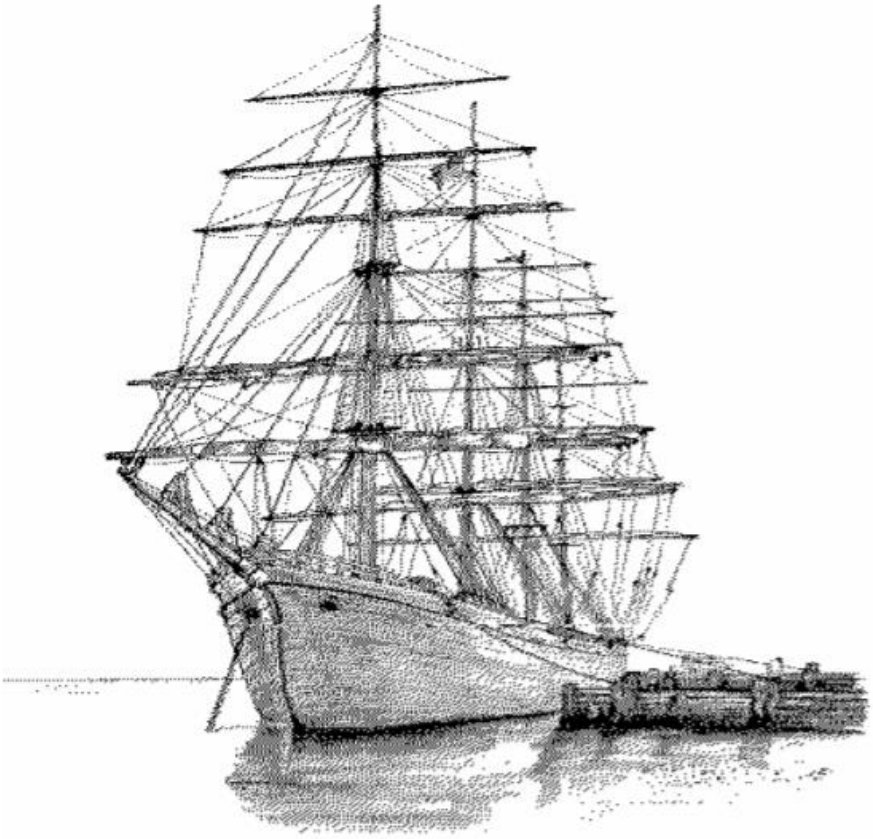
Industrial Assessment Center
Assessment Recommendation Codes (ARC)



The ARC
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Written by:
Michael R. Muller
Kelly Baber
Sarah Landis
Rutgers University

CAES
CENTER FOR ADVANCED ENERGY SYSTEMS

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1. Introduction

The database is a product of the Industrial Assessment Centers which aggregates results from assessments carried out by ABET Accredited Universities across the country for the Department of Energy's Advanced Manufacturing Office. This manual, developed for the program, contains a list of recommendations involving enhancements in energy efficiency, waste minimization and manufacturing productivity. In order to organize the data in a useful way, a coding system called the Assessment Recommendation Code (ARC) has been developed to list each recommendation.

The list is assembled and maintained by the IAC Field Management Team at the Center for Advanced Energy Systems at Rutgers, the State University of New Jersey. The majority of the recommendations for increased energy efficiency come, in some part, from the list presented in the early Department of Commerce Guidebook (EPIC). The recommendations for waste reduction used, in part, comes from a list assembled by Professor Richard J. Jendrucko, Thomas N. Coleman and Todd M. Thomas of the University of Tennessee and their contribution is gratefully acknowledged. The productivity recommendations are taken from the Industrial Productivity Training Manual assembled by, Dr. Michael Muller, Dr. David Briggs, and Mr. Donald Kasten at Rutgers University.

Most recommendations can be collected into groups that focus either on the same system or on the same general strategy for enhancement. Attempts were made to develop a coding scheme, which would be consistent along either one of these lines, but neither approach proved satisfactory. The resulting organization of recommendations has been done in an "expert system" fashion. Therefore, the code has been assembled to best collect recommendations, which would be considered together by an experienced professional. For example, recommendations for energy savings for air compressors (a system) are grouped. In a similar fashion, recommendations for waste heat recovery (a strategy) are collected together.

A coding system like this will change frequently as new technologies and strategies reach the manufacturing floor. Therefore, it is important that the database version being used match the ARC code version.

The ARC consists of a code as follows:

X.YYYY.Z

The first number, "X" is the recommendation type. Examples are 2 for energy savings, 3 for waste reduction, 4 for productivity. The second four numbers, "YYYY", detail the strategy being employed. The final number, "Z" is the application of the strategy, indicating whether the recommendation impacts the process, the building and grounds, or other application.

2. Energy Management

2.1 Combustion Systems

2.11 FURNACES, OVENS & DIRECTLY FIRED OPERATIONS

2.111 Operations

2.1111 CONTROL PRESSURE ON STEAMER OPERATIONS
2.1112 HEAT OIL TO PROPER TEMPERATURE FOR GOOD ATOMIZATION
2.1113 REDUCE COMBUSTION AIR FLOW TO OPTIMUM
2.1114 LIMIT AND CONTROL SECONDARY COMBUSTION AIR IN FURNACE
2.1115 ELIMINATE COMBUSTIBLE GAS IN FLUE GAS
2.1116 IMPROVE COMBUSTION CONTROL CAPABILITY
2.1117 RELOCATE OVEN / FURNACE TO MORE EFFICIENT LOCATION

2.112 Hardware

2.1121 USE INSULATION IN FURNACES TO FACILITATE HEATING / COOLING
2.1122 RE-SIZE CHARGING OPENINGS OR ADD A MOVABLE DOOR ON EQUIPMENT
2.1123 INSTALL AUTOMATIC STACK DAMPER
2.1124 REPLACE DIRECT FIRED EQUIPMENT WITH STEAM HEAT
2.1125 CONVERT TO OXY-FUEL BURNERS

2.113 Maintenance

2.1131 REPAIR FAULTY INSULATION IN FURNACES, BOILERS, ETC
2.1132 REPAIR FAULTY LOUVERS AND DAMPERS
2.1133 ADJUST BURNERS FOR EFFICIENT OPERATION
2.1134 ELIMINATE LEAKS IN COMBUSTIBLE GAS LINES
2.1135 REPAIR FURNACES AND OVEN DOORS SO THAT THEY SEAL EFFICIENTLY

2.12 BOILERS

2.121 Operation

2.1211 MOVE BOILER TO MORE EFFICIENT LOCATION
2.1212 OPERATE BOILERS ON HIGH FIRE SETTING
2.1213 DIRECT WARMEST AIR TO COMBUSTION INTAKE

2.122 Hardware

2.1221 REPLACE OBSOLETE BURNERS WITH MORE EFFICIENT ONES
2.1222 INSTALL TURBULATORS
2.1223 INSTALL SMALLER BOILER (INCREASE HIGH FIRE DUTY CYCLE)
2.1224 REPLACE BOILER

2.123 Maintenance

2.1231 ESTABLISH BURNER MAINTENANCE SCHEDULE FOR BOILERS
2.1232 KEEP BOILER TUBES CLEAN
2.1233 ANALYZE FLUE GAS FOR PROPER AIR/FUEL RATIO

2.124 Blowdown

2.1241 REDUCE EXCESSIVE BOILER BLOWDOWN
2.1242 MINIMIZE BOILER BLOWDOWN WITH BETTER FEEDWATER TREATMENT
2.1243 USE HEAT FROM BOILER BLOWDOWN TO PREHEAT BOILER FEED WATER

2.13 FUEL SWITCHING

2.131 Electric to Fossil Fuel

2.1311 REPLACE ELECTRICALLY-OPERATED EQUIPMENT WITH FOSSIL FUEL EQUIPMENT

2.132 Fossil Fuel to Electric

2.1321 REPLACE FOSSIL FUEL EQUIPMENT WITH ELECTRICAL EQUIPMENT
2.1322 USE ELECTRIC HEAT IN PLACE OF FOSSIL FUEL HEATING SYSTEM
2.1323 REPLACE GAS-FIRED ABSORPTION AIR CONDITIONERS WITH ELECTRIC UNITS

2.133 Alternate Fuel

2.1331 BURN A LESS EXPENSIVE GRADE OF FUEL
2.1332 CONVERT COMBUSTION EQUIPMENT TO BURN NATURAL GAS
2.1333 CONVERT COMBUSTION EQUIPMENT TO BURN OIL
2.1334 CONVERT OIL OR GAS BURNERS TO COMBUSTION OF COAL
2.1335 REPLACE GASOLINE WITH DIESEL, LPG, OR NATURAL GAS
2.1336 INSTALL EQUIPMENT TO UTILIZE WASTE FUEL

