



# Retiring Paper-based Maintenance Systems In Commercial Heat Treating Shops

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October 20, 2015

2:40pm Room 251B

# Background

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- Solar Atmospheres is a commercial heat treating company with over 60 vacuum furnaces, various air furnaces and cryogenic freezers – covering four locations and 6 buildings total
- Furnaces function around the clock, year in and year out
- Furnaces can give decades of productive service if properly maintained



# Aspects of Maintenance

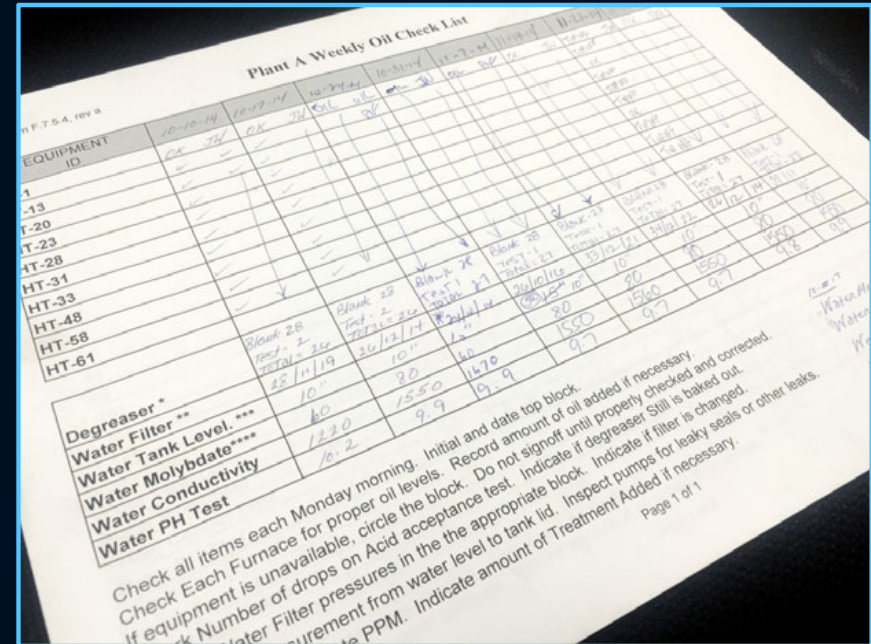
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- ~~Reactive Maintenance -~~  
"If it ain't broke, don't fix it"
- Preventive maintenance
- Predictive maintenance –  
evaluate condition and repair  
before failure



# Previous Maintenance Tracking

- Paper-based system
- Handwritten logs to track maintenance
- Maintenance task completion was difficult to track
- All the records were not in a central location
- Records were difficult to trace and not necessarily secure



# Previous Maintenance Tracking

- Maintenance requests were hand written and collected each day
- Work assigned manually and in person each day
- Multiple spreadsheets needed to be updated manually to keep records
- Oversight was limited



# Previous Maintenance Tracking

- Completed work orders were scanned and updated manually
- Furnace records recorded in logbooks at the furnaces
- Tracking of furnace components after repair was difficult



# Consequences of Minimal Preventive Maintenance

- Pump failures
- Melted hot zone components
- Broken belts
- Degraded performance



# Quality System

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ISO 9001:2008  
AS 9100C  
registered 

Accredited  
**Nadcap**<sup>TM</sup>  
Heat Treating

Accredited  
**MedA**ccred  
Heat Treating

- Quality systems are driving the traceability of preventive maintenance, and calibration records
- Internal audits assure that the system is being properly utilized



# CMMS (Computerized Maintenance Management System)



- Implemented CMMS in May 2014
- 6-12 months to enter data/records for equipment (Assets) and set up PM scheduling
- Central location for all maintenance records – calibration, preventive maintenance schedules, work orders
- Mobile platform – work orders assigned digitally by supervisors

The screenshot shows the 'Work Requests' interface in the M+ ManagerPlus system. It displays a table with columns for Request ID, Asset ID, Purpose, Status, Priority, Work Order #, and Requested By. The table contains several rows of data, including requests for valve inspection, control valve issues, and heat treatment tooling.

