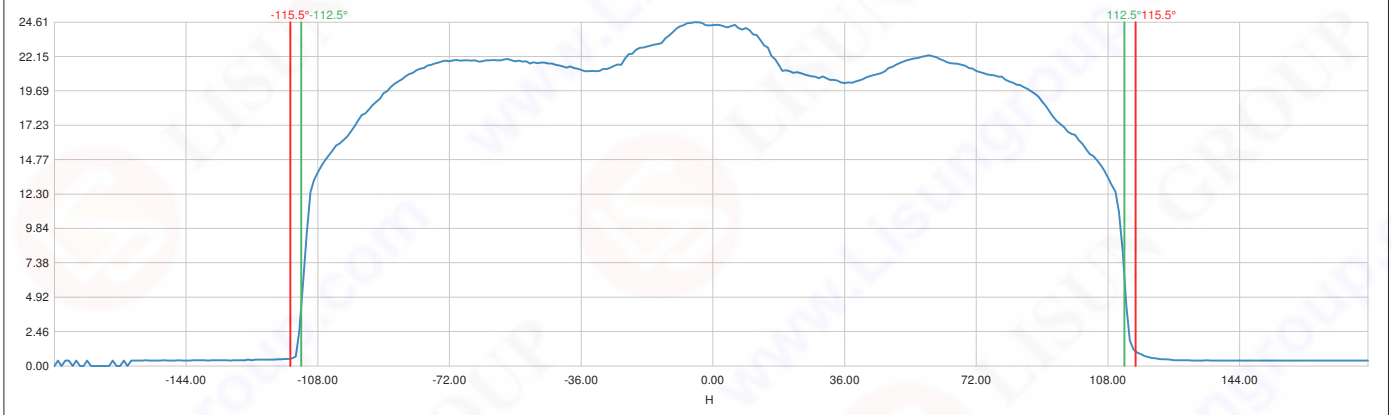
0 Horizontal Limit[0 Horizontal Limit]					
Calculation	Min. limit	Max. limit	Test Value	Unit	Test Result
MIN([0 Horizontal],-112.5,112.5))	12		2.824	cd	Failed

0 Horizontal Limit Max vs Min[0 Horizontal Limit Max vs Min]					
Calculation	Min. limit	Max. limit	Test Value	Unit	Test Result
MAXMIN([0 Horizontal],-112.5,112.5)		1.5	8.7613		Failed

0 Cut-off Angles starboard abeam direction[0 Cut-off Angles starboard abeam direction]					
Calculation	Min. limit	Max. limit	Test Value	Unit	Test Result
CUTOFF([0 Horizontal],1)	112.5	115.5	113.8	°	Passed

0 Cut-off Angles port abeam direction[0 Cut-off Angles port abeam direction]					
Calculation	Min. limit	Max. limit	Test Value	Unit	Test Result
CUTOFF([0 Horizontal],0)	-115.5	-112.5	-113.0	°	Passed

7.5 Horizontal Distribution[7.5 Horizontal]						
H [°]	V [°]	Min. limit	Max. limit	Test Value	Unit	Test Result
-180~180:1	7.5			[0.000, 24.609]	cd	Passed



