



# HIGH OUTPUT ALTERNATOR PERFORMANCE TESTING

Testing Performed by ARCO Marine  
Updated: 5/10/2024



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## **Testing Protocol:**

ARCO internally developed tests to assess components for its high output alternator line. These tests are designed to identify the highest performing components, replicating real-world conditions for accuracy.

## **Comparative Analysis:**

ARCO applies the same testing procedures to compare its new alternators with popular market models, ensuring a comprehensive evaluation of performance.

## **In-House Testing:**

ARCO conducts all tests in-house, maintaining full control over the evaluation process.

## **Quality Assurance Measures:**

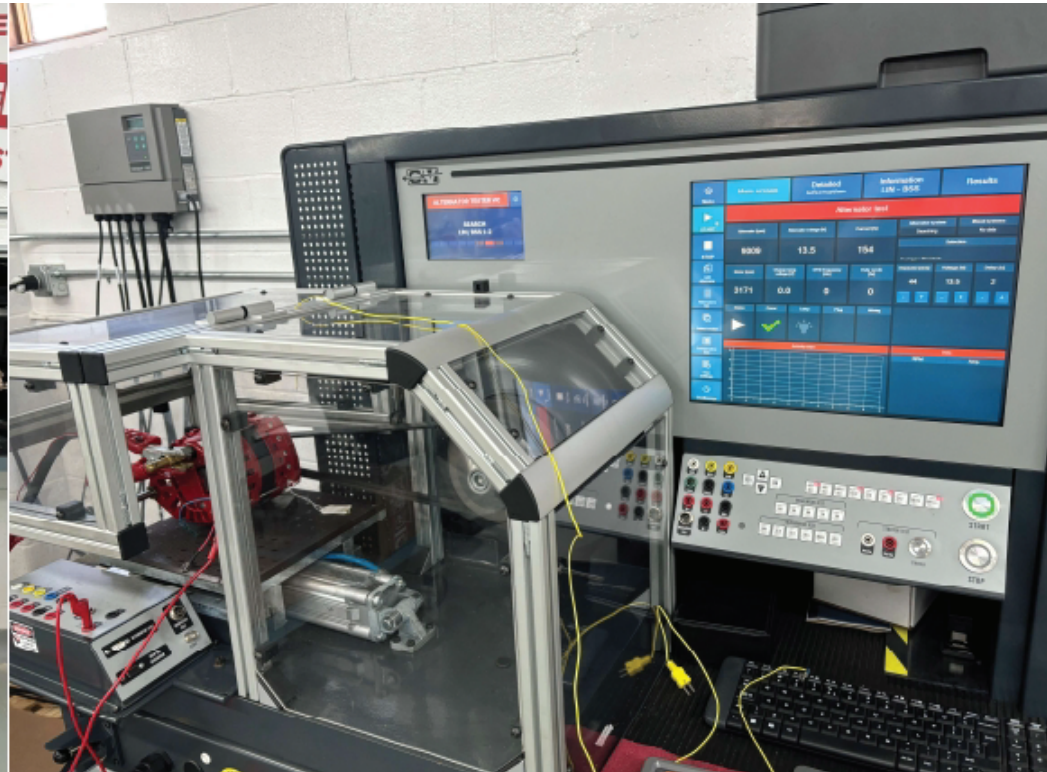
ARCO takes all reasonable measures to minimize errors and biases, though the possibility of honest mistakes is acknowledged.

## **Transparency and Consistency:**

Enhancing transparency and consistency in alternator testing benefits customers by highlighting the highest performing products.

## **Strategic Sampling:**

Unable to test every alternator on the market, ARCO selects representative examples for comparison, all of which are new units.





- ARCO Zeus A275L
- ARCO Zeus A225S
- American Power Systems APS 360
- Balmar XT250
- Balmar XT170
- Nations XP280
- Mechman 250

## **Testing Procedure:**

Alternator output is tested at 7 RPM speeds using a Motoplat CV-623A Alternator Tester.

## **Consistency Assurance:**

Tests are repeated on 3 separate days with overlapping RPM intervals to ensure data consistency.

## **Standardization Efforts:**

Where possible, a uniform 44mm, 6-groove pulley is used to reduce variables, although variations exist in shaft diameter and pulley nut thread pitch. Where lack of compatibility prevented the installation of the 44mm pulley, the manufacturer's original pulley was measured, used, and input into the tester to ensure accuracy of results.