Request ID	Asset ID	Purpose	Status	Priority	Work Order #	Requested By
365	HT-023	Heat valve inspection (see control nitrogen leak)	CREATE WORK ORDER	2 Standard	3045	Steve Hill
363	HT-022	High up valve 4.2.2 meters air flow	COMPLETED	1 High	3050	Steve Hill
362	HT-023	Control TC issue	COMPLETED	2 Standard	3036	Steve Hill
361	HT-021	High zones in hot condensing	CREATE WORK ORDER	5 Critical	3037	Steve Hill
359	HT-022	High valve needs to be cleaned	COMPLETED	2 Standard	3029	Steve Hill
355	HT-023	Load cart not come shut off	COMPLETED	2 Standard	3043	Steve Hill
354	HEAT TREAT TOOLING	DRUMS FROM HT-03 NEEDS REPAIR, WIND MELTED BRASS OR COPPER ON IT	COMPLETED	2 Standard	3076	Steve Hill
352	HT-027	Water vacuum pump not working properly	COMPLETED	1 High	3013	Steve Hill
350	HT-022	T/C #1 Leak Flange	CREATE WORK ORDER	1 High	3011	Steve Hill
348	HT-021	FAILED LEAK UP TR WORKING AN HOUR	COMPLETED	2 Standard	3002	Steve Hill

# (Assets) managed by this system

- Buildings
- Gas and water systems
- Furnaces and support equipment associated with heat treating processes
- Testing and measuring equipment
- Vehicles
- Material handling equipment
- And more . . .

Schedule ID	Work Type	Percent Due	Next Date
Group Name : Mass Flow Cont. Acetylene - Quarterly			
MFC ACETYLENE - QUART	PREVENTIVE MAINTENANCE	100 %	8/15/2015 11:09:00 A
Group Name : Mass Flow Cont. Hydrogen - Annual			
MFC HYDROGEN - ANNUAL	PREVENTIVE MAINTENANCE	88 %	10/1/2015
Group Name : PFM - VACUUM FURNACE			
1-MONTH VACUUM PMS	PREVENTIVE MAINTENANCE	27 %	9/17/2015 3:21:00 PM
1-YEAR VACUUM PMS	PREVENTIVE MAINTENANCE	70 %	12/17/2015
2-YEAR DIFF PUMP OIL	PREVENTIVE MAINTENANCE	32 %	1/17/2017 3:49:02 PM
2-YEAR DIFF PUMP FLOU	PREVENTIVE MAINTENANCE	46 %	10/9/2016
2-YEAR MAIN VALVE	PREVENTIVE MAINTENANCE	53 %	8/15/2016
6-MONTH VACUUM PMS	PREVENTIVE MAINTENANCE	38 %	1/22/2016 5:57:00 AM
Group Name : Pyrometric Calibration - Quarterly			
PYROMETRIC CAL QUART	CALIBRATION	10 %	11/11/2015 3:27:00 PM
Group Name : T/C Replacement - 2 Year			
CONTROL T/C - 2 YEAR	REPLACEMENT	67 %	4/12/2016
OVERTEMP T/C - 2 YEAR	REPLACEMENT	67 %	4/12/2016
Group Name : TUS - 6 Months			
TUS - 6 MONTH	PYROMETRY	17 %	1/20/2016
Group Name : Vacuum Calibration - Quarterly			
VACUUM CALIB - QUART	CALIBRATION	95 %	8/25/2015 2:28:00 PM

# CMMS (Computerized Maintenance Management System)

- Work orders issued digitally using mobile platform with explicit instructions
- Unplanned maintenance tasks are in the forefront every day
- Completed work orders become permanent record for that asset
- Equipment records can be reviewed during future troubleshooting