V \H	180.00	-179.00	-178.00	-177.00	-176.00	-175.00	-174.00	-173.00	-172.00	-171.00
7.50	0.000	0.393	0.000	0.393	0.393	0.000	0.393	0.000	0.000	0.393
V \H	-170.00	-169.00	-168.00	-167.00	-166.00	-165.00	-164.00	-163.00	-162.00	-161.00
7.50	0.000	0.000	0.000	0.000	0.000	0.000	0.393	0.000	0.000	0.393
V \H	-160.00	-159.00	-158.00	-157.00	-156.00	-155.00	-154.00	-153.00	-152.00	-151.00
7.50	0.000	0.393	0.393	0.393	0.393	0.426	0.393	0.393	0.393	0.393
V \H	-150.00	-149.00	-148.00	-147.00	-146.00	-145.00	-144.00	-143.00	-142.00	-141.00
7.50	0.426	0.393	0.393	0.393	0.426	0.393	0.393	0.393	0.426	0.426
V \H	-140.00	-139.00	-138.00	-137.00	-136.00	-135.00	-134.00	-133.00	-132.00	-131.00
7.50	0.426	0.426	0.393	0.426	0.426	0.426	0.426	0.426	0.393	0.426
V \H	-130.00	-129.00	-128.00	-127.00	-126.00	-125.00	-124.00	-123.00	-122.00	-121.00
7.50	0.426	0.426	0.426	0.458	0.426	0.458	0.458	0.458	0.458	0.458
V \H	-120.00	-119.00	-118.00	-117.00	-116.00	-115.00	-114.00	-113.00	-112.00	-111.00
7.50	0.458	0.491	0.491	0.524	0.524	0.557	0.688	2.520	6.021	9.425
V \H	-110.00	-109.00	-108.00	-107.00	-106.00	-105.00	-104.00	-103.00	-102.00	-101.00
7.50	12.468	13.319	13.875	14.333	14.726	15.086	15.413	15.806	15.937	16.199
V \H	-100.00	-99.00	-98.00	-97.00	-96.00	-95.00	-94.00	-93.00	-92.00	-91.00
7.50	16.428	16.755	17.148	17.573	17.966	18.097	18.391	18.686	18.915	19.144
V \H	-90.00	-89.00	-88.00	-87.00	-86.00	-85.00	-84.00	-83.00	-82.00	-81.00
7.50	19.536	19.700	19.995	20.224	20.387	20.551	20.747	20.911	21.009	21.173
V \H	-80.00	-79.00	-78.00	-77.00	-76.00	-75.00	-74.00	-73.00	-72.00	-71.00
7.50	21.303	21.336	21.533	21.565	21.663	21.729	21.827	21.860	21.827	21.892
V \H	-70.00	-69.00	-68.00	-67.00	-66.00	-65.00	-64.00	-63.00	-62.00	-61.00
7.50	21.925	21.860	21.892	21.892	21.860	21.892	21.794	21.827	21.892	21.892
V \H	-60.00	-59.00	-58.00	-57.00	-56.00	-55.00	-54.00	-53.00	-52.00	-51.00
7.50	21.925	21.892	21.892	21.958	21.991	21.892	21.827	21.860	21.794	21.827
V \H	-50.00	-49.00	-48.00	-47.00	-46.00	-45.00	-44.00	-43.00	-42.00	-41.00
7.50	21.663	21.762	21.696	21.729	21.729	21.663	21.663	21.565	21.533	21.467
V \H	-40.00	-39.00	-38.00	-37.00	-36.00	-35.00	-34.00	-33.00	-32.00	-31.00
7.50	21.369	21.467	21.336	21.303	21.205	21.107	21.107	21.140	21.107	21.140