2.139 Miscellaneous

2.1391 REPLACE PURCHASED STEAM WITH ELECTRIC HEATING
2.1392 REPLACE PURCHASED STEAM WITH OTHER ENERGY SOURCE
2.1393 USE STEAM SPARGING OR INJECTIONS IN PLACE OF INDIRECT HEATING
2.1394 REPLACE STEAM JETS ON VACUUM SYSTEM WITH ELECTRIC MOTOR DRIVEN VACUUM PUMPS

2.2 Thermal Systems

2.21 STEAM

2.211 Traps

2.2111 INSTALL STEAM TRAP
2.2112 USE CORRECT SIZE STEAM TRAPS
2.2113 REPAIR OR REPLACE STEAM TRAPS
2.2114 SHUT OFF STEAM TRAPS ON SUPERHEATED STEAM LINES WHEN NOT IN USE

2.212 Condensate

2.2121 INCREASE AMOUNT OF CONDENSATE RETURNED
2.2122 INSTALL / REPAIR INSULATION ON CONDENSATE LINES
2.2123 INSULATE FEEDWATER TANK
2.2124 INSTALL DEAERATOR IN PLACE OF CONDENSATE TANK
2.2126 LOWER OPERATING PRESSURE OF CONDENSER (STEAM)
2.2127 FLASH CONDENSATE TO PRODUCE LOWER PRESSURE STEAM
2.2128 USE STEAM CONDENSATE FOR HOT WATER SUPPLY (NON-POTABLE)

2.213 Leaks and Insulation

2.2134 ELIMINATE LEAKS IN HIGH PRESSURE REDUCING STATIONS
2.2135 REPAIR AND ELIMINATE STEAM LEAKS
2.2136 INSTALL/REPAIR INSULATION ON STEAM LINES

2.214 Distillation

2.2141 OPERATE DISTILLATION COLUMNS EFFICIENTLY
2.2142 UPGRADE DISTILLATION HARDWARE

2.215 Maintenance

2.2151 CLEAN STEAM COILS IN PROCESSING TANKS
2.2152 MAINTAIN STEAM JETS USED FOR VACUUM SYSTEM
2.2153 CLOSE OFF UNNEEDED STEAM LINES

2.216 Operations

2.2161 OPTIMIZE OPERATION OF MULTI-STAGE VACUUM STEAM JETS
2.2162 REDUCE EXCESS STEAM BLEEDING
2.2163 USE MINIMUM STEAM OPERATING PRESSURE
2.2164 TURN OFF STEAM TRACING DURING MILD WEATHER
2.2165 SUBSTITUTE AIR FOR STEAM TO ATOMIZE OIL

2.219 Miscellaneous

2.2191 SUBSTITUTE HOT PROCESS FLUIDS FOR STEAM
2.2192 USE HEAT EXCHANGE FLUIDS INSTEAD OF STEAM IN PIPELINE TRACING SYSTEMS

2.22 HEATING

2.221 Operation

2.2211 USE OPTIMUM TEMPERATURE
2.2212 USE MINIMUM SAFE OVEN VENTILATION

2.222 Hardware

2.2221 USE IMMERSION HEATING IN TANKS, MELTING POTS, ETC
2.2222 CONVERT LIQUID HEATERS FROM UNDERFIRING TO IMMERSION OR SUBMERSION HEATING
2.2223 ENHANCE SENSITIVITY OF TEMPERATURE CONTROL AND CUTOFF

2.23 HEAT TREATING

2.231 General

2.2311 HEAT TREAT PARTS ONLY TO REQUIRED SPECIFICATIONS OR STANDARDS
2.2312 MINIMIZE NON-ESSENTIAL MATERIAL IN HEAT TREATMENT PROCESS
2.2313 USE BATCH FIRING WITH KILN "FURNITURE" SPECIFICALLY DESIGNED
2.2314 REPLACE HEAT TREATING OVEN WITH MORE EFFICIENT UNIT

2.24 HEAT RECOVERY

2.241 Flue Gas - Recuperation

2.2414 USE WASTE HEAT FROM HOT FLUE GASES TO PREHEAT

2.242 Flue Gas - Other Uses

2.2421 INSTALL WASTE HEAT BOILER TO PROVIDE DIRECT POWER
2.2422 USE WASTE HEAT FROM HOT FLUE GASES TO GENERATE STEAM
2.2423 INSTALL WASTE HEAT BOILER TO PRODUCE STEAM
2.2424 USE HEAT IN FLUE GASES TO PREHEAT PRODUCTS OR MATERIALS
2.2425 USE FLUE GASES TO HEAT PROCESS OR SERVICE WATER
2.2426 USE WASTE HEAT FROM FLUE GASES TO HEAT SPACE CONDITIONING AIR
2.2427 USE WASTE HEAT FROM HOT FLUE GASES TO PREHEAT INCOMING FLUIDS
2.2428 USE FLUE GASES IN RADIANT HEATER FOR SPACE HEATING, OVENS, ETC

2.243 Heat Recovery from Specific Equipment

2.2437 RECOVER WASTE HEAT FROM EQUIPMENT

2.244 Other Process Waste Heat

2.2441 PREHEAT BOILER MAKEUP WATER WITH WASTE PROCESS HEAT
2.2442 PREHEAT COMBUSTION AIR WITH WASTE HEAT
2.2443 RE-USE OR RECYCLE HOT OR COLD PROCESS EXHAUST AIR
2.2444 USE HOT PROCESS FLUIDS TO PREHEAT INCOMING PROCESS FLUIDS
2.2445 RECOVER HEAT FROM EXHAUSTED STEAM
2.2446 RECOVER HEAT FROM HOT WASTE WATER
2.2447 HEAT WATER WITH EXHAUST HEAT

2.249 Miscellaneous

2.2491 USE COOLING AIR WHICH COOLS HOT WORK PIECES FOR SPACE HEATING
2.2492 USE “HEAT WHEEL” OR OTHER HEAT EXCHANGER TO CROSS-EXCHANGE BUILDING EXHAUST AIR WITH MAKE-UP AIR
2.2494 RECOVER HEAT IN DOMESTIC HOT WATER GOING TO DRAIN
2.2495 USE EXHAUST HEAT FROM BUILDING FOR SNOW AND ICE REMOVAL
2.2496 HEAT SERVICE HOT WATER WITH AIR CONDITIONING EQUIPMENT

2.25 HEAT CONTAINMENT

2.251 Insulation

2.2511 INSULATE BARE EQUIPMENT
2.2514 COVER OPEN TANKS 2.2515 USE OPTIMUM THICKNESS INSULATION
2.2515 USE OPTIMUM THICKNESS INSULATION

2.252 Isolation

2.2521 ISOLATE STEAM LINES TO AVOID HEATING AIR CONDITIONED AREAS
2.2522 ISOLATE HOT OR COLD EQUIPMENT
2.2523 REDUCE INFILTRATION; ISOLATE HOT EQUIPMENT FROM REFRIGERATED AREAS
2.2524 AVOID COOLING OF PROCESS STREAMS OR MATERIALS THAT MUST SUBSEQUENTLY BE HEATED
2.2525 ELIMINATE COOLING OF PROCESS STREAMS WHICH SUBSEQUENTLY MUST BE HEATED AND VICE VERSA

2.253 Infiltration

2.2531 RE-SIZE CHARGING OPENINGS OR ADD MOVABLE COVER OR DOOR
2.2532 USE ONLY AMOUNT OF AIR NECESSARY TO PREVENT EXPLOSION HAZARD
2.2533 REPLACE AIR CURTAIN DOORS WITH SOLID DOORS

2.26 COOLING

2.261 Cooling Towers

2.2611 MODERATE COOLING TOWER OUTLET TEMPERATURE
2.2612 USE COOLING TOWER WATER INSTEAD OF REFRIGERATION
2.2613 USE ANTIFREEZE IN COOLING TOWERS TO ALLOW WINTER USE
2.2614 USE COOLING TOWER OR ECONOMIZER TO REPLACE CHILLER COOLING
2.2615 CLEAN CONDENSER TUBES

2.262 Chillers and Refrigeration

2.2621 MODIFY REFRIGERATION SYSTEM TO OPERATE AT A LOWER PRESSURE
2.2622 REPLACE EXISTING CHILLER WITH HIGH EFFICIENCY MODEL
2.2623 MINIMIZE CONDENSER COOLING WATER TEMPERATURE
2.2624 USE COLD WASTE WATER TO COOL CHILLER FEED WATER
2.2625 CHILL WATER TO THE HIGHEST TEMPERATURE POSSIBLE
2.2626 AVOID FROST FORMATION ON EVAPORATORS
2.2627 USE MULTIPLE-EFFECT EVAPORATORS
2.2628 UTILIZE A LESS EXPENSIVE COOLING METHOD