Asset ID	Description	Category	Type	Status	Entry Name	Actual Model
SP-075	1982 Clear view Road	ADR PURVANCES	PURVANCE	ACTIVE	Sub atmosphere	SP-075
SP-068	1982 Clear view Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-068
SP-060	1982 Clear view Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-060
SP-061	1982 Clear view Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-061
SP-058	1982 Clear view Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-058
SP-048	1982 Clear view Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-048
SP-046	235 Trenching Line Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-046
SP-044	1982 Clear view Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-044
SP-036	235 Trenching Line Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-036
SP-024	1982 Clear view Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-024
SP-022	1982 Clear view Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-022
SP-023	1982 Clear view Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-023
SP-021	1982 Clear view Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-021
SP-020	1982 Clear view Road	ADR PURVANCES	PURVANCE	ACTIVE	Sub atmosphere	SP-020
SP-019	1982 Clear view Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-019
SP-018	1982 Clear view Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-018
SP-017	1982 Clear view Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-017
SP-016	1982 Clear view Road	ADR PURVANCES	PURVANCE	ACTIVE	Sub atmosphere	SP-016
SP-014	1982 Clear view Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-014
SP-012	1982 Clear view Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-012
SP-010	1982 Clear view Road	ADR PURVANCES	PURVANCE	ACTIVE	Sub atmosphere	SP-010
SP-002	1982 Clear view Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-002
SP-000	1982 Clear view Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-000
SP-001	1982 Clear view Road	VACUUM PURVANCES	2.868	ACTIVE	Sub atmosphere	SP-001
HEAT TREAT TOOLING	Heat Treat tools, Pickups, Baskets, Crabs etc.	HEAT TREAT TOOLING	PRODUCTION	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant A	TEST INSTRUMENTS	FIELD TEST INSTRUMENT	FIELD TEST INSTRUMENT	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant A - Quality	TEST INSTRUMENTS	FIELD TEST INSTRUMENT	FIELD TEST INSTRUMENT	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant A	TEST INSTRUMENTS	FIELD TEST INSTRUMENT	FIELD TEST INSTRUMENT	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant C - Shop Floor Place	MEASURING EQUIPMENT	MEASURING EQUIPMENT	MEASURING EQUIPMENT	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant C - Big Surface Place	MEASURING EQUIPMENT	MEASURING EQUIPMENT	MEASURING EQUIPMENT	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant C	MEASURING EQUIPMENT	MEASURING EQUIPMENT	MEASURING EQUIPMENT	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant A	TEST INSTRUMENTS	FIELD TEST INSTRUMENT	FIELD TEST INSTRUMENT	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant B	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant A	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant B	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant C	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant A	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant B	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant C	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant A	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant B	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant C	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant A	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant B	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant C	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant A	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant B	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant C	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant A	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant B	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING
Plant C	PROBES	PROBES	PROBES	ACTIVE	Sub atmosphere	HEAT TREAT TOOLING

# Paperless Maintenance System

Work Order #: 4384

Entity: Solar Atmospheres Status: NEW

Work Order #: 4384 Created: 9/28/2015 4:45 PM

Work Type: PREVENTIVE MAINTENANCE Due: 10/9/2015 9:18 AM

Purpose: Monthly PM Oil for Vacuum Furnace Completed:

Asset ID: HT-033 [1969 Clearview Road] Schedule: 1-MONTH VACUUM PMS

Budget: OPERATIONS Assigned: Frankowski, Art

Priority: 2-Standard

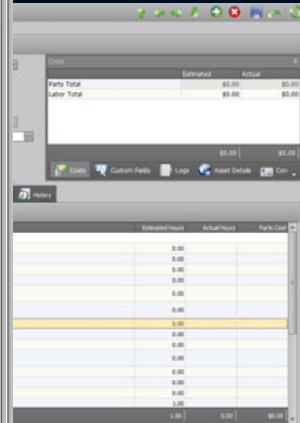
	Estimated	Actual
Parts Total	\$0.00	\$0.00
Labor Total	\$0.00	\$0.00