V \H	-30.00	-29.00	-28.00	-27.00	-26.00	-25.00	-24.00	-23.00	-22.00	-21.00
7.50	21.271	21.271	21.369	21.500	21.598	21.565	22.023	22.318	22.383	22.645
V \H	-20.00	-19.00	-18.00	-17.00	-16.00	-15.00	-14.00	-13.00	-12.00	-11.00
7.50	22.776	22.809	22.874	22.940	23.005	23.071	23.136	23.463	23.660	23.889
V \H	-10.00	-9.00	-8.00	-7.00	-6.00	-5.00	-4.00	-3.00	-2.00	-1.00
7.50	24.150	24.314	24.412	24.543	24.576	24.609	24.609	24.576	24.412	24.379
V \H	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00
7.50	24.412	24.445	24.412	24.314	24.249	24.347	24.445	24.216	24.085	24.216
V \H	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00
7.50	24.052	23.758	23.692	23.332	22.972	22.809	22.220	21.958	21.565	21.140
V \H	20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00
7.50	21.173	21.107	21.009	21.042	20.976	20.878	20.813	20.747	20.714	20.616
V \H	30.00	31.00	32.00	33.00	34.00	35.00	36.00	37.00	38.00	39.00
7.50	20.747	20.616	20.485	20.485	20.453	20.322	20.256	20.322	20.289	20.387
V \H	40.00	41.00	42.00	43.00	44.00	45.00	46.00	47.00	48.00	49.00
7.50	20.453	20.551	20.682	20.780	20.845	20.911	20.976	21.107	21.336	21.402
V \H	50.00	51.00	52.00	53.00	54.00	55.00	56.00	57.00	58.00	59.00
7.50	21.565	21.696	21.794	21.892	21.958	22.023	22.056	22.154	22.187	22.252
V \H	60.00	61.00	62.00	63.00	64.00	65.00	66.00	67.00	68.00	69.00
7.50	22.187	22.122	21.991	21.892	21.762	21.696	21.663	21.631	21.565	21.500
V \H	70.00	71.00	72.00	73.00	74.00	75.00	76.00	77.00	78.00	79.00
7.50	21.336	21.303	21.140	21.042	20.976	20.878	20.845	20.813	20.714	20.714
V \H	80.00	81.00	82.00	83.00	84.00	85.00	86.00	87.00	88.00	89.00
7.50	20.485	20.387	20.289	20.158	20.125	19.962	19.864	19.667	19.504	19.275
V \H	90.00	91.00	92.00	93.00	94.00	95.00	96.00	97.00	98.00	99.00
7.50	18.947	18.620	18.227	17.867	17.540	17.344	17.115	16.788	16.624	16.559
V \H	100.00	101.00	102.00	103.00	104.00	105.00	106.00	107.00	108.00	109.00
7.50	16.199	15.904	15.544	15.184	15.053	14.726	14.399	14.006	13.483	12.992
V \H	110.00	111.00	112.00	113.00	114.00	115.00	116.00	117.00	118.00	119.00
7.50	12.501	11.028	8.149	4.353	1.833	1.178	0.982	0.851	0.720	0.655
V \H	120.00	121.00	122.00	123.00	124.00	125.00	126.00	127.00	128.00	129.00
7.50	0.589	0.557	0.524	0.491	0.491	0.458	0.426	0.426	0.426	0.426
V \H	130.00	131.00	132.00	133.00	134.00	135.00	136.00	137.00	138.00	139.00
7.50	0.426	0.393	0.393	0.393	0.393	0.426	0.393	0.393	0.393	0.393
V \H	140.00	141.00	142.00	143.00	144.00	145.00	146.00	147.00	148.00	149.00
7.50	0.393	0.393	0.393	0.393	0.393	0.393	0.393	0.393	0.393	0.393
V \H	150.00	151.00	152.00	153.00	154.00	155.00	156.00	157.00	158.00	159.00
7.50	0.393	0.393	0.393	0.393	0.393	0.393	0.393	0.393	0.393	0.393
V \H	160.00	161.00	162.00	163.00	164.00	165.00	166.00	167.00	168.00	169.00
7.50	0.393	0.393	0.393	0.393	0.393	0.393	0.393	0.393	0.393	0.393
V \H	170.00	171.00	172.00	173.00	174.00	175.00	176.00	177.00	178.00	179.00
7.50	0.393	0.393	0.393	0.393	0.393	0.393	0.393	0.393	0.393	0.393