## **Outlier Handling:**

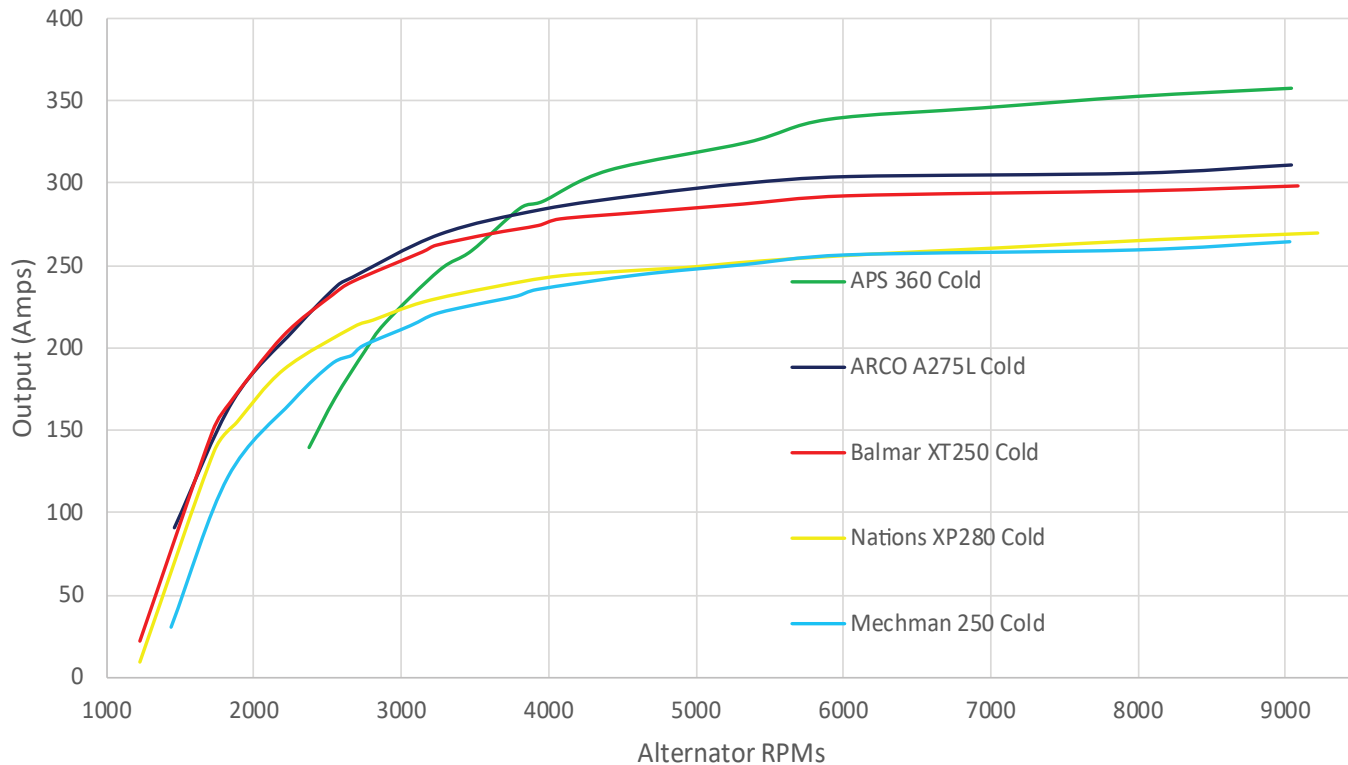
Clear outliers from the power curve data are removed for accuracy.

## **Controlled Environment:**

Tests are conducted in a climate-controlled building with an ambient temperature of 19-24°C, ensuring consistent conditions. It is worth noting that minor discrepancies in ambient temperature can make minor impacts on “Cold” curves, while any such ambient temperature discrepancies make zero tangible impacts on “Hot” curves.