Costs: \$0.00 | \$0.00

Service Items | Notes | Parts | Labor | Other Costs | Attachments | History

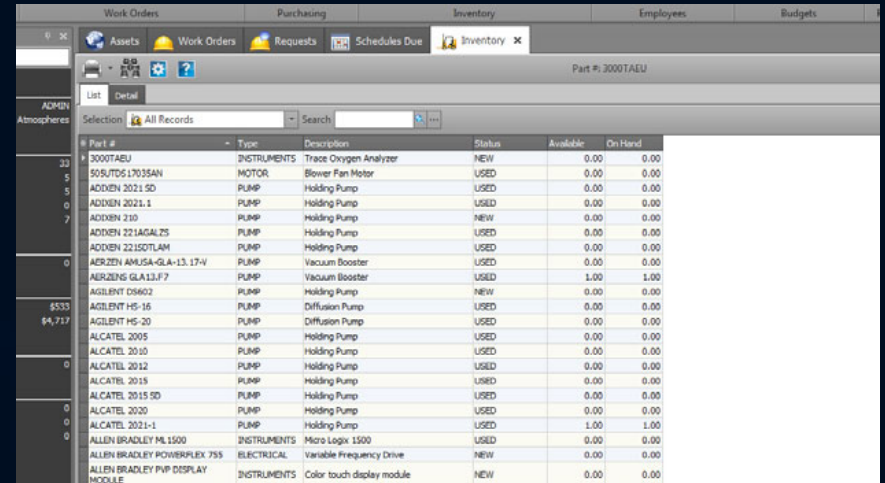
+ Add Service(s) - Remove Service(s)

* Complete	Service Code	Service Description	Estimated Hours	Actual Hours	Parts Cost
Service Class : PREVENTIVE MAINTENANCE					
<input checked="" type="checkbox"/>	PM - BELT DEFLECTION	Check belt deflection	0.00		
<input checked="" type="checkbox"/>	PM - CHANGE H.P. OIL	Change holding pump oil	0.00		
<input checked="" type="checkbox"/>	PM - CHANGE RP OIL	Change roughing pump oil	0.00		
<input checked="" type="checkbox"/>	PM - CHECK 1/2LB SWITCH	Check 1/2lb. pressure switch for proper operation.	0.00		
<input checked="" type="checkbox"/>	PM - CHECK CAM FOLLOWERS	Check cam followers on autodave, replace if needed	0.00		
<input checked="" type="checkbox"/>	PM - CHECK D.P. OIL	Check oil in diffusion pump for discoloration. Fully Clean DP and Change Oil if discolored!	0.00		
<input checked="" type="checkbox"/>	PM - CHECK FLOWMETER	Check flowmeter for free movement of float.	0.00		
<input type="checkbox"/>	PM - CHECK PNU OIL LEVEL	Check oil level in pneumatic oilers	0.00		
<input type="checkbox"/>	PM - CHECK RP BELTS	Check roughing pump belts, replace as needed	0.00		
<input type="checkbox"/>	PM - CHECK V.B. OIL	Check oil level in vacuum booster Check for Visual Oil Leaks	0.00		
<input type="checkbox"/>	PM - CLEAN AIR FILTER	Clean air filters	0.00		
<input type="checkbox"/>	PM - CLEAN DOOR O-RING	Clean & grease door O-ring	0.00		
<input type="checkbox"/>	PM - CLEAN DOOR WEDGE	Clean and grease door wedges	0.00		
<input type="checkbox"/>	PM - COMPLETE / TIME	PM - Final Sign off - Please enter Time	1.00		
			1.00	0.00	\$0.00



# Paperless Maintenance System

- Component tracking – if a component is repaired and installed on a different asset - it is traceable
- Barcoded tracking of inventory
- Inventory management – if inventory goes below a certain level, automatic purchasing lists can be generated