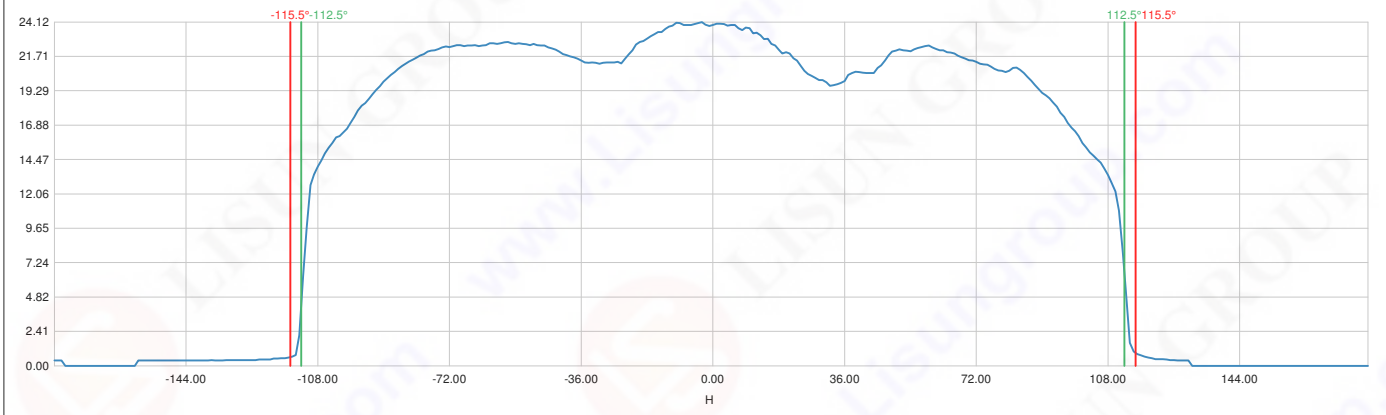
7.5 Horizontal Limit[7.5 Horizontal Limit]					
Calculation	Min. limit	Max. limit	Test Value	Unit	Test Result
MIN([7.5 Horizontal],-112.5,112.5))	12		3.020	cd	Failed

7.5 Horizontal Limit Max vs Min[7.5 Horizontal Limit Max vs Min]					
Calculation	Min. limit	Max. limit	Test Value	Unit	Test Result
MAXMIN([7.5 Horizontal],-112.5,112.5)		1.5	8.1484		Failed

7.5 Cut-off Angles starboard abeam direction[7.5 Cut-off Angles starboard abeam direction]					
Calculation	Min. limit	Max. limit	Test Value	Unit	Test Result
CUTOFF([7.5 Horizontal],1)	112.5	115.5	113.8	°	Passed

7.5 Cut-off Angles port abeam direction[7.5 Cut-off Angles port abeam direction]					
Calculation	Min. limit	Max. limit	Test Value	Unit	Test Result
CUTOFF([7.5 Horizontal],0)	-115.5	-112.5	-113.0	°	Passed

352.5 Horizontal Distribution[352.5 Horizontal]						
H [°]	V [°]	Min. limit	Max. limit	Test Value	Unit	Test Result
-180~180:1	352.5			[0.000, 24.118]	cd	Passed