2.269 Miscellaneous

2.2691 SHUT OFF COOLING IF COLD OUTSIDE AIR WILL COOL PROCESS
2.2692 USE OUTSIDE COLD WATER SOURCE AS A SUPPLY OF COOLING WATER
2.2693 USE WASTE HEAT STEAM FOR ABSORPTION REFRIGERATION
2.2694 USE HIGHEST TEMPERATURE FOR CHILLING OR COLD STORAGE
2.2695 USE CASCADE SYSTEM OF RECIRCULATING DURING COLD WEATHER TO AVOID SUB-COOLING
2.2696 USE EXCESS COLD PROCESS FLUID FOR INDUSTRIAL COOLING NEEDS

2.27 DRYING

2.271 Use of Air

2.2711 UTILIZE OUTSIDE AIR INSTEAD OF CONDITIONED AIR FOR DRYING

2.3 Electrical Power

2.31 DEMAND MANAGEMENT

2.311 Thermal Energy Storage

2.3111 HEAT WATER DURING OFF-PEAK PERIODS AND STORE FOR LATER USE
2.3112 STORE HEATED / COOLED WATER FOR USE DURING PEAK DEMAND PERIODS
2.3113 MAKE ICE DURING OFF PEAK HOURS FOR COOLING

2.313 Scheduling

2.3131 RESCHEDULE PLANT OPERATIONS OR REDUCE LOAD TO AVOID PEAKS
2.3132 RECHARGE BATTERIES ON DURING OFF-PEAK DEMAND PERIODS
2.3133 CONSIDER THREE OR FOUR DAYS AROUND-THE-CLOCK OPERATION RATHER THAN ONE OR TWO SHIFTS PER DAY
2.3134 SHIFT FROM DAYTIME TO NIGHTTIME OPERATION
2.3135 SCHEDULE ROUTINE MAINTENANCE DURING NON-OPERATING PERIODS
2.3136 OVERLAP CUSTODIAL SERVICES WITH NORMAL DAY HOURS
2.3137 USE POWER DURING OFF-PEAK PERIODS

2.314 Battery Storage

2.3141 USE BATTERIES FOR DEMAND CONTROL
2.3142 USE BATTERIES FOR POWER QUALITY ISSUES

2.319 Miscellaneous

2.3191 USE DEMAND CONTROLLER OR LOAD SHEDDER
2.3192 USE FOSSIL FUEL POWERED GENERATOR DURING PEAK DEMAND PERIODS

2.32 POWER FACTOR

2.321 General

2.3212 OPTIMIZE PLANT POWER FACTOR

2.33 GENERATION OF POWER

2.331 DC

2.3311 REPLACE DC EQUIPMENT WITH AC EQUIPMENT
2.3312 INSTALL EFFICIENT RECTIFIERS

2.332 AC

2.3321 USE STEAM PRESSURE REDUCTION TO GENERATE POWER
2.3322 USE EXISTING DAM TO GENERATE ELECTRICITY
2.3323 INSTALL EMISSIONS CONTROLS TO INCREASE CAPACITY

2.34 COGENERATION

2.341 General

2.3411 REPLACE ELECTRIC MOTORS WITH BACK PRESSURE STEAM TURBINES AND USE EXHAUST STEAM FOR PROCESS HEAT
2.3412 USE WASTE HEAT TO PRODUCE STEAM TO DRIVE A STEAM TURBINE-GENERATOR
2.3413 BURN FOSSIL FUEL TO PRODUCE STEAM TO DRIVE A STEAM TURBINE-GENERATOR AND USE STEAM EXHAUST FOR HEAT
2.3414 BURN WASTE TO PRODUCE STEAM TO DRIVE A STEAM TURBINE GENERATOR SET AND USE STEAM EXHAUST FOR HEAT
2.3415 USE A FOSSIL FUEL ENGINE TO COGENERATE ELECTRICITY OR MOTIVE POWER; AND UTILIZE HEAT
2.3416 USE COMBINED CYCLE GAS TURBINE GENERATOR SETS WITH WASTE HEAT BOILERS CONNECTED TO TURBINE EXHAUST
2.3417 USE WASTE HEAT WITH A CLOSED-CYCLE GAS TURBINE-GENERATOR SET TO COGENERATE ELECTRICITY AND HEAT

2.35 TRANSMISSION

2.351 Transformers

2.3511 USE PLANT OWNED TRANSFORMERS OR LEASE TRANSFORMERS
2.3512 DE-ENERGIZE EXCESS TRANSFORMER CAPACITY
2.3513 CONSIDER POWER LOSS AS WELL AS INITIAL LOADS AND LOAD GROWTH IN DOWN-SIZING TRANSFORMERS

2.352 Conductor Size

2.3521 REDUCE LOAD ON ELECTRICAL CONDUCTOR TO REDUCE HEATING LOSSES
2.3522 INCREASE ELECTRICAL CONDUCTOR SIZE TO REDUCE DISTRIBUTION LOSSES

2.4 Motor Systems

2.41 MOTORS

2.411 Operation

2.4111 UTILIZE ENERGY-EFFICIENT BELTS AND OTHER IMPROVED MECHANISMS
2.4112 INSTALL SOFT-START TO ELIMINATE NUISANCE TRIPS
2.4113 INSTALL MOTOR VOLTAGE CONTROLLER ON LIGHTLY LOADED MOTORS

2.413 Hardware

2.4132 SIZE ELECTRIC MOTORS FOR PEAK OPERATING EFFICIENCY
2.4133 USE MOST EFFICIENT TYPE OF ELECTRIC MOTORS
2.4134 REPLACE ELECTRIC MOTOR WITH FOSSIL FUEL ENGINE

2.414 Motor System Drives

2.4145 INSTALL ISOLATION TRANSFORMER ON ADJUSTABLE FREQUENCY DRIVE
2.4146 USE ADJUSTABLE FREQUENCY DRIVE OR MULTIPLE SPEED MOTORS ON EXISTING SYSTEM

2.415 Motor Maintenance/Repair

2.4151 DEVELOP A REPAIR/REPLACE POLICY
2.4152 USE ONLY CERTIFIED MOTOR REPAIR SHOPS
2.4153 AVOID EMERGENCY REWIND OF MOTORS
2.4154 AVOID REWINDING MOTORS MORE THAN TWICE
2.4155 STANDARDIZE MOTOR INVENTORY
2.4156 ESTABLISH A PREVENTATIVE MAINTENANCE PROGRAM
2.4157 ESTABLISH A PREDICTIVE MAINTENANCE PROGRAM

2.42 AIR COMPRESSORS

2.422 Hardware

2.4221 INSTALL COMPRESSOR AIR INTAKES IN COOLEST LOCATIONS
2.4222 INSTALL ADEQUATE DRYERS ON AIR LINES TO ELIMINATE BLOWDOWN
2.4223 INSTALL DIRECT ACTING UNITS IN PLACE OF COMPRESSED AIR PRESSURE SYSTEM IN SAFETY SYSTEM
2.4224 UPGRADE CONTROLS ON COMPRESSORS
2.4225 INSTALL COMMON HEADER ON COMPRESSORS
2.4226 USE / PURCHASE OPTIMUM SIZED COMPRESSOR
2.4227 USE COMPRESSOR AIR FILTERS

2.423 Operations

2.4233 ELIMINATE PERMANENTLY THE USE OF COMPRESSED AIR
2.4234 COOL COMPRESSOR AIR INTAKE WITH HEAT EXCHANGER
2.4235 REMOVE OR CLOSE OFF UNNEEDED COMPRESSED AIR LINES
2.4236 ELIMINATE LEAKS IN INERT GAS AND COMPRESSED AIR LINES/ VALVES
2.4237 SUBSTITUTE COMPRESSED AIR COOLING WITH WATER OR AIR COOLING
2.4238 DO NOT USE COMPRESSED AIR FOR PERSONAL COOLING
2.4239 ELIMINATE OR REDUCE COMPRESSED AIR USAGE

2.43 OTHER EQUIPMENT

2.431 Operations

2.4311 RECOVER MECHANICAL ENERGY
2.4312 IMPROVE LUBRICATION PRACTICES
2.4313 PROVIDE PROPER MAINTENANCE / OF MOTOR DRIVEN EQUIPMENT
2.4314 USE SYNTHETIC LUBRICANT