Part #	Type	Description	Status	Available	On Hand
3000TAEU	INSTRUMENTS	Trace Oxygen Analyzer	NEW	0.00	0.00
50SUTDS17055AN	MOTOR	Blower Fan Motor	USED	0.00	0.00
ADIXEN 2021-SD	PUMP	Holding Pump	USED	0.00	0.00
ADIXEN 2021-1	PUMP	Holding Pump	USED	0.00	0.00
ADIXEN 210	PUMP	Holding Pump	NEW	0.00	0.00
ADIXEN 2214CAL25	PUMP	Holding Pump	USED	0.00	0.00
ADIXEN 2215OTL4M	PUMP	Holding Pump	USED	0.00	0.00
AERZEN AM45A-GLA-13-174	PUMP	Vacuum Booster	USED	0.00	0.00
AERZEN GL13.F7	PUMP	Vacuum Booster	USED	1.00	1.00
AGILENT D9602	PUMP	Holding Pump	NEW	0.00	0.00
AGILENT HS-16	PUMP	Diffusion Pump	USED	0.00	0.00
AGILENT HS-20	PUMP	Diffusion Pump	USED	0.00	0.00
ALCATEL 2005	PUMP	Holding Pump	USED	0.00	0.00
ALCATEL 2010	PUMP	Holding Pump	USED	0.00	0.00
ALCATEL 2012	PUMP	Holding Pump	USED	0.00	0.00
ALCATEL 2015	PUMP	Holding Pump	USED	0.00	0.00
ALCATEL 2015 SD	PUMP	Holding Pump	USED	0.00	0.00
ALCATEL 2020	PUMP	Holding Pump	USED	0.00	0.00
ALCATEL 2021-1	PUMP	Holding Pump	USED	1.00	1.00
ALLEN BRADLEY ML 1500	INSTRUMENTS	Micro Logix 1500	USED	0.00	0.00
ALLEN BRADLEY POWERPLEX 755	ELECTRICAL	Variable Frequency Drive	NEW	0.00	0.00
ALLEN BRADLEY PNP DISPLAY MODULE	INSTRUMENTS	Color touch display module	NEW	0.00	0.00

# Paperless Maintenance System

- Tracks labor hours used to complete work order tasks
- Used to generate detailed reports on equipment

Work Order Summary										
WO #	Asset ID	Assigned	Created	Due	Completed	Hours	Labor Cost	Part Costs	Other Costs	Total Costs
<b>CALIBRATION</b>										
3245 [Vacuum Calibration - Quarterly ]	HT-061		6/25/2015	7/8/2015	7/8/2015	1.50				
3272 [Vacuum Calibration - Quarterly ]	HT-010		6/27/2015		7/1/2015	3.00				
3273 [Vacuum Calibration - Quarterly ]	HT-046		6/27/2015		7/2/2015	4.00				
3274 [Vacuum Calibration - Quarterly ]	HT-036		6/27/2015		7/1/2015	3.00				
3375 [Monthly Pyrometric Calibration]	HT-081		7/6/2015		7/6/2015	1.50				
3419 [Quarterly Pyrometric Calibration]	HT-058		7/8/2015	8/1/2015	7/8/2015	1.25				
3486 [Quarterly Pyrometric Calibration]	HT-072		7/14/2015	8/11/2015	7/14/2015	3.00				
						<b>7</b>	<b>17.25</b>			
						<b>CALIBRATION Totals : 7</b>	<b>17.25</b>			
<b>CALL IN'S</b>										
3528 [HT-75 Process Cycle Start problem]	HT-073		7/17/2015		7/15/2015	4.00				
						<b>1</b>	<b>4.00</b>			
						<b>CALL IN'S Totals : 1</b>	<b>4.00</b>			
<b>PREVENTIVE MAINTENANCE</b>										
3262 [Annual PM Air Furnace]	HT-021		6/27/2015		7/2/2015	2.00				
3281 [Monthly PM Oil for Vacuum Furnace]	HT-013		6/27/2015		7/7/2015	3.50				
3282 [Monthly PM Oil for Vacuum Furnace]	HT-061		6/27/2015		7/2/2015	2.00				
3283 [Monthly PM Oil for Vacuum Furnace]	HT-023		6/27/2015		7/1/2015	1.50				
3364 [Monthly PM Oil for Vacuum Furnace]	HT-081		7/6/2015	7/6/2015	7/6/2015	2.50				
3365 [Monthly PM Oil for Vacuum Furnace]	HT-027		7/6/2015	7/6/2015	7/7/2015	2.00				
3366 [Monthly PM Oil for Vacuum Furnace]	HT-072		7/6/2015	7/6/2015	7/6/2015	1.50				
3367 [Monthly PM Oil for Vacuum Furnace]	HT-073		7/6/2015	7/24/2015	7/10/2015	5.00				
3396 [Monthly PM Oil for Vacuum Furnace]	HT-066		7/7/2015	7/24/2015	7/7/2015	2.00				
3398 [Monthly vacuum pm]	HT-106		7/7/2015		7/7/2015	1.00				
3405 [Monthly PM Oil for Vacuum Furnace]	HT-044		7/8/2015	7/18/2015	7/8/2015	2.50				
3406 [Monthly PM Oil for Vacuum Furnace]	HT-036		7/8/2015	7/10/2015	7/13/2015	1.50				
3409 [Monthly PM Oil for Vacuum Furnace]	HT-005		7/8/2015	7/10/2015	7/13/2015	1.50				
3410 [Monthly PM Oil for Vacuum Furnace]	HT-010		7/8/2015	7/10/2015	7/13/2015	1.50				
3414 [Monthly PM Oil for Vacuum Furnace]	HT-107		7/8/2015	7/10/2015	7/13/2015	1.50				
						<b>15</b>	<b>31.50</b>			
						<b>PREVENTIVE MAINTENANCE Totals : 15</b>	<b>31.50</b>			