# COLD POWER CURVE RESULTS LARGE FRAME

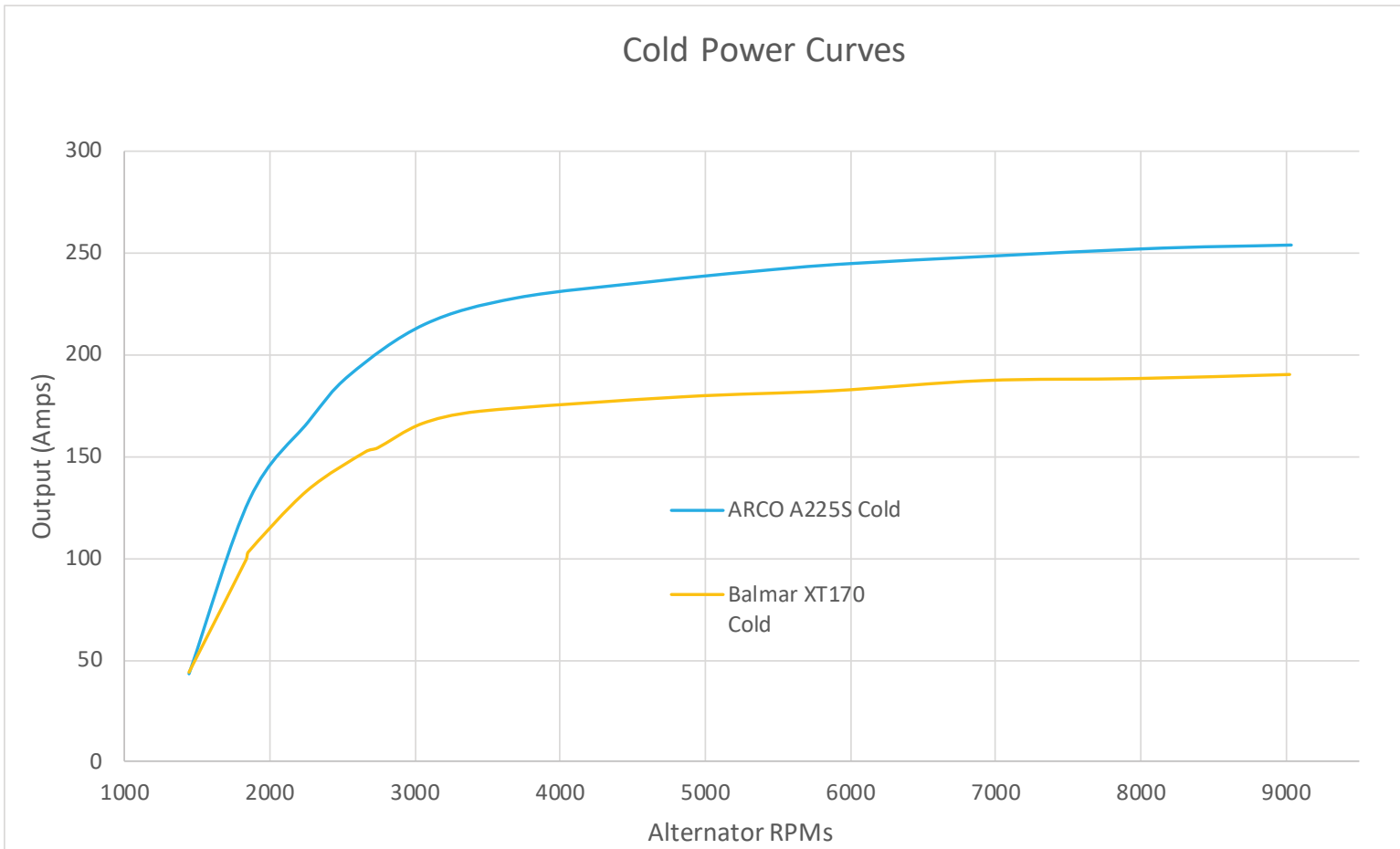
Cold Power Curves



**ARCO A275L at Idle:**  
The ARCO A275L exhibited the highest amperage output at idle speeds.

**APS 360 Comparison:**  
While the APS 360 recorded the most amps at over 4,300 alternator RPMs, it demonstrated the lowest output at low idle speeds.

# COLD POWER CURVE RESULTS SMALL FRAME



**ARCO A225S  
Outperforms:**  
The ARCO A225S  
significantly  
outperforms similarly  
sized alternators  
across all speeds.



# LOW RPM ENDURANCE TEST OVERVIEW

## Operational Conditions:

Alternators were run at 3,000 RPMs for 60 minutes beneath a plexiglass shield to simulate engine compartment conditions. During the 60-minute test, alternators typically reached 100°C, with temperatures inside the shield hitting 60°C.

## Performance Trend:

All alternators exhibited a significant output drop within the first 10 minutes, followed by a gradual decline over the next 20 minutes, stabilizing for the remaining 30 minutes.

## ARCO A275L Performance:

The ARCO A275L demonstrated the highest amp production at idle speeds. While initially matching the ARCO A275L's performance, the Balmar XT250 experienced a more pronounced output decline as it heated up.

Low RPM Endurance Tests		Amps							
Time	ALT RPM	ARCO A275L	ARCO A225S	Balmar XT250	Mechman 250	Balmar XT170	Nations XP280	APS 360	
0	3,000	256	205	256	210	163	225	237	
5	3,000	223	171	214	187	136	200	210	
10	3,000	207	160	197	175	126	189	200	
15	3,000	196	151	187	169	122	181	195	
20	3,000	193	149	183	165	119	178	192	
30	3,000	190	146	180	162	118	174	187	
40	3,000	191	143	179	161	116	172	186	
50	3,000	190	143	178	160	116	172	185	
60	3,000	190	142	178	159	116	172	184	



## **Simulation of Extended Idle Conditions:**

The alternator undergoes a 60-minute test at 3,000 RPMs under a plexiglass shield, replicating prolonged idle speed conditions.