2.432 Hardware

2.4321 UPGRADE OBSOLETE EQUIPMENT
2.4322 USE OR REPLACE WITH ENERGY EFFICIENT SUBSTITUTES
2.4323 USE OPTIMUM SIZE AND CAPACITY EQUIPMENT
2.4324 REPLACE HYDRAULIC / PNEUMATIC EQUIPMENT WITH ELECTRIC EQUIPMENT
2.4325 UPGRADE CONVEYORS

2.5 Industrial Design

2.51 SYSTEMS

2.511 Thermal

2.5111	CONVERT FROM INDIRECT TO DIRECT FIRED SYSTEMS
2.5112	USE CONTINUOUS EQUIPMENT WHICH RETAINS PROCESS HEATING CONVEYORS WITHIN THE HEATED CHAMBER
2.5113	USE DIRECT FLAME IMPINGEMENT OR INFRARED PROCESSING FOR CHAMBER TYPE HEATING
2.5114	USE SHAFT TYPE FURNACES FOR PREHEATING INCOMING MATERIAL
2.5115	REPOSITION OVEN WALLS TO REDUCE HEATED SPACE
2.5116	USE EXCESS COLD PROCESS FLUID FOR INDUSTRIAL COOLING NEEDS
2.5117	CONVERT TO INDIRECT TEMPERATURE CONTROL SYSTEM

2.512 Mechanical

2.5121	REDESIGN FLOW TO MINIMIZE MASS TRANSFER LENGTH
2.5122	REPLACE HIGH RESISTANCE DUCTS, PIPES, AND FITTINGS
2.5123	REDUCE FLUID FLOW RATES
2.5124	USE GRAVITY FEEDS WHEREVER POSSIBLE
2.5125	SIZE AIR HANDLING GRILLS/ DUCTS COILS TO MINIMIZE AIR RESISTANCE

2.519 Miscellaneous

2.5191	MODIFY DYE BECK
2.5192	MODIFY TEXTILE DRYERS
2.5193	CONVERT FROM BATCH TO CONTINUOUS OPERATION
2.5194	REDESIGN PROCESS
2.5195	CHANGE PRODUCT DESIGN TO REDUCE ENERGY REQUIREMENTS
2.5196	USE SMALL NUMBER OF HIGH OUTPUT UNITS INSTEAD OF MANY SMALL INEFFICIENT UNITS

2.6 Operations

2.61 MAINTENANCE

2.612 General

2.6121 REDUCE HOT WATER TEMPERATURE TO THE MINIMUM REQUIRED
2.6122 ADJUST VENTS TO MINIMIZE ENERGY USE
2.6123 REMOVE UNNEEDED SERVICE LINES TO ELIMINATE POTENTIAL LEAKS
2.6124 ESTABLISH EQUIPMENT MAINTENANCE SCHEDULE
2.6125 KEEP EQUIPMENT CLEAN 2.6126 KEEP SOLID FUELS / RAW MATERIALS DRY
2.6127 MAINTAIN AIR FILTERS BY CLEANING OR REPLACEMENT

2.62 EQUIPMENT CONTROL

2.621 Equipment Use Reduction

2.6211 CONSERVE ENERGY BY EFFICIENT USE OF VENDING MACHINES
2.6212 TURN OFF EQUIPMENT DURING BREAKS, REDUCE OPERATING TIME
2.6213 TURN OFF STEAM / HOT WATER LINES LEADING TO SPACE HEATING UNITS
2.6214 SHUT OFF PILOTS IN STANDBY EQUIPMENT
2.6215 SHUT OFF AIR CONDITIONING IN WINTER HEATING SEASON
2.6218 TURN OFF EQUIPMENT WHEN NOT IN USE

2.622 Equipment Scheduling

2.6221 USE MOST EFFICIENT EQUIPMENT AT ITS MAXIMUM CAPACITY AND LESS EFFICIENT EQUIPMENT ONLY WHEN NECESSARY
2.6222 USE DRYING OVEN (BATCH TYPE) ON ALTERNATE DAYS OR OTHER OPTIMUM SCHEDULE TO RUN EQUIPMENT WITH FULL LOADS
2.6223 SCHEDULE USE OF ELEVATORS TO CONSERVE ENERGY
2.6224 SCHEDULE BAKING TIMES OF SMALL AND LARGE COMPONENTS
2.6225 ELIMINATE THIRD SHIFT
2.6226 OPTIMIZE FILTRATION CLEANING/ REPLACEMENT TO MINIMIZE AIR RESISTANCE

2.623 Equipment Automation

2.6231 UTILIZE CONTROLS TO OPERATE EQUIPMENT ONLY WHEN NEEDED
2.6232 INSTALL SET-BACK TIMERS

2.624 Load Reduction

2.6241 REDUCE TEMPERATURE OF PROCESS EQUIPMENT WHEN ON STANDBY
2.6242 MINIMIZE OPERATION OF EQUIPMENT MAINTAINED IN STANDBY CONDITION

2.7 Building and Grounds

2.71 LIGHTING

2.711 Level

2.7111 REDUCE ILLUMINATION TO MINIMUM NECESSARY LEVELS

2.712 Operation

2.7121 UTILIZE DAYLIGHT WHENEVER POSSIBLE IN LIEU OF ARTIFICIAL LIGHT
2.7122 DISCONNECT BALLASTS
2.7123 KEEP LAMPS AND REFLECTORS CLEAN
2.7124 MAKE A PRACTICE OF TURNING OFF LIGHTS WHEN NOT NEEDED

2.713 Controls

2.7131 ADD AREA LIGHTING SWITCHES
2.7132 INSTALL TIMERS ON LIGHT SWITCHES IN LITTLE USED AREAS
2.7133 USE SEPARATE SWITCHES ON PERIMETER LIGHTING WHICH MAY BE TURNED OFF WHEN NATURAL LIGHT IS AVAILABLE
2.7134 USE PHOTOCELL CONTROLS
2.7135 INSTALL OCCUPANCY SENSORS

2.714 Hardware

2.7141 LOWER LIGHT FIXTURES IN HIGH CEILING AREAS
2.7142 UTILIZE HIGHER EFFICIENCY LAMPS AND/OR BALLASTS
2.7144 INSTALL SPECTRAL REFLECTORS / DELAMP
2.7145 INSTALL SKYLIGHTS

2.72 SPACE CONDITIONING

2.721 Maintenance

2.7211 CLEAN AND MAINTAIN REFRIGERANT CONDENSERS AND TOWERS
2.7212 INSTALL OR UPGRADE INSULATION ON HVAC DISTRIBUTION SYSTEMS

2.722 Operation

2.7221 LOWER TEMPERATURE DURING THE WINTER SEASON AND VICE-VERSA
2.7222 AIR CONDITION ONLY SPACE IN USE
2.7223 CONDITION SMALLEST SPACE NECESSARY
2.7224 REDUCE SPACE CONDITIONING DURING NON-WORKING HOURS
2.7225 CLOSE OUTDOOR AIR DAMPERS DURING WARM-UP / COOL-DOWN PERIODS
2.7226 USE COMPUTER PROGRAMS TO OPTIMIZE HVAC PERFORMANCE
2.7227 USE WATER ON AIR CONDITIONING EXCHANGER
2.7228 AVOID INTRODUCING HOT, HUMID, OR DIRTY AIR INTO HVAC SYSTEM

2.723 Hardware - Heating / Cooling

2.7231 USE RADIANT HEATER FOR SPOT HEATING
2.7232 REPLACE EXISTING HVAC UNIT WITH HIGH EFFICIENCY MODEL
2.7233 USE PROPERLY DESIGNED AND SIZED HVAC EQUIPMENT
2.7234 USE HEAT PUMP FOR SPACE CONDITIONING
2.7235 INSTALL FOSSIL FUEL MAKE-UP AIR UNIT

2.724 Hardware - Air Circulation

2.7241 INSTALL OUTSIDE AIR DAMPER / ECONOMIZER ON HVAC UNIT
2.7242 CHANGE ZONE REHEAT COILS TO VARIABLE AIR VOLUME BOXES
2.7243 IMPROVE AIR CIRCULATION WITH DESTRATIFICATION FANS / OTHER METHODS
2.7244 REVISE SMOKE CLEANUP FROM OPERATIONS
2.7245 USE DIRECT AIR SUPPLY TO EXHAUST HOODS

2.725 Evaporation

2.7251 REDUCE AIR CONDITIONING LOAD BY EVAPORATING WATER FROM ROOF
2.7252 UTILIZE AN EVAPORATIVE AIR PRE-COOLER OR OTHER HEAT EXCHANGER IN AC SYSTEM

2.726 Controls

2.7261 INSTALL TIMERS AND/OR THERMOSTATS
2.7262 SEPARATE CONTROLS OF AIR HANDLERS FROM AC/ HEATING SYSTEMS
2.7263 LOWER COMPRESSOR PRESSURE THROUGH A/C SYSTEM MODIFICATION
2.7264 INTERLOCK HEATING AND AIR CONDITIONING SYSTEMS TO PREVENT SIMULTANEOUS OPERATION

2.727 Humidity Control

2.7271 REPLACE ELECTRIC REHEAT WITH HEAT PIPES
2.7272 INSTALL HEAT PIPES / RAISE COOLING SETPOINT
2.7273 INSTALL DESICCANT HUMIDITY CONTROL SYSTEM

2.729 Miscellaneous

2.7291 RESCHEDULE AND REARRANGE MULTIPLE-SOURCE HEATING SYSTEMS
2.7292 LOWER CEILING TO REDUCE CONDITIONED SPACE
2.7293 MODIFY SPRINKLER SYSTEM TO REDUCE HEATING REQUIREMENTS

2.73 VENTILATION

2.731 General

2.7311 VENTILATION SYSTEM TO SHUT OFF WHEN ROOM IS NOT IN USE
2.7312 MINIMIZE USE OF OUTSIDE MAKE-UP AIR FOR VENTILATION EXCEPT WHEN USED FOR ECONOMIZER CYCLE
2.7313 RECYCLE AIR FOR HEATING, VENTILATION AND AIR CONDITIONING
2.7314 REDUCE VENTILATION AIR
2.7316 CENTRALIZE CONTROL OF EXHAUST FANS TO ENSURE THEIR SHUTDOWN, OR ESTABLISH PROGRAM TO ENSURE MANUAL SHUTDOWN

2.74 BUILDING ENVELOPE

2.742 Solar Loading

2.7421 REDUCE GLAZED AREAS IN BUILDINGS
2.7422 PLANT TREES OR SHRUBS NEAR WINDOWS TO SHIELD FROM SUNLIGHT
2.7423 REDUCE HEAT GAIN BY WINDOW TINTING
2.7424 SHADE WINDOWS FROM SUMMER SUN
2.7425 CLEAN OR COLOR ROOF TO REDUCE SOLAR LOAD

2.744 Infiltration

2.7441 REPLACE BROKEN WINDOWS AND/OR WINDOW SASH
2.7442 KEEP DOORS AND WINDOWS SHUT WHEN NOT ON USE
2.7444 CLOSE HOLES AND OPENINGS IN BUILDING SUCH AS BROKEN WINDOWS
2.7446 UTILIZE SENSORS CONTROLLING ROOF AND WALL OPENINGS
2.7447 INSTALL VINYL STRIP / HIGH SPEED / AIR CURTAIN DOORS

2.749 Miscellaneous

2.7491 INSULATE GLAZING, WALLS, CEILINGS, AND ROOFS
2.7492 USE PROPER THICKNESS OF INSULATION ON BUILDING ENVELOPE
2.7493 USE DOUBLE OR TRIPLE GLAZED WINDOWS TO MAINTAIN HIGHER RELATIVE HUMIDITY AND TO REDUCE HEAT LOSSES
2.7494 INSTALL STORM WINDOWS AND DOORS
2.7495 INSTALL REPLACEMENT DOORS
2.7496 INSTALL PARTITIONS TO REDUCE SIZE OF CONDITIONED SPACE

2.8 Ancillary Costs

2.81 ADMINISTRATIVE

2.811 Utility Costs

2.8111 CHECK FOR ACCURACY OF UTILITY METERS
2.8112 COMBINE UTILITY METERS
2.8113 PURCHASE GAS DIRECTLY FROM A CONTRACT GAS SUPPLIER
2.8114 CHANGE RATE SCHEDULES OR OTHER CHANGES IN UTILITY SERVICE
2.8115 BASE UTILITY CHARGES ON USAGE RATHER THAN AREA OCCUPIED
2.8116 CHECK FOR ACCURACY OF POWER METER
2.8117 INSTALL SUB-METERING EQUIPMENT

2.812 Fiscal

2.8121 APPLY FOR TAX-FREE STATUS FOR ENERGY PURCHASES
2.8122 USE UTILITY CONTROLLED POWER MANAGEMENT
2.8123 PAY UTILITY BILLS ON TIME
2.8124 HIRE ENERGY MANAGER

2.82 SHIPPING, DISTRIBUTION, AND TRANSPORTATION

2.821 Shipping

2.8211 CONSOLIDATE FREIGHT SHIPMENTS AND/OR DELIVERIES
2.8212 REDUCE DELIVERY SCHEDULES

2.822 Vehicles

2.8221 CONSIDER INTERMEDIATE OR ECONOMY SIZE AUTOS / TRUCKS
2.8222 SIZE TRUCKS TO JOB
2.8223 ADD AIR SHIELDS TO TRUCKS TO INCREASE FUEL MILEAGE
2.8226 INCREASE EFFICIENCY OF TRUCKS
2.8227 ADJUST / MAINTAIN FORK LIFT TRUCKS FOR MOST EFFICIENT OPERATION

2.9 Alternative Energy Usage

2.91 GENERAL

2.911 Solar

2.9111 USE SOLAR HEAT TO HEAT MAKE-UP AIR
2.9112 USE SOLAR HEAT TO HEAT WATER
2.9113 USE SOLAR HEAT FOR HEAT
2.9114 USE SOLAR HEAT TO MAKE ELECTRICITY

2.912 Wind Power

2.9121 INSTALL WIND POWERED ELECTRIC GENERATOR

2.913 Hydrogen

2.9131 INSTALL FUEL CELL TO UTILIZE WASTE HYDROGEN

2.914 Biofuels

2.9141 INSTALL ANAEROBIC DIGESTER

3. Waste Minimization / Pollution Prevention

3.1 Operations

3.11 PROCEDURES

3.111 Process Specific

3.1111 COVER INK CONTAINERS WHEN NOT IN USE
3.1114 REUSE HIGH FERROUS METAL DUST AS RAW MATERIAL
3.1115 ORDER PAINT PIGMENTS IN PASTE FORM INSTEAD OF DRY POWDER TO ELIMINATE HAZARDOUS DUST WASTE
3.1116 REPAIR / UPGRADE GRATE CONVEYORS TO MINIMIZE LOSS OF COAL FINES

3.112 Material Application

3.1121 USE MORE EFFICIENT ADHESIVE APPLICATORS
3.1122 SWITCH FROM AUTOMATIC TO HAND APPLICATION

3.113 Stripping

3.1131 USE MECHANICAL STRIPPING METHODS

3.115 Desulfurization / Slag Management

3.1152 USE HIGH QUALITY SCRAP (LOW SULFUR) TO REDUCE HAZARDOUS SLUDGE GENERATION
3.1154 USE AN ALTERNATIVE DESULFURIZING AGENT TO ELIMINATE HAZARDOUS SLAG FORMATION

3.116 Reduction / Elimination

3.1161 ELIMINATE/REDUCE AN OPERATION
3.1162 USE LESS WASTEFUL PACKAGING
3.1163 USE PLASTIC PALLETS INSTEAD OF WOOD

3.117 Product Specifications

3.1171 CHANGE PRODUCT SPECS
3.1172 REVISE RAW MATERIAL SPECS
3.1173 USE A DIFFERENT RAW MATERIAL
3.1174 USE A RECYCLED RAW MATERIAL

3.118 By-product Use

3.1181 ELIMINATE A BY-PRODUCT
3.1182 MAKE A NEW BY-PRODUCT

3.119 Miscellaneous

3.1191	CHANGE PROCEDURES / EQUIPMENT / OPERATING CONDITIONS
3.1192	REDUCE SCRAP PRODUCTION
3.1193	CONVERT FROM BATCH OPERATION TO CONTINUOUS PROCESSING
3.1194	USE AUTOMATIC FLOW CONTROL
3.1196	MONITOR SOLUTIONS TO MAINTAIN SOLUTION STRENGTH

3.12 WASTE STREAM CONTAMINATION

3.122 Rinsing Strategies

3.1221	USE REACTIVE RINSING
3.1222	REDUCE WATER USE WITH COUNTERCURRENT RINSING
3.1223	USE FOG NOZZLES / SPRAY RINSING INSTEAD OF IMMERSION RINSING
3.1227	USE COUNTERCURRENT RINSING TO REDUCE RINSE WATER VOLUME (GRAVURE)

3.124 Dragout Reduction

3.1241	SLOW INSERTION / WITHDRAWAL OF PARTS FROM DEGREASING TANK
3.1242	ALLOW DRAINAGE BEFORE WITHDRAWING OBJECT
3.1244	REDUCE SOLUTION DRAG-OUT TO PREVENT SOLUTION LOSS
3.1245	EXTEND SOLUTION LIFE BY MINIMIZING DRAG-IN
3.1247	USE DRAG-OUT REDUCTION METHODS (GRAVURE)-SEE SURFACE COATING

3.129 Miscellaneous

3.1291	ELIMINATE PRACTICE OF MIXING WASTE STREAMS
3.1292	DEVELOP SEGREGATED SEWER SYSTEMS
3.1293	SEPARATE TREATMENTS FOR EACH TYPE OF SOLUTION AND RECYCLE
3.1294	SEGREGATE SPENT SOLVENTS AND REUSE IN SUBSEQUENT WASHINGS
3.1296	AVOID CONTAMINATION OF SCRAP GLASS AND REUSE AS FEED STOCK

3.2 Equipment

3.21 GENERAL

3.211 Fault Tolerance

3.2111 INSTALL REDUNDANT EQUIPMENT TO AVOID LOSSES CAUSED BY EQUIPMENT FAILURE AND ROUTINE MAINTENANCE

3.212 Painting Operations

3.2121 CONVERT TO ELECTROSTATIC POWDER COATING
3.2122 CONVERT FROM WATER CURTAIN SPRAY BOOTHS TO A DRY SYSTEM
3.2123 CONVERT TO HIGH VOLUME LOW PRESSURE (HVLP) PAINT GUNS
3.2124 CONVERT TO AIR ASSISTED / AIRLESS PAINT GUNS

3.213 Process Specific Upgrades

3.2134 USE HIGH PURITY ANODES TO INCREASE SOLUTION LIFE
3.2135 EXTEND SOLUTION LIFE WITH FILTERING OR CARBONATE FREEZING
3.2136 USE "WASH-LESS" PROCESSING EQUIPMENT

3.214 Tank Design

3.2141 USE CYLINDRICAL TANKS WITH HEIGHT TO DIAMETER RATIOS CLOSE TO ONE TO REDUCE WETTED SURFACE
3.2142 USE TANKS WITH A CONICAL BOTTOM OUTLET SECTION TO REDUCE WASTE ASSOCIATED WITH THE INTERFACE OF TWO LIQUIDS

3.216 System Monitoring

3.2161 CLOSELY MONITOR CHEMICAL ADDITIONS TO INCREASE BATH LIFE
3.2162 INSTALL WEB BREAK DETECTORS TO PREVENT EXCESSIVE WASTE PAPER

3.217 Automation

3.2171 USE AN AUTOMATIC PLATE PROCESSOR
3.2172 USE AUTOMATIC CLEANING EQUIPMENT
3.2173 CONVERT TO ROBOTIC PAINTING
3.2174 AUTOMATE INK MIXING
3.2176 INCREASE USE OF AUTOMATION

3.3 Post Generation Treatment / Minimization

3.31 GENERAL

3.311 Neutralization

3.3111 ADJUST PH FOR NEUTRALIZATION
3.3112 UTILIZE OXIDATION/REDUCTION FOR NEUTRALIZATION
3.3113 USE OTHER METHODS FOR NEUTRALIZATION

3.312 Removal of Contaminants

3.3121 USE SCREENING, MAGNETIC SEPARATION TO REMOVE CONTAMINANTS
3.3122 USE FILTRATION, CENTRIFUGING TO REMOVE CONTAMINANTS
3.3123 USE DECANTING, FLOTATION TO REMOVE CONTAMINANTS
3.3124 USE CYCLONE SEPARATION TO REMOVE CONTAMINANTS
3.3125 USE DISTILLATION, EVAPORATION TO REMOVE CONTAMINANTS
3.3126 USE ABSORPTION, EXTRACTION TO REMOVE CONTAMINANTS
3.3127 USE ADSORPTION, ION EXCHANGE TO REMOVE CONTAMINANTS
3.3128 UTILIZE OTHER METHODS TO REMOVE CONTAMINANTS

3.313 Material Concentration

3.3131 USE EVAPORATION TO CONCENTRATE MATERIAL
3.3132 USE REVERSE OSMOSIS TO CONCENTRATE MATERIAL
3.3133 USE OTHER WASTE CONCENTRATION METHODS

3.4 Water Use

3.41 GENERAL

3.411 Close Cycle Water Use

3.4111	USE CLOSED CYCLE PROCESS TO MINIMIZE WASTE WATER PRODUCTION
3.4112	RECOVERY METALS FROM RINSE WATER (EVAP., ION EXCHANGE, RO, ELECTROLYSIS, ELECTRODIALYSIS) AND REUSE RINSE WATER
3.4113	TREAT AND REUSE RINSE WATERS
3.4114	REPLACE CITY WATER WITH RECYCLED WATER VIA COOLING TOWER
3.4115	RECOVER AND REUSE COOLING WATER
3.4116	METER RECYCLED WATER (TO REDUCE SEWER CHARGES)

3.413 Water Quality

3.4131	MINIMIZE CONTAMINATION OF WATER BEFORE TREATMENT
3.4132	USE DEIONIZED WATER IN UPSTREAM RINSE TANKS
3.4133	CLEAN FOULING FROM WATER LINES REGULARLY

3.414 Water Treatment

3.4141	REPLACE THE CHLORINATION STAGE WITH AN OXYGEN OR OZONE STAGE
3.4142	RECYCLE CHLORINATION STAGE PROCESS WATER
3.4143	USE WATER FROM THE WASHING SYSTEM IN THE CHLORINATION STAGE
3.4144	PERFORM HIGH CONSISTENCY GAS PHASE CHLORINATION
3.4145	USE MAGNETIC TECHNOLOGY TO TREAT WATER
3.4146	CHANGE METHOD OF DEIONIZED WATER PRODUCTION

3.415 Reduction

3.4151	MINIMIZE WATER USAGE
3.4152	CAREFULLY CONTROL WATER LEVEL IN MASS FINISHING EQUIPMENT
3.4153	USE COUNTERCURRENT RINSING TO REDUCE WASTE WATER
3.4154	ELIMINATE LEAKS IN WATER LINES AND VALVES
3.4155	SUB-METER / QUANTIFY WATER USE
3.4156	USE FLOW CONTROL VALVES ON EQUIPMENT TO OPTIMIZE WATER USE
3.4157	REPLACE WATER COOLING ON PROCESSES WITH AIR COOLING
3.4158	USE MINIMUM COOLING WATER TO BEARINGS
3.4159	REPLACE TREATED WATER WITH WELL / SURFACE WATER

3.5 Recycling

3.51 LIQUID WASTE

3.511 Oil

3.5111 FILTER AND REUSE HYDRAULIC OIL
3.5112 REPROCESS SPENT OILS ON SITE FOR RE-USE
3.5113 SELL OIL TO RECYCLER

3.512 Ink

3.5121 RECYCLE WASTE INK AND CLEANUP SOLVENT

3.513 White Water

3.5131 RECYCLE WHITE WATER
3.5132 REUSE RICH WHITE WATER IN OTHER APPLICATIONS

3.514 Miscellaneous

3.5142 TREAT AND REUSE EQUIPMENT CLEANING SOLUTIONS
3.5143 RETURN SPENT SOLUTIONS TO THE MANUFACTURER
3.5144 RECYCLE SPENT TANNING SOLUTION
3.5145 RECOVER AND REUSE SPENT ACID BATHS
3.5146 UTILIZE A CENTRAL COOLANT SYSTEM FOR CLEANING AND REUSE OF METAL WORKING FLUID

3.52 SOLID WASTE

3.521 General

3.5211 REUSE SCRAP GLASS AS FEED STOCK
3.5212 REGRIND, REUSE, OR SELL SCRAP PLASTIC PARTS
3.5213 REUSE SCRAP PRINTED PAPER FOR MAKE-READY
3.5215 AVOID CONTAMINATION OF END PIECES AND REUSE AS FEED STOCK
3.5216 RECYCLE NON-FERROUS DUST
3.5217 REUSE / RECYCLE/ SELL PAPER PRODUCTS
3.5218 REUSE / RECYCLE/ SELL RUBBER PRODUCTS

3.522 Sand

3.5221 RECYCLE CASTING SAND
3.5222 USE SAND FOR OTHER PURPOSES (EG CONSTRUCTION FILL, COVER FOR MUNICIPAL LANDFILLS)

3.524 Metals

3.5241	SELL USED PLATES TO AN ALUMINUM RECYCLER
3.5242	RECOVER METALS FROM SPENT SOLUTIONS AND RECYCLE
3.5243	RECYCLE FILM FOR SILVER RECOVERY
3.5244	RECOVER METALS FROM CASTING SAND
3.5245	SEPARATE AND RECYCLE SCRAP METAL TO FOUNDRY
3.5246	SEGREGATE METALS FOR SALE TO A RECYCLER