V \H	180.00	-179.00	-178.00	-177.00	-176.00	-175.00	-174.00	-173.00	-172.00	-171.00
-7.50	0.393	0.393	0.393	0.000	0.000	0.000	0.000	0.000	0.000	0.000
V \H	-170.00	-169.00	-168.00	-167.00	-166.00	-165.00	-164.00	-163.00	-162.00	-161.00
-7.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
V \H	-160.00	-159.00	-158.00	-157.00	-156.00	-155.00	-154.00	-153.00	-152.00	-151.00
-7.50	0.000	0.000	0.000	0.393	0.393	0.393	0.393	0.393	0.393	0.393
V \H	-150.00	-149.00	-148.00	-147.00	-146.00	-145.00	-144.00	-143.00	-142.00	-141.00
-7.50	0.393	0.393	0.393	0.393	0.393	0.393	0.393	0.393	0.393	0.393
V \H	-140.00	-139.00	-138.00	-137.00	-136.00	-135.00	-134.00	-133.00	-132.00	-131.00
-7.50	0.393	0.393	0.393	0.426	0.393	0.393	0.393	0.426	0.426	0.426
V \H	-130.00	-129.00	-128.00	-127.00	-126.00	-125.00	-124.00	-123.00	-122.00	-121.00
-7.50	0.426	0.426	0.426	0.426	0.426	0.426	0.458	0.458	0.458	0.458
V \H	-120.00	-119.00	-118.00	-117.00	-116.00	-115.00	-114.00	-113.00	-112.00	-111.00
-7.50	0.524	0.524	0.557	0.557	0.589	0.655	0.786	2.160	6.349	9.687
V \H	-110.00	-109.00	-108.00	-107.00	-106.00	-105.00	-104.00	-103.00	-102.00	-101.00
-7.50	12.697	13.450	14.006	14.431	14.922	15.315	15.642	16.035	16.133	16.395
V \H	-100.00	-99.00	-98.00	-97.00	-96.00	-95.00	-94.00	-93.00	-92.00	-91.00
-7.50	16.657	17.049	17.475	17.933	18.260	18.457	18.751	19.078	19.373	19.635
V \H	-90.00	-89.00	-88.00	-87.00	-86.00	-85.00	-84.00	-83.00	-82.00	-81.00
-7.50	19.962	20.191	20.420	20.616	20.845	21.042	21.205	21.369	21.500	21.631
V \H	-80.00	-79.00	-78.00	-77.00	-76.00	-75.00	-74.00	-73.00	-72.00	-71.00
-7.50	21.794	21.892	22.056	22.122	22.154	22.252	22.351	22.416	22.383	22.449
V \H	-70.00	-69.00	-68.00	-67.00	-66.00	-65.00	-64.00	-63.00	-62.00	-61.00
-7.50	22.514	22.514	22.449	22.482	22.482	22.514	22.449	22.482	22.514	22.645
V \H	-60.00	-59.00	-58.00	-57.00	-56.00	-55.00	-54.00	-53.00	-52.00	-51.00
-7.50	22.645	22.612	22.645	22.711	22.743	22.645	22.612	22.645	22.612	22.580
V \H	-50.00	-49.00	-48.00	-47.00	-46.00	-45.00	-44.00	-43.00	-42.00	-41.00
-7.50	22.514	22.612	22.514	22.482	22.482	22.351	22.285	22.187	22.056	21.892
V \H	-40.00	-39.00	-38.00	-37.00	-36.00	-35.00	-34.00	-33.00	-32.00	-31.00
-7.50	21.827	21.729	21.663	21.565	21.434	21.303	21.271	21.303	21.271	21.205
V \H	-30.00	-29.00	-28.00	-27.00	-26.00	-25.00	-24.00	-23.00	-22.00	-21.00
-7.50	21.271	21.303	21.303	21.303	21.336	21.238	21.565	21.860	22.154	22.547
V \H	-20.00	-19.00	-18.00	-17.00	-16.00	-15.00	-14.00	-13.00	-12.00	-11.00
-7.50	22.743	22.809	22.972	23.136	23.267	23.431	23.431	23.660	23.823	23.889