# Challenges to the Transition

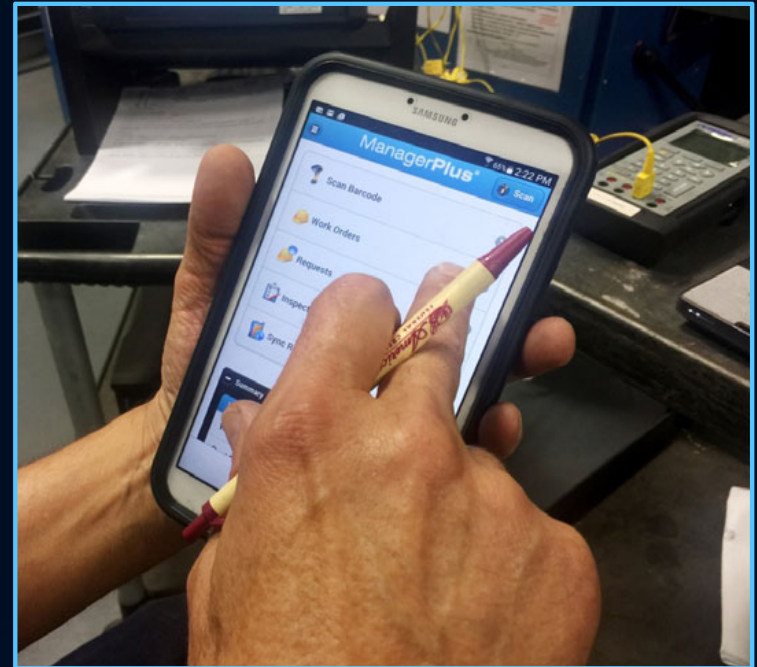
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- Resistance to change is inevitable and must be addressed (human nature)
- System setup requires careful planning
- Thorough training is necessary to ensure the system's success
- Daily effort is required to maintain the system once it is in place



# Paperless Maintenance System Benefits

- Satisfies quality requirements for a traceable maintenance and calibration system
- Improve efficiency in tracking and work order scheduling
- Create a history of maintenance issues
- Improve scheduling of preventive maintenance for equipment
- Increase accountability to meeting corporate goals





# Paperless Maintenance System Benefits

- Routine and scheduled tasks readily accessible from any location
- Increased assurance that equipment is up-to-date to satisfy customer and quality requirements
- Digital, automated maintenance record keeping
- Paperless system has allowed unplanned maintenance tasks to be completed faster and efficient
- Improved communication between production, quality and maintenance



# Paperless Maintenance System

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**Thank you for your time!**

**Questions?**

Roger Jones

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Presentation is accessible on our website under Technical Documents