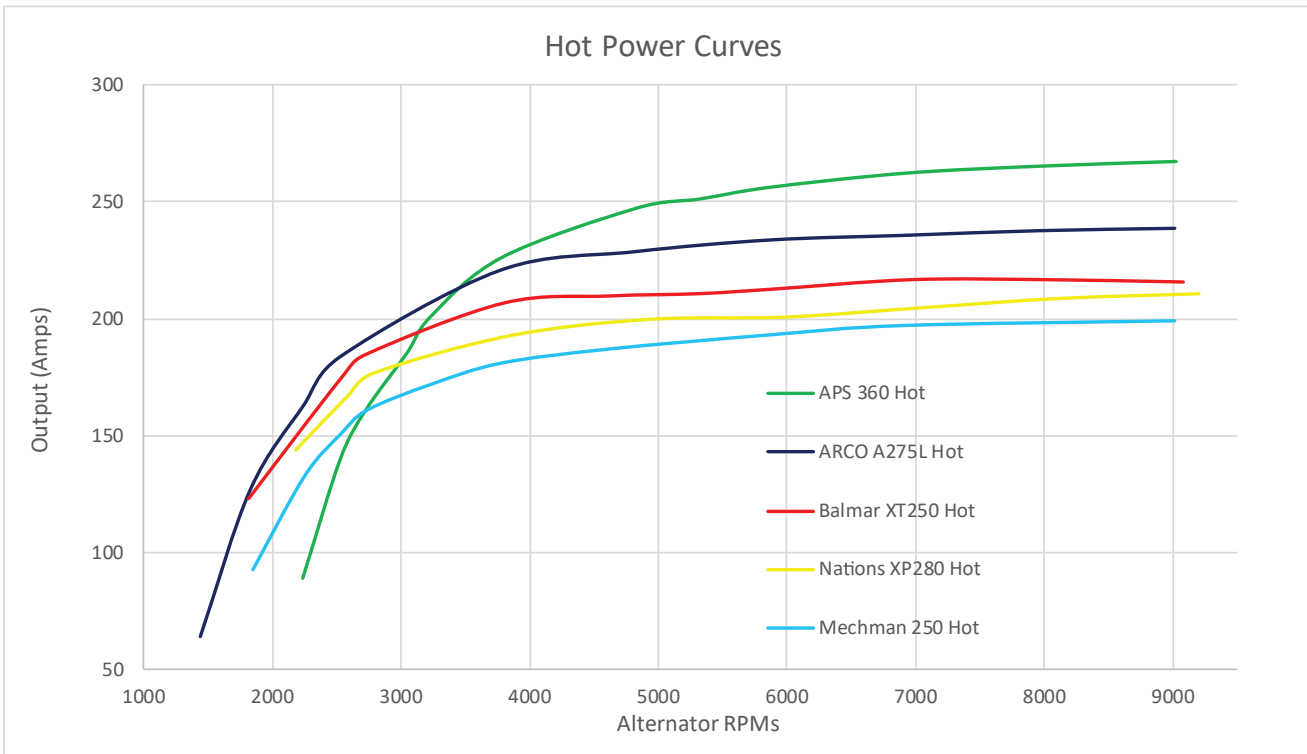
## **Power Curve Analysis:**

Immediately post-endurance test, the machine conducts 3 overlapping and redundant power curve tests, charting output at various RPMs.

## **Data Refinement:**

Overlaying the 3 power curves allows for outlier identification, with any clear outliers removed for accuracy. The resulting curve reflects the expected alternator output during extended periods at a given speed.

# HOT POWER CURVE RESULTS LARGE FRAME



## Heat Build-Up:

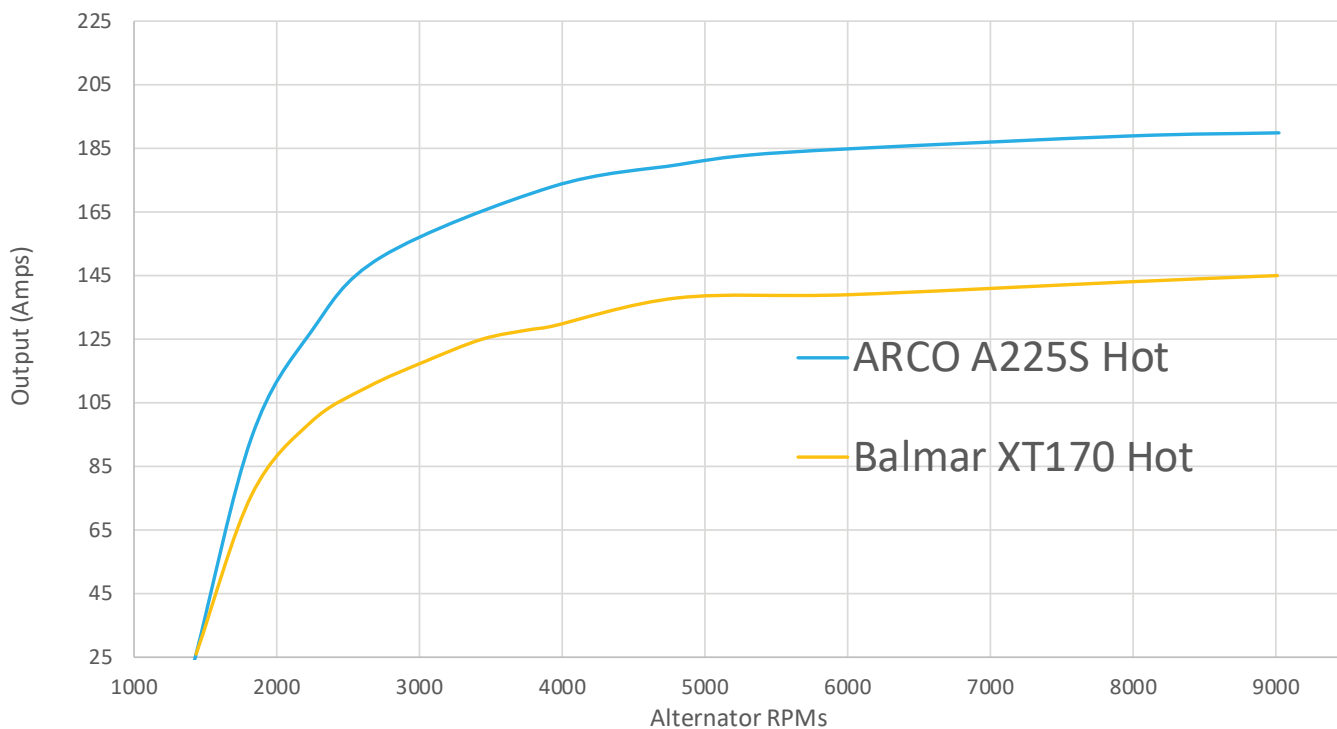
Extended idle operation leads to significant alternator heating without adequate fan cooling, resulting in reduced performance.

## ARCO A275L Dominance:

The ARCO A275L demonstrated superior performance, surpassing all alternators below 3,500 RPMs and outperforming all except the APS 360 above this threshold.

# HOT POWER CURVE RESULTS SMALL FRAME

Hot Power Curves (Small Frame)



## Product Comparison:

The smaller ARCO unit, A225S, was compared against a popular unit of the same size, the Balmar XT170.

## Performance Differential:

The ARCO A225S boasts approximately 30% more power output compared to the similarly sized Balmar XT170.



# HIGH RPM ENDURANCE TEST OVERVIEW

## High-Speed Evaluation:

Each alternator underwent a 60-minute test at 9,000 alternator RPMs, catering to those focused on performance at extreme speeds.

## Enhanced Performance at High RPMs:

Higher RPMs result in increased alternator output, fan speed, improved air circulation, and cooler alternator temperatures compared to idle speeds.

## Performance Rankings:

For those prioritizing high RPM performance, the APS 360 emerged as the top performer, followed closely by the ARCO A275L.

High RPM Endurance Tests		Amps						
Time	ALT RPM	ARCO A275L	ARCO A225S	Balmar XT250	Mechman 250	Balmar XT170	Nations XP 280	APS 360
0	9,000	312	245	295	260	185	265	355
5	9,000	252	208	243	224	164	236	305
10	9,000	248	198	235	216	158	229	295
15	9,000	247	196	234	214	156	227	292
20	9,000	247	195	231	213	156	226	289
30	9,000	245	194	231	212	154	225	290
40	9,000	244	194	130	212	153	225	297
50	9,000	244	194	228	212	152	225	284
60	9,000	244	193	228	211	152	225	281

# WARM POWER CURVE OVERVIEW

## **Testing Procedure:**

Immediately after the high RPM Endurance test, which runs the alternator at 9,000 RPMs for 60 minutes, alternator output is evaluated at various RPMs.

## **Standardization Effort:**

All alternators are tested with a uniform 44mm, 6-groove pulley to eliminate variables. Where lack of compatibility prevented the installation of the 44mm pulley, the manufacturer's original pulley was measured, used, and input into the tester to ensure accuracy of results.

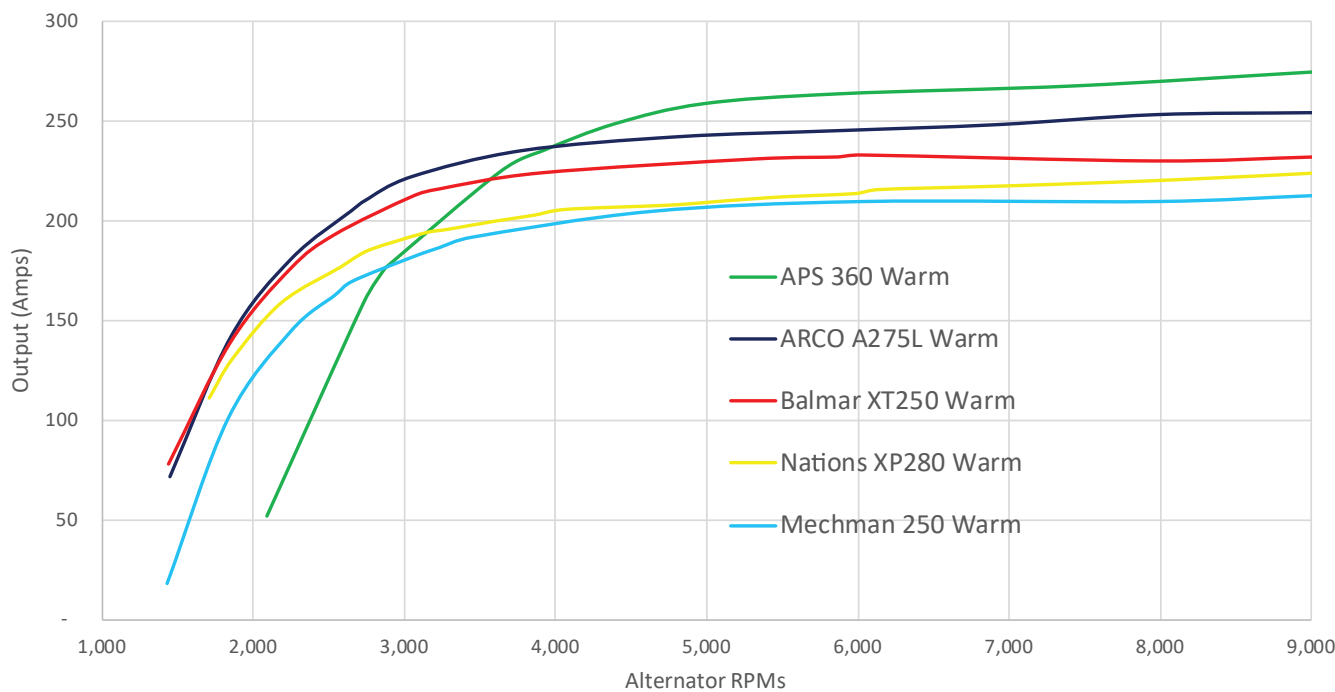
## **Data Refinement:**

Three power curve tests are conducted, and the resulting curves are overlaid to identify and remove outlier data points.



# WARM POWER CURVE RESULTS

Warm Power Curves



## Consistent Performance:

Performance across all units showed slight improvement but remained very similar to the results after an hour of running at low RPMs.

## Low RPM Dominance:

The ARCO A275L demonstrated the highest output at low RPMs. The APS 360 excelled at high RPMs but performed poorest at low RPMs.



# TEST RESULTS SUMMARY TABLE

	ARCO A275L	ARCO A225S	Balmar XT250	Mechman 250	Balmar XT170	Nations XP280	APS 360
Max Cold Output	311	254	298	264	190	270	358
Max Warm Output (After High RPM Endurance Test)	246	197	232	213	152	200	255
Max Hot Output (After Low RPM Endurance Test)	239	189	217	199	145	216	267
1 Hour Idle Output (At 3,000 Alt RPMs)	198	151	188	167	122	180	193
1 Hour Cruising Output (At 9,000 RPMs)	249	198	218	216	156	228	294
Alternator Weight	15.27 Lbs	12.45Lbs**Prototype	14.79Lbs	15.249 Lbs	12.45 Lbs	16.03Lbs	15.21Lbs
Turn on RPMs	1080	1196	1077	1268	1170	2432	1736

## Performance Comparisons:

ARCO alternators outperformed units of similar size, delivering the highest amperage at lower RPMs. The APS 360 excelled in amperage output at higher RPMs but demonstrated the least output at idle speeds. The Nations XP280 required the highest RPMs for activation.