V \H	-10.00	-9.00	-8.00	-7.00	-6.00	-5.00	-4.00	-3.00	-2.00	-1.00
-7.50	24.085	24.052	23.921	23.921	23.921	23.987	24.052	24.118	23.954	23.856
V \H	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00
-7.50	23.921	24.020	24.020	23.987	23.889	23.921	23.921	23.692	23.561	23.758
V \H	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00	18.00	19.00
-7.50	23.692	23.332	23.398	23.201	22.940	22.972	22.612	22.482	22.187	21.925
V \H	20.00	21.00	22.00	23.00	24.00	25.00	26.00	27.00	28.00	29.00
-7.50	22.023	21.925	21.598	21.434	21.042	20.714	20.485	20.354	20.224	20.060
V \H	30.00	31.00	32.00	33.00	34.00	35.00	36.00	37.00	38.00	39.00
-7.50	20.060	19.896	19.667	19.700	19.765	19.864	19.995	20.420	20.551	20.649
V \H	40.00	41.00	42.00	43.00	44.00	45.00	46.00	47.00	48.00	49.00
-7.50	20.616	20.584	20.551	20.551	20.551	20.911	21.107	21.434	21.794	22.056
V \H	50.00	51.00	52.00	53.00	54.00	55.00	56.00	57.00	58.00	59.00
-7.50	22.122	22.220	22.154	22.122	22.089	22.220	22.318	22.383	22.449	22.482
V \H	60.00	61.00	62.00	63.00	64.00	65.00	66.00	67.00	68.00	69.00
-7.50	22.351	22.252	22.154	22.154	22.023	21.991	21.925	21.762	21.663	21.565
V \H	70.00	71.00	72.00	73.00	74.00	75.00	76.00	77.00	78.00	79.00
-7.50	21.467	21.434	21.336	21.205	21.173	21.140	21.009	20.845	20.747	20.714
V \H	80.00	81.00	82.00	83.00	84.00	85.00	86.00	87.00	88.00	89.00
-7.50	20.616	20.714	20.911	20.944	20.780	20.551	20.289	20.027	19.733	19.438
V \H	90.00	91.00	92.00	93.00	94.00	95.00	96.00	97.00	98.00	99.00
-7.50	19.176	18.980	18.784	18.489	18.195	17.769	17.475	17.049	16.722	16.460
V \H	100.00	101.00	102.00	103.00	104.00	105.00	106.00	107.00	108.00	109.00
-7.50	16.133	15.642	15.348	14.988	14.759	14.497	14.268	13.875	13.384	12.861
V \H	110.00	111.00	112.00	113.00	114.00	115.00	116.00	117.00	118.00	119.00
-7.50	12.239	10.897	7.985	4.843	1.637	1.015	0.851	0.753	0.655	0.589
V \H	120.00	121.00	122.00	123.00	124.00	125.00	126.00	127.00	128.00	129.00
-7.50	0.557	0.491	0.491	0.491	0.458	0.426	0.426	0.393	0.393	0.393
V \H	130.00	131.00	132.00	133.00	134.00	135.00	136.00	137.00	138.00	139.00
-7.50	0.393	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
V \H	140.00	141.00	142.00	143.00	144.00	145.00	146.00	147.00	148.00	149.00
-7.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
V \H	150.00	151.00	152.00	153.00	154.00	155.00	156.00	157.00	158.00	159.00
-7.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
V \H	160.00	161.00	162.00	163.00	164.00	165.00	166.00	167.00	168.00	169.00
-7.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
V \H	170.00	171.00	172.00	173.00	174.00	175.00	176.00	177.00	178.00	179.00
-7.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

352.5 Horizontal Limit[352.5 Horizontal Limit]					
Calculation	Min. limit	Max. limit	Test Value	Unit	Test Result
MIN([352.5 Horizontal],-112.5,112.5))	12		2.660	cd	Failed

352.5 Horizontal Limit Max vs Min[352.5 Horizontal Limit Max vs Min]					
Calculation	Min. limit	Max. limit	Test Value	Unit	Test Result
MAXMIN([352.5 Horizontal],-112.5,112.5)		1.5	9.0665		Failed

352.5 Cut-off Angles starboard abeam direction[352.5 Cut-off Angles starboard abeam direction]					
Calculation	Min. limit	Max. limit	Test Value	Unit	Test Result
CUTOFF([352.5 Horizontal],1)	112.5	115.5	113.8	°	Passed

352.5 Cut-off Angles port abeam direction[352.5 Cut-off Angles port abeam direction]					
Calculation	Min. limit	Max. limit	Test Value	Unit	Test Result
CUTOFF([352.5 Horizontal],0)	-115.5	-112.5	-112.9	°	Passed