3.53 OTHER MATERIALS

3.531 General

3.5311	RECOVER AND REUSE WASTE MATERIAL
3.5313	INCREASE AMOUNT OF WASTE RECOVERED FOR RESALE
3.5314	USE IN-PROCESS RECYCLING WHENEVER POSSIBLE
3.5315	LEASE / PURCHASE BALER; SELL CARDBOARD TO RECYCLER
3.5316	CONTRACT A WOOD PALLET RECYCLING COMPANY
3.5317	SELL / OFFER BY-PRODUCT AS ANIMAL FEED
3.5318	RECYCLE FLUORESCENT LAMPS

3.6 Waste Disposal

3.61 GENERAL

3.611 Sludge Maintenance

3.6111	USE ALTERNATIVE FLOCCULENT TO MINIMIZE SLUDGE VOLUME
3.6112	USE FILTER AND DRYING OVEN TO REDUCE SLUDGE VOLUME
3.6113	REMOVE SLUDGE FROM TANKS ON A REGULAR BASIS
3.6114	USE PRECIPITATING AGENTS IN WASTEWATER TREATMENT THAT PRODUCE THE LEAST QUANTITY OF WASTE

3.612 Combustion of Waste Products

3.6121	BURN WASTE PAPER FOR HEAT
3.6122	INSTALL SOLID WASTE INCINERATOR FOR HEAT
3.6123	BURN WOOD BY-PRODUCTS FOR HEAT
3.6124	BURN WASTE OIL FOR HEAT
3.6125	SELL COMBUSTIBLE WASTE
3.6126	DIRECT WASTE GASSES TO BOILER COMBUSTION AIR

3.619 Miscellaneous

3.6191	RETURN SPENT SOLUTIONS TO THE MANUFACTURER
3.6192	USE A LESS EXPENSIVE METHOD OF WASTE REMOVAL
3.6193	INSTALL EQUIPMENT (E.G. COMPACTOR) TO REDUCE DISPOSAL COSTS
3.6194	SHIP HYDRAULIC OIL TO SECONDARY FUEL PROGRAM

3.7 Maintenance

3.71 CLEANING / DEGREASING

3.711 Mechanical Cleaning

3.7112 USE SQUEEGEES, MOPS, AND VACUUMS FOR FLOOR CLEANING
3.7113 USE MECHANICAL WIPERS FOR CLEANING OF VESSELS
3.7115 CLEAN LINES WITH “PIGS" INSTEAD OF SOLVENTS / SOLUTIONS

3.712 Reduction of Cleaning

3.7121 IMPROVE HANDLING PRACTICES
3.7122 MAXIMIZE PRODUCTION RUNS TO REDUCE CLEANING
3.7123 USE CONTINUOUS PROCESSING
3.7124 INSTALL DEDICATED MIXING EQUIPMENT TO OPTIMIZE REUSE OF USED RINSEATE AND TO PRECLUDE THE NEED FOR INTER-RUN CLEANING
3.7125 SHORTEN PAINT LINES AS MUCH AS POSSIBLE
3.7127 MINIMIZE PART CONTAMINATION BEFORE WASHING

3.713 Rag Use

3.7131 USE A RAG RECYCLE SERVICE
3.7132 REUSE RAGS UNTIL COMPLETELY SOILED
3.7133 USE RAGS SIZED FOR EACH JOB
3.7134 WASH AND REUSE RAGS ON-SITE
3.7135 MINIMIZE USE OF RAGS THROUGH WORKER TRAINING
3.7137 REPLACE CLOTH RAGS WITH PAPER TOWELS

3.714 Preventive Maintenance

3.7141 IMPROVE CLEANING EFFICIENCY BY MAINTAINING CLEANING SYSTEM
3.7142 USE CLEAN IN PLACE (CIP) SYSTEMS
3.7143 CLEAN EQUIPMENT IMMEDIATELY AFTER USE

3.719 Miscellaneous

3.7191 USE WATER BASED SPRAY ABRASIVES INSTEAD OF BAR ABRASIVES
3.7193 USE HIGH PRESSURE WASH SYSTEMS
3.7195 USE TEFLON LINED TANKS
3.7196 USE REUSABLE FILTERS
3.7197 USE ULTRASONIC CLEANING
3.7198 REDUCE / ELIMINATE USE OF DISPOSABLE PRODUCT

3.72 SPILLAGE

3.721 Operations

3.7211 MODIFY MATERIAL APPLICATION METHODS
3.7212 IMPROVED MATERIAL HANDLING (MIXING AND TRANSFER)
3.7213 USE MORE EFFICIENT SPRAY METHOD FOR GELCOAT APPLICATION
3.7214 REDUCE OR ELIMINATE WASTE

3.722 Hardware

3.7221 IMPROVE PROCESS CONTROL TO PREVENT SPILLS OF MATERIAL
3.7222 MINIMIZE OVERFLOWS BY INSTALLING LEVEL CONTROLS
3.7223 INSTALL SHROUDING ON MACHINES TO PREVENT SPLASHING
3.7224 USE PUMPS AND PIPING TO DECREASE THE FREQUENCY OF SPILLAGE DURING MATERIAL TRANSFER

3.73 OTHER

3.731 Leak Reduction

3.7311 MAINTAIN MACHINES WITH TO REDUCE LEAKS
3.7312 IMPLEMENT A REGULAR MAINTENANCE PROGRAM TO REDUCE EMISSIONS FROM LEAKY VALVES AND PIPE FITTINGS
3.7313 ELIMINATE OXYGEN LOSS

3.739 Miscellaneous

3.7391 IMPLEMENT A MAINTENANCE PROGRAM TO KEEP RACKS AND TANKS FREE OF RUST, CRACKS, OR CORROSION
3.7392 APPLY A PROTECTIVE COATING TO RACKS AND TANKS
3.7393 IMPLEMENT A MACHINE AND COOLANT SUMP CLEANING PROGRAM TO MINIMIZE COOLANT CONTAMINATION

3.8 Raw Materials

3.81 SOLVENTS

3.811 Use Reduction

3.8111 MAINTAIN WATER SEPARATOR AND COMPLETELY DRY PARTS TO AVOID WATER CONTAMINATION OF SOLVENT

3.8112 USE DEIONIZED WATER FOR MAKE-UP AND RINSE WATER TO INCREASE SOLUTION LIFE

3.8113 PREVENT EXCESSIVE SOLVENT USAGE (OPERATOR TRAINING)

3.8115 REDUCE THE NUMBER OF PARTS WASHERS

3.812 Emission Reduction

3.8121 COVER CONTAINERS TO MINIMIZE EVAPORATIVE LOSSES

3.8122 USE TIGHT-FITTING LIDS ON MATERIAL CONTAINERS TO REDUCE VOC EMISSIONS USE TIGHT FITTING LIDS ON MATERIAL CONTAINERS TO REDUCE VOC EMISSION

3.8124 INSTALL FLOATING COVERS ON TANKS OF VOLATILE MATERIALS TO REDUCE EVAPORATION

3.8125 REMOVE ROLLERS FROM THE MACHINES AND CLEAN IN A CLOSED SOLVENT CLEANER

3.8126 USE FLUE GAS RECUPERATION TO REDUCE VOC

3.813 Material Replacement

3.8131 USE WATER-BASED ADHESIVES

3.8132 USE LESS TOXIC AND VOLATILE SOLVENT SUBSTITUTES

3.8133 CONVERT TO AQUEOUS CLEANING

3.8134 USE WATER-BASED CUTTING FLUIDS TO ELIMINATE NEED FOR SOLVENT CLEANING

3.8135 USE LOW VOC OR WATER BASED PAINT

3.8136 SWITCH TO A SOLVENT THAT CAN BE CLEANED AND REUSED

3.8137 USE SOY OR WATER-BASED INKS

3.814 Solvent Recovery

3.8141 REGENERATE CLEANING SOLVENT ON-SITE AND REUSE

3.8142 DISTILL CONTAMINATED SOLVENTS FOR REUSE

3.8143 RECYCLE CLEANING SOLVENT AND REUSE

3.82 OTHER SOLUTIONS

3.821 Water-Based Substitutes

3.8211 CONVERT TO AQUEOUS CLEANING SYSTEM
3.8214 USE WATER-BASED DEVELOPERS AND FINISHERS

3.822 Other Substitutes

3.8221 USE ALTERNATIVES FOR ACIDS / ALKALINE (WATER, STEAM, ABRASIVE)
3.8224 CONVERT TO LESS TOXIC HYDROCARBON CLEANERS
3.8225 REPLACE HEXAVALENT CHROMIUM SOLUTIONS WITH TRIVALENT SOLUTIONS
3.8228 REPLACE HEAVY METAL REAGENTS WITH NON-HAZARDOUS REAGENTS

3.83 SOLIDS

3.831 General

3.8312 USE BUILDING MATERIALS WHICH REQUIRE LESS ENERGY TO PRODUCE
3.8313 ALTER RAW MATERIALS TO REDUCE AIR EMISSIONS
3.8314 PURCHASE HIGH MATERIALS IN RETURNABLE BULK CONTAINERS

4. Direct Productivity Enhancements

4.1 Manufacturing Enhancements

4.11 BOTTLENECK REDUCTION

4.111 ADD EQUIPMENT/ OPERATORS TO REDUCE PRODUCTION BOTTLENECK
4.112 REPLACE OLD MACHINE WITH NEW AUTOMATIC MULTI-STATION TOOL
4.113 INSTALL REFRIGERATION SYSTEM TO COOL PRODUCT
4.114 ADD/MODIFY EQUIPMENT TO IMPROVE DRYING PROCESS

4.12 DEFECT REDUCTION

4.121 MAINTAIN CLEAN CONDITIONS BEFORE PAINTING
4.122 DEVELOP STANDARD PROCEDURES TO IMPROVE INTERNAL YIELDS
4.123 REDUCE DEFECTS BY REDUCING PRODUCT TIPPING
4.124 INSTALL CONTINUOUS LUBRICATION EQUIPMENT
4.125 MODIFY PROCESS TO REDUCE MATERIAL COSTS
4.126 INSTALL SENSORS TO DETECT DEFECTS

4.13 MATERIAL REDUCTION

4.131 MODIFY PROCESS TO REDUCE MATERIAL USE/COST
4.132 PURCHASE NEW EQUIPMENT TO REDUCE MATERIAL USE / COST

4.2 Purchasing

4.21 RAW MATERIALS

4.211 CONSIDER USE / PURCHASE OF BULK MATERIALS WHERE POSSIBLE
4.212 ADOPT IN-HOUSE MATERIAL GENERATION
4.213 PURCHASE MATERIAL FROM SUPPLIER IN CUSTOMIZED PACKAGING
4.214 PURCHASE APPROPRIATELY SIZED MATERIAL

4.22 ANCILLARY MATERIALS

4.221 USE ONLY AMOUNT OF PACKAGING MATERIAL NECESSARY
4.222 PURCHASE RECONDITIONED MATERIAL INSTEAD OF NEW

4.23 CAPITAL

4.231 PURCHASE EQUIPMENT INSTEAD OF LEASING
4.232 LEASE EQUIPMENT INSTEAD OF PURCHASING

4.3 Inventory

4.31 JUST IN TIME

4.311 SCHEDULE DELIVERIES ACCORDING TO DEMAND

4.32 OTHER INVENTORY CONTROLS

4.321 OPTIMIZE PRODUCTION LOT SIZES AND INVENTORIES
4.322 ELIMINATE OLD STOCK AND / OR MODIFY INVENTORY CONTROL
4.323 OPTIMIZE LOT SIZES TO REDUCE INVENTORY CARRYING COSTS

4.4 Labor Optimization

4.42 PRACTICES / PROCEDURES

4.421 MODIFY CURRENT INCENTIVE PROGRAM
4.422 UTILIZE OUTSIDE CONTRACTING
4.423 MOVE PRODUCT USING MECHANICAL MEANS
4.424 IMPROVE SPACE COMFORT CONDITIONING
4.425 ELIMINATE/REDUCE REDUNDANT INSPECTIONS
4.426 MODIFY WORKLOAD

4.43 TRAINING

4.431 TRAIN OPERATORS FOR MAXIMUM OPERATING EFFICIENCY
4.432 CROSS-TRAIN PERSONNEL TO AVOID LOST TIME

4.44 AUTOMATION

4.441 INSTALL AUTOMATIC PACKING EQUIPMENT
4.442 INSTALL MAGAZINES FOR TEMPORARY STORAGE
4.443 INSTALL AUTOMATIC BOILER FUEL FEED SYSTEM
4.444 INSTALL SYSTEM TO COLLECT SCRAP
4.445 INSTALL EQUIPMENT TO MOVE PRODUCT
4.446 AUTOMATE FINISHING PROCESS
4.447 AUTOMATE PAYROLL SYSTEM
4.448 INSTALL AUTOMATIC PART STORAGE / RETRIEVAL SYSTEM

4.45 SCHEDULING

4.451 ADD ADDITIONAL PRODUCTION SHIFT
4.452 ELIMINATE SHIFT
4.453 RESCHEDULE BREAKS TO ALLOW FOR CONTINUOUS PRODUCTION
4.454 MODIFY STARTUP/SHUTDOWN TIMES

4.46 MAINTENANCE

4.463 MODIFY FACILITY TO AVOID EXCESS MAINTENANCE COSTS

4.5 Space Utilization

4.51 FLOOR LAYOUT

4.511 EXPAND OPERATIONS INTO UNUSED SPACE
4.512 CONDENSE OPERATION INTO ONE BUILDING
4.513 REARRANGE EQUIPMENT LAYOUT TO REDUCE LABOR COSTS
4.514 REARRANGE EQUIPMENT LAYOUT TO REDUCE HANDLING COSTS
4.515 INSTALL SHELVES / RACKS TO UTILIZE UNUSED SPACE

4.52 RENTAL SPACE

4.521 CLEAR AND RENT EXISTING SPACE
4.522 MODIFY STORAGE SPACE TO AVOID RENTAL OF A WAREHOUSE

4.6 Reduction of Downtime

4.61 MAINTENANCE

4.611 BEGIN A PRACTICE OF PREDICTIVE / PREVENTATIVE MAINTENANCE
4.612 CONTRACT OUT MAINTENANCE

4.62 QUICK CHANGE

4.621 USE FIXTURES TO REDUCE MACHINE CHANGEOUT TIMES
4.622 INSTALL ROTATING CAROUSELS TO REDUCE SET-UP TIMES
4.623 EMPLOY MODULAR JIGS TO REDUCE PROCESS SET-UP TIME
4.624 HIRE ADDITIONAL PERSONNEL TO REDUCE CHANGE-OUT TIME
4.625 DEVELOP STANDARD OPERATING PROCEDURES

4.63 POWER CONDITIONING

4.631 INSTALL AN UNINTERRUPTIBLE POWER SUPPLY
4.632 CHANGE OPERATING CONDITIONS

4.64 ALARMS

4.641 ELIMINATE SHUTDOWNS OF CONTROLS DUE TO OVERHEATING
4.642 INSTALL SENSORS TO DETECT AND AVOID JAMS

4.65 OTHER EQUIPMENT

4.651 INSTALL BACKUP EQUIPMENT
4.652 REPLACE EXISTING EQUIPMENT WITH MORE SUITABLE SUBSTITUTES
4.653 MAINTAIN/ENLARGE A STOCK OF SPARE PARTS

4.66 INDUSTRIAL INTERNET OF THINGS SENSORS (IIOT)

4.661 USE IIOT SENSORS AS ALARMS
4.662 USE IIOT SENSORS FOR DUTY CYCLE DETERMINATION
4.663 USE IIOT SENSORS FOR TRENDING ANALYSIS

4.7 Management Practices

4.71 TOTAL QUALITY MANAGEMENT

4.711 INITIATE A TOTAL QUALITY MANAGEMENT PROGRAM
4.712 UTILIZE JOB COSTING SOFTWARE

4.72 CERTIFICATIONS

4.721 INITIATE A PROGRAM TO ACQUIRE ISO CERTIFICATION

4.73 MARKETING

4.731 ADVERTISE PRODUCT OR SERVICE

4.8 Other Administrative Savings

4.81 TAXES

4.811 DEMOLISH OLD BUILDING TO REDUCE TAX AND INSURANCE BILLS
4.812 APPLY FOR INVESTMENT INCENTIVES

4.82 FEES

4.821 PAY BILLS ON TIME TO AVOID LATE FEES

Application Codes

A suffix is used with the Assessment Recommendation codes listed above in this manual to designate the general area of application of the recommendation. Therefore, a similar strategy applied to a space heating boiler or a process furnace would be distinguishable. The codes are:

Number	Application	Examples
1	Manufacturing Process	Process Heat Recovery, Variable Speed Drives on Process Equipment, Solvent Recovery
2	Process Support	Air Compressors, Steam, Nitrogen, Cogeneration
3	Building and Grounds	Lights, HVAC, Burn Waste for Heat
4	Administrative	Taxes, Inventory Control, Sale of Wastes