# APPENDIX: POWER CURVE SAMPLES

These results are from the second test of each alternator, referencing the original test conducted on a different day for the same alternator.

CV-623

PASS

08.05.2024 13:57:55

Company name	Arco Marine
Reference number	A225-44-44-Cold
Part	A225-44-44-Cold
Manufacturer	ARCO
Nominal current [A]	225
Tested by	WLI

Test results table		
Parameter	Value	Reference
Output at low revolutions	120 A	126 A
Maximum output power	3243 W	3280 W
Max output current	242 A	243 A
Ripple	12 A	14 A
Leakage	<5mA	<5mA
Maximum efficiency	56 %	57 %
Initial voltage	13.2 V	13.1 V
Direction	CCW	CCW
Turn on speed	1195 rpm	1195 rpm
Motor power	5.6 kW	5 kW
Torque	19.6 Nm	20Nm
Rated voltage	12 V	12 V
Output Voltage Tested	13.5 V	13.5 V
Number of reached levels	7	6
Charge lamp voltage	0	0 V
Status light RPM	352 rpm	372 rpm
VSP @2.500	14.5 V	14.5 V
VSP @4.250	14.5 V	14.5 V
VSP @6.000	14.5 V	14.5 V
Duration of the procedure	59.1 s	50.8 s
Three-phase voltage	349.7 V	

Connection definition			
Parameter	Value	Reference	
Alternator system	B+B-		B+B-

## ARCO A225S Cold Test Sample

Activity chart

Data		
[RPM]	Current [A]	Reference [A]
6031	242	243
5332	238	236
4636	231	231
3943	223	224
3247	212	212
2545	182	184
1835	120	126

CV-623

PASS

08.05.2024 11:59:37

Company name	Arco Marine
Reference number	A275-44-44-Cold
Part	A275-44-44-Cold
Manufacturer	ARCO
Nominal current [A]	275
Tested by	WLI

Test results table		
Parameter	Value	Reference
Output at low revolutions	166 A	167 A
Maximum output power	4033 W	4056 W
Max output current	301 A	299 A
Ripple	9 A	17 A
Leakage	<5mA	<5mA
Maximum efficiency	55 %	54 %
Initial voltage	13.1 V	13.1 V
Direction	CCW	CCW
Turn on speed	1077 rpm	1080 rpm
Motor power	7.4 kW	6 kW
Torque	25.2 Nm	25.4Nm
Rated voltage	12 V	12 V
Output Voltage Tested	13.5 V	13.5 V
Number of reached levels	7	7
Charge lamp voltage	0	0 V
Status light RPM	344 rpm	369 rpm
VSP @2.500	14.5 V	14.5 V
VSP @4.250	14.5 V	14.5 V
VSP @6.000	14.5 V	14.5 V
Duration of the procedure	58.2 s	57.2 s
Three-phase voltage	355.2 V	

Connection definition			
Parameter	Value	Reference	
Alternator system	B+B-		B+B-

## ARCO A275L Cold Test Sample

Activity chart

Data		
[RPM]	Current [A]	Reference [A]
6037	301	299
5344	298	295
4645	290	290
3955	282	281
3256	266	265
2560	235	235
1855	166	167

CV-623

PASS

08.05.2024 13:50:35

Company name	Arco Marine
Reference number	APS360-44-44-Cold
Part	APS360-44-44-Cold
Manufacturer	APS
Nominal current [A]	360
Tested by	WLI

Test results table		
Parameter	Value	Reference
Output at low revolutions	0	0 A
Maximum output power	4604 W	4665 W
Max output current	341 A	343 A
Ripple	17 A	20 A
Leakage	<5mA	<5mA
Maximum efficiency	58 %	58 %
Initial voltage	13.1 V	13.1 V
Direction	CCW	CCW
Turn on speed	1784 rpm	1736 rpm
Motor power	7.9 kW	6 kW
Torque	27.2 Nm	27.2Nm
Rated voltage	12 V	12 V
Output Voltage Tested	13.5 V	13.5 V
Number of reached levels	0	7
Charge lamp voltage	0	0 V
Status light RPM	354 rpm	366 rpm
VSP @2.500	15.1 V	15.6 V
VSP @4.250	14.3 V	14.3 V
VSP @6.000	14.2 V	14.3 V
Duration of the procedure	80.9 s	80.4 s
Three-phase voltage	351.3 V	

Connection definition			
Parameter	Value	Reference	
Alternator system	B+B-		B+B-

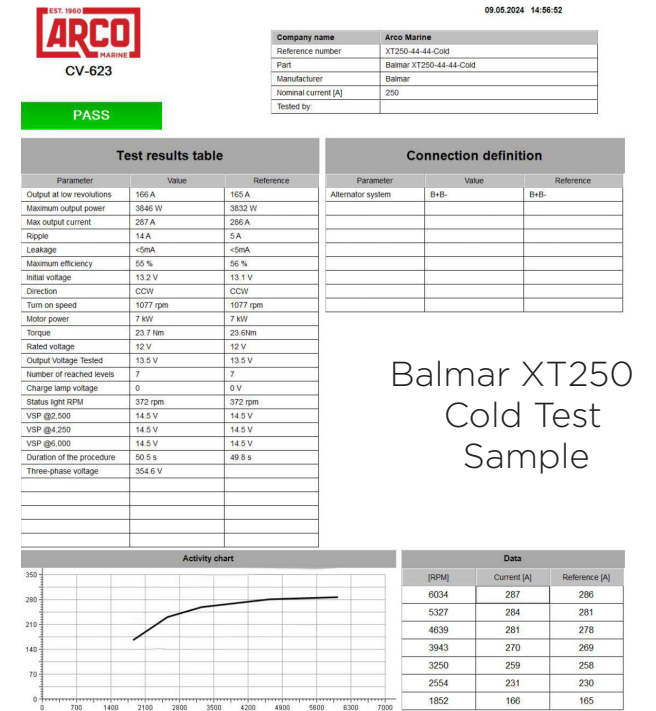
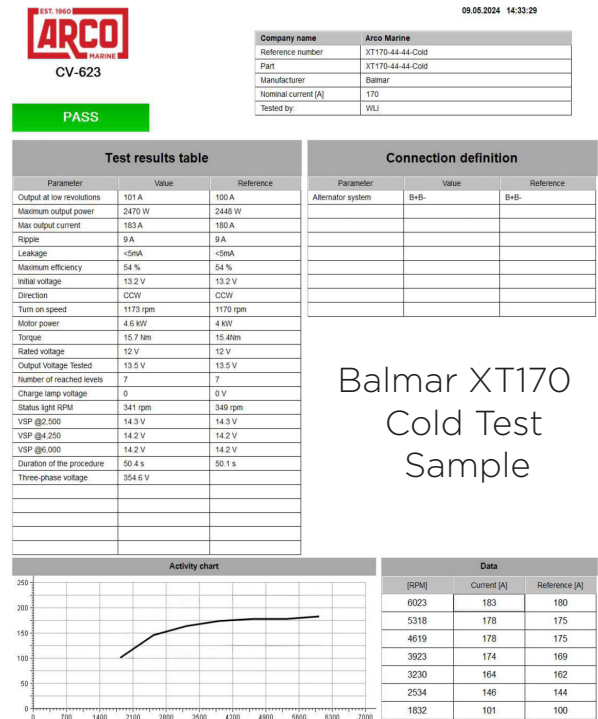
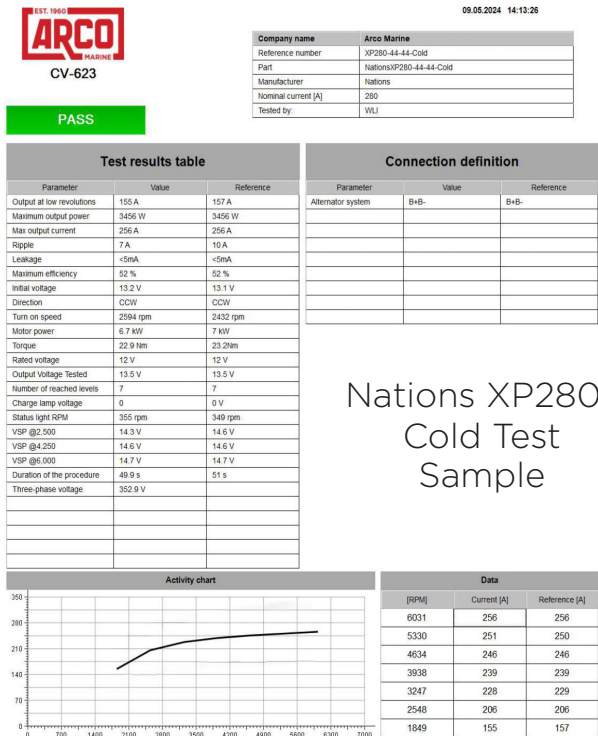
## APS 360 Cold Test Sample

Activity chart

Data		
[RPM]	Current [A]	Reference [A]
6043	341	343
5344	331	332
4648	317	320
3952	295	298
3253	251	256
2543	161	177

# APPENDIX: POWER CURVE SAMPLES

Results were compared to the original test to confirm the absence of significant deviations. The second test served solely to validate the original test, utilizing data from the initial assessment.



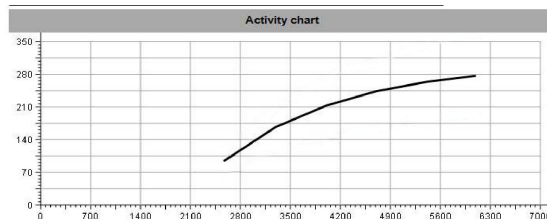
# APPENDIX: TESTING EXTREME RPM RANGES

## Speed Range Extension:

The CV-623, originally set to test 7 data points from 1,800 to 6,000 alternator RPMs, was adapted with a false pulley ratio setting to capture more data across a wider speed spectrum.

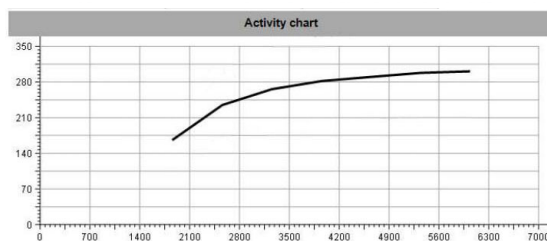
## Result Adjustment:

Following testing, the results were exported to Excel and recalibrated to align with the actual alternator speeds. The example below are cold power curves from an ARCO A275L.



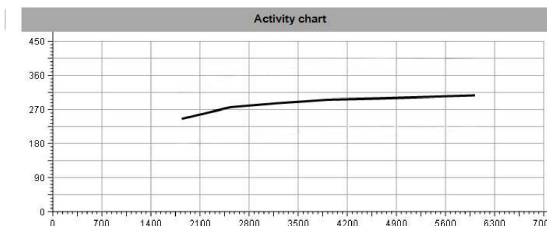
Data		
[RPM]	Current [A]	Reference [A]
6095	277	279
5410	264	265
4705	244	238
4000	213	210
3290	167	160
2565	94	91

**Pulley Setting:** 25mm  
**Actual Pulley Size:** 44mm  
**Speed Adjustment:** 56.8%



Data		
[RPM]	Current [A]	Reference [A]
6037	301	299
5344	298	295
4645	290	290
3955	282	281
3256	266	265
2560	235	235
1855	166	167

**Pulley Setting:** 44mm  
**Actual Pulley Size:** 44mm  
**Speed Adjustment:** None



Data		
[RPM]	Current [A]	Reference [A]
6021	307	311
5316	303	308
4619	299	304
3926	296	299
3227	287	290
2532	276	278
1837	245	247

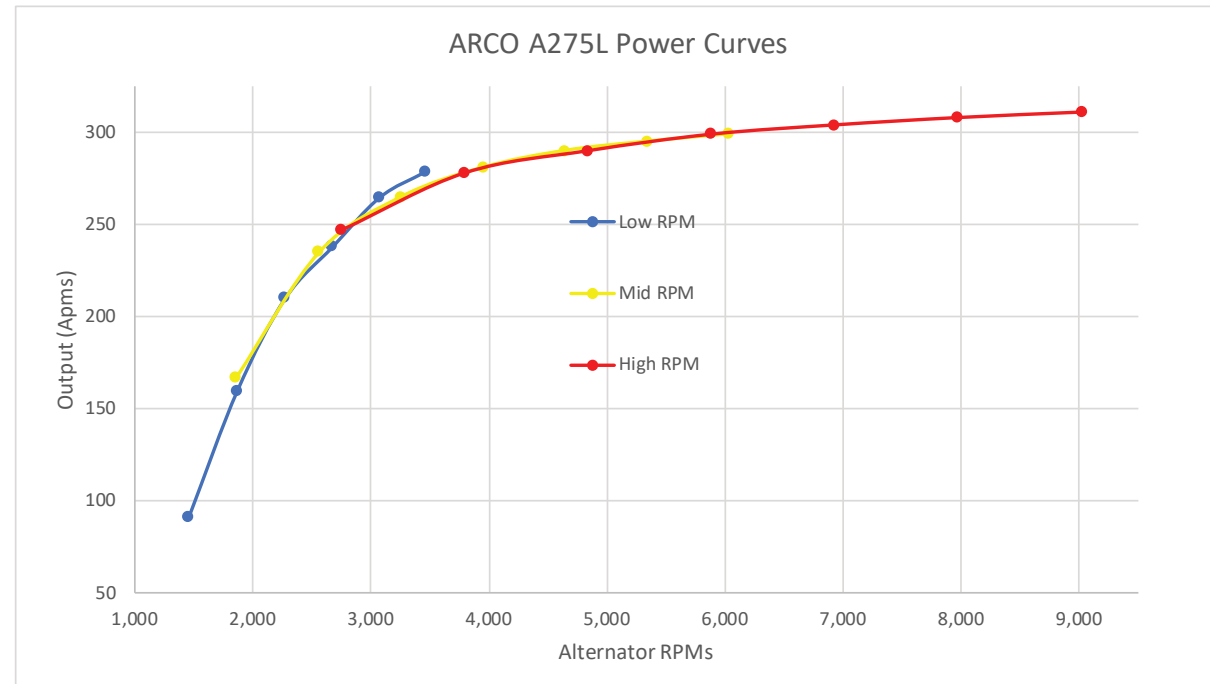
**Pulley Setting:** 66mm  
**Actual Pulley Size:** 44mm  
**Speed Adjustment:** 150%



# APPENDIX: COMBINING DATA

The data from the previous page was converted into actual RPM values to ensure accuracy in analysis. Overlaying three distinct power curves, covering different yet overlapping RPM ranges, facilitates comprehensive result validation and aids in outlier detection.

Displayed RPM	Pulley Setting	Crank RPM	Actual RPM	Amps
6095	25	1,219	3,463	279
5410	25	1,082	3,074	265
4705	25	941	2,673	238
4000	25	800	2,273	210
3290	25	658	1,869	160
2565	25	513	1,457	91
6037	44	2,125	6,037	299
5344	44	1,881	5,344	295
4645	44	1,635	4,645	290
3955	44	1,392	3,955	281
3256	44	1,146	3,256	265
2560	44	901	2,560	235
1855	44	653	1,855	167
6021	66	3,179	9,032	311
5316	66	2,807	7,974	308
4619	66	2,439	6,929	304
3926	66	2,073	5,889	299
3227	66	1,704	4,841	290
2532	66	1,337	3,798	278
1837	66	970	2,756	247



The three separate datasets are merged and sorted based on alternator RPMs, streamlining the analysis process. Outlier points are systematically identified and removed from the dataset to ensure data integrity.

## Example:

The data point indicating 279 amps at 3,463 RPMs was eliminated as it was identified as an outlier, despite being a positive outlier for ARCO.

Alternator RPM	Amps
9,032	311
7,974	308
6,929	304
6,037	299
5,344	295
4,841	290
3,955	281
3,798	278
3,074	265
2,756	247
2,560	235
2,273	210
1,855	167
1,457